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The Journal of Military Electronics & Computing

Tech Focus:
Multicore Boards Roundup

RUGGED BOX-LEVEL SYSTEMS Ease Development Hurdles

PLUS:

Display and Control Subsystems Embrace Open Architectures

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Features

April 2009 Volume 11 Number 4

Special Feature

Stand-Alone Rugged Boxes

Tech Recon

Display and Control Subsystems

System Development

Exploiting the Multicore Trend

Technology Focus

Multicore Boards

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

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

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Rugged box-level computers are particularly suited to new platforms like the mine-resistant, ambush-protected (MRAP) vehicle. Shown here, Marines assigned to the 1st Marine Logistics Group (MLG), put a Cougar H 4x4 MRAP vehicle to the test, on the off-road course, during a demonstration at Camp Taqaddum, Iraq last fall. The demonstration was a part of the 1st MLG Commanders' Conference.

Courtesy: U.S. Marine Corps photo by Sgt. Jason W. Fudge

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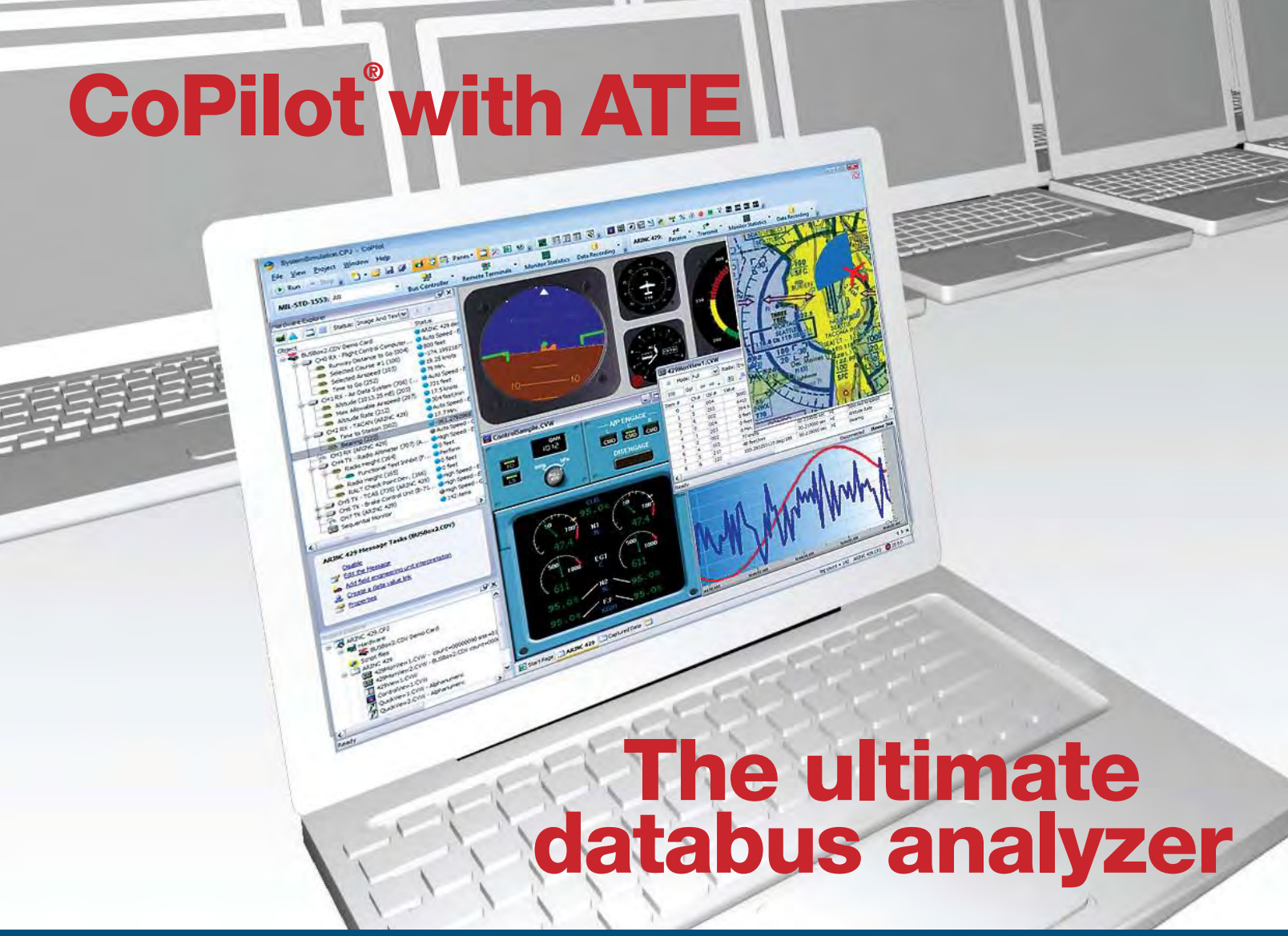

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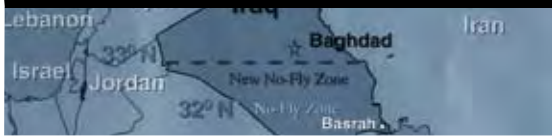
Publisher's Notebook



Exciting Times

This is an exciting time to be in the embedded military electronics market. A time for agile companies that can fight through or avoid internal corporate anxiety. Between world affairs and procurement changes, things could really continue to be pretty good at our end of the market. Russia is doing some saber rattling and President Dmitry Medvedev stated that, in spite of the current world economic problems, Russia will maintain the military spending increases of recent years. That's a situation that can not go unnoticed by our government. The most recent confrontation off their shore by Chinese boats in international waters is another statement to the administration regarding the requirement for maintaining a strong, technically advanced military. Meanwhile, the DoD is about to initiate some procurement changes that will make it more advantageous for suppliers of boards and subsystems to get a greater share of this market.

The procurement changes the DoD is going to implement will probably shift more system content from primes doing ground-up open-ended builds to contractors supplying fixed-price subsystems to the primes. The biggest kink that everyone—primes and suppliers of military electronics products—may have is obsolescence. The environmental and durability requirements that the military asks for are of little to no interest to commercial market silicon manufacturers. That puts continued pressure on designers of military electronics systems to use as much ingenuity as possible in the development of boards or systems.

In the '80's board manufacturers would take the next-generation data provided by a microprocessor company like Motorola and design small mezzanine boards that utilized current microprocessors and also incorporated all the upgraded features of the next-generation microprocessor. This allowed board development prior to the availability of beta silicon of the next-generation product. When the beta silicon became available, system designers could then just remove the mezzanine module and drop in the chip. There would always be a few things that needed to be changed—driven both by our own issues as well as work-arounds driven by the chip supplier's bug list. But despite those challenges, that enabled board manufacturers to get a six-month head start on product introduction and design wins.

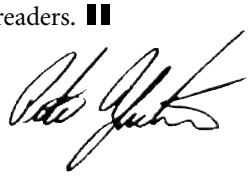
Along came the '90s and the microprocessor-on-mezzanine concept turned into the development of PrPMCs (Processor PMCs), taking the microprocessor off the motherboard and placing it on an open architecture mezzanine card that could be replaced. Now in this decade we find Intel's processor road map as the backbone for proprietary mezzanine CPU modules that marry to either bus-based motherboards or in stand-alone small systems. As Intel introduces a faster model or new generation of microprocessor, a customer can upgrade systems already deployed or just enhance new incoming systems by replacing the CPU module. The recent announcement by Intel that it is placing the Atom on their extended lifecycle road map is very exiting for designers of military electronics.

Another approach to fight the obsolescence issue is through the use of FPGAs wherever practical. As FPGAs increase in size or performance you move the IP to the next generation. The flexibility that FPGAs offer also enables systems developers to employ a building block approach by just adding small hardware modules onto an FPGA carrier board along with standard IP for the modules functions. As silicon elements change on these small hardware modules you just replace them with versions based on newer silicon—without affecting the application. When all else fails there's the Defense Microelectronics Activity (DMEA) (www.dmea.osd.mil), an element of the DoD whose mission it is to help with the obsolescence issue. They can provide services that range from consulting right through to fabrication.

Those of you that have been with *COTS Journal* for a while know that we try to stay ahead of the curve on what's going on and what industry designers and decision makers require in order to be successful. Our editorial staff is constantly challenged to ensure that we stay focused on providing the most pertinent information regarding the embedded technology used by the military. When we started *COTS Journal* over ten years ago we were read almost exclusively by engineers and engineering management. We have evolved to the point where not only has our circulation increased, but we've also broadened the base of our readership. Now our readership includes all levels of management—where technology is key—at primes, PEO offices, subsystem suppliers and users. Knowing what technologies are available and viable is not only critical to the designers but to the people responsible for the deliverable programs and their maintenance. We're proud that these people find the information we provide as a key resource to their decision making process.

To further enhance our usefulness we are working with major industry analyst firms to provide readers not only useful information but also a portal to these firms. Each issue will have a page where an analyst firm provides some relevant and current data about the market; and some months they may request an exchange or dialog with our readers. We've managed to work out this relationship, because you, our readers, are a select and respected group of decision makers that are key to the evolution of the embedded military electronics industry. Bottom line: Not only is now an exciting time for the military embedded electronics market, it's an exciting time for *COTS Journal* and our readers. ■■

Pete Yeatman, Publisher
COTS Journal



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Army Orders More COTM Systems for MRAP Vehicles

DataPath is providing MobiLink Technologies communications on-the-move (COTM) systems to a deployed U.S. Army unit in support of battlefield operations. The MobiLink Technologies COTM system from DataPath was successfully tested in Iraq in late 2008 and early 2009 and is now an operational system that quickly installs in Mine Resistant Ambush Protected (MRAP) vehicles (Figure 1). Eight additional COTM systems as well as field technical support and other services have been procured through exercised options under an existing delivery order. The COTM systems are expected to be deployed within weeks.

Figure 1

MRAPs with MobiLink COTM systems are enabled with broadband connectivity while traveling at high speeds. In battle, the systems provide an unbroken satellite link on-the-move and operate without interference from military jammers.

While on long convoys and operations in Iraq, MRAPs with MobiLink COTM systems are enabled with broadband connectivity while traveling at high speeds. In the battlefield environment, the systems provide an unbroken satellite link on-the-move and operate without interference from military jammers. Commanders on the battlefield use the COTM systems to simultaneously receive live UAV video feeds and use voice-over-IP, video teleconferencing, SIPRNet Web connectivity and other command and control applications. With these capabilities, forces in the field are able to create a robust local and over-the-horizon network that is reliable regardless of the terrain and the distance from a military base. The MobiLink mSAT-C2V systems can be deployed on a variety of platforms such as MRAP, HMMWV, Stryker, Bradley and armored commercial SUV vehicles.

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

U.S. Marine Corps Taps NGRAIN for Virtual Task Trainers

U.S. Marine Corps has tapped NGRAIN to provide sixty Virtual Task Trainers (or Virtual Training Software). The NGRAIN training solution will support maintenance training for individual and crew weapons, ground weapon systems and vehicle subsystems, and will be used to support both instructor-led and self-paced student learning.

The Virtual Task Trainers (VTTs), based on NGRAIN software, will conform to the Shareable Content Object Reference Model, allowing the USMC to use them in conjunction with Learning Management Systems. The VTTs, which include 3D equipment models and task animations, will support a range of instructional approaches and supplement hands-on training.

USMC instructors will use Producer, NGRAIN's software simulation authoring tool, to update equipment parts information, procedural animations and tasks provided with the VTTs. Non-technical users with no programming, scripting, or previous 3D graphics experience can learn how to use Producer in two days, empowering the USMC to use their own subject matter experts to update the 3D simulations included with the VTTs; a critical component of the contract requirements.

NGRAIN
Vancouver, BC
Canada
(604) 669-9973.
[www.ngrain.com].

Secure and Raytheon Awarded Air Warrior Tablet PC Contract

The U.S. Army has awarded Raytheon a 5-year IDIQ contract to continue production on the Electronic Data Manager (EDM) for the Program Executive Office (PEO) Soldier's Air Warrior program for which Secure Communication Systems is a prime subcontractor. Secure will also handle production, RMAs and end-of-life management, with Raytheon providing software and design support over the 5-year IDIQ contract. The EDM is a kneeboard Tablet PC used by U.S. Army aviators for blue-force tracking and moving map applications. The deployment of the unit to Army aviators is managed by the PEO Soldier's Air Warrior Product Office in Redstone Arsenal, Alabama. The Air Warrior EDM Tablet PC kneeboard (Figure 2) computer system is a rugged, lightweight, portable workstation that provides the Windows XP Professional Operating System in a configuration optimized for rugged wearable, kneeboard requirements.

Figure 2

The Air Warrior program includes a kneeboard Tablet PC used by U.S. Army aviators for blue-force tracking, and moving map applications.

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The EDM Tablet PC is used on U.S. Army helicopters to provide blue-force tracking and moving map applications. It features weights and measures software and can be used as an Electronic Flight Bag. The Air Warrior program is the U.S. Army's next-generation aircrew ensemble providing advanced life support, ballistic protection and nuclear, biological and chemical (NBC) protection in rapidly tailorable, mission-configurable modules.

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

Secure Communication Systems
Santa Ana, CA.
(714) 547-1174.
[www.securecomm.com].

DSPCon Gets SBIR Grant to Improve Real-time Data Collection in UAVs

The Naval Air Warfare Center has awarded an $80,000 grant to DSPCon to support development of a small, highly efficient data acquisition and analysis system for recording full mission and event data as well as extracting pertinent "seen" information for transmission over limited bandwidths to ground-based control centers. Hyper-spectral camera technology resolves any image chosen for analysis into many narrow spectral bands.

Figure 3
A pair of Marines clean dirt and mud off the propeller of a 'Silver Fox' UAV. The Silver Fox can carry a hyper-spectral camera that resolves any image chosen for analysis into many narrow spectral bands.

When utilized in UAVs (Figure 3), the technology is viewed as advantageous in supporting a number of next-generation military and commercial applications such as faster, more

Military Market Watch

Net-Centric Trend Fuels 2009 Military VME Market Growth

The application landscape of the military embedded computer market is continually in flux as the requirements of military equipment, mission objectives and technology platforms shift and evolve. The application landscape of today's military embedded market is illustrated quantitatively in Figure 4, showing the breakdown by application of VME-based systems for 2009, from VDC's most previous research on military embedded systems in Military, Aerospace and Defense Applications. The shift today is primarily in the direction of network-centric equipment as technology allows network centricity to proliferate in many new platforms, bringing with it the benefit of much "smarter" platforms/equipment that allow information and intelligence to be delivered in real time and direct to the personnel that need it most.

There is increasing demand for local, tactical computing systems to be used by ground troops in limited engagements as well as by security forces—both homeland and in combat theatres. Communications are becoming integrated into most military systems, making the military network larger, more advanced and much more useful. Future Combat Systems and the latest military equipment link people with one another, and with vehicles, aircraft, ships and command centers. Many military/aerospace systems that previously did not require embedded computers now require these to enable communication. In addition, many systems that previously included embedded computers now require more powerful systems to enable a higher level of communication and functionality.

This increase in military communications also creates new requirements to process, route and, if necessary, store all of the new data that is created by having a greater number of connected elements in the military telecom/datacom network. Military systems are becoming extremely network-centric. VDC Research Group is currently updating its research on Embedded COTS Systems in Military, Aerospace and Defense Applications to continue to track these application trends along with many more. For more information please contact Eric Heikkila of VDC at: erich@vdcresearch.com

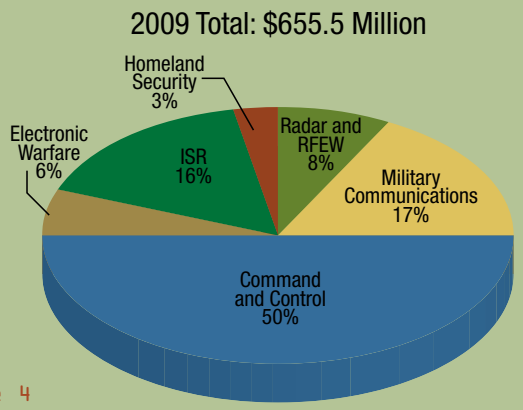

Figure 4
2009 North American military VME integrated system shipments, in percent of dollar volume shipments, categorized by electronics mission classification.

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

thorough detection of land- and coastal-based mines, expanded perimeter investigation of enemy personnel and ordnance location over challenging topographies, and improved agricultural and crop management in terms of soil and moisture and analysis. DSPCon's data acquisition and analysis system will be used in conjunction with hyper-spectral cameras to facilitate improved, real-time collection, analysis and subsequent transmission of relevant data to ground-based mission control centers.

DSPCon
Bridgewater, NJ.
(908) 722-5656.
[www.dspcon.com].

Symmetricom Contracted to Supply Timing for GPS III

Symmetricom has been awarded a contract from ITT Corporation Space Systems Division valued at a minimum of $4 million, part of the building of GPS IIIA (Figure 5), the next-generation Global Positioning System (GPS) Space System program. Under the award, Symmetricom will deliver its Model 9552 Ovenized Quartz Master Oscillators over three years, including developing, qualifying and delivering flight oscillators for the first two space vehicles.

The Model 9552 is a high-performance oven-controlled quartz crystal oscillator that produces a highly stable, low noise reference frequency output. It is particularly suited to space applications and can be used as the onboard frequency reference for a satellite or ground station. The oscillator will produce the output frequency for the GPS IIIA Navigation payload by means of steering from the onboard Atomic Frequency Standards. The U.S. Air Force announced last May that Lockheed Martin was awarded the contract to build GPS III. Under the $1.4 billion contract, Lockheed Martin along with ITT and General Dynamics will produce the first two GPS IIIA satellites with first launch projected for 2014. The contract also includes options for up to 10 additional spacecraft. GPS III will improve position, navigation and timing services for military troops and civilian users worldwide with anti-jam capabilities that will yield superior system security, accuracy and reliability.

Figure 5
GPS III will improve position, navigation and timing services for military troops and civilian users worldwide with anti-jam capabilities.

Symmetricom
San Jose, CA.
(408) 433-0910.
[www.symmetricom.com].

Special Feature

Stand-Alone Rugged Boxes

Stand-Alone Rugged Boxes
Fine-Tune their Feature Sets

Designed as stand-alone solutions, rugged box-level embedded computers rank as the fastest growing area of military embedded computer design. Choices for system designers have expanded to new areas of I/O capacity and thermal performance.

Jeff Child
Editor-in-Chief

A trend has been building in the past couple of years where traditional embedded board vendors are adding stand-alone rugged box-level systems to their military market offerings. These complete system boxes—which often support standard form-factor boards inside them—provide a complete, tested and enclosed computing solution that eliminates complex integration chores for customers. The term "Stand-Alone Rugged Boxes," as coined by *COTS Journal*, applies to complete system boxes. Often the boards in the box are standards-based cards such as PC/104, PMC and 3U CompactPCI. But the enclosures by and large aren't in any industry standard footprint, although that may change as emerging system architectures from PICMG and VITA gain traction in the military realm.

Taking Center Stage

The growing significance of this product category shouldn't be underestimated. In many ways it's moved to the center spot of the military embedded computing industry—the spot once held by SBCs. Now rugged box systems have become a second center of gravity alongside SBC's center of gravity. At one time the SBC was sort of the driver of the military embedded computing market. The major vendors rolled out new SBC products—in VME, cPCI and other form factors—every couple months, and 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 center stage as indicators of the industry's state of the technology.

Today, at least a dozen vendors have some sort of stand-alone rugged box-level system in their offerings—many even have whole product lines in that category. Among these are Advantech, Aitech Computers, Ampro Computers, AP Labs, Curtiss-Wright, DRS Technologies, Extreme Engineering, General Micro Systems, GE Fanuc Embedded Systems, Macrolink, Mercury, MEN Micro, Octagon Systems, Parvus, Quantum 3D, Rave Computer, RTD Embedded Technologies, Tracewell Systems, VersaLogic, WIN Enterprises and WinSystems. And it's not just traditional SBC vendors that are joining this trend. Some I/O specialists like Ballard Technology, Acromag and ACCES I/O have entered the game too.

No Longer Just Custom

The notion of offering a more complete system solution is nothing new. In fact, the trend has been gaining momentum for almost a decade now—starting with solutions that were mainly "custom" offerings for specific customers. The term "custom" gets a lot of leeway here, because in the military embedded computing market, some degree of customization has always gone on—whether you're talking about boards or system boxes. More recently, however, the concept has really become a kind of staple in this market. There are a handful of companies, Octagon Systems, Parvus, Quantum 3D, Rave Computer, RTD Embedded Technologies, that were doing box-level products before the traditional board vendors joined it.

The latest board form factor to ride this rugged box system trend is VPX. Extreme Engineering Solutions (X-ES) has rolled out its recent XPand3200 system (Figure 1) that supports both 3U VPX and cPCI backplanes. Measuring 4.88 x 5.62 in x 8.75 inches, the unit is a sub ½ ATR sized conduction-cooled, fully ruggedized system designed to meet the rigorous standards of MIL-STD-810F.

Depending on processing requirements, the XPand3200 can be populated with 3U modules from X-ES based on the

Intel Core2 Duo processor, the Freescale dual-core MPC8572E PowerQUICC III processor, or the Freescale dual-core MPC8640D processor. The XPand3200 can then be configured to meet I/O requirements. Configurable standard I/O includes Gigabit Ethernet, USB and RS-232/RS-422. An optional 32 Gbyte SATA SSD memory module provides the convenience of removable storage and the ruggedness of solid-state memory. An optional USB port provides system monitoring and maintenance capabilities.

Field Upgradable Capability

An important subtlety that distinguishes some rugged box systems is the ability to swap out modules in the system when the system is already fielded. With just that in mind, RTD Embedded Technologies makes box-level PC/104-based systems qualified for demanding applications like military vehicles. RTD's rugged HighRel line of systems is built using frames milled from solid aluminum blocks to exacting specifications, ensuring that the solution is rugged and reliable. Frames for thermally sensitive components have internally milled heat sinks and embedded heat pipes to move heat to the outside walls of the enclosure, allowing operation from -40° to +85°C without the use of active cooling. Optional shock-mount bases withstand specific shock and vibration specifications.

RTD's IDAN box-level product consists of any RTD PC/104, PC/104-Plus, or PCI-104 board mounted in its own frame and wired to the standard PC connectors on that frame, thus eliminating the need for module-to-module wiring inside the case. This solution maintains PC/104's modularity and lets system designers configure a system as rapidly as one would configure a stack of boards. The product line is also available in a watertight version, HiDANplus (Figure 2), with environmental sealing and EMI suppression O-rings coupled with MIL I/O connectors. HiDANplus does inter-module communications via a custom wiring harness that is enhanced by an internal 100 pin stackable signal raceway.

Avionics-Centric Approach

The trend toward complete box-level systems has broadened to include some offerings that target specific needs like avionics. Along those lines, Ballard Technology offers its Avionics BusBox 2000 (AB2000) systems (Figure 3)—a family of over 30 small, lightweight, conduction-cooled, embedded computers for rugged environments. These systems have many built-in standard peripherals and interfaces for various avionics databuses, as well as PMC expansion capability. Typical applications for the AB2000 include data and protocol conversion, databus and network bridging, data servers, data recorders, communications, power controllers, federated controllers and multiple net-centric applications. The AB2000 is suited for helicopter, fixed wing and ground mobile platforms.

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

Figure 1

Jeff Porter, designer of the XPand3200, with *COTS Journal*'s Jeff Child at Milcom 2008 last November. This sub ½ ATR-sized conduction-cooled, fully ruggedized system supports both 3U VPX and cPCI backplanes. Configurable standard I/O includes Gbit Ethernet, USB and RS-232/RS-422.

tethered case is where a separate computer runs the application and controls the AB2000 over Ethernet.

Full Environmental Control

Another twist on the rugged box-level system trend is the emergence of sophisticated cooling enclosure solutions such as SprayCool's MPE Chassis (Figure 4). Although not a complete stand-alone box itself, enclosures like this are fueling the trend toward more integrated box-level solutions. Along those lines, SprayCool has partnered with a number of embedded computer vendors. The Multi-Platform Enclosure (MPE) chassis employs the company's patented two-phase cooling technology and has already been selected by prime integrators Lockheed Martin and Northrop Grumman for DoD programs involving radar and image processing electronic warfare applications, and is being considered for a number of other airborne and land-based applications.

The MPE enclosure can scale from 4 slots to 21 slots and is designed to meet

Figure 2

IDAN box-level systems consist of any RTD PC/104, PC/104-Plus, or PCI-104 board mounted in its own frame and wired to the standard PC connectors on that frame. This lets system designers configure a system as rapidly as one would configure a stack of boards. The watertight HiDANplus version here has environmental sealing and EMI suppression O-rings coupled with MIL I/O connectors.

Figure 3

Targeting avionics applications, the Avionics BusBox 2000 (AB2000) systems feature built-in standard peripherals and interfaces for various avionics databuses like MIL-STD-1553 and ARINC 429/708/717, as well as PMC expansion capability.

industry standard designs for 6U x 160 mm VME-64X, VPX, VXS, cPCI and CP-CIe (EXP.0) and proprietary electronics boards. It offers significantly more cooling capability per slot (above 300 atts) than enclosures using older cooling technologies such as air or conduction-cooling. The operating environment can range from -65° to +71°C, and up to 100,000 ft. altitude in unpressurized compartments. The unit meets or exceeds MIL-STD-810 and MIL-STD-461 requirements for harsh environments. ▮▮

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Figure 4

The MPE chassis employs SprayCool's patented two-phase cooling technology that enables a cooling capability per slot above 300W. The operating environment can range from -65° to +71°C, and up to 100,000 ft. altitude in unpressurized compartments.

Octagon Systems
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[www.octagonsystems.com].

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Special Feature

Stand-Alone Rugged Boxes

Caged Cards versus Rugged Box-Level Systems

As ever more choices of rugged box-level systems emerge, military system designers need to consider all the benefits and trade-offs when deciding between a "caged cards" or "box-level computing" approach.

Rick Davis, Principal Application Engineer
Quantum3D

Companies in the military and aerospace industries compete for business, but they are united in the goal of providing our warfighters the best possible advantage. In aircraft and vehicles especially, sophisticated devices are being designed and integrated to help lift the fog of war and replace uncertainty with knowledge, purpose and precision. At the heart of each device is usually a computer, and the computer architecture that is chosen will have considerable sway over the cost, acceptance, reliability and maintainability of the device. A key decision facing today's military system developer is that of caged cards versus an off-the-shelf box-level computer.

A traditional approach would be caged cards: select a bus standard, a rugged card cage and an SBC, plus any additional I/O boards to fulfill the requirements. This approach would rarely be criticized, but may not always be best. Lately, the industry is making available a number of monolithic integrated computers—also called stand-alone rugged boxes—designed for vehicle-embedded applications. The U.S. Marine Corps Gladiator Tactical Unmanned Ground Vehicle (TUGV) (Figure 1) Operator Control Unit (OCU), for example, uses a stand-alone rugged box computing solution from Quantum3D called the Thermite Tactical Visual Computer (TVC).

Figure 1

The Thermite Tactical Visual Computer (TVC) is a stand-alone rugged box computing solution used in the U.S. Marine Corps Gladiator Tactical Unmanned Ground Vehicle (TUGV) Operator Control Unit (OCU).

Merits of the Caged Cards Approach

The caged cards approach certainly has merits. This choice, for example, gives 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. Figure 2 shows an example card cage VME system. That sort of flexibility is especially welcome when not all the I/O requirements are clear at the outset of a project—a situation that is not uncommon. With this flexibility may come some unwelcome responsibilities, however. The integrator may discover he's the first to combine some of the board-level components and that they won't work together. That could be due to factors like mismatched driver levels, tangled up pin assignments, or even mechanical interference. In an integrated, box-level platform the supplier has already worked out these problems. Indeed, it's the predictable outcomes from the use of an integrated platform that favors that alternative.

With an integrated box-level computer the following factors are know at the outset—details that would be a voyage of discovery with caged boards:

- Power, weight, heat dissipation and cooling strategy.
- Rugged Mil worthiness—likely comes with certification credentials.
- Cable construction—likely comes with sample cables.

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- Availability—as quoted from the factory, instead of as a schedule from an engineering team.
- Appropriate OS drivers for components. Many ad hoc integrations fall down here.

In some ways an integrated box-level computer is the right choice simply because it makes the platform someone else's responsibility. Should the integration team focus on assembling a computer or on the specific domain expertise that won them the opportunity? They may prefer a ready-to-run platform, especially if they have bounded engineering resources—and what group doesn't? The end-customer (Army, Navy and so on) may prefer this approach also, as the use of an off-the-shelf platform is likely to lower risk and accelerate the integration schedule.

Figure 2

A card cage solution example is this VME card cage with SBC and slots ready for project-specific I/O boards.

Size and Power Efficiency

It often works out that an off-the-shelf embedded computing system can be smaller, more power efficient, more rugged and so forth, if only because its broader utilization (broader than a purpose-built computer) can afford it more engineering attention. Similarly, if the box-level system supplier is building the platform all the time, to fulfill demand, one can be pretty confident in their procedures and outcomes, compared to the early specimens of a project-specific computer. Finally, once the deployment has reached an appreciable size, it may be a welcome luxury to regard the computer as a single LRU, and just return it for service when necessary, instead of owning fault isolation down to the board level. Figure 3 shows Quantum3D's Thermite T2 Model 3500 series, an example rugged box-level system.

Before we tip the scales too far in favor of a rugged box computer though, it's important to look at some additional merits of the caged-card approach. The same openness of the computer down to the board level—which presents an integration and maintenance burden—can also be an appreciable plus for the platform lifecycle. It allows technology insertions like an upgraded CPU or graphics processor. This is useful for handling "feature creep" or to sidestep EOL component issues. Analogous upgrades to a box-level computer would likely require reengaging the computer supplier and replacing whole computer units. That said, the box system supplier is likely to have a platform roadmap, and may be able to provide technology insertion at the box level, without reintroducing integration issues, which can arise with board-level upgrades.

A factor that could tip the architect in either direction is cost. Any engineer or business development person can do calculations and weigh out the relative costs of caged cards versus box systems. It's important though to avoid superficial assessments, and consider all the costs over the whole lifecycle of the device's deployment. A common trap is "we can throw together a board set more cheaply than we can purchase a box-level computer."

Expense of Purpose-Built Approach

When doing the analysis, it's important to include consideration of the integration effort and expense associated with a purpose-built computer, like:

- Dealing with multiple suppliers for components—who may lapse into finger pointing when problems arise.
- Preparing an operating system image for the platform—sourcing OS drivers for components is often problematic.
- I/O connectorization—a problem already solved in box-level platforms.
- Development cables—which give the software team a head start while vehicle cabling is worked out.
- Platform certifications—such as MIL-STD-810F, MIL-STD-461C, MIL-STD-1275, MIL-STD-704F and others.
- Service costs—box COTS platforms likely to be supplied with warranty.
- Preparing diagnostics and procedures for fault isolation down to the board level

The supplier of a rugged box-level computer will start you out already ahead of these challenges. When the whole lifecycle is considered, caged cards are very likely to have higher initial (non-recurring) costs. As the size of a deployment grows though, the potential for lower recurring (per unit) costs of this approach may swing the overall cost equation positive. One shouldn't underestimate the

Figure 3

The Thermite T2 Model 3500 series is a line of rugged, tactical visual computers specifically designed for deployed environments where 28V vehicle power is available. The unit combines an Intel Pentium M CPU with up to 1 Gbyte system memory as well as 2D/3D graphics capabilities and video-intensive C4ISR.project-specific I/O boards.

value of a box-level computer warranty, however. It can be expensive to maintain service facilities for a purpose-built computer, and these costs extend out through the device's lifecycle.

More Questions to Consider

Additional considerations that neighbor closely to cost include the following: Are we in the business of integrating computers, or is our value in layered special knowledge/expertise? Do we need the margin on the computer assembly itself to make our earnings satisfactory? Are we quite sure that this margin will cover our initial and incremental costs for maintaining the computer architecture? All these are questions the integrator should ask himself and his business management.

The rugged box platform supplier has an advantage over the creator of a purpose-built platform, in that he can spread the cost of support infrastructure over multiple programs. A purpose-built platform must bear these costs alone. Finally, there is the challenge of acceptance. It's only when the integrated device is accepted and placed into service that the integrator makes appreciable earnings, and that the warfighter gets its benefits. Integrators who select box-level computers that are already familiar to, and trusted by, their customer (from other deployments) are likely to encounter a lower hurdle in reaching acceptance. This can save cost, and get revenue flowing sooner. Clearly the question of rugged box-level computers verses caged cards has multiple facets, and integrators should weigh in on a diversity of considerations before making this call. ■■

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Special Feature

Stand-Alone Rugged Boxes

Stand-Alone Rugged Boxes Come into their Own

Advances in low-power processors, thermal modeling and flash-based storage are helping to enable the rise of highly functional stand-alone rugged box systems, and military applications are reaping the rewards.

Mike Southworth, Director of Marketing
Parvus

Technology developments that reduce complexity and enhance usability are always a welcome addition to military applications. That need is being fueled by the increasing availability of stand-alone rugged boxes. The development of stand-alone rugged boxes has provided a singular computing solution for the military's manned and unmanned applications where reliable high-performance computing is a must. The term "stand-alone rugged box," first introduced by *COTS Journal*, refers to complete system boxes, which provide a tested and enclosed computing solution that eliminates complex integration chores for military customers. The military's demand for stand-alone rugged boxes has spurred large-scale development in this technology—a boon for military engineers tasked with integrating onboard electronics in tactical vehicles.

Since the success of Net-Centric Warfare (NCW) depends on the quality and reliability of transmitted information, technological developments that decrease the potential points of failure and time wrestling with technical failures, can help ensure mission success. Stand-alone rugged boxes have been gaining momentum as they are also tested to quality for military-standards, which means faster time to deployment and lower costs.

(a) (b)

Figure 1

The U.S. Navy Littoral Combat Ship (a) hosts four unmanned surface vehicles that integrate DuraCOR Computers and DuraMAR Routers. DuraMAR Rugged Mobile Routers support IPv6 networking for Network Centric Operations (b).

Possibly the most intriguing development of stand-alone rugged boxes is their modular nature. The modularity of some stand-alone rugged boxes provides longevity and flexibility as components can be upgraded in the future without a complete system redesign—an especially attractive feature to military contractors faced with tightening budgets. Since most stand-alone rugged boxes are based on open architecture embedded board standards such as PC/104, VPX, and EPIC, customers can add additional cards into available card slots with minimal engineering required. For this reason, military system designers are not only interested in these rugged boxes as mission computers, but also as an upgradeable computing platform. The ability for customers to tailor their device with mission-specific I/O is a key motivator for the further adoption of this technology as it reduces costs and speeds time to deployment.

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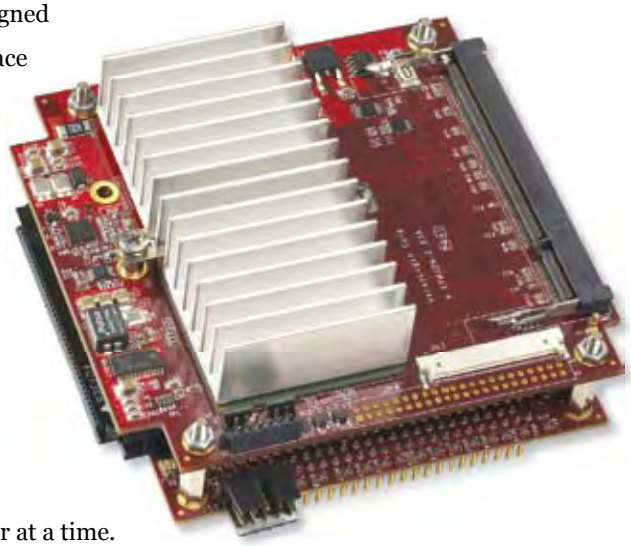

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Tech Advancements Fuel Box Trend

The spike in demand for stand-alone rugged boxes can be attributed to the technological advancements in embedded computing designs that have made these systems increasingly reliable, powerful and rugged. One of the most significant developments moving stand-alone rugged boxes to the frontlines is low-power processors. Intel's Pentium M and Celeron M processors are a popular choice for rugged systems as they are designed from the ground up to deliver high performance with low power consumption. Initially designed for notebook computers, these types of mobile processors serve as an ideal choice for deeply embedded designs.

Advancements in thermal management have also helped to propel stand-alone rugged boxes forward. Thermal management for defense applications has always been a challenge due to the high operating temperatures of the latest processors and dense packaging needed for environmental ruggedness. Fortunately, advancements made in conduction-cooling techniques mean that this preferred cooling technique will continue to meet the military's requirements. New designs in conduction-cooling are now capable of cooling over 100 watts. Some of the advances that have made this possible include developments in embedded heat pipes, heat sinks, new thermal interface materials and heat spreaders.

The inclusion of heat spreaders, a thin sheet of metal incorporated on top of a device to help dissipate heat, has drastically reduced thermal issues in embedded designs. These heat spreaders are now designed to accommodate a number of thermal options, such as top-mounted heat sinks, fan heat sinks and heat pipes to effectively cool microprocessors. Innovative heat pipe/heat spreader combinations are proving especially effective in the thermal management of stand-alone rugged boxes. Although not a new cooling technique, the use of embedded heat pipes in conduction frames can dissipate

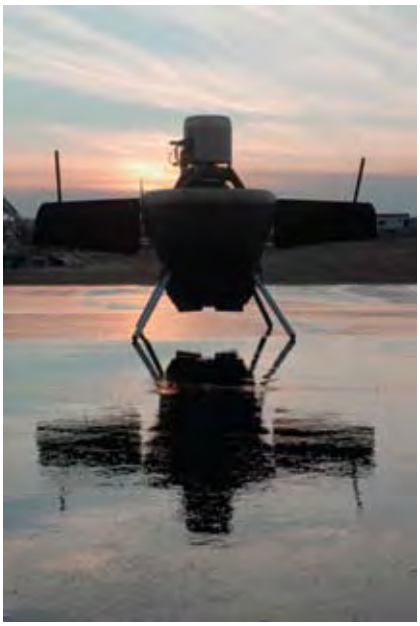

Figure 2

Aurora Flight Sciences' GoldenEye-80 Unmanned Aircraft System integrates a small form factor Mission Computer based on the DuraCOR 820 rugged box system.

large amounts of heat with very little temperature difference, eliminating the need for any input power for active cooling or the inclusion of moving parts.

Thermal Modeling Opens the Door

Thermal modeling software is responsible for making significant advancements in conduction-cooling. By identifying potential cooling issues, thermal modeling software has led to important thermal management developments by ensuring new thermal devices will meet specific standards.

Cable-less technology has also improved the reliability and ruggedness of these box designs by eliminating points of possible failure. By using I/O breakout boards, rigid flex connectors and board-to-board connectors, a cable-less internal interconnect scheme can be achieved to ensure high reliability and signal integrity, yet still support modular customization.

The ongoing development in solid-state drives is another catalyst helping stand-alone boxes come into their own. Based on flash technology, solid-state drives have proven to be rugged and perform well in extreme conditions. For this reason, solid-state drives have become the leading data storage technology for almost all mission-critical military applications. With no moving parts, these devices are not hindered by seek time, latency nor other electromechanical delays found in traditional hard drives. The drawbacks commonly associated with solid-state drives are being dismissed as random access speeds rival and now beat other media, retention and re-writing cycles have dramatically increased, and many systems offer a single-control erase-all function for security-sensitivity applications. These developments have played a critical role in the increasing popularity of stand-alone rugged boxes.

Military Ruggedness Standards

As mentioned earlier, stand-alone rugged boxes are often tested and qualified to meet military standards, making them mission-ready. However, buyers need to be aware of the differences in the levels of testing and qualifications in today's available stand-alone rugged boxes. For example, some suppliers advertise products as "designed" to meet military standards. This simply means that the manufacturer took

Figure 3

DuraCOR Mission Computer Platforms are based on a modular PC/104+ architecture and are prequalified for airborne and vehicle military deployments.

certain military standards under consideration but appropriate testing has not been done to ensure compliance with military standards. Buyers need to ensure that the system they are investigating for purchase has not only been designed but also "qualified" to meet military standards.

To be truly mission-ready, stand-alone rugged boxes should at minimum meet the military standards for temperature, shock, vibration and ingress conditions relevant to the target platform under consideration. For example, the operating environment inside a climate-controlled cargo aircraft will differ greater from an externally mounted device onboard a wheeled personnel vehicle. Additionally, there is an increasing demand for these boxes to be prequalified for MIL-STD-461E for electromagnetic interference/compatibility (EMI/EMC) and power supply operation (per MIL-STD-1275D/MIL-STD-704E). System failures due to voltage surges and spikes cannot be tolerated.

Stand-Alone Rugged Boxes at Work

Among the many military units deploying stand-alone rugged boxes is the Naval Surface Warfare Center (NSWC). The NSWC recently implemented Parvus' DuraCOR 810 computer and DuraMAR 1000 mobile router in the Navy's newest class of surface warship, the Littoral Combat System (LCS) (Figure 1). The LCS operates manned and unmanned vehicles for conducting mine warfare, anti-submarine warfare and surface warfare. Two DuraCORs and one DuraMAR unit are installed in each LCS Unmanned Surface Vehicle (USV) to carry out these warfare missions.

Stand-alone rugged boxes also caught the eye of Smiths Detection, a leading technology developer and manufacturer of sensors that detect and identify explosives, chemical and biological agents, weapons and contraband. Smiths Detection specified the DuraCOR 810 as the central computing unit for its Chemical Biological Protective Shelter (CBPS). CBPS shelters provide medical personnel and soldiers a highly mobile, self-contained collective protection system. With a contamination-free, environmentally controlled working area, these shelters serve medical combat services and combat service support personnel as mobile medical aid stations, field command posts or emergency facilities.

Rugged Boxes in UAVs

Unmanned Aircraft Vehicles are also tapping into the benefits of stand-alone rugged boxes as demonstrated by Aurora Flight Sciences' deployment of the common mission computer for the GoldenEye 80 Unmanned Aircraft System (UAS) (Figure 2). The GoldenEye 80 is an advanced Vertical Take-Off and Landing (VTOL) aircraft designed to carry advanced sensor payloads for homeland security and battlefield operations. Aurora uses a stand-alone rugged box based on the small form factor DuraCOR 820 (Figure 3) mission computer subsystem dubbed the Aurora Common Mission Computer (ACMC). The computing architecture for this Parvus subsystem is based on a low-power mobile Pentium CPU, solid-state memory, Linux operat-

ing system, military-grade power supply, and various peripheral and network inputs. It is anticipated that the ACMC's robust combination of function and small form factor ruggedness will enable the company to support a wide range of unmanned vehicle operator control applications.

Procurement of stand-alone rugged boxes is happening at a breakneck speed in support of wheeled and armored vehicle programs for the wars being fought in Afghanistan and Iraq. Ground Penetrating Radar (GPR) equipment onboard mine sweeping vehicles is also utilizing Parvus mission computers. One user attests to the durability of the DuraCOR 810 mission computer as Army vehicles equipped with the device endured four different Improvised Explosive Device (IED) blasts and kept booting up without a problem—all while being externally mounted to their vehicle.

Trends to Watch

Perhaps the most promising upcoming technology for stand-alone rugged boxes is multicore processors—specifically dual and quad core processor technology. By providing new levels of energy-efficient performance, multicore technology enables each core to run at a lower frequency, dividing the power normally given to a single core. For stand-alone rugged boxes this means reduced footprints, lower power and thermal burdens, and energy efficiency, compared to multiple separate CPU nodes.

In addition, Intel's new Atom processor family injects more possibilities for rugged stand-alone boxes. This new low-power processor has a thermal design power (TDP) specification in the 0.6-2.5W range and scales to 1.8 GHz speeds depending on customer need. By comparison, today's mainstream mobile Core 2 Duo processors have a TDP in the 25-35W range.

The development of Gbit Ethernet and IPv6 network addressing is another exciting step for many military electronic systems. The speeds that Gigabit Ethernet can handle and its pervasiveness in defense systems make it the ideal choice for designers working on network-centric warfare applications. New stand-alone and fully integrated rugged Gigabit Ethernet Switch and network router subsystems are being introduced. These devices will further the Department of Defense's ambitions for IPv6, providing the warfighter with advanced networking capabilities for Network-Centric Warfare, by way of improved routing, enhanced security and Quality of Service (QoS).

Stand-alone rugged boxes have proven themselves as a necessary component to the military's arsenal of computing devices. The advances made in embedded computer technology will continue to push stand-alone rugged boxes further into military programs, helping to actualize Net-Centric Warfare. ▮▮

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Special Feature

Stand-Alone Rugged Boxes

Simultaneous Multiaxis Vibration Test: Vital for Rugged Box Systems

"Simultaneous" and "Multiaxis" are more than just words when it comes to describing "real-world" vibrations and shocks. They're vital to success in embedded system designs for systems aboard military land, sea and air vehicles.

Wayne Tustin, President
Equipment Reliability Institute

The words "simultaneous" and "multiaxis" are important when specifying a dynamic (vibration and shock) test for rugged box-level systems. The new Test Method 527 (multi-exciter testing) in the late-2008 "G" revision to the venerable MIL-STD-810 was overdue, but certainly is welcome. Unfortunately the vast majority of present-day vibration test plans call for shaking in the test article's X axis, then its Y axis, then its Z axis. Three tests. Three fixtures. Much handling. Sequential-axis testing is time-consuming and not as effective at finding product weaknesses as simultaneous multiaxis testing.

Only single-axis-at-a-time shaking was possible with mechanical shakers prior to 1950, limited typically to 10 to 55 Hz. Wider frequency range (typically 10 to 200 or to 500 Hz) EH or electrohydraulic (servohydraulic) shakers also are single axis. However, automotive test engineers long ago combined three or more EH shakers for multiaxis shaking, replicating road inputs. So did seismic test engineers, replicating earthquake inputs to buildings.

Figure 1

Eight electrodynamic shakers combine to provide three orthogonal and three rotational vibratory motions to aerospace load. (Photo Courtesy Boeing and USAF Hill AFB.)

Flight Vehicle Simultaneous Multiaxis Shaking

Higher aircraft and missile in-flight frequencies necessitated the development of ED or electrodynamic shakers for laboratory testing. Somewhat resembling electrodynamic loudspeakers, ED shakers are driven by power amplifiers under specialized computer control. Relatively few have been combined for simultaneous multiaxis shaking. Figure 1 involves eight ED shakers at Hill AFB in Utah. Four vertical-thrusting units are difficult to see. They provide thrust-axis translation, also pitch and yaw, to the aerospace load above them. The two pairs of horizontal-thrusting units provide vertical and lateral translation, also rotation, to that load.

Figure 2 (which predates Figure 1) was taken at the Army Research Lab in Adelphi, Maryland after two ED shakers were added. Earlier, with just one shaker exciting specimen axes sequentially, field failures often could not be replicated. Now, field failures are much more likely to be replicated. Successor systems include White Sands Proving Ground, Hill Air Force Base in Utah (shown in Figure 1) and Keyport Naval Undersea Warfare Center in Washington State. Experience at those facilities led to the new Test Method 527 (multi-exciter Testing) mentioned earlier. At those military facilities, individual ED shakers were on-site combined at considerable engineering and labor expense.

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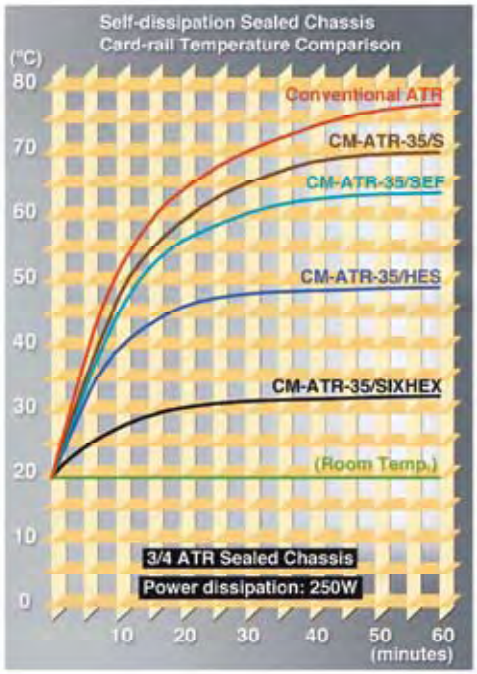

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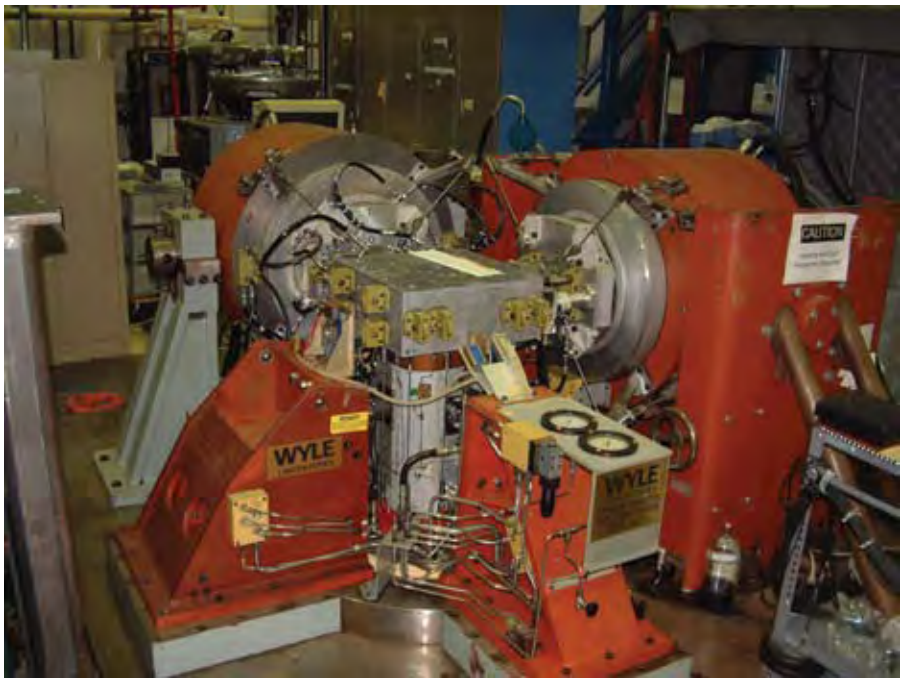

Figure 2

The system at Army Research Lab in Adelphi, Maryland after two ED shakers were added. With just one shaker exciting specimen axes sequentially, field failures often could not be replicated. Now, field failures are much more likely to be replicated.

Figure 3

Triaxial shaking identifies automotive and aircraft headlamp weaknesses.

Three ED Shakers

At least two Japanese firms are supplying factory-assembled arrays of three ED shakers to Japanese automobile manufacturers. One such system, Figure 3a, was purchased by Spectrum Technologies, a commercial environmental testing laboratory at Redford, Michigan; their multiaxis shaking service is being used by Detroit-area firms.

Over-the-road vibration data is acquired from three accelerometers, one sensing fore-and-aft motions, one sensing left-right motions, and one sensing vertical motions—almost always the most severe. Alternately, one three-axis accelerometer can be used. The accelerometer signals for those three axes—X, Y and Z—are recorded, later edited and still later fed to a specialized computer that controls the motions of the X, Y and Z shakers that together drive hardware being tested. The sidebar "Time Waveform versus Spectra" explores the issue of using time domain measurement versus acceleration spectral data. ■■

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Time Waveform versus Spectra

A major advantage of electrohydraulic (EH) and electrodynamic (ED) shakers over mechanical shakers: EH and ED shakers can reproduce measured over-the-road motions. For many years, lacking today's powerful computers, shakers reproduced random vibration that was described by spectra. Spectra show PSD or power spectral density—also known as ASD or acceleration spectral density, also known as autospectral density—in units of g^2/Hz, plotted against frequency in Hz. Such testing is said to be "in the frequency domain." Military service vibration measurements, generally taken with accelerometers and recorded as millivolts vs. time, were Fourier transformed into those spectra and used as the basis for laboratory test spectra.

Increasingly, military supplier laboratories are performing their random vibration tests "in the time domain," retaining their accelerometers signals in millivolts, which they feed into the power amplifiers driving their shakers. Often, when those who have taken field vibration measurements find themselves witnessing laboratory tests, and listening to the audio comments they had made during data capture, they state their impression that "time domain" testing provides greater realism that spectral testing.

Tech Recon

Display and Control Subsystems

Display Subsystems Feed the Network-Centric Push

As demands in the military climb for advanced networked video and graphics displays, display subsystem makers are working to provide secure and rugged solutions.

Jeff Child
Editor-in-Chief

As the military migrates toward its goal of Network-Centric Operations, all the many end-nodes of the networked military—tanks, aircraft, ships and man-portable gear—will need to process and display all that data shared among the nodes. Feeding those needs, makers of display subsystems, embedded graphics boards and related software are joining forces to fuel sophisticated display stations capable of complex graphics and video.

Exemplifying that trend is the Navy's Common Display System (CDS) program, an $83 million project that calls for a family of common display systems that will be implemented across platform systems on Navy surface ships, submarines and aircraft. CDS is compliant with Open Architecture Computing Environment (OACE) requirements and implements a common presentation using Human Systems Integration (HSI) design techniques. Through multi-mission functionality, CDS enhances survivability and reconfigurability by allowing watchstanders access to their applications at any platform display workstation.

Figure 1

Common Display System (CDS) is a survivable and configurable high-assurance workstation providing an operator access to multiple shipboard applications simultaneously. These console displays are to be integrated into DDG 1000 destroyers and used in the modernization of the Aegis guided missile destroyers. Here, a harbor tug helps guide the guided-missile destroyer USS Mustin (DDG 89) as it gets under way.

Flat Panel Solutions

Early this year Aydin Displays was awarded a contract by General Dynamics Advanced Information Systems, to supply the U.S. Navy with 24-inch rugged flat panel monitors for the Common Displays System (CDS) Program.

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Vibration:	MIL-STD 810F, Figure 514.5C-3, Table 514.5C-VII
Shock:	MIL-STD 810, 10g’s
EMC/RFI:	MIL-STD-461E
EMI Options:	RE101-1 Army limits, RE102-3 Aircraft > 25m RS101-2 Army levels, RS103 Ground systems, Airforce
Ergonomics:	MIL-STD-1472F

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Figure 2

ITAPS technology monitors and manages system voltage and temperature on the Denali 7000 Industrial Panel PC platform. ITAPS protects the system from being damaged by low and high temperature conditions, under- and over-voltage problems and brown-out and surge events.

The contract will provide Aydin displays for the Navy's CDS consoles in support of the DDG and Aegis Modernization. CDS is a survivable and configurable high-assurance workstation providing an operator access to multiple shipboard applications simultaneously. This family of console displays is to be integrated into the ships that comprise the DDG 1000 Zumwalt class of next-generation destroyers as well as the modernization of the Aegis class of guided missile destroyers (Figure 1).

For this part of the CDS program, Aydin will provide General Dynamics with a 24-inch 4424 Rugged Flat Panel Display, specifically designed to meet the stringent shock, vibration, EMI and temperature requirements of the U.S. Navy while providing superior visual performance under all conditions. The design and qualification of the displays is scheduled to be completed in early 2009, with production orders commencing shortly thereafter.

Aside from ruggedness and performance, another critical element of the CDS program is security. At the Embedded Systems Conference earlier this month, LynuxWorks announced that its LynxSecure separation kernel will be incorporated in the U.S. Navy's CDS display. The LynxSecure separation kernel and hypervisor provide an environment in which multiple guest operating systems running at different security levels (such as Secret, Top Secret and Unclassified) will execute at the same time without compromising security, reliability or data integrity. This is critical because military systems such as the CDS display console system require adherence to rigid high-assurance security requirements. Program plans include evaluation of LynxSecure to EAL-7 per the Common Criteria and the Separation Kernel Protection Profile.

Temperature Management for Panel Displays

A significant portion of the military's demand for display-based systems is the mobile panel type systems. Serving that need, Ocular recently announced a technology called Intelligent Thermal And Power Supervisor (ITAPS) that allows the company's industrial panel PCs to be deployed over the extended temperature range of -20° to +60°C. ITAPS monitors and manages power and temperature to prevent data corruption, ensuring reliable system operation in extremely harsh conditions.

Until now, most panel PCs were limited to the 0° to +50°C temperature range. As a result, many embedded systems operating in harsh conditions could not take advantage of a panel PC or a human-machine interface (HMI). ITAPS is available on Ocular's Denali 7000 Industrial Panel PC platform (Figure 2), which features a 7-in. TFT screen, an x86-based processor and the WinCE operating system. ITAPS will be available on the Denali 1040 Industrial Panel PC with its 10.4-in. TFT display during the second half of 2009. In addition, it can be implemented on any of Ocular's standard embedded processor display platforms as well as customized panel PCs or HMIs.

By monitoring and managing the panel PC's system voltage and temperature, ITAPS protects the system from being damaged by low and high temperature conditions, under- and over-voltage problems and brown-out and surge events. For example, when the ambient temperature is low, ITAPS heats the system before it attempts to boot start, ensuring the panel PC is at a safe operating temperature before it starts.

In high temperature conditions, ITAPS prevents the system from starting to avoid circuit and component damage. If the system is running and the temperature exceeds a safe operating range, ITAPS intervenes directly with the operating system to execute an orderly shutdown. In addition, ITAPS constantly monitors the state of any battery connected to the system and charges the battery when necessary. In the event of a brown-out or power failure, the system can be switched immediately and seamlessly to battery power.

Interface Development Support

Developing the sophisticated graphical interfaces on today's military display systems can be a daunting task. To ease the way, Lockheed Martin selected Quantum3D's IData Human Machine Interface (HMI) toolset to support the simulation and embedded display of graphical information shown on cockpit displays. Instead of employing outdated code generation methods, the IData toolset outputs data defining the HMI's graphics and behavior.

This approach can significantly reduce the time and expense in each phase of the embedded display lifecycle, from prototyping and simulation through development and deployment of the embedded target application. The tools redefine how HMI rapid prototyping can be done by allowing engineers to try new HMI behaviors and "looks" without ever stopping the target system or needing to recompile code. Lockheed Martin Systems Integration in Owego will use the HMI toolset to more rapidly develop tactical and situational awareness information that is graphically displayed to military pilots and crew aboard a range of rotary wing and fixed wing aircraft, including the Merlin Mk1 helicopter (Figure 3). ▮▮

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[www.aydindisplays.com].

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[www.lynuxworks.com].

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

Figure 3

Systems engineers at Lockheed Martin are using the IData HMI toolset to develop graphical information shown on cockpit displays. Instead of employing outdated code generation methods, the IData toolset outputs data defining the HMI's graphics and behavior. These HMIs will be graphically displayed to military pilots and crew aboard a range of rotary wing and fixed wing aircraft, including this Merlin Mk1 helicopter.

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Expansion Bus	PC/104 ISA Bus	✓					✓	✓	✓	✓	✓	✓	✓	✓	✓
	PCI-104 PCI Bus	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		✓
	PCI Bus Masters	4	4	4	4	4		4	4	4	4	4	4		4
	APIC (add'l PCI interrupts)	9	9	9	9	9	9	9	9	9	9	9	9		
CPU and BIOS	CPU Max Clock Rate (MHz)	1400	1400	1400	1400	1400	650	400	650	400	650	400	650	500	500
	L2 Cache (KB)	2048	2048	2048	2048	2048	256	256	256	256	256	256	256	128	128
	Intel SpeedStep Technology	✓	✓	✓	✓	✓									
	ACPI Power Mgmt	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	2.0	2.0
	Max Onboard DRAM (MB)	512	1024	1024	1024	1024	512	512	512	512	512	512	512	512	512
	RTD Enhanced Flash BIOS	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Nonvolatile Configuration	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	RTD Quick Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Boot	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Peripherals	Watchdog Timer & RTC	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	ATA/IDE Disk Chip (MB)	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192	8192
	Audio		✓	✓	✓	✓		✓	✓	✓	✓	✓	✓		
	Analog Video	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA	SVGA
	Digital Video	LVDS	LVDS	LVDS	LVDS	LVDS				TTL	TTL	LVDS	LVDS	LVDS	
	AT Keyboard/Utility Port	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	PS/2 Mouse	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	USB Mouse/Keyboard	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
I/O	**RS-232/422/485 Ports**	4	4	2	4	2	2	2	2	2	2	2	2	2	2
	USB Ports	4	2	4	2	4	2	2	2	2	2	2	2	2	2
	10/100Base-T Ethernet	1	1	1	1	1	1	1	1	1	1	1	1	2	1
	ECP Parallel Port		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	aDIO (Advanced Digital I/O)	14	18	18	36	36	18	18	18	18	18	18	18	18	18
	multiPort (aDIO, ECP, FDC)		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
SW	ROM-DOS Installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	DOS, Windows, Linux	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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Bus	Active Bus	PCI	PCI	ISA	ISA	PCI	PCI	PCI	PCIe	ISA	ISA	ISA	PCI	PCI	PCIe	PCI
	Passthrough Bus	ISA				ISA	ISA		PCI				ISA		PCI	ISA
	DMA or PCI Bus Master	✓	✓	✓	✓	✓	✓	✓	✓				✓	✓	✓	✓
	McBSP Serial Ports	✓	✓			✓	✓	✓	✓							
Analog Input	Single-Ended Inputs	16	16	16	16	16	16	16	16							
	Differential Inputs	8	8	8	8	8	8	8	8							
	Max Throughput (KHz)	1250	1250	500	100	1250	500	500	500							
	Resolution (bits)	12	12	12	16	12	16	16	16							
	Input Ranges/Gains	3/7	3/7	3/4	1/4	3/6	3/3	3/3	3/3							
	Autonomous Calibration	✓	✓													
	Data Marker Inputs	3	3	3		3										
Conversions	Channel-Gain Table	1K	1K	1K	1K	1K	1K	1K	1K							
	Scan/Burst/Multi-Burst	✓	✓	✓	✓	✓	✓	✓	✓							
	A/D FIFO Buffer	8K	8K	8K	8K	8K	8K	8K	8K							
	Sample Counter	✓	✓	✓	✓	✓	✓	✓	✓							
	SyncBus	✓	✓			✓	✓	✓	✓							
Digital I/O	Total Digital I/O	16	16	16	16	16	16	16	16	48	18/9	64	48	48	48	48
	Bit Programmable I/O	8	8	8	8	8	8	8	8	24	6/0		48	48	48	✓‡
	Advanced Interrupts	2	2	2	2	2	2	2	2	2			2	2	2	✓‡
	Input FIFO Buffer	8K	8K	8K	8K	8K	8K	8K	8K							
	Versatile Memory Buffer												4M	4M	4M	8MB
	Opto-Isolated Inputs											48				
	Opto-Isolated Outputs											16				
	User Timer/Counters	3	3	2	2	3	3	3	3	3	3		10	10	10	6
	External Trigger	✓	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓‡
	Incr. Encoders/PWMs										3/9		4/8	4/8	4/8	✓‡
Analog Out	Analog Outputs	2	2	2	2	2	2	2	2							
	Max Throughput (KHz)	200	200	200	100	200	100	100	100							
	Resolution (bits)	12	12	12	16	12	16	16	16							
	Output Ranges	4	4	3	1	4	5	5	5							
	D/A FIFO Buffer	8K	8K			8K	8K	8K	8K							

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The challenges involved in crafting a reliable UAV to Ground Control data link are many. With an end-to-end design, app developers can naturally access data on either end of the link and achieve simpler distributed application design.

Edwin de Jong, Director of Core Product Management and Strategy
Real-Time Innovations

In the complex software environments of both aircraft and ground station, many applications must communicate. Historically, developers built these as complex independent systems, connected over an equally complex data-link management system. Recently, both air and ground platforms have turned to standards-based messaging middleware with great success. Messaging middleware provides a "clean" interface to dataflow, greatly increases development ease, enables simpler system evolution and improves performance.

Unmanned Aerial Vehicles (UAVs) demand reliable communications with ground stations. Developers invest heavily in the data link; it has direct impact on the range, flight time and sensor feedback capabilities of the system. It is crucial to the competitive value and ultimate success of the platform. There are many technologies to provide data links. How-

Figure 1

The Insitu (Boeing) ScanEagle UAV runs DDS middleware as the backbone of the flight software. The design simplified system integration. Here, a contractor for a Marine Unmanned Aerial Vehicle Squadron carries a ScanEagle to put it away after retrieving it from a flight.

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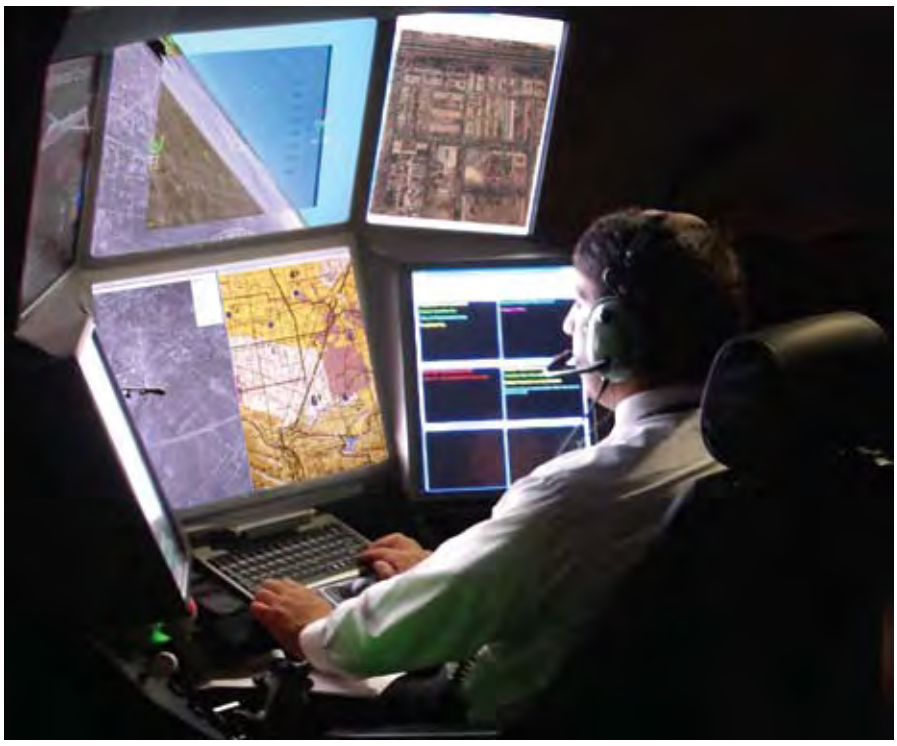

(a)

(b)

Figure 2

DDS real-time middleware is being used in the General Atomics Aeronautical Systems, Inc. (GA-ASI), Advanced Cockpit Ground Control Station (GCS) (a). A recent flight demonstration on a mission-configured MQ-1 Predator (b) unmanned aircraft system (UAS) validated GA-ASI's major upgrade of the Advanced Cockpit GCS using networking middleware, which was completed in only 14 months.

ever, the data link provides just low-level physical transport and signaling, and just air-to-ground communications. For example, the Insitu (Boeing) ScanEagle UAV (Figure 1) runs DDS middleware as the backbone of the flight software.

With that in mind it's useful to examine the potential of extending messaging into an end-to-end coherent architecture. With an end-to-end design, application developers can naturally access data on either end of the link, greatly simplifying distributed application design. Of course, it places much more stringent demands on the middleware, since it now must integrate the aircraft software, the ground station software and the data link between them. A tall order.

UAVs: A Challenging Environment

The software that drives UAVs can be very roughly divided into three obvious pieces: the aircraft avionics, the ground station and data link. These are very different environments with unique challenges.

Avionics and Ground Station Software: The deeply embedded UAV is a constrained environment, where power and weight limits impact every decision. UAVs must house a flight control computer, a sensor array, payload management and possibly weapons systems. These will likely be connected via a variety of system bus and network transports and may be supported by a real-time operating system (RTOS). Additionally, the software may be subject to safety certification standards, such as DO178B.

The ground station, by contrast, is more likely to resemble a high-powered ruggedized workstation. It usually runs a general-purpose operating system such as Linux or Windows, and includes a flight-operator interface, a data visualization/display computer that connects to the UAV payload, and increasingly an interface to a broader net-centric environment into which the UAV system is integrated. Both aircraft and ground station must have a data link controller to affect communications. In complex systems, the UAV may need to communicate with many ground stations, or even interact with other UAVs or manned aircraft.

The Data Link: The data link connects the UAV to the ground station. The data link signal has to contend with a wide range of communication problems, such as lost packets or connections, maximizing the use of limited bandwidth, and changes in ground station control authority.

In addition, there are several link types, each with its own unique set of performance, integrity and reliability requirements. Any messaging system built to run over each link type must meet the specific demands of that link. Low-level data link protocols, like Link 16 and the newer Link 22, do a good job of managing the fundamental connection. Depending on the design, the data link layer may mitigate some of the fundamental issues, such as signal reflection management.

Fundamentally, however, the data link layer cannot present a view of the connection that completely hides reality, such as working over transient, lossy links. That level of service must be provided by a higher-level protocol

UAV Messaging

Of course, applications running in all three parts of the system must cooperate to accomplish the mission. With the wide range of requirements, physical transports and constraints, it is tempting to believe that only a set of very specifically developed and separately optimized communication methods will suffice. In fact, in the past, this is exactly the chosen path. Unfortunately, this path is indeed rocky, resulting in expensive, difficult-to-maintain software. A more ideal architecture would provide clean, powerful communications within and between components.

Many UAV and other defense application developers have turned to the open Data Distribution Service (DDS) standard, managed by the Object Management Group (OMG), for a messaging framework. Existing applications include UAV applications such as the Insitu Scan Eagle UAV and the General Atomics Predator UAV ground station (Figures 2a and 2b), as well as many other mission-critical communication applications such as the U.S. Air Force/Navy Common Link Integration Processing design. Of course DDS adoption goes well beyond UAVs. In fact, DDS is becoming the standard messaging communication in most military systems.

U.S. Navy programs that have designed DDS into their future include most surface ships (LHA, LPD, LCS, Aegis and the DDG 1000 destroyer series), weapon systems (SSDS, VLS), and many communication and C4ISR systems (CLIP, CEC, CNI). The Army's huge Future Combat Systems (FCS) program heavily uses DDS, as do many airborne radar systems (AWACS, E2C). Several European and Asian designs also use DDS, including the Tacticos battle management system by Thales in France, and the FFX ship being developed in South Korea. Key applications within these systems include radar track management, communication management, cooperative engagement and sensor fusion.

DDS specifies a publish-subscribe (PS) model. DDS is most distinguished from previous communication standards by its strong Quality of Service (QoS) parameters. DDS QoS parameters specify the degree of coupling between participants, properties of the overall model, and real-time communication and delivery requirements on a per-data-stream basis. DDS service control includes deadlines for message delivery, bandwidth control, reliability model control, failover and backup specification, data filtering and more. It has proven flexibility to adapt to embedded environments, high-performance server and workstation integration, and use over both extremely fast and slow, lossy communication paths such as satellite links.

Simplifying UAV Design

Working systems demonstrate that DDS can successfully deliver the needed capabilities within ground and air systems. The question now is if DDS can serve as a link protocol and thus offer a complete system-wide messaging framework. Such a framework would open a new vista in system design. It could allow not only point-to-point data links, but also provide distribution capability in real time across the entire UAV system and out to the net-centric environment.

Application developers on both the aircraft and ground station could directly subscribe to needed information, insulating current and future designs from changes in the data link protocol or applications on either end. Data "discovery" could simplify initial connection, as well as connection management such as backup channel use, switching ground station control and "area of interest" management. The data-centric view offers potential for full-system connectivity.

Of course, this vision requires a strong dose of reality. DDS is proven as a distributed messaging environment without the challenges of a data link. Let's take a look at three of these challenges and how DDS could address them: link

fallback, power conservation and multi-station handoff.

Example: Link Fallback

The most fundamental issue between the UAV and ground station is that the data link is lossy and transient. These effects should not require management by an application like the flight controller. Therefore, the messaging layer should hide and resolve problems such as lost or out-of-order packets from the application layer. For example, commands sent from the ground station to the UAV flight computer usually require confirmed result feedback to the ground station.

DDS provides consistent, configurable reliability and delivery on top of any type of reliable or unreliable transport. The middleware thus abstracts the handling of these issues so that applications become modular without specific code for handling reliability and delivery. Application code only needs to configure the level of QoS required for their particular data streams.

For example, with DDS, the application could define this publisher/subscriber relationship as "Reliable." This tells DDS to select a reliable packet model (one of several options) on top of the transport to deal with lost packets. Despite the automatic reliability, the application may still want to control detection and response when the link fails. Setting the QoS of Durability = Transient_Local with a further qualifier N for the amount of historic messages to keep, directs DDS to keep the last N messages stored locally in memory; this message data is then available for an application re-synch after re-establishment of a lost connection. The flight computer application may also want to define what time duration of link loss constitutes a link failure from its point of view. If so, the "Liveliness" lease duration can be set to this acceptable link down-time (for example 5 seconds), or even modified dynamically to account for mission events, such as intentionally going out of communication for a few minutes.

DDS also allows applications to be notified, and therefore respond, whenever events occur that violate the reliability (or other QoS) settings. Thus, it can deliver both transparent reliability, or application control, or any combination between.

These QoS configuration options demonstrate the flexibility of DDS to be adapted to some of the real-time message issues in a UAV data link. It also shows how DDS allows an application the ability to define its real-time constraints in terms familiar to the application developer. DDS automatically executes against those constraints and validates that both the subscriber and publisher, and by implication the physical transport, can meet those requirements, reporting back to the application when those real-time communication objectives are not met.

Example: Power Conservation

Power conservation is paramount within the UAV system. Minimizing the amount of data transmission off-vehicle can greatly help reduce power consumption. One benefit of publish-subscribe is easy connectivity. Unfortunately, this also encourages expensive transmission.

To mitigate this, DDS provides additional data-filtering capabilities. For instance, the UAV can set filters limiting the rate of reception of commands, limit receipt of situational data to that in its area of operation, or select which ground sources it will accept. DDS will then eliminate any unneeded data instances from the data link. The same holds true for the opposite direction; the ground station can filter data from the UAV before transmission across the data link. These filters are dynamically changeable to accommodate changes in mission operations. Grouping is also available; a QoS called PARTITION divides the network into subsets, saving transmissions between uninterested parties. The result is a dynamically self-optimizing data link that only sends relevant data to/from the UAV, therefore reducing unnecessary power consumption.

Example: Multi-Station Handoff

Because it supports automatic discovery and easy transfer of connections, publish/subscribe helps deal with one of the fundamental challenges of the UAV System design: the transfer of control of the UAV between ground stations. With DDS, a UAV application subscriber can 'listen' to multiple ground station 'command' publishers. Every publisher can be assigned a 'strength'. If a 'command' subscriber in the UAV receives messages from several ground stations, the application will only receive the 'command' from the strongest publisher.

To explicitly manage transfer of control of a UAV from one ground station to another, the currently active ground station 'command' publisher could await notification from the UAV that it was receiving a satisfactory validated stream from another 'command' publisher. A ground station can take control by increasing its strength, automatically superseding the current controller. This capability also provides failover; if a publishing ground station goes dark or a data link fails, the next-lowest strength station or backup data link will automatically get control. This is of course simplified, but is illustrative of the potential.

Data Link: The Critical Glue

The data link is the critical glue that integrates a successful UAV system design. Ultimately, evolving from a series of specialized links into an end-to-end messaging framework promises much more flexible, powerful integration. The fundamental benefit of quality-of-service publish-subscribe messaging is that the complexity of determining who is sending "what data over which transport when" becomes transparent to the application. This effectively decouples the system, making the application code far more portable and reusable. Management of data sources, transport selection and data stream filtering is automatic. This results in an intelligent communication architecture that reconfigures based on mission scenarios.

This offers obvious benefit, but is it practical today? The DDS standard is proven in many mission-critical military applications and successful UAV vehicles and ground stations. As it evolves to encompass more platforms and to integrate more systems, it becomes viable to consider it for UAV ground-air integration. ▮▮

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Multicore Solutions Target a Variety of Emerging Military Needs

The era of multicore CPUs is here, and defense applications are exploiting the compute density and power efficiency of today's multicore boards across several form factors.

Christine Van De Graaf, Product Marketing Manager
David Pursley, Field Applications Engineer
Kontron

Embedded developers in many arenas are constantly facing competitive pressure to provide more application features and improve performance capabilities. As a result, it's become critical to master the ability to scale solutions and add features within embedded form factors without dramatically affecting energy variables such as power consumption and thermal output. With the growing need for mobility across many military applications, end-use, in fact, now demands reduced Size, Weight and Power (SWaP) to ensure reliable portability. Multicore technology has addressed these challenges by offering higher compute performance, reduced chip count and lower bill of material (BOM) costs, with reduced power consumption.

While the technical extent of what multicore can enable may still be a moving target for many designers, the prime benefit of providing more for less is not lost on anyone. More performance per watt, more functionality for less dollars and less physical space are all design tenets that clearly represent the way forward for embedded solutions in every imaginable market or application. Military design in particular is leading the way as designers are enabling a modernized battlefield with multicore architec-

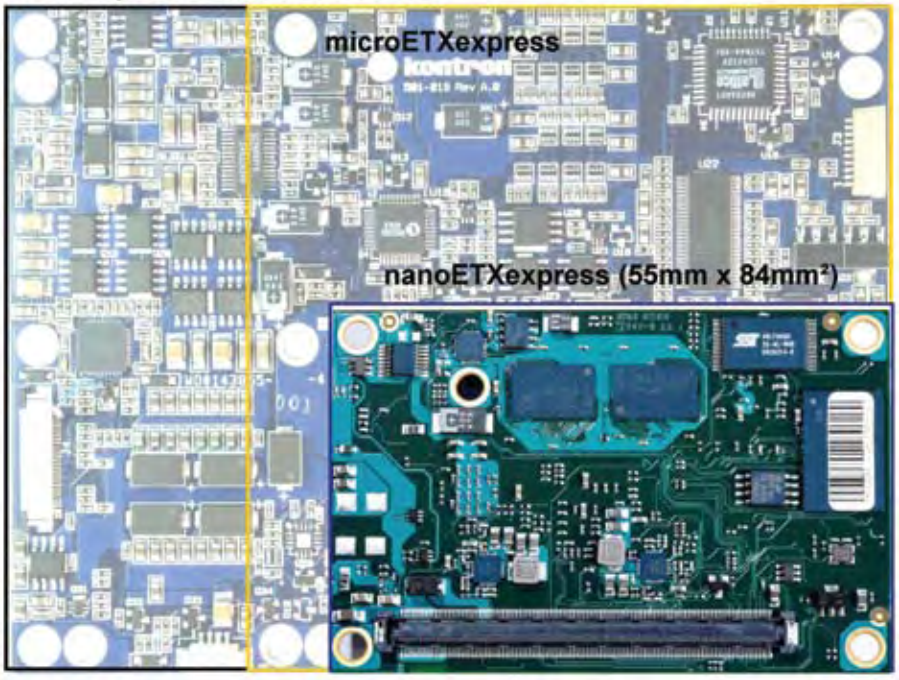


Figure 1
Overlaid images show the difference between COM Express solutions, which now include compact and ultra-small form factor COM Express-compatible modules.

tures on a variety of platforms, ranging from Computer-on-Module (COM) to VME and CompactPCI to the newest VPX implementations.

Divide and Conquer Processing

Simply stated, multicore processor architecture places two or more processor-based "execution cores" within a single processor, which in turn plugs directly into a single processor socket. The operating system, however, perceives each of these execution cores as a discrete logical processor, with all the associated execution resources.

Since the chip's internal architecture actually shares the computational work of a single microprocessor between multiple execution cores, more work can be completed in a single clock cycle. Controls that previously required separate dedicated systems can be integrated into one system—meaning a single computer can handle both control and visualization tasks even for critical and highly complex real-time applications.

Sounds simple—however multicore technology is one of those course-changing computing technologies, providing new levels of energy-efficient performance enabled by advanced parallel processing and next-generation hafnium-based 45nm technology.

The recently introduced 45nm Intel Atom Z5xx series processors provide robust performance per watt in an ultra-small 13x14 mm package. The processors are validated with the Intel System Controller Hub (SCH) US15W, which integrates a graphics memory controller hub (Intel GMA 500) and I/O controller hub into one small 22x22 mm package. According to Intel, the two-chip platform provides more than 80 percent reduction in total footprint over the previous-generation three-chip solution, with a combined thermal design power under 5 watts.

COMs and Multicore: A United Front

Applications using the ETX standard experienced next to zero growing pains with the onset of multicore, making a seamless jump in performance by shifting from one core to two. The COM Express platform was actually developed in tandem with the advent of multicore; its reason for being was to provide a means to take advantage of the additional capabilities that came with multicore but were just not compatible with ETX. SATA, PCI Express and increased graphics processing are all hallmarks of COM Express and its multicore foundation.

Characterized by their demand for high performance and low power all within a small form factor computing platform, small but powerful devices—either handheld by individual soldiers or integrated into tight spaces on vehicles or aircraft—are chief among military designs today. COMs have gained significant ground here, largely because the amount of performance that can be squeezed into a small form factor has improved so dramatically with the advent of Intel's 45nm architecture (Figure 1). Developed specifically to address very compact, performance-hungry and thermally constrained embedded applications, 45nm technology achieves fast performance (with clock speeds between 1.1 GHz and 1.6 GHz) in a sub-5-watt thermal power envelope. Since it is power-optimized on the front side bus (of up to 533 MHz), it enables faster data transfer. Probably the most visible shift in multicore is in motherboards, where designers are truly getting their arms around "more for less" and its impact on functionality, performance and power management.

Figure 2

Many UAVs and rugged ground vehicles are incorporating multicore VPX systems. As mil/aero programs become increasingly net-centric, having several processors computing data expedites the speed of the system. Multiple cores running on one board ultimately saves space when it comes to the final system.

VPX and Multicore

The VPX platform has emerged as ideal for data-intensive UAV applications, especially where high bandwidth is an issue. These high-performance boards (more costly than other form factors) save data transmission time and increase intelligence gathering capabilities—and multicore computing absolutely plays a significant role in their growing value as a military resource.

Flown either autonomously or remotely under the control of a seasoned pilot perhaps thousands of miles away, today's UAVs range widely in size, weight and function. Maybe it's a full-

Multicore cPCI for Naval Sounding

Modern hydrographic technology enables marine researchers to explore and map ocean depths in greater detail than ever before. Surveillance of continental slopes, rifts and ridges provides vital information for the military's disaster management efforts as well as expert knowledge of ocean depths for safe passage of any type of military vessel. Commercial applications follow, and oil and gas companies are better able to locate undiscovered natural resources, and lay pipelines and cables cost-effectively and with minimum disruption to the environment.

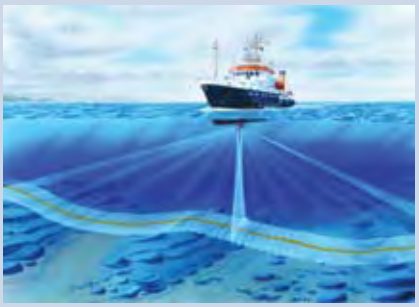
All of these sectors require high-availability systems that produce detailed hydrographic information, or bathymetric maps, captured in the most cost-effective and efficient way. As a result, rugged 6U CompactPCI multicore computing technology based on the PICMG 2.16 standard is currently enabling unprecedented levels of detail and accuracy at a faster rate of production.

Hydrographic systems use echo sounding to create maps of the seabed. An array of transducers is mounted on the hull of a ship that traverses the area to be surveyed (Figure a). Each transducer element sends out a sound pulse, or 'ping', creating a sheet of sound that covers a large area to the right and the left of the ship. The returning signals are processed by an onboard computer to produce detailed bathymetric maps.

Systems that generate more detailed and more accurate maps have a competitive advantage. Some ships are now processing up to 1.8 million digital amplitude signals per second instead of the previous 0.9 million samples—an increase of 100 percent—and also covering a wider seabed area in the same period of time, in other words, 5.5 times the water depth coverage compared with the previous 3.5 times water depth coverage—an increase of 60 percent.

CompactPCI boards equipped with Intel Core Duo 2.0 GHz processors and 4 Gbyte of dual channel 400 MHz DDR 2 RAM enable reliable operation at a higher ping rate for processing information in a shorter period of time. The same boards also control the entire ship's system, receiving and executing operator commands from PC terminals connected via Ethernet and automatically controlling intelligent subsystems, which are also connected via Ethernet as well as via the board's serial ports.

System users benefit from the impressive power/watt ratio of the multicore technology that provides approximately double the performance of a single core processor at similar power consumption and at a TDP of only 31W. Overall, multicore architecture increases CompactPCI's data throughput significantly from earlier processor generations (Figure b) with up to 25 percent faster core speeds (2.53 GHz), 50 percent more L2 cache and a 60 percent faster FSB (1066 MHz) with similar energy consumption.



(a)

(b)

Figure a & b

Hydrographic systems use echo sounding to create maps of the seabed. An array of transducers is mounted on the hull (a). Each transducer element sends out a sound pulse, or 'ping', creating a sheet of sound that covers a large area to the right and the left of the ship. The multicore CP308 3U CompactPCI board (b) in the system enables reliable operation at a higher ping rate for processing information in a shorter period of time.

sized Predator aircraft, or maybe it's a portable surveillance drone that can be carried in a soldier's field pack and deployed as an advance guard. UAV systems currently run the gamut from telemetry to flight control to target acquisition to surveillance and even armament deployment.

Multicore processing helps combat issues of power consumption and heat dissipation resulting from the use of serial switched fabrics, as well as the integration of multiple integrated systems and platforms. Designers must also consider the increased use of video and graphics, digital signal processing, sensor data acquisition and processing, and the UAV's more compute-intensive applications with feedback being provided in real time to ground monitoring systems.

Borrowing from 25 years of VME experience, VPX systems are designed to withstand the hardest shock and vibration levels. They are frequently found in extremely rugged environments, UAVs for example, and also ground vehicles (Figure 2) where space constraints are a key factor. VPX connectors handle high-frequency signals and support 10GbE, PCIe fabric and SATA II—and as mil/aero programs become increasingly net-centric, having several processors computing data expedites the speed of the system. Multiple cores running on one board ultimately saves space when it comes to the final system.

TPM and More on Multicore

So what's next for multicore in military embedded systems? 32nm of course, and overall, designers can expect greater advantages from the "more for less" concept. Sheer performance enhancements are the name of the game, especially as increased functionality impacts exactly what an end-use application can achieve. Greater security features such as Trusted Platform Management (TPM) are becoming commonly important in network-centric military applications. Better graphics are part of the picture as well, and require more compute power readily at hand. Military leaders have high-definition 1080p imaging on their televisions at home; designers can expect them to require it on-screen with their surveillance and reconnaissance imaging, or even targeting mechanisms that clearly benefit from better resolution.

Continued physical size reduction is critical as well. With Intel's stated embedded roadmap moving from a three-chip solution all the way down to a single-chip solution (even in the not-too-distant future), military engineers will continue to have more design options. When high-level performance requires less physical space, designers can simply put more on their boards, using fewer peripheral solutions along the way. As the CPU and chipset merge into smaller quantity pieces, the motherboard is able to contain more within its existing physical footprint. For example, with a single-chipset solution, a designer might be able to add a communication piece such as Firewire—tapping that extra board space to allow for the Firewire controller and connector without a separate peripheral.

Advances in multicore processing platforms have proven to offer higher compute performance, reduced chip count, and lower BOM costs with drastically reduced power consumption. As technology shrinks and there is more real estate available on the die, chipmakers will continue to push for greater performance, using a combination of improvements in circuitry and more advanced manufacturing technologies. Intel is looking to its next-generation 32nm multicore processors to outpace demands well into the future—and military developers will benefit with each new advancement. ▮▮

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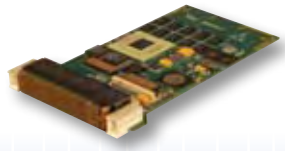

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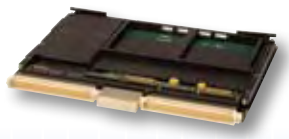

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Technology Focus

Multicore Boards

Multicore Processor Boards Push the Compute-Density Envelope

Compute-intensive military systems are riding the trend toward multicore processors. A variety of dual-core and multicore CPU boards is available to serve military needs.

Jeff Child
Editor-in-Chief

Processor architectures sporting multiple CPU cores on the same device have moved swiftly from the exotic and into the mainstream desktop and sever realm. Gone now are the days when there was a long gap between the emergence of a microprocessor product line and the demand for it among the military embedded computing realm. Now with the dual-core, multicore CPU trend firmly established in the general computing market, embedded board vendors have followed up quickly with boards based on those CPUs like the Core2Duo and others. This product roundup displays a representative sample of multicore boards on a variety of embedded form factors.

The multicore transition in the microprocessor world is already in full swing. 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. Compute-intensive applications such as sonar, radar, SIGINT and UAV control systems fall into that category, along with several others. AMOD, an upgrade to the Aegis Weapon System (AWS), the automated segment of the Aegis Combat System (ACS) (Figure 1), is using 2.16 GHz Core2Duo-based conduction-cooled CompactPCI boards, for example, for its processing needs.

For well over a decade, microprocessor designers have made clever use of the ever-increasing number of transistors that bless semiconductor fab advances. In order to wring the greatest possible performance increases, they used the largest number of transistors to refine their superscalar architectures and lengthen 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 they once had. With that in mind, processor architects 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.

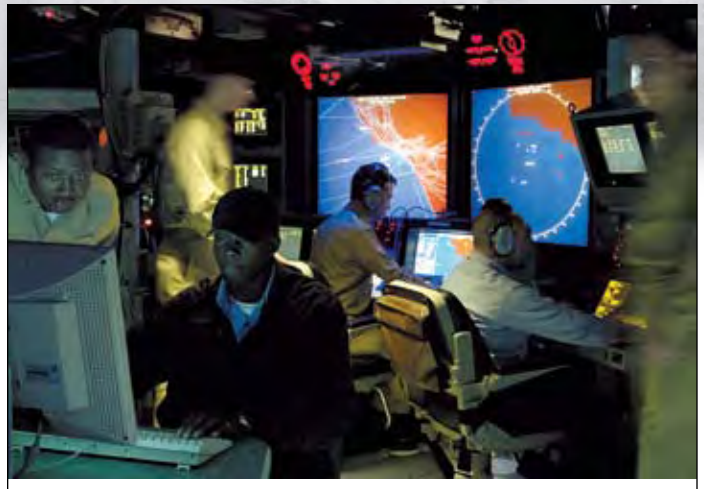

Figure 1

AMOD, the upgrade program for the automated segment of the Aegis Combat System (ACS), is using 2.16 GHz Core2Duo-based conduction-cooled CompactPCI boards for its processing needs.

Although the trend toward multicore processing is nearly universal, there are two fundamentally different approaches to it. 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 is what academics call "tiled" processors. The tiled processor most talked about these days is the Cell processor. Developed by IBM, Toshiba and Sony Group, the Cell architecture features eight synergistic processing elements plus a Power Architecture-based core. Since its introduction a couple of years ago, the Cell hasn't captured quite the interest in the military embedded computer market that some expected it to. ▮▮

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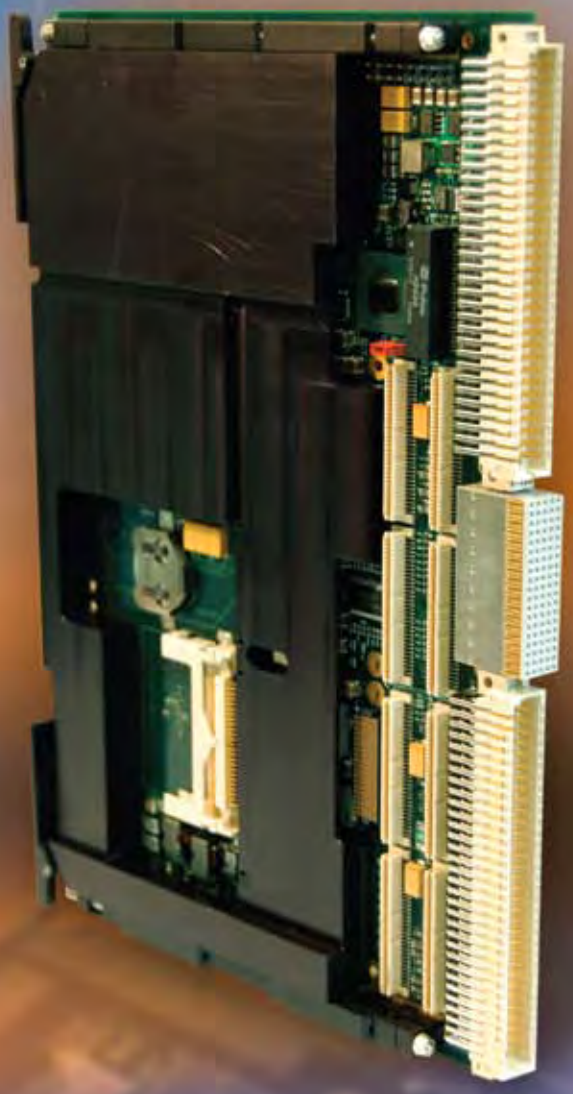

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Technology Focus:
Multicore Boards Roundup

6U CompactPCI Boards Sport Quad Core Xeons

The multicore trend has hit all levels of processor families, and the Xeon is no exception. Concurrent Technologies has released the PP 66x/071 family of 6U CompactPCI boards, one of the first product lines to feature the quad core 2.13 GHz Intel Xeon processor L5518 or the dual core 2.0 GHz Intel Xeon processor L5508. Based on 45nm process technology and the new Intel microarchitecture, formerly codenamed "Nehalem," both processors are from the Intel embedded roadmap, which offers at least seven-year availability. With up to 64 Gbytes of DDR3-1066 ECC SDRAM, two 10 Gigabit Ethernet ports and several SAS and SATA300 disk interfaces, the PP 66x/071 family has one of the highest specifications available to 6U CompactPCI users today; the boards are particularly suitable for defense and homeland security market sectors.

For high-performance I/O, control and data processing flexibility, the PP 66x/071 supports, via the front panel, a PMC/XMC site (133 MHz PCI-X and up to x8 PCI Express lanes) as well as optional I/O interconnections via two 10 Gigabit Ethernet ports (copper or optical). The rear connectors provide an interface to an optional onboard 8-port hardware RAID Controller supporting SAS and SATA300 drives. The PP 66x/071 can operate as a system controller board (left slot or right slot), a peripheral board or as a satellite board (blade). Support is also provided for PICMG 2.16 (Ethernet fabric), PICMG 2.9 (IPMI) and PICMG 2.1 (hot swap); the CompactPCI backplane interface operates at 33/66 MHz PCI signaling speeds.

Concurrent Technologies
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[www.gocct.com].

6U VPX SBC Serves up 45nm Core2 Duo CPU

The multicore processor trend fits neatly into the desires of today's military system designers who want to pack as much compute density into a slot as possible. A new rugged 6U VPX SBC from Curtiss-Wright is based on the Intel Core2 Duo processor T9400. The Intel Core2 Duo processor T9400 is validated with the Mobile Intel GM45 Express chipset, providing graphics core performance up to 533 MHz and up to 8 Gbytes of 800 MHz DDR3 system memory. This platform is suitable for a broad range of embedded applications such as interactive clients, embedded platforms and industrial automation equipment.

The VPX6-1952 is available with 4 Gbytes or 8 Gbytes of high-bandwidth SDRAM and comes with a complement of high-speed I/O, including dual Gigabit Ethernet, three serial ports, ten USB 2.0 ports, and an XMC site with 20 differential and two single-ended signal pairs mapped to the backplane. The board's integral high-speed SERDES Gigabit Ethernet and XMC mezzanine module connectivity enable high-bandwidth data flows. Data can also flow from the VPX backplane to the XMC site to support demanding high-bandwidth applications. Pricing for the VPX6-1952 starts at $13,500.

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2.16 GHz Core 2 Duo Rides 6U cPCI

Compute-density is the goal of many of the latest military embedded computer applications.

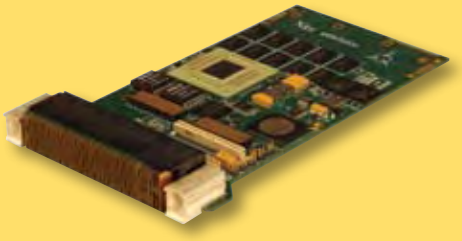
Along those lines, Dynatem is now shipping the Intel Core2 Duo-based CRD CompactPCI/PICMG 2.16 SBC. The CRD is a 6U single-slot CompactPCI-compatible platform based on the Intel low-power Core2 Duo processor. The CRD takes advantage of the L7400 Core2 Duo's low power consumption as a rugged SBC. Versions supporting the T7400 2.16 GHz Core2 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].

3U VPX SBC Serves up Dual Core Freescale MPC8640D CPU

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



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

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

2.53 GHz Core 2 Duo Climbs Aboard 6U VME

VME, combined with VXS, is an ideal way to marry the legacy of installed VME with the performance of fabric-based VXS. Doing exactly that, GE Fanuc Intelligent Platforms announced the V7875 SBC with extensive I/O capability and advanced graphics. VITA 41.3 (VXS) for Gigabit Ethernet across the backplane is also optionally available. Featuring the Intel Core2 Duo T9400 processor running at 2.53 GHz, the V7875 also provides up to 6 Mbytes of L2 cache. Use of the Intel GM45 chip set provides fast access to up to 4 Gbytes of DDR3 SDRAM and a x16 PCI Express interface to deliver exceptional performance for demanding applications.

The V7875 provides support for a PCI-X XMC/PMC site, but also a connector to the EXP237 mezzanine board to deliver an optional three additional XMC/PMC sites. Additional connectivity is provided by a dual SATA disk interface, two Gbit Ethernet ports routed to the front panel, four USB 2.0 ports and two serial ports. For applications not requiring the XMC/PMC site, even further I/O—one eSATA port, one USB 2.0 port and two Gbit Ethernet ports (when VITA 41 is not available)—can be provided via the front panel.

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

6U 2.16 GHz Core 2 Duo Board Boasts Health Monitoring

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].

Dual 1.4 GHz PowerPCs Reside on 6U CompactPCI

CompactPCI has passed the test of longevity and maturity, making it one of the accepted form factors in today's military applications. Feeding that trend, Interface Concept has unveiled a high-performance 6U CompactPCI board, the IC-xe6-cPCIb, powered by one or two Freescale 1.4 GHz MPC7448 PowerPC processors. This new single or dual processor SBC is PICMG 2.16-compliant and blends low power consumption and large communications capabilities. The board implements a Marvell Discovery III chipset (MV64460).

The memory banks are made of up to 2 Gbytes of DDR-ECC SDRAM, up to 256 Mbytes of mirror flash and up to 1 Gbyte of soldered NAND flash. A quad UART provides four additional asynchronous channels available on P2 connector. The 64-bit PCI/PCI-X bridge allows the IC-xe6-cPCIb to handle two PMC slots with PnIO routed to J3/J5. Thanks to its SATA controller, the IC-xe6-cPCIb can manage directly four storage devices. The IC-xe6-cPCIb provides one Gbit Ethernet, one console, one USB-2 and two SATA ports on the front panel. This board has been designed to meet the most severe environments—standard, extended and rugged grades. Prices start at $3,950.

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

3U VPU Features Core2 Duo Processor

The ranks of VPX vendors continue to grow. Kontron's latest offering is the VX3020 based on the Intel Core 2 Duo processor. VPX, a proposed ANSI standard, breaks out from the traditional connector scheme of VMEbus to merge the latest in connector and packaging technology with the latest in bus and serial fabric technology. The boards are available in Rugged Conduction-Cooled (RC) versions that support operational temperatures ranging from -40° to +85°C according to VITA 47 recommendations.

Based on the latest dual-core 1.5 GHz Intel Core2 Duo LV processor, the Kontron VX3020 VPX CPU board offers high-end processing performance to meet a wide range of demanding signal and data processing requirements. With the Intel 3100 chipset the Kontron VX3020 supports up to 2 Gbytes of DDR2 SDRAM and features all the high-performance I/Os that are available on the latest laptop PCs such as the UXGA graphics controller with PCI Express, two Gigabit Ethernet network interfaces configurable by software either on the front RJ45 connector or the rear VPX backplane connector, 3 x SATA-150 interfaces and multiple USB 2.0 ports. An onboard USB connector is able to support a standard USB Flash disk module. The Kontron VX3020 can also easily run high demanding PCI-based applications with support for high-performance and PCI software backward-compatible PCI Express, which is configurable either as x4 or quad x1 over the backplane.

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

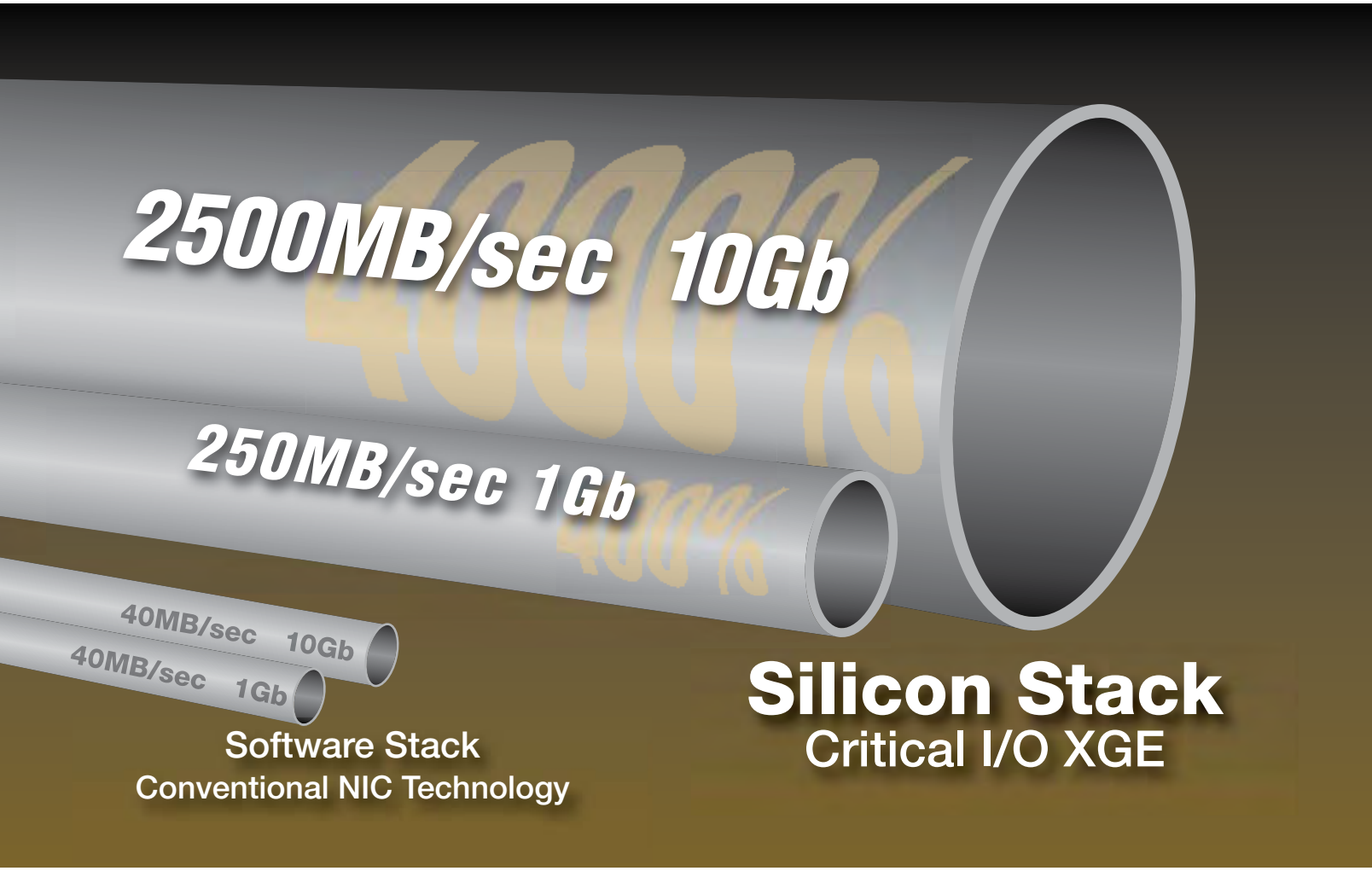
Core2Duo cPCI Board Provides Advanced Graphics

Military and aerospace applications such as aircraft monitoring, visualization and control all have something common. They demand a blend of high-performance compute muscle, with a ruggedness suited to harsh environments. Along those lines, MEN Micro offers a 6U CompactPCI SBC that combines Intel's multicore technology with a flexible mezzanine card extension and rugged design to provide exceptional performance in industrial applications. The D9 can be equipped with the Intel Core2 Duo, Core Duo or Celeron M processors to support a multitude of dual-core and single-core CPUs depending on specific application requirements.

By incorporating the Intel Mobile 945GME Express Chipset with an integrated 256-bit graphics engine providing up to 250 MHz, the D9 combines outstanding computing and graphics performance with low power consumption. The 945GME supports the connection of two monitors with either the same or different displays. Provisions for a VGA connector or up to two digital video portals are provided via a mezzanine card. The card is equipped with a tailored heat sink and up to 4 Gbytes of soldered DDR2 RAM for optimum shock and vibration resistance. The D9 offers an extensive combination of I/O functions with rear I/O, mezzanine extension cards as well as XMC or PMC. A total of six USB 2.0 interfaces, up to four UARTs and up to four Gigabit Ethernet ports are available at the front or at the rear of the D9.

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

Which Way do You Want Your 10Gb Ethernet?



Silicon Stack Technology from Critical I/O. 10Gb Ethernet at Wire Speed.

[**Problem**] You're expecting 10Gb Ethernet to deliver a whole lot more performance to your embedded system. But what if you invest in it and get no gain at all? The performance of nearly all existing 1Gb applications are limited by the software overhead associated with the TCP/IP protocol stack. This bottleneck is in the software stack, not the network hardware. So, simply upgrading to 10Gb pipes will not improve your system's performance.

[**Solution**] Unlike conventional Ethernet interfaces or processor-based "offload" products, Critical I/O's Silicon Stack technology eliminates this inherent bottleneck by offloading protocol processing to silicon; thereby achieving sustained line-rate performance, microsecond latency, and rock-solid deterministic behavior. And, Silicon Stack is 100% compliant with Ethernet standards, allowing you to leverage existing applications and hardware.

XGE Silicon Stack Ethernet
vs. Software-based Stack

	Software Stack		Silicon Stack	
	1Gb	10Gb	1Gb	10Gb
Throughput max sustained rate in MBytes/sec	40 varies with protocol		250	2500
Host Overhead	Very High		Very Low	
Latency	125 µsec		12 µsec	5 µsec
Determinism typical variation	Horrible ± 200 µsec		Rock Solid ± 1 µsec	
Reliability	Poor when under heavy load		Excellent under all load conditions, no dropped data	

CRITICAL IO

www.criticalio.com

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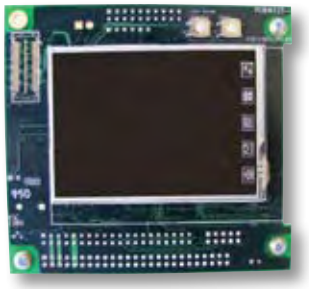
Controller Adds Graphics to StackableUSB



USB for years went underutilized in military embedded applications. That's starting to change as uses from the technology present themselves. Using USB as a link for stacked embedded boards is the whole idea behind StackableUSB. Micro/sys satisfies the demand for graphical user interfaces in low-power, space-constrained embedded applications with the introduction of its new USB3201, a graphics controller and a compact 2.8-inch (320x240 pixel) color LCD, which comes with a highly modular, easy-to-use software package. Using StackableUSB, the USB3201 easily mates with small, energy-efficient microcontrollers operating off a 9V battery, as well as x86 and ARM SBCs, to provide OEMs complex 2D and simple 3D graphics within the popular 104 form factor. The USB3201 exemplifies USB's ability to enable sophisticated, low-power systems across all CPU platforms.

Powered by the Microchip PIC32 and the Microchip Graphics Library, the USB3201 can support multiple input devices. The user-friendly software package has an open documented interface for LCD driver support making it easy to interface to any LCD with the creation of a single low-level C file. With both a CPU and RGB interface, it is easy to accommodate an LCD with a maximum 480x272 WQVGA resolution. The USB3201 set including the controller and LCD touchscreen starts at $265 in single quantity.

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

Compact, Rugged PC/104-Plus SBC Rolls

Fans are frowned on in harsh environment military applications. They represent a single point of failure that's not worth the risk. Offering its latest fanless SBC solution, VersaLogic began shipping a new PC/104-Plus SBC called the "Manx"—a mid-range SBC featuring a highly efficient AMD Geode LX 800 processor. The product is function and pin-out compatible with VersaLogic's older Puma SBC, offering customers a higher performance migration path from that popular product. The new Manx incorporates mid-range processing speed (500 MHz) with very low power consumption (less than 5W). The ACPI suspend-to-RAM state feature reduces power draw to an incredible 0.2W between active sessions.

This high-reliability fanless design is available in both standard (0° to +60°C) and extended (-40° to +85°C) temperature versions. The Manx has standard onboard features that include 256 Mbytes of soldered-on DRAM, 10/100 Ethernet, four USB 2.0 ports, LPT port, IDE interface, three COM ports, and analog audio. A CompactFlash socket provides reliable, high-capacity onboard storage with no moving parts. The PC/104-Plus expansion interface supports both ISA and PCI add-on modules. The Manx will be available in production quantities in June. Pricing is about $550 in OEM quantities.

VersaLogic, Eugene, OR. (541) 485-8575. [www.versalogic.com].

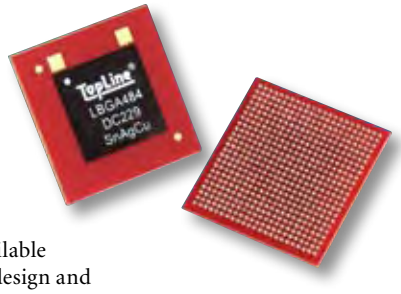
Rugged Box System Supports Wireless Connectivity

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

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

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

BGA Adapters Enable Smaller Pitch Device Use



A classic military obsolescence problem is that of making legacy board designs work with cutting-edge small pitch component packages. In order to solve this issue, Aries Electronics has added a unique adapter series to its extensive line of Correct-a-Chip adapters. The new BGA Switch-A-Pitch Adapters enable the use of smaller pitch devices with larger pitch boards. The first Switch-A-Pitch adapters in the series have tops where the BGA "landing pads" (on the top of the adapter) are on a 0.5 mm, while the adapter bottoms are populated with BGA balls on a 1.27 mm pitch.

Switch-A-Pitch boards are 0.062 inch (1.57 mm) thick FR4 or Rogers 370 HR, with 1/2 oz. copper traces on both sides. The non-solder mask defined (NSMD) pads are finished with electroless nickel immersion gold (ENIG) and have solder spheres of 63/37 lead/tin or of lead-free SAC305 alloy. Switch-A-Pitch adapters are available in panelized form, as an adapter only, or as a turn key solution with mounted devices. Specializing in custom design and production, Aries offers standard products as well as special materials, platings, sizes and configurations upon request. Switch-A-Pitch adapters are custom made to customer requirements. A typical adapter with 64 positions is priced at $25 each for a quantity of 300 adapters.

Aries Electronics, Bristol, PA. (215) 781-9956. [www.arieselec.com].

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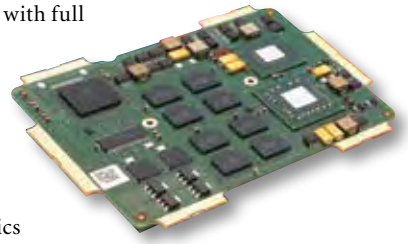
ESMexpress Modules Serve up Intel Core 2 Duo



The multicore trend has hit the embedded board realm with full force. MEN Micro now offers the next generation of ESMexpress products with the new XM2, based on the latest Intel Core 2 Duo SP9300 processor with a clock frequency of up to 2.26 GHz. The XM2 provides levels of processing speed and data integrity previously unobtainable by other system-on-modules (SOMs).

The XM2 is also equipped with the new Intel GS45 graphics controller that provides a x16 PCI Express graphics link or up to two SDVO interfaces, a DisplayPort or two HDMI ports. The new Core 2 Duo-based module also features a host of I/O functions, including four x1 or one x4 PCI Express links as well as two Gigabit Ethernet ports, eight USB ports, three SATA ports and one HD audio port. The XM2 dissipates up to 40W via the advanced fanless cooling system defined by the ESMexpress standard. All ESMexpress modules support a single 95 mm x 125 mm form factor. Pricing for the XM2 ESMexpress module starts at $ 1,911.

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

ATCA Carrier/Hub Has 26-Port 10GbE Switch

ATCA is finding a niche in the defense market. Applicatons heavy on network reliability and bandwidth find themselves looking to this form factor. JumpGen Systems announced the PSA-100, an AdvancedTCA (ATCA) Carrier/Hub blade featuring the Fujitsu MB86C69RBC 26 port 10GbE switch IC together with an Intel EP80579 Integrated Processor and up to 4 Gbytes of ECC DDR2 memory for switch management and/or control plane functions. The PSA-100 supports three mid-size B+ AMC bays each with two 10GBase-KX4 Fat Pipe and two 1000Base-KX Base interfaces.

The Fujitsu switch connects the three AMC sites to the ATCA backplane fabric and base channels. The PSA-110 may be deployed with 600 MHz, 1.066 GHz, or 1.2 GHz processors, with or without QuickAssist Technology. The PSA-100 may also serve as an ATCA Hub in systems up to 7 slots (such as a 5U ATCA Chassis). The PSA-100 is shipping to select customers in Q2, 2009 and will be generally available in Q3, 2009.

JumpGen Systems, Carlsbad, CA. (760) 931-7800. [www.jumpgen.com].

Digital Delay Generator Boasts High Resolution

Applications like laser timing, radar simulation and ultra-high-speed imaging require complex digital delay functionality. Feeding such needs, Highland Technology has released the T564, the latest in its series of mini embedded digital delay generators. Starting with an internal or external trigger, the module produces four output pulses programmable for delay and width, with nanosecond-to-second range and picosecond jitter and resolution.

The T564 introduces three unique features to digital delay generation: "Queued Updates" allow time settings to be changed without corrupting ongoing timings; a "Train" function allows multiple pulses to be generated from each trigger; and the "Frames" feature allows complex delay sweeps and pulse scenarios to be preloaded and rapidly executed. Because of its low 20 ns insertion delay, the T564 is ideal for timing and gating laser, Q-switch, ICCD and other electro-optical devices, and for applying picosecond-resolution time trims to nuclear, radar and sonar cabling and instrumentation.

Highland Technology
San Francisco, CA.
(415) 551-1700.
[www.highlandtechnology.com].

Module Links USB to Four RS-232/422/485 Ports

In many military systems—UAVs for example—there are never enough serial ports to communicate with legacy devices. ACCES I/O Products has rolled out is next-generation of serial communications adapters—Model USB-FLEXCOM4. The unit offers users the choice of four field-selectable RS-232, RS-422, or RS-485 protocols per port. The USB-FLEXCOM4 conforms to the USB/104 form factor for flexible mounting either in PC/104 or USB/104 stacks. The device is available either packaged in a small, rugged, industrial enclosure or as an OEM board (no enclosure).

This USB device is an ideal solution for adding portable, easy-to-install serial ports to any PC or embedded system with a USB port. It is fully compatible with both USB 1.1 and USB 2.0 ports. Hot-plug functionality allows for quick connect/disconnect whenever you need additional I/O on your USB port. The low-profile enclosure was designed to occupy less space overall and allow access to the four DB9M connectors, two per side for interfacing with communication cabling, and includes adjacent LEDs indicating serial port activity. The Model USB-FLEXCOM4 is priced at $254.

ACCES I/O Products, San Diego, CA. (858) 550-9559. [www.accesio.com].

Board Pair Blend Atom and I/O Variety

Non-backplane, stand-alone board form factors continue to expand their acceptance among military developers. Riding that wave, GE Fanuc Intelligent Platforms announced the bCOM2-L8000 COM Express module (shown) and the mITX-945S-ED motherboard. These new platforms—the first from GE Fanuc to feature the Intel Atom processor—can provide the foundation for systems builders, whether integrators or end users, to create embedded solutions that provide PC functionality in a broad range of applications where low power consumption and minimal heat dissipation are key requirements, but where the system designer cannot compromise on I/O capability.

The bCOM2-L8000's extensive I/O capability includes one Gigabit Ethernet port, two Serial ATA interfaces, support for up to two IDE devices and eight USB 2.0 ports, while expansion can be achieved via three PCI Express lanes. The mITX-945S-ED is equally well provided with I/O functionality, and includes two Gigabit Ethernet ports, PCI Express and PCI expansion slots, a COM port, two Serial ATA ports, support for up to two IDE devices and four USB 2.0 ports. Support for graphics (up to SXGA+ resolution) and audio is also provided. Importantly, the mITX-945S-ED features a 12-volt DC input, eliminating the need for an ATX power supply.

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

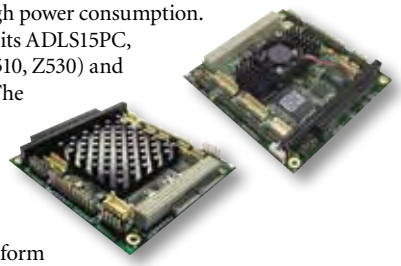
Clock Synthesizer Delivers Signal Quality

The clock source is one of the most important components of any digital signal processing, data acquisition or recording system. In these applications, accuracy and purity of the sample clock are critical and the connection to a very high-precision source is essential. Feeding exactly such needs, Pentek has introduced the Model 7190 Multifrequency Clock Synthesizer—a high-performance, highly precise source of clock signals in an unusually small PMC format. For larger, multichannel radar and beamforming systems, synchronous sampling is mandatory. In addition, as new A/Ds achieve 16-bit resolution and exceed sampling rates of 200 MHz, a far more functional, flexible and precise clock is required.

A key feature of the 7190 is that all eight output clocks are phase locked to an external frequency reference, typically 5 or 10 MHz. It uses four TI CDC7005 Clock synchronizers, each controlling a quad frequency voltage controlled crystal oscillator (VCXO). Up to five different frequencies from this set can be delivered to the eight front-panel SMC output connectors, or a single identical clock can be sent to all eight outputs. The price of the Model 7190 Multifrequency Clock Synthesizer is $2,495.

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

PC/104-Plus SBC Sports 1.60 GHz Atom CPU



The Atom processor is quickly pushing aside the idea that PC compatibly means suffering with high power consumption. Advanced Digital Logic has released its ADLS15PC, which is based on the Intel Atom (Z510, Z530) and the IntelUS15W (Poulsbo) chipset. The Intel Atom is a single core processor built on a 45nm process that boasts an impressive 2.0 watts TDP (Intel) for the CPU. This processor delivers the benefits of genuine Intel architecture to a small form factor for low-power, thermally and space-constrained markets.

The ADLS15PC takes advantage of these features by delivering high performance and low thermals in a compact, single board PC/104-Plus form factor. Memory is added via an SODIMM200 socket that will accept up to 2 Gbytes of DDR2-400/533 DRAM. In addition to ACPI/APM functions, the ADLS15PC provides EIDE, 8xUSB 2.0, 2xRS232 COM ports, PS/2 Keyboard and Mouse, LPT, 7.1 HDA Audio, 10/100/1000MBit LAN and more are provided. The ADLS15PC can also come equipped with an onboard Solid State Disk (SSD) of 2 or 4 Gbytes. With the use of ADL's advanced conductive and convective thermal solutions engineered for the Atom design, the boards can be placed in nearly any application under environmentally demanding conditions.

Advanced Digital Logic, San Diego, CA.
(858) 490-0597. [www.adl-usa.com].

Gbit Ethernet Cube Boasts Rich I/O Support

The military is all in with the idea of using Ethernet for both networking and as a data interconnect. United Electronic Industries has released its new PowerDNA PPCx-1G Gigabit Ethernet I/O Cube. Available in two basic models—a 3-I/O layer (5-slot PPC5-1G) or a 6-I/O layer (8-slot PPC8-1G)—the new GigE Cube offers higher speed and greatly enhanced diagnostics capability relative to the standard Cubes but remains compatible with all 30+ UEI I/O board types.

The 6-layer model (PPC8-1G Cube) can provide up to: 150 analog inputs, 192 analog outputs, 288 digital I/O, 48 counter or quadrature channels, 72 ARINC-429 channels and/or 24 Serial or CAN-bus ports. Software for the GigE Cube is provided in the UEIDAQ Framework. The Framework provides a comprehensive, easy-to-use API that supports all popular programming and operating systems such as Windows, Vista, Linux and most real-time operating systems. In addition, the product is fully supported by LabVIEW, MATLAB/Simulink, DASYLab, or any application that supports ActiveX, OPC or Modbus TCP control.

Pricing for the DNA-PPC8/PP5-1G ranges from $1,395 to $1,595 depending on configuration.

United Electronic Industries, Walpole, MA. (508) 921-4600. [www.ueidaq.com].

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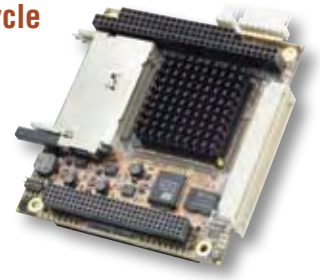
Rugged Ethernet Switch Ready for Aircraft Duty

Looking for a faster solution than 1553, aircraft system integrators are looking for an easy way to implement Gbit Ethernet to handle high bandwidth elements such as multifunction displays, moving maps and multiple full rate video feeds. With just that in mind, the Aeronix GES provides twelve Gbit Ethernet ports in a rugged package designed specifically to address this problem. At less than 3 pounds and with dimensions of 8.25 x 5.1 x 1.38 inches, the GES is very compact. With an average power consumption of 16W with all 12 ports active, the GES is very low power, which allows for ambient air cooling.

The GES meets MIL-STD-704A power specifications and shock/vibration qualification to aircraft gun fire levels. The small footprint of the GES is not at the cost of functionality. At the heart of the GES is a fully manageable switch fabric that includes support for VLANs, QoS, Link Aggregation, IPv6 and Ingress/Egress monitoring. The GES contains an in-band ARM9 management processor, which will allow custom management functions as required by the integrator. A serial port is also available in the form of an Ethernet to serial bridge, which allows control of legacy equipment from anywhere in the network.

Aeronix, Melbourne, FL. (321) 984-1671. [www.aeronix.com].

All-in-One PC/104-Plus SBC Offers Long Life Cycle



Obsolescence continues to vex military system designers. PC and consumer processor silicon goes end-of-line so fast it can make your head spin. WinSystems eases that burden with their PPM-LX800-G, a highly integrated, PC/104-Plus-compatible, 500 MHz Pentium-class SBC. This SBC is based on the low-power AMD LX 800 at 0.9W CPU, which has product availability through at least 2015. The board includes the CPU, video, Ethernet, USB, COM ports, EIDE controller, digital I/O, mouse, PC 97 audio and keyboard controllers on one board that measures only 3.6 x 3.8 inches (90 x 96 mm).

The PPM-LX800-G can be populated with up to 1 Gbyte of system DRAM plus onboard CompactFlash. A high-resolution video engine is on board that supports displays with resolutions up to 1920 x 1440 for a CRT or up to 1600 x 1200 for a flat panel. An Intel 82551ER 10/100 controller supports Ethernet networking. Further I/O support includes two USB 2.0 ports (with in-rush and over-current protection), four independent full-duplex serial UARTs, 16-lines of TTL-compatible digital I/O and AC97 audio. The PPM-LX800-G contains the core logic to provide PC compatibility for the I/O and bus interface logic including the Ultra DMA100 controller for hard drives, keyboard/mouse controller, LPT interface, interrupt controller and real-time clock. The PPM-LX800-G is priced at $495.

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

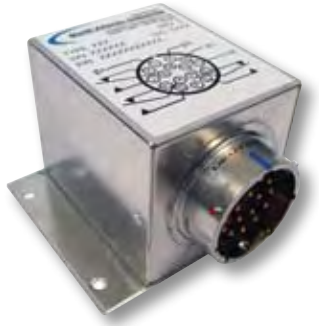
1U Net Appliance Marries Core 2 Duo and Ethernet

Designed around the Intel Core 2 Duo processor and Intel Q35 chipset, the PL-10570, a new 1U rackmount network appliance from WIN Enterprises, offers a solution for military networking applications. The Q35 chipset features on-chip PCI Express x4 and x1 lanes. The highly efficient 45nm Intel Core 2 Quad/Duo processor supports a maximum 1,333 MHz front-side bus speed and 800 MHz dual-channel DDRII memory. Designed for a broad range of networking applications, the unit can support UTM network management, load balancing, WAN acceleration and VoIP gateway uses.

The device features a maximum of 10 x GbE. There are 6 PCIe x1 GbE copper 82573L LANs on the board, and the option of one of two expansion modules. One module has 4 GbE copper LANs using two 82571EB PCIe chips. The other module has 2 GbE copper LANs and 2 SFP GbE LANs using two 82571EB PCIe chips. Linux, Windows Embedded XP and FreeBSD are supported. PL-10570 is available as a commercial, off-the-shelf platform or it can serve as the basis for a custom OEM design. Unit pricing begins at $1,033 in OEM quantities.

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

Intelligent Power Monitor and Control Unit Is DSP-Based

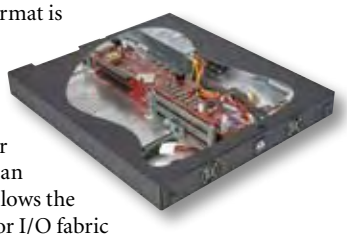


How power is managed can make a significant impact on the functionality of a system. Feeding that need, North Atlantic Industries (NAI) has announced the availability of a next-generation DSP-based intelligent power monitor and control unit. The model iPM monitors 1-phase or 3-phase wye or delta connected power lines for voltage, frequency, phase sequence, THD and DC component. When any of these parameters are outside of their pre-programmed limits, the iPM internal 10 amp relay opens and disconnects the power from the load. The iPM has a universal input voltage range of 80 Vrms to 230 Vrms and a universal input frequency range of 47 Hz to 800 Hz. It includes a background self-test capability that constantly monitors the health of the unit.

With its full feature set, serial interface and rugged compact design, the iPM is ideally suited for military and aerospace programs, including airborne, shipboard and ground applications. The unit is designed to meet the environmental requirements of MIL-STD-810C, the EMI requirements of MIL-STD-461 and the Input Transient requirements of MIL-STD-704E, when installed within the system. The iPM is hermetically sealed and operates over a temperature range of -55° to +100°C.

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

1U Box Offers Seamless PCIe Express Expansion

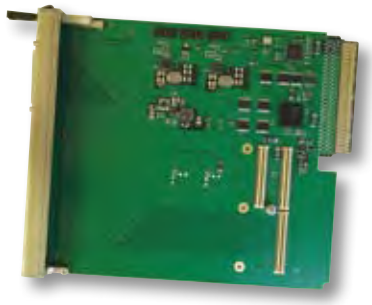


The 1U form factor has secured its own special niche in defense system designs. The format is compatible with a variety of off-the-shelf gear such as network routers. Magma's ExpressBox2 (EB2) is a 1U solution that can provide up to 2 PCI Express slots for plugging in graphics or other I/O cards to attach to laptops via an ExpressCard interface. Magma's EB2 allows the extension of a system's backplane and/or I/O fabric via cable to an external chassis that can take 2 PCI Express I/O cards. This chassis allows for space and power to accommodate up to four hard drives. Further, the chassis can be daisy-chained to allow for the extension of two PCI Express slots per chassis.

Key features include a communication bandwidth supported between host and EB2 chassis that is up to 20 Gbits/s in each direction, in simultaneous transmit and receive mode, and the ability to daisy-chain as many slots as the host configuration will allow. The EB2 supports automatic power-up control of the chassis by the host as well as hot-swappable PCI Express slots.

Magma, San Diego, CA.
(858) 530-2511. [www.magma.com].

Carrier Blends AMC with Hot Swap PMC



AMCs have found their place as a highly capable mezzanine form factor designed to work with ATCA and MicroTCA. The military still has a rich and long tradition in the older PMC form factor. Blending those two worlds is a double-width, full-size PMC carrier for AMC that supports one single-width PMC module. The TAMC260 from Tews Technologies is a solution to upgrade well-known legacy PMC I/O solutions to the high-performance AMC form factor. PMC modules provide modular, cost-effective I/O solutions for applications in aerospace and defense.

32-bit PCI accesses are supported on the PCI bus at both 33 MHz and 66 MHz. The PLX8112 PCIe-to-PCI bridge provides the real connection between the primary PCIe link and the secondary PMC slot. The bridge controls all PCI accesses and sets the frequency for the PMC access. The TAMC260 supports front panel I/O, and additionally a 68pin SCSI-V type connector provides access to the PMC P14 back I/O lines. In compliance with specification AMC.0, the TAMC260 provides an IPMI-compliant Module Management Controller (MMC) with temperature monitoring and hot-swap support.

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

Atom-Based Qseven Module Is 70 mm x 70 mm

As processors and other chips get smaller and more integated, it's the I/O connectors on an embedded board that are looking like the big space hogs. With that in mind, the Qseven module form factor was initiated by congatec AG and SECO, and enhanced by Portwell. Portwell's latest Qseven family of embedded system solutions is based on Intel's Atom processor. With a power consumption under 12W (+5V input), the Qseven is an appropriate module form factor to implement the Intel Atom processor Z5xx series and Intel System Controller Hub (SCH) US15W in terms of space, power consumption and thermal and expansion interfaces.

The interconnection between the Qseven module board and the carrier board is the MXM (Mobile PCI Express Module) edge connector. Common signals between the two boards include PCI Express x1, LVDS, SATA, SDVO, HAD, Gigabit Ethernet, Low Pin Count bus, Secure Digital I/O, SMBus and I2C bus. The Qseven module board is installed on top of the carrier board for improved mechanical stability. This means a small keep-out zone that leaves more space on the carrier board for additional devices. It also means that the carrier board itself can be smaller.

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

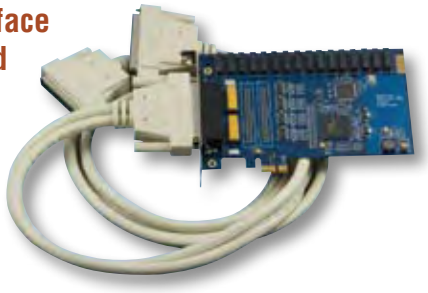
Boundary Scan Platform Supports Universal Fixtures

As embedded systems get ever more complex, military system developers are more dependent than ever on powerful test and debug tools. With that in mind, Goepel offers a series of universal board fixtures for the Boundary Scan hardware platform called Scanflex Board Grabber, which is comprised of three models in different sizes that are compliant with IEEE Std. 1149.x. Especially with complex boards, the professional mechanical handling of the design verification in the stage of development is often difficult. The Scanflex Board Grabber from not only solves this problem but offers the possibility of easily and reliably generating signal probing.

The Scanflex Board Grabber was specifically designed for the support of laboratory verification and programming of prototypes; it is also applicable at military repair stations. It brings along a width adaptable fixture, which can hold PCBs of different sizes. While the L-version can hold boards of 300 x 300 mm, the XL-version allows dimensions of 495x340 mm and the XXL-version dimensions of 555 x 440 mm. Due to the integrated pivoting mechanism it is easily possible to reach the top side and bottom side of the board.

Goepel Electronic, Jena, Germany.
+49 3641-6896-739. [www.geopel.com].

PCIe Digital I/O Interface Has Optically Isolated Inputs



PCI Express wasn't the first switched fabric to enter the game, but it's got the staying power that the military likes. A PCI Express digital I/O interface adapter provides 16 optically isolated inputs and 16 Reed relay outputs. The DIO-32.PCIe from Sealevel Systems can be applied to control and automation of equipment including sensors, switches security control systems and other net-centric military applications. Sealevel PCI Express serial boards are designed for computers with x1 PCI Express slots. Software for standard PCI boards will also work with PCI Express boards, simplifying your transition to this next-generation PCI bus.

The isolated inputs protect the PC and other sensitive equipment from the voltage spikes and ground loop currents that are common to industrial environments. The board is available in two versions with inputs rated for 3-13V or 10-30V. Socketed dip resistors allow user-configurable input ranges from +2V to +30V. The outputs provide high-quality, long-life, dry contact switch closures suitable for low-current applications. The highly reliable 10VA Reed relays are normally open and close when energized. The DIO-32.PCIe is available immediately from stock priced at $479.

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

Atom-Based Mini-ITX Board Runs on 15W

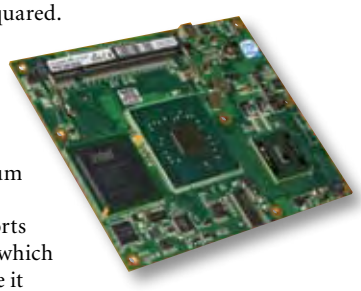
Intel PC compatibility and low power were always conflicting ideas for military portable system designers. That's changed with the emergence of the Atom processor. The NP101-D16C from Itox Applied Computing is a Mini-ITX motherboard based on the 45nm 1.6 GHz Intel Atom N270 processor with Intel 945GSE Express chipset and ICH7M I/O controller hub. Exhibiting a total system thermal design power (TDP) of less than 15W, it provides higher performance-per-watt than previous mobile platforms. A single energy-saving 12 VDC power input further reduces overall system configuration and operating costs.

In addition, this motherboard utilizes one 240-pin DDR2 DIMM socket supporting up to 2 Gbytes of economical DDR2 400 or 533 MHz memory. Other significant NP101-D16C features include an 18-bit LVDS display interface, VGA graphics interface and an SDVO connector for optional DVI or 24-bit LVDS display interfaces. This mini-ITX motherboard also provides 2 SATA ports, 8 USB 2.0 ports, 2 Serial COM ports, 2 PCI Express Gbit LAN controllers, 1 PCI Express x1 slot and 1 PCI slot. A standard ATX power input model, NP100-N16C, is also available with the same features as the NP101-D16C. In addition, the NP100-N16C Mini-ITX board includes an onboard DVI graphics port and CompactFlash socket.

ITOX Applied Computing, East Brunswick, NJ.
(732) 390-2815. [www.itox.com].

Atom-Based COM Express Board Boosts Graphics Performance

The Atom processor seems likely to win the distinction of the most designed-in CPU for new embedded board products this year. Riding that wave, Congatec has introduced the conga-BA945, a COM Express module with type 2 pinout that conforms to the specified COM Express basic size of 95 x 125 mm-squared.



The Intel Atom processor N270 has a clock speed of 1.60 GHz, as well as 512 Kbyte cache and a 533 MHz front side bus speed. Despite the high processing power, the processor gets by with a maximum power dissipation of 2.5W.

The congatec conga-BA945 supports Intel Hyper Threading Technology, which means with the appropriate software it has the capability of running two operating systems in parallel and completely independent of one another. The 945GME chip set facilitates the parallel use of two memory modules, which allows the memory to be expanded to a maximum of 4 Gbytes and makes dual channel memory access possible. In order to allow rapid system expansion, five PCI Express lanes, a PCI Express graphics slot (PEG 1x16), eight USB 2.0 ports, two serial ATA ports and the signals for two ExpressCards are provided. The conga-BA945 is available now with evaluation unit pricing of $362 each.

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

VPX SerDes Test Module Sports 16 Channels

Even though the world has moved from parallel to serial interconnects, placing many serial links in parallel is a powerful notion. A new 16-channel version of SerDes Test Modules for VPX systems allows testing and pre-emphasis of the SerDes signals to ensure signal performance of the system. The 16-channel SerDes modules from Elma Electronic are designed to plug into VPX backplanes and directly test the channel compliance. They can be used to test VPX switch and node cards and/or the backplane channels without requiring external equipment or special test fixtures. The modules provide a quick and efficient look at the "vital signs" of the signals in the VPX system.

The SerDes test modules also allow pre-emphasis tuning of VPX cards. The modules allow the user to measure the initial performance of the VPX boards and fine-tune them for optimum performance. Plugging directly into the backplane/chassis, the modules allow quick and easy characterization of the signals and eliminate the need for SMA connectors, cables and capital-intensive measurement hardware. Pricing for the 16-channel SerDes test modules starts under $30,000 depending on configuration.

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

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Coming Next Month

COTS JOURNAL

Special Feature: Rugged Displays and Display Interface Board Trends: Leveraging cutting-edge graphics chips developed for the demanding gaming market, military graphics subsystems are now able to offer complex video and graphics functionality in highly integrated board-level solutions. Cockpit displays and simulation/training applications rank as two of the most demanding users of these advanced graphics technologies. Articles in this section examine the graphics solutions available in PMC and other form factors, as well as a product roundup of display interface products.

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: Memory and Storage Interfaces: Over the past several years serial interconnect schemes have been steadily pushing aside parallel buses, and that trend has impacted the memory and storage realm just as it has every other facet of military embedded computing. And as military systems continue to rely more and more on compute- and data-intensive software, the interface to memory and storage subsystems can't risk becoming a bottleneck. This section examines the emergence of Ethernet and IP-based storage interfaces, while comparing how traditional interface schemes like Fibre Channel and SCSI are positioned these days.

Tech Focus: PCI/104-Express, PCIe/104 and EPIC Boards: PC/104 has become entrenched as a popular military form factor thanks to its compact size and inherent ruggedness. Sweetening the deal, a number of special enclosure techniques are used to outfit PC/104 for extremely harsh environments. This Tech Focus section updates readers on these trends, along with a look at the new PC/104 follow-ons: EPIC and EPIC Express. Also provided is a product album of representative boards.


DROWNING IN A SEA OF INFORMATION?
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Editorial

Jeff Child, Editor-in-Chief

The Customer Shall Judge

As a member of the trade press I can't hide a little bit of glee when controversies erupt in the standards-based embedded computer industry. That stuff never fails to provide juicy material to write about. A few months back in this column I wrote about the scuffle that appeared to be brewing between those behind the Open VPX initiative and those in favor of moving VPX forward through VITA exclusively. It seems like even there things are moving toward an accord—even as I write this I've learned that Curtiss-Wright, the most vocal detractor of Open VPX early on, is now a member of Open VPX.

This time I'll focus on another segment of the industry: the small embedded board arena. There's a lot going on there, and much of it is fresh in my mind from attending the Embedded Systems Conference in San Jose earlier this month. Such computing technology—although always of interest to the military market—is becoming ever more critical for defense applications. These include small UAVs, robotics, mission-specific handheld systems, intelligent munitions and many others.

In this area of the embedded computer market, there are three groups that take different—although often overlapping—views on how to move forward with standards-based small form factor technology. The PC/104 Consortium seems to favor marrying PCI Express with the tried and true PC/104 form factor. The Small Form Factor Special Interest Group (SFF SIG) meanwhile is focused on trying a variety of different approaches to suit the miniaturization of board-level electronics. Unlike the others, the SFF-SIG is pushing the idea that the connector interface scheme can and should be independent from mechanical board form factors. And not to be left out, the StackableUSB camp remains focused on using USB (and I^2C and SPI) to replace ISA as the board-to-board interconnect in rugged stacked systems.

With just a year and a half since formation, the SFF-SIG has been remarkably productive in its accomplishments so far. At ESC, the SFF-SIG followed up on its earlier work by ratifying Revision 1.0 of the MiniBlade spec and also introducing a new revision to its SUMIT specification. SUMIT Interface Standard Revision 1.3 supports four additional PCIe x1 lanes for a total of six, one additional USB 2.0 interface for a total of four, and DMA support on the LPC bus to enable higher-speed data transfers. The update is fully upward compatible with the earlier SUMIT version.

The most interesting SFF-SIG development at ESC, however, was its rollout of a new form-factor-independent, Computer-on-Module interface standard. Called COMIT (Computer On Module Interconnect Technology), this electromechanical interface specification is designed to be processor-independent and focuses on bus interconnect and module manufacturing technology rather than any single processor, DSP, or microcontroller architecture. The idea is to use COMIT to support different processors with a single baseboard, allowing easy migration to future processors. Both concepts are well suited to the performance/feature tech upgrade and obsolescence mitigation needs that are so key for the military.

For its part, the StackableUSB camp at ESC introduced the concept of using other standard format embedded boards as carrier boards for Stackable USB modules. The idea is for StackableUSB Clients to be used in conjunction with any Nano-ITX, Pico-ITX or full-size PC/104 Form Factor single board computers. This is made possible by the use of carrier boards that conform to each of these popular SBC form factors. These carrier boards attach to the SBC and provide up to four USB mounting bays for StackableUSB Clients. For SBCs that don't have a StackableUSB connector, a USB cable can be used to attach the carrier board to the SBC.

In keeping with a strategy of preserving ties to legacy PC/104, the PC/104 Embedded Consortium's major ESC announcement was the addition of USB connections to the stackable PCI/104-Express and PCIe/104 specifications. Since the adoption of those two specs a year ago, a number of vendors have rolled out products based on the PCI/104-Express and PCIe/104 specs. The addition of the industry-standard USB will help provide quick connectivity for add-on modules that have USB-driven devices. Interestingly, the result of marrying USB and PCI Express to the PC/104 world may eventually be the elimination of PCI bus for the PC/104 realm, even though the venerable ISA bus will still have a place.

Any application—whether it's in the embedded or desktop/server space—that needs performance will want to migrate to PCI Express or USB anyway. In contrast, ISA still has a role as a low-speed, easy-to-implement interface to sensors, analog/digital I/O and so on.

Speaking as an editor who's covered this area of technology for over 20 years now, my impression of this industry segment has been that it was—until these past couple of years—holding its breath. But now, even though there are significant differences in strategy among the various small embedded computing standards groups, the overall results are positive. When there are disagreements about technology standards sometimes that can slow down progress. But in this case it seems to be sparking a lot of innovation. In the words of Dr. Paul Haris, president of both RTD Embedded Technologies and the PC/104 Embedded Consortium, "the fact that there are so many choices for system designers today is a good thing. It's an exciting time for this technology. It's the customer that will ultimately decide." ▮▮

High Performance Reflective Memory Solutions

Dolphin's embedded products include high performance board level and software solutions that address the needs of the military, industrial automation, and test/measurement markets.The Dolphin Express Reflective Memory solution provides significantly higher performance at lower cost than other shared memory solutions. Rather than using expensive on-board RAM, the adapter leverages PCI Express technology to effectively utilize system memory leading to a high performance yet low cost solution. Typical applications range from a two node fail-over pair to large distributed shared memory applications like aircraft, ship and submarine simulators, automated testing systems, industrial automation and high-speed data acquisition.

Configuration	Bandwidth	Latency	Price
2 Node	1.3 GBytes/sec	1.2 µsec	$1,350

Memory free adapter cards based on PCI Express

Dolphin

www.dolphinics.com/rm

Photo courtesy of Lockheed Martin

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