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2009 Executive outlook

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Trends in the embedded computing market reveal what technology advancements will be made in the coming months and years. For more insight into where the industry is headed in 2009, see the Executive outlook feature on page 12.

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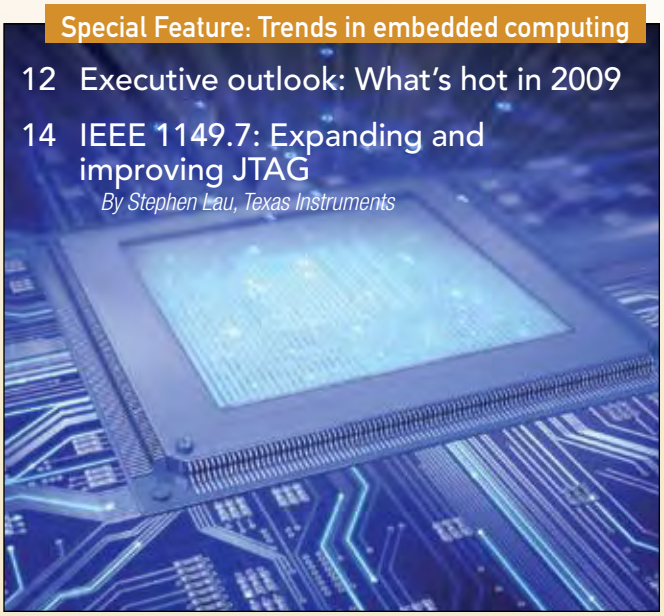
Special Feature: Trends in embedded computing



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Editor's Foreword

Jerry Gipper

Market crisis or opportunity?

By the time you read this, the U.S. elections will be over and American voters will have selected a new president elect. This has proven to be a momentous election year with lots of firsts, most notably the first African American presidential candidate and the first female vice presidential candidate. The usual political rhetoric is on overdrive as the campaigns head toward Election Day.

Making this voting season even more interesting is the worldwide economic meltdown. Everyone wants to know how the candidates plan to address this financial crisis, to which no industry is immune. High technology has done much to strengthen its position as the current slump deepens, but even now, it's starting to feel the impact and showing signs of a slowdown. Earnings are soft and cutbacks have begun.

Within these tough economic times are some golden opportunities. Billionaire Warren Buffet's "Be fearful when others are greedy and be greedy when others are fearful" rule of investing leads me to believe that we will see an increase in or at least a steady stream of acquisitions as companies with cash look for great deals. Valuations are low, and many companies are looking for buyers to bail them out. Watch for some acquisition activity in the coming months as aggressors try to strengthen their product and market positions.

Local manufacturing could see a surge in the near future as companies consider bringing jobs back home. Government incentives will become common as politicians seek to improve the unemployment situation and local economies. Companies are discovering that Asian manufacturing doesn't offer the same financial benefits as it did a few years ago. Salaries around the world are quickly becoming flat, and fuel costs for shipping products are tacking a significant chunk of change onto the total product cost. Moving manufacturing and design jobs back to local sites improves product quality and boosts employee morale. Smaller regional companies can especially benefit from local manufacturing and design.

Belt tightening is affecting companies now and will continue to do so for the next few quarters. This is a great time to improve processes and increase automation as the workforce shrinks. Reduction means that someone has to pick up the slack, and without process improvement and automation, it is difficult to pull off. Some great productivity tools that may have seemed too expensive in the past are now essential for designers to remain competitive with smaller workforces.

Innovation is another way to gain ground during an economic downturn. Though we seem to be in an innovation lull, the companies that can create breakthrough products will get more than their share of the tight spending. Apple is a prime example of a company doing just that. With buyers specifically requesting iPhones and iPods and Apple stores busy at all hours, the company is thriving and even ranks as the third-largest mobile phone supplier in the world. This type of innovation is essential for success at any time, especially when the market is slow.

Energy-efficient products will have an advantage as buyers continue to feel the energy crunch. Most buyers don't consider embedded electronics to be large energy consumers, but they are becoming more conscious of how much it costs to maintain entertainment systems, lighting technologies, and transformers in their homes. Government initiatives on energy consumption continue to raise awareness about this issue.

The last opportunity I'll mention is one of my favorite topics – mass customization. As buyers become more discerning about how they spend their hard-earned cash, they expect products to do exactly what they want. Products that meet their needs and make them feel unique will gain the greatest interest from penny-pinching buyers. Companies must be able to quickly modify and personalize their products to grab consumers' attention.

To voice your comments on this subject, send me an e-mail or visit our blog at www.embedded-computing.com.

I'm off to go vote now. Have a happy holiday season! I look forward to a very interesting 2009.

Jerry Gipper
Editorial Director
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Hermann Strass

Models show which way the wind blows

Skyscraper aerodynamics

Ruscheweyh Consult (RC), Germany, constructs aerodynamic models of high-rise buildings and large industrial facilities. Professor Hans Ruscheweyh, CEO of RC and vice president of the Association for Wind Engineering for Austria, Germany, and Switzerland, has been conducting aerodynamic research for more than 30 years.

RC's aerodynamic simulation designs include projects around the world, from the European Southern Observatory's Very Large Telescope in Chile's Atacama Desert to the Radio Telescope MAN in Germany. The company has a flow laboratory and boundary layer wind tunnel where researchers analyze the aerodynamic behavior of building models. Using a turntable located in the wind tunnel, researchers can simulate wind loads on buildings from different angles. The wind tunnel uses various embedded computing systems for data collection and analysis.

Researchers at RC recently analyzed a model of the 162 m (531 foot) Esentai Tower in Almaty, Kazakhstan (see Figure 1). Up to 360 pressure sensors supplied by Sensortechnics, Germany, are integrated into the surface of this model to report wind pressure and structural flexions, as shown in Figure 2. A modular measurement system equipped with analog and digital I/O from Geitmann, Germany, collects, stores, and forwards data produced in the wind tunnel. Measurement software includes the DQSoft software suite as well as drivers for DASYLab, DIAdem, and LabVIEW from National Instruments, United States, and FlexPro from Scientific Solutions, Switzerland.

These embedded systems can capture and display video sequences in real time at up to 200 frames per second, time-synchronized with sensor data. Each analog channel is digitized by its own A/D converter with 24-bit resolution (0.05 percent accuracy). Calibration and conversion at up to 20,000 samples per second are based on extremely precise DSPs. Measurement data is transferred via Ethernet to other computers where it is further analyzed using complex, compute-intensive algorithms.

Automation market growth

Market volume for electrical automation worldwide is estimated at about €253 billion (U.S. $342 billion), as reported by ZVEI. Domestic and export growth rates for the German automation market were both almost 15 percent in 2007. Robotics had a growth rate of 20 percent in 2007, according to VDMA. While the United States, Japan, and Germany lead the embedded systems market (in that order), Germany is the largest exporter of automation equipment, which is often used in embedded microprocessor, board, and system applications.

Figure 1

Figure 2

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Executive outlook: What's hot in 2009

Trends in the embedded computing industry serve as important indicators of what innovation we can expect to see in the coming months and years. We asked several industry thought leaders to comment on key trends affecting their specific areas of the market now and in the immediate future. It should come as no surprise that multicore processors continue to set the pace in embedded developments. Open source methodologies and standards are also maintaining their influence on the direction of innovation.

"Designing handheld or mobile devices requires combining rich functionality and high-performance computing while minimizing power consumption. Multicore processor-based systems will provide the embedded computing in such devices. The sheer size of these Systems-on-Chip (SoCs) creates serious implementation challenges, from design partitioning, time budgeting, and hierarchy management to block shaping, macro placement, and power planning. As we move into 2009, designers of embedded multicore processor-based systems are demanding hierarchical chip planning and finishing systems that automate these tasks, allowing them to reuse desired portions of the floorplan throughout the prototyping phase and in subsequent designs as well as to accelerate design closure."

Yukti Rao, Senior Product Manager
Design Implementation Business Unit
Magma Design Automation
www.magma-da.com

"We see the consistent trends of custom boards and in-house designs switching to outsourced design and increasing use of standards as well understood. In markets that are medium volume and long product life, which describes a lot of the embedded space, COM Express is an excellent choice. It gives you a chance to be able to upgrade your product with minimal R&D at a couple of different price points. Many customers differentiate their products by designing their own carrier cards.

There is an increasing leveraging of technologies in adjacent markets, a spillover of dominant technology. The Atom processor is a good example. It is creating a discontinuity by entering a space for which it was not targeted. A lot of customers are lining up to take advantage of the opportunity to use code on a wider range of platforms."

Wade Clowes, Vice President and General Manager of Commercial Markets
RadiSys Corporation
www.radisys.com

"2009 should be an inflection point for embedded computing. We've seen three trends emerge: The first is increasing use of open source, nonproprietary tools and models; second is the emergence of next-generation software development tools; and finally, true multicore software with parallelism, not just multiple individual applications running on multiple individual processors. We expect to see the convergence of these trends, resulting in new opportunities for embedded systems that can utilize the available technology and for providers of development environments and tools to enable the next generation in embedded computing."

Simon Davidmann, Chief Executive Officer
Imperas Ltd.
www.imperas.com

"Security – of devices, data, and network access – is one of the industry's biggest problems and biggest opportunities. Trusted Computing Group is working to expand industry knowledge regarding the usage of the Trusted Platform Module (TPM), which is not only in virtually all enterprise PCs, but also in many servers and most new embedded PC hardware. We are also looking beyond devices to the data on them by enabling self-encrypting hard drive technology for true data-at-rest solutions in many enterprise PCs and other non-PC devices. In addition, the network, which is frighteningly vulnerable to data loss and breach in many organizations and for end users, also benefits from the TPM."

Brian Berger
Board Member and Marketing Work Group Chair, Trusted Computing Group
www.trustedcomputinggroup.org
Executive Vice President, Marketing and Sales, Wave Systems
www.wave.com

"Three key trends are driving ZigBee technology. First, the growth of the market and the adoption of ZigBee in green networking and energy management networks are accelerating and expected to double to nearly 10 million nodes in 2009, according to West Technology Research Solutions. ZigBee should reach public consciousness in 2009 with a large number of utility companies adopting the technology.

From an engineer's perspective, greater integration and processing capability is going into the actual silicon that implements ZigBee. Complementing this is the continued development of tools that make use and adoption easier in embedded devices."

Bob Gohn, Vice President of Marketing
Ember Corporation
www.ember.com

"In 2009, engineering teams will turn to emulations systems to serve as a key component of a hardware/software codesign flow. Consumer electronics, in particular, require smaller process technologies, multicore architectures, and embedded software content in chips. This focus brings more SoC designs and the need for emulation.

Emulation provides an all-in-one system for hardware debugging and embedded software validation. Hardware designers and software developers can share the same system and design representations and work together to debug hardware/software interactions."

Lauro Rizzatti, General Manager
EVE-USA
www.eve-team.com

"There is an increasing emphasis on modeling the multidomain aspects of systems. How does one determine what part of the system should be done with digital electronics, mixed-signal electronics, and software? Designers are trying to better understand how a system will operate under various design architectures. Verification and validation of the entire system are becoming more urgent. Detecting errors as soon as possible is critically important. Aerospace and automotive are driving this need, but other markets are just as concerned. Putting together workflows and processes that enable designers to innovate while detecting bad design ideas as early as possible is an increasing trend that we see."

Jim Tang, The MathWorks Fellow
The MathWorks
www.mathworks.com

"2009 will be the year the Transaction-Level Modeling (TLM) 2.0 standard from the Open SystemC Initiative is adopted by the embedded design community. TLM 2.0 is a neatly defined interoperability standard that gives engineers more freedom and creativity to design components and leverage the link between hardware and software. It offers a way for system and IP models and system-level design tools used in SystemC-based SoC design flows to work together. More importantly, TLM 2.0 will enable a new generation of virtual platform models and the delivery of a fully functioning virtual prototype of the system on every software engineer's desk in advance of silicon."

Bill Neifert, Chief Technology Officer
Carbon Design Systems
www.carbondesignsystems.com

"Key emerging trends in embedded reflect what is happening in consumer displays – the move from 4:3 aspect ratio displays to 16:9 aspect ratio displays. Influencing this trend is panel makers' preference for the 16:9 aspect ratio because it makes their manufacturing processes more efficient. Further influencing the trend is the creation of a large amount of high-definition content, which fits the 16:9 aspect ratio much better.

A second trend is the increasing use of outdoor kiosk systems that must operate in ambient daylight and in a wide range of outdoor environments. This is driving display technology to higher contrast ratios and wider operating temperature ranges."

Douglas K. Barnes, Vice President and
General Manager, Industrial Business Unit
Planar Systems
www.planar.com

"Driven forward by Moore's Law is the wonderful array of a new semiconductor processor technology called multicore. It is smaller and higher performing and offers many new design choices for the embedded device OEM product designer. To fully optimize its use requires new OEM device design paradigms. Also causing the introduction of new design paradigms are the market-driving needs to competitively innovate with open source, address security needs and standards, and provide product differentiation through proprietary software and branding. Real-time virtualization is the new OEM device design paradigm."

Peter Richards, Chief Executive Officer
VirtualLogix
www.virtuallogix.com

"There is speculation that we may be approaching an inflection point where the rate of technology advancements is accelerating at an exponential rate, and machines could even overtake humans in their ability to reason in the not-so-distant future. To make robotics personal, robots need to move and manipulate objects in cluttered and dynamic human environments. They need to be cognizant of their surroundings by sensing and recognizing movement in a dynamic physical world and learn to adapt to new scenarios. In addition to robots becoming more human-like, more innovation will emerge to make human and machine interaction more robust."

Excerpt from keynote speech at
Intel Developer Forum San Francisco 2008
Justin Rattner, Chief Technology Officer
Intel
www.intel.com

IEEE 1149.7: Expanding and improving JTAG

By Stephen Lau

IEEE 1149.7 goals

- Be compatible with existing IEEE 1149.1 systems
- Operate with fewer pins
- Provide background instrumentation capability using the same pins
- Provide mechanisms for TAP power management
- Preserve gateway for debugging semiconductor errors/defects
- Improve performance for selected debug use cases
- Preserve investment of semiconductor IP, software IP, and existing debug and test tools
- Provide a framework for other debug pin protocols to gain access to the pins

Stephen offers an exclusive preview of the IEEE 1149.7 standard and its key features.

The IEEE 1149.1 standard was adopted in 1990. Built upon the work of the Joint Test Action Group (JTAG), it provided a pins-out view from one IC pad to another to help test engineers locate and discover faulty PC boards. A description of the boundary scan description language was added in 1994.

Complications arose as chips increased functionality and designs shifted away from PC boards to multichip modules and stacked die packages. These difficulties included handling the pin count requirements and multiple Test Access Port (TAP) controllers for System-on-Chip (SoC) devices, testing multichip modules and stacked die configurations, enhancing debug performance, and improving test and debug logic power-down in low-power conditions.

Organizations like the Mobile Industry Processor Interface Alliance and the NEXUS 5001 Forum took up the challenge to solve the problems specific to their industries. Their work laid the foundation for the IEEE 1149.7 standard, which is expected to be ratified early next year.

Increasing test system functionality

Rather than replacing IEEE 1149.1, the new IEEE 1149.7 standard expands its functionality by reducing the number of pins used. This provides new scan topologies that are favorable to stacked die and multichip module configurations and offers advanced capabilities to aid in software debug.

The IEEE 1149.7 standard has two groups of capabilities: Classes T0 through T3, which extend IEEE 1149.1 and enable new operations, and Classes T4 and T5, which are focused on advanced two-pin operation.

Class T0

Class T0 ensures compliance with the industry's test infrastructure by setting up IEEE 1149.7 devices to make them act compatibly with IEEE 1149.1. These techniques include the use of N-bit IR, 1-bit DR for bypass instruction, mandatory IDCODE (32-bit path), and mandatory instructions behaving as specified in the IEEE 1149.1 specification. After a test logic reset is initiated, all multi-TAP

devices must conform to the mandatory IEEE 1149.1 instruction behavior and implement a 1-bit DR scan for the bypass instruction.

Class T1

Class T1 instantiates a control system for the IEEE 1149.7 standard that is transparent to IEEE 1149.1 devices, providing a foundation for the advanced functionality implemented in Classes T1 through T5 without changing the IEEE 1149.1 state machine. In addition to creating a control system, this class addresses the needs of power-sensitive devices with four power-down modes.

The key innovation is the combination of the IEEE 1149.1-compatible TAP state sequences and shift state watching, which creates an IEEE 1149.7 control system that utilizes the bypass or IDCODE instructions plus a series of IEEE 1149.1-compliant sequences called Zero-Bit DR Scans (ZBS), shown in Figure 1.

Beginning at zero, the ZBS count is incremented with each consecutive occurrence of a ZBS without encountering a Shift-DR TAP Controller (TAPC) state. When a DR scan containing a Shift-DR occurs and the ZBS count is greater than zero, the ZBS count is locked, activating a corresponding control level (shown in Table 1).

Commands are typically 10-bit values and consist of two consecutive DR scans while the controller is locked at Control Level 2. Command Part 1 (CP1) provides a 5-bit operating code, and Command Part 2 (CP2) provides the immediate operand, which is the lower 5 bits of the command. The function specified by the command is performed when CP2 completes.

A three-part command can be created by appending a third DR scan (a Control Register or CR scan) after CP1 and CP2 and transporting a data value. Each of the three three-part commands has a special purpose.

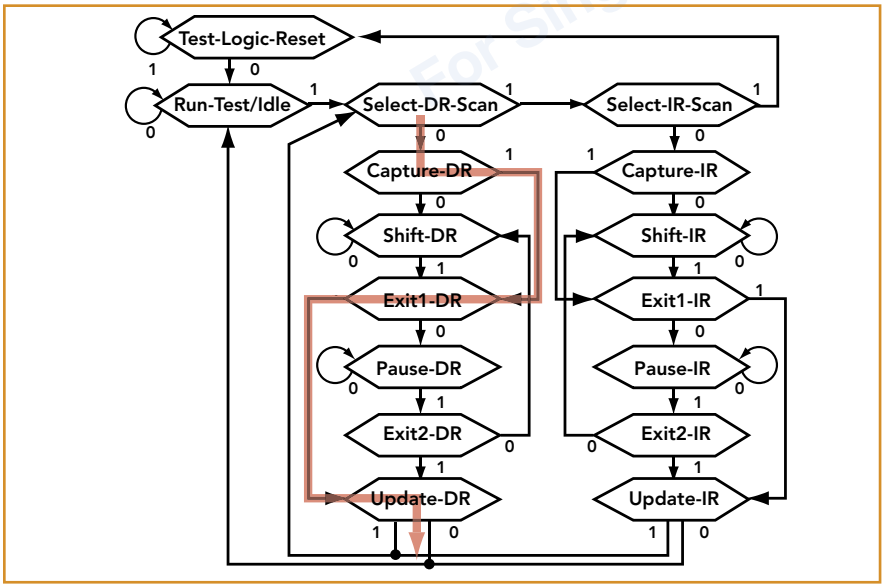

Figure 1

Control level	Overloaded function	DR scan path
0-1	None	System
2	Commands	Chip-level bypass bit
3	None (reserved)	Reserved
4-5	Auxiliary scan paths	User defined
6-7	DTS utilizes these levels	User defined

Table 1

Class T2

To achieve higher performance for engineers involved in testing high chip count applications, Class T2 offers a chip-level bypass mechanism that shortens scan chains and another mechanism that provides hot connect capability. Class T2 adds three scan formats to implement these new features:

- **JSCAN0:** Offers IEEE 1149.1-compliant operation.
- **JSCAN1:** Provides hot connection and disconnection protection. At power-up, bypass can be the default (JSCAN1 format). This protects TAPs from spurious signals and prevents core corruption during hot connections.
- **JSCAN2:** Implements bypass to improve series connected devices' performance. The mechanism also functions as a firewall, enabling access to chip TAPs only after a predetermined sequence is initiated. This security measure ensures that only a debug test controller can access the system once a running, powered target has a stable electrical connection.

Class T3

Although provisions for boundary scan testing using a star topology are included, IEEE 1149.1 does not provide enough detail to make this mode of testing viable. A new scan format – JSCAN3 – is included in IEEE 1149.7 to correct this omission. A write-only register used to specify the scan format and a device address assignment for star configurations also have been added to the new standard.

IEEE 1149.7 supports both series and star topologies, the latter of which is preferable for testing stacked die configurations. Star topology is desirable for stacked die configurations because the location of the debug connection is consistent. Whereas Figure 2a shows the series scan topology, Figure 2b illustrates the Star-4 or Wide Star configuration.

IEEE 1149.7 maintains compatibility with the IEEE 1149.1 standard by making all

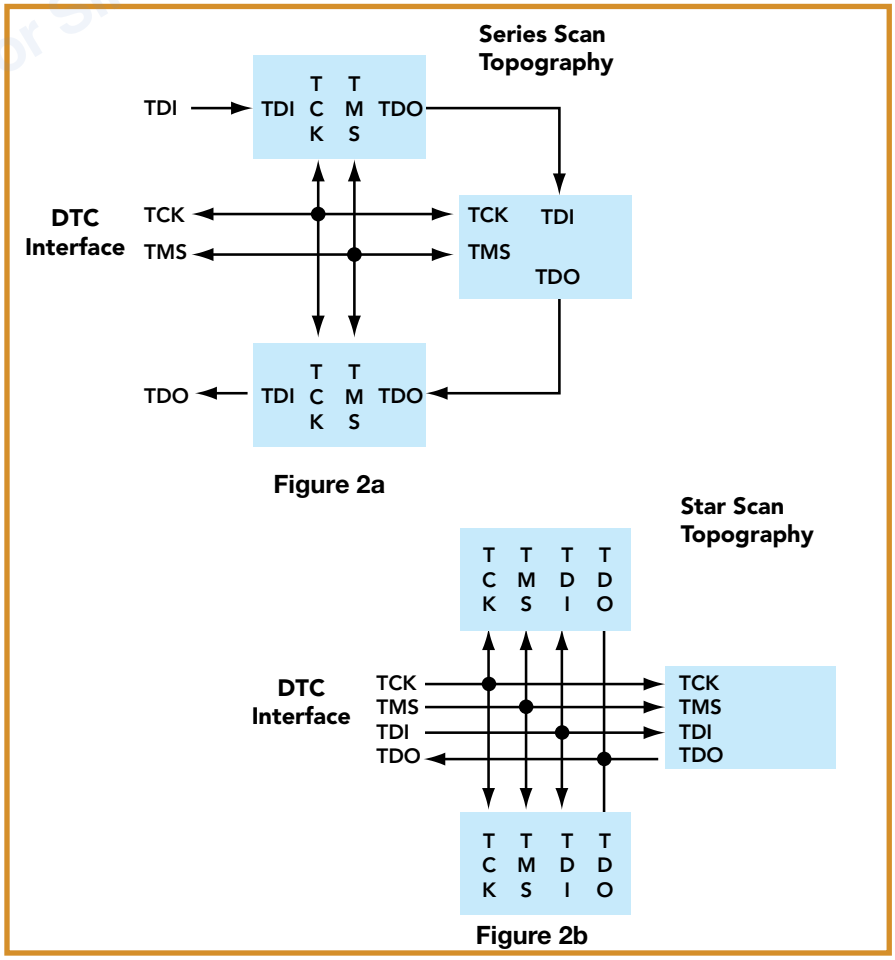

Figure 2a

Figure 2b

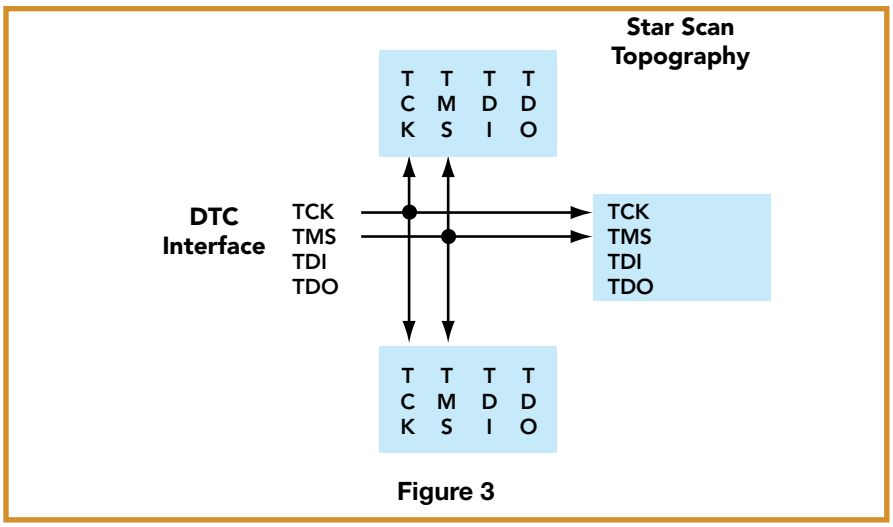

Figure 3

operations appear to be series scans using Capture-xR and Update-zR TAPC states in a group of selected IEEE 1149.7-enabled TAP controllers. To operate in this mode, chips in the star configuration must be assigned Controller Identification (CID) numbers. An iterative arbitration system is used to assign CIDs, and operations are executed using Control Level 2.

Class T4

To address the rising number of pins in SoC devices, Class T4 adds scan formats to support transactions with two pins instead of four, resulting in fewer total pins required on chip packages. This also helps with stacked die configurations because it is highly desirable to have the fewest number of connectors possible when die are stacked.

The key to two-pin operation is eliminating the original data lines and sending bidirectional serialized data over the Test Mode Select (TMS) line, which is renamed TMS Counter (TMSC). To implement this capability, the glueless star configuration from Class T3 is utilized, this time without Test Data In (TDI) and Test Data Out (TDO). This is the Star-2 configuration shown in Figure 3.

Besides reducing pin count, Class T4 defines optimized download-specific scan modes in which only useful information is downloaded. To improve pin operation performance, the clock rate also can be doubled. These features combined with the optimized transactions do not cause performance loss, instead improving performance in some cases.

Class T5

Class T5 functionality is beneficial primarily to software designers utilizing JTAG for debugging. This class gives the test port the ability to perform debug and instrumentation operations concurrently (data is transferred during idle time), which reduces the number of pins dedicated to instrumentation, and enables custom protocols to use the pins, a feature many vendors offer in nonstandard ways. Class T5 standardizes the process to access the pins. ECD

Stephen Lau *is the product manager for emulation technology at Texas Instruments, based in Dallas, Texas. His responsibilities include the definition of on-chip debug technology and associated emulator products deployed through third-party partnerships. Stephen established and manages the TI Third-Party Emulation Developer Community. He is also responsible for marketing IEEE 1149.7 technology and established the first commercial IP license for debug technology at TI. Stephen holds a BS in Electrical Engineering from McMaster University in Hamilton, Ontario, Canada.*

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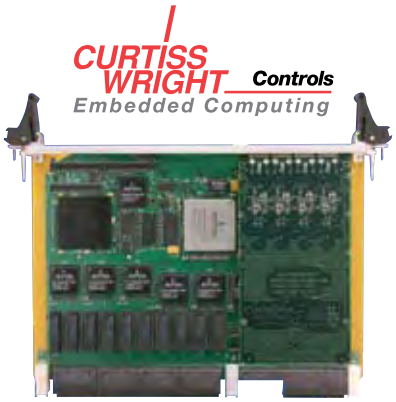
Editor's Choice



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The VPX6-684 is the world's densest managed switch/router designed to create simple to advanced intra-platform networks targeted for rugged environments. Based on the next-generation VPX (VITA 46) standard, the VPX6-684 provides 24 wire-speed GbE interfaces with an option for four optical ports and four 10 GbE interfaces for backbone connections.

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– Curtiss-Wright Controls Embedded Computing

Battlefield LAN? Will travel.

Ethernet is as ubiquitous on the modern battlefield as disposable batteries. All manner of equipment, be it ground-, ship-, or air-based, relies on 10, 100, or 1,000 Mbps Ethernet ports. So Curtiss-Wright Controls Embedded Computing decided to bring 1 and 10 GbE to the up-and-coming VME VPX form factor. The company's VPX6-684 FireBlade II resides on a 6U VPX module and is specifically designed for networking in extremely harsh environments. With switching and routing capabilities, plus VITA 48 REDI two-level maintenance options, this board is ready to travel.

The heart of the board includes 12, 20, or 24 1 GbE interfaces capable of autonegotiating 10/100/1000 speeds. The board can also support 4x 10 GbE ports as part of a blazing-fast backbone configuration. Current versions of the board offer front-panel optical ports (1000BASE-SX), while future versions will route fiber over one of the VPX connectors. There's IPv4/v6 support, wirespeed routing, enhanced security, BIT, and a whole host (no pun) of management interfaces, protocols, and software from CLI and Telnet to SNMP and NAT.

Model: VPX6-684 FireBlade II
Published in: *Military Embedded Systems* January/February 2008

Military Embedded Systems ★★★★★ Editor's Choice

RSC# 35576

www.cwcembedded.com

The CHAMP-FX2 from Curtiss-Wright Controls Embedded Computing is a 6U VPX heterogeneous FPGA/microprocessor DSP compute engine designed for tough signal and image processing tasks in either benign or rugged deployed embedded environments. The CHAMP-FX2 combines the raw parallel computational power of two Xilinx Virtex-5 FPGAs with the floating-point computational power provided by the AltiVec-enabled dual-core 8641D processor, all connected with a high-performance Serial RapidIO switched fabric to bring unprecedented computational densities to the VPX form factor.

Curtiss-Wright worked with customers to design the CHAMP-FX2 so that the bandwidth provided by the Virtex-5's off-board and inter-FPGA I/O links is carefully balanced with the bandwidths of multiple SRAM and SDRAM banks to ensure that there are no natural bottlenecks to the data flow. The onboard Serial RapidIO fabric ties the CHAMP-FX2 computing resources with other Serial RapidIO-enabled boards such as the CHAMP-AV6 and VPX3-185 to provide solutions for tough deployed embedded systems including radar, image processing, and signals intelligence.

– Curtiss-Wright Controls Embedded Computing

More FPGAs power VPX DSP board

As FPGAs trounce the world of DSP designs, having more of them – with more I/O and more memory – is "more better." Curtiss-Wright Controls Embedded Computing's CHAMP-FX2 – the latest incarnation of the company's venerable CHAMP DSP series – uses two Xilinx Virtex-5 LXT FPGAs to provide true heterogeneous processing. A "lowly" Freescale 8641D PowerPC processor handles general-purpose processing, as well as DSP algorithms in its own right. Collectively, these three nodes are mounted on a 6U VPX board that affords more I/O capabilities than Bill Gates has copies of Windows. Well, maybe not that many, but a lot.

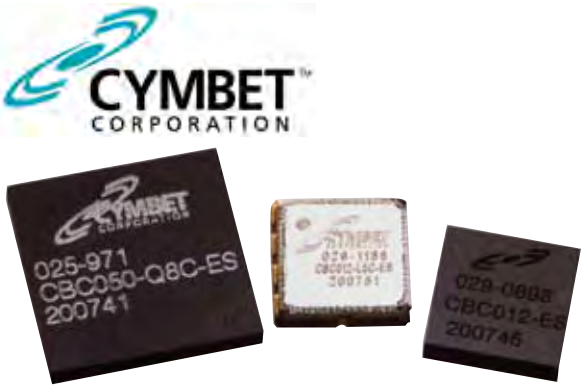
Each FPGA node is swimming in memory: up to 1 GB DDR2 SDRAM (4.4 GBps peak) and up to 32 MB QDR-II+ SRAM (8.8 GBps peak). Additionally, nodes are interconnected in various ways: four-lane RocketIO LVDS; four-lane high-speed serial links to the backplane, XMC site, and one optionally to the front panel; and 18 pairs of discrete LVDS to the VPX-equipped backplane in case you want to roll your own. And the 8641D dual core is no slouch, either. It can run up to 1.33 GHz and has up to 1 GB of DDR2 SDRAM with ECC and 512 MB of flash plus 128 KB of NVRAM. There's Ethernet (two), serial (two), and an onboard Serial RapidIO switch spidering lines all over the board and out to the VPX backplane. There's more, but we're out of room. Check it out at the Curtiss-Wright website.

Model: CHAMP-FX2
Published in: *Military Embedded Systems* July/August 2008

Military Embedded Systems ★★★★★ Editor's Choice

RSC# 34875

Speakout



www.cymbet.com

Cymbet's EnerChip solid-state thin-film batteries provide significant advantages over legacy lithium coin cell and supercapacitor technologies. EnerChips use semiconductor packaging that is surface mounted and reflow soldered with the rest of the devices on the board. The new EnerChip CC is the world's first intelligent thin-film battery with integrated battery management in a single package. Designers are using the EnerChip CC for power bridging, secondary holdover, and as a localized power source.

The recently released EnerChip EH module couples energy harvesting circuitry with two EnerChips to provide power created from solar, motion, vibration, thermal, or RF induction energy transducers. The EnerChip EH is especially useful in wireless sensor applications. Designers can evaluate the EnerChip EH as part of the Texas Instruments eZ430-RF2500 solar energy harvesting wireless demo kit. All the EnerChip products are described in detail at www.cymbet.com. **– Cymbet Corporation**

A very different battery

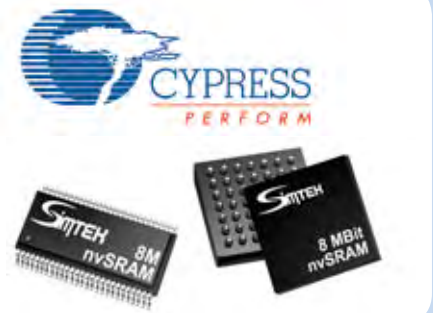
Onboard battery power can be a headache – or worse. In addition to disposal problems, conventional batteries can leak or even explode. SNAPHAT packages are relatively bulky and a hassle to replace. Super caps lose storage life because of leakage currents.

Cymbet's EnerChip batteries, however, are made of a thin-film nanotech material, not a chemical paste, so there's nothing to leak. These batteries come in surface-mount packages, solder to a board just like a regular IC, and can recharge via any number of harvesting techniques. They're a good match for ultra-low-power MCUs.

Model: EnerChip
Published in: *Industrial Embedded Systems* Resource Guide 2008

INDUSTRIAL EMBEDDED SYSTEMS Editor's Choice

RSC# 36922



www.cypress.com

NvSRAM uses a one-to-one pairing of a nonvolatile memory bit and a fast SRAM memory bit in each memory cell. These nvSRAMs behave exactly as standard fast SRAMs with access times as fast as 20 ns, so they can be interfaced easily to leading microprocessors and microcontrollers. When IC power is disrupted or lost, the event is detected and every SRAM bit is saved into nonvolatile memory in one quick array write using energy from a small capacitor. Data is automatically recalled to SRAM on power restore. Writes to the SRAM during active operation are nondestructive and unlimited.

NvSRAM has been a mainstay for quality industrial control, server, and military systems for many years. In 2008, Cypress pushed nvSRAM densities up to 8 Mb from 256 Kb and 1 Mb in 2007 using breakthrough 130 nm SONOS process technology. Now designers can take advantage of nvSRAM in service processors, point-of-sale, RAID systems, and a variety of new industrial control and medical applications. **– Cypress Semiconductor**

8 Mb nvSRAM never loses data

In an era of falling NAND flash ROM prices, many of us carry around over 1 GB of data on our keychains. So why is 8 Mb – a mere fraction of that amount – something to get excited about? The answer is simple: When data is written to these SRAMs and a tiny glitch such as a power spike or other anomaly occurs, the data is safe and secure. In defense systems, such a power interruption cannot be tolerated, else lives might be lost. Previously, small amounts of serial EEPROMs or battery-backed SRAMs were used to prevent critical data loss, but they were either slow, required CPU intervention of an unforeseen event, or had that nasty battery to maintain.

Cypress Semiconductor's (formerly Simtek's) STK14EE8 and STK14EE16 nvSRAMs are available in x8 or x16 widths and use a captured charge to maintain data integrity. Read access is as fast as 25 ns with a 45 ns R/W cycle time. Unlike flash, they feature unlimited endurance, and data is automatically recalled from buried nonvolatile store when the power returns; no CPU is required. Data retention exceeds 20 years, they are powered from a standard 3.0 VDC supply, and, of course, they're available in industrial temperatures from -40 °C to +85 °C. These fast, reliable nvSRAMs are available in svelte 44-pin/54-pin (x8/x16) TSOPII or 48-pin BGA packages. Future versions of the family will be denser and might have security features such as scrubbing.

Model: STK14EE8 and STK14EE16
Published in: *Military Embedded Systems* May 2008

Military EMBEDDED SYSTEMS ★★★★★ Editor's Choice

RSC# 36499

Editor's Choice Speakout

www.degreec.com

Thermal controllers represent the absolute core of DegreeC expertise. For more than a decade, we have designed many hundreds of thermal controllers, and our team is fast and sure at customizing controllers/monitors for a wide variety of thermal circumstances.

Our PRONTOflow series of off-the-shelf programmable controllers provides cost-effective fan control for thermal management applications. From mission-critical enclosures to medical equipment and from mobile equipment to large rack and room assemblies, we have delivered cool solutions to the market for the past 12 years.

Solving thermal challenges, reducing time to market, and creating a cost-effective manufacturing strategy are several reasons our clients choose us as their partner in thermal management. We pride ourselves on being the most innovative name in thermal and airflow management solutions. **– DegreeC**

MIL-STD-461 fan controller

Not all military systems are conduction cooled; in fact, most of the systems used in defense applications are convection cooled and often use fans. But have you ever stood next to a cage with 10,000 RPM fans screaming at full throttle? The best solution is to manage those fans with an intelligent controller that can also serve in rugged applications. Such is the case with Degree Controls' rugged military fan controllers, which meet both MIL-STD-461 for EMI/EMC and MIL-STD-810F for environmental constraints.

The family of products utilizes microcontroller designs and DegreeC software to monitor system temperatures and adjust fan speed(s) accordingly. Programmable alarm thresholds can be set, along with speed curves that more precisely adjust temperatures to minimize thermal shock or deal with specialized ambient conditions. But beyond just a robust feature set, what sets DegreeC's products apart is the company itself: a Cage Code (when was the last time you read that term?), ITAR registered, and rigorous test methodologies including HASS, HALT, ESS, MTBF, and all the "ilities" you'd expect from a MIL-SPEC supplier. The company also provides specialized heat-sink designs, as well as thermal and airflow sensors.

Model: PRONTOflow Rugged Fan Controllers
Published in: *Military Embedded Systems* July/August 2008

RSC# 37434

www.digitalview.com

Digital View's Harsh Environment Series controllers (HE-1920, HE-1600, and HE-1400) were developed in response to our customer needs for ruggedized product solutions. Benefits include wide operating temperature range (-40 °C to +80 °C); vibration, shock, and humidity resistance; and wide range power supply (±25 percent).

The HE Series COTS LCD controllers comply with the strict standards required for harsh environments encountered in military and many industrial applications. Our customers' applications include mobile military displays, avionics systems, maritime information displays, manufacturing monitoring, and outdoor digital signage.

When we established Digital View in 1995, we set out to be one of the world's foremost suppliers of advanced interface solutions for the digital display market. We have deployed more than 500,000 systems worldwide. As the need for visual data increases in all environments, we are pleased that the HE Series controllers are recognized as leading product solutions for the industry. **– Digital View**

Rugged LCD controllers

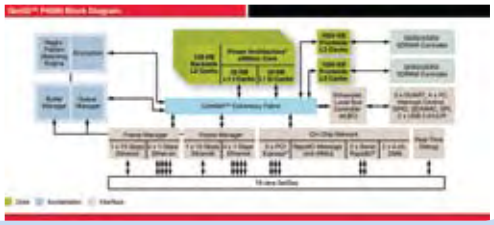
So you've hardened the chassis, ruggedized the boards, chosen solid-state storage for reliability – even shock-mounted the LCD. But what about the LCD controller board? That's the realm of Digital View's HE-1400 and HE-1600 Series rugged LCD controllers. These COTS LRUs specifically target industrial and military installations with a -40 °C to +80 °C operation and "dirty" 12 VDC power that can vary by as much as 25 percent. Shock and vibration are handled from the board design up, including locking connectors and such attention to detail as low-mass tantalum capacitors that don't act like cantilevered masses. They are even available in conformal-coated versions.

The HE-1400 is 4.2" x 3.6" and supports LVDS and TTL LCD panels at SXGA (4:3) and WXGA (16:9 at 1,366 x 768 pixels) feeding DVI and ARGB. The HE-1600 is a fully buffered, multisync interface controller feeding both analog and digital up to UXGA resolution (that's 1,600 x 1,200) over DVI, dual VGA, composite video, S-Video, and component video. It too handles standard 4:3 and widescreen 16:9. Both controllers feature remote management via RS-232.

Model: HE Series
Published in: *Military Embedded Systems* January/February 2008

RSC# 34063

freescale semiconductor



www.freescale.com

QorIQ communications platforms are more than a product portfolio – they're an intelligent and comprehensive approach established to help the embedded community move to multicore with confidence. Multicore is an exceptionally complex technology, especially within the strict power, cost, and performance requirements of the embedded space. Getting multicore right takes more than advanced silicon; it requires a deep, systems-level understanding of how cores, operating systems, and software all work together.

With QorIQ platforms, the industry now has a coherent multicore migration solution from a trusted, proven partner in Freescale. Our eight-core QorIQ P4080 processor addresses the need to dramatically scale performance without introducing complexity for developers. By offering breakthrough technology and engaging deeply with our partners, we're ensuring that our customers have what they need to take full advantage of all that our architecture has to offer. **– Freescale Semiconductor**

PowerQUICC evolves into QorIQ

Having a solid migration path with significant performance and functionality improvements in each successive generation of products is essential for embedded computing systems. In a move that fulfilled this requirement, Freescale Semiconductor recently introduced QorIQ, a new brand of communications platforms designed to enable the next era of networking and promote embedded multicore adoption.

The PowerQUICC series of communications processors has long been a successful product line for Freescale, with roots going back to the 68K processors. As the next-generation evolution of the PowerQUICC processor line, Freescale's QorIQ platforms are designed to help developers migrate to multicore with confidence.

QorIQ platforms include single-, dual-, and many-core processors based on Freescale's e500 Power Architecture technology. The platforms start with P1 and P2 levels, which consist of five package-, pin-, and software-compatible processors that can ease the transition from single- to dual-core processing. The P3 and P4 platforms allow developers to move into the many-core arena and address more advanced processing. This is an impressive-looking roadmap with product families that promise to have something for everyone.

Model: QorIQ
Published in: *Embedded Computing Design* August 2008

RSC# 38105

iVeia
Enabling Small Form Factor Solutions

www.iveia.com

The Titan-V5*e* is an advanced SBC that combines a PowerPC general-purpose processor and Xilinx Virtex-5 FPGA in an ultra-small credit card-size form factor. iVeia's System-on-Chip (SoC) technology and tools provide an easy-to-use deployable platform for high-performance signal and image processing applications.

"The low power and small size of the Titan-V5*e* enables our customers to push their critical processing out to the edge, something they couldn't do before with typical COTS hardware," says iVeia CTO Michael Fawcett. "Our flexible architecture allows us to provide a number of COTS and quick-turn I/O solutions for a variety of markets, including unmanned vehicles, robotics, portable and handheld applications, wireless communications, and machine vision."

The Titan system is modular and scalable with a variety of different processor, I/O, backplane, and enclosure options to suit your specific commercial and ruggedized processing needs. **– iVeia**

Small module eats images for lunch

In our never-ending search for small form factor modules, we turned up iVeia's Titan-V5*e* processing module. Based on a Xilinx Virtex-5, this platform combines general-purpose signal and video processing in a tiny 2.125" (W) x 3.375" (L) x 0.25" (H) package. It runs Linux 2.6 to manage the Virtex-5's PowerPC 440 CPU and the DSP48E slice along with additional programmable logic in the FPGA.

The Titan-V5*e* development kit includes the hardware, a Velocity-SoC IP core and SDK, and an optimized framework and abstraction layer that decouples the FPGA and software design to aid in development. Additional GigaFlex I/O modules complete the package.

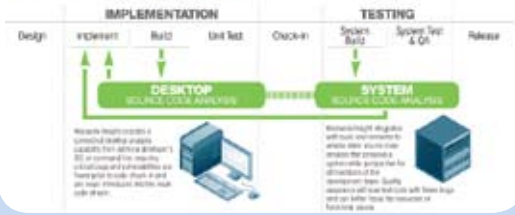
Model: Titan-V5e
Published in: *PC/104 and Small Form Factors* Fall 2008

RSC# 37007

Editor's Choice Speakout

Klocwork

Klocwork *Insight* in Your Process



www.klocwork.com

The need to produce reliable and secure embedded devices – whether it's a consumer device such as a mobile handset or a safety-critical device such as a defibrillator – has always been a paramount concern due to the high costs and risks associated with a field failure. As embedded devices become increasingly dependent on software, the need for more effective and sophisticated forms of software validation is rising at a dramatic rate.

More and more, embedded software developers are turning to static code analysis as an effective approach to automated software validation. Organizations such as Siemens Wind Power, Cisco, and Motorola use Klocwork static analysis tools to reduce costs and improve software reliability. Learn how your embedded software can benefit from the use of static code analysis by visiting www.klocwork.com. **– Klocwork**

Bye-bye, build audits; hello, on-the-fly debug

Statistics from analysts much smarter than us report that up to 70 percent of design time is consumed in writing, debugging, debugging, and debugging software. You get the idea. So any kind of tool that contracts this iterative process – especially if it can help during the coding part of the process – might be a real money saver. We don't care if you're designing VME systems or coding the next PS3 game. The automated source code analysis tool called *Insight* from Klocwork specifically targets mission-critical systems, making it perfect for VME/VXS/VPX board-based designs. Of particular importance is that this desktop tool is intended for use by the developer during local build, instead of providing an after-the-fact audit build report.

Some of the tricks in Insight have spawned patents, including certain static analysis techniques and system-level collaboration to track bug fixes. The list of features is too numerous to describe here, but highlights include: identification and analysis of critical and security bugs (handy in mission-critical systems); IDE-based code analysis (no need to exit your favorite tool); detailed software architecture visualization; user-defined style or path analysis checkers; and bug tracking and reporting – locally or team-based. We are impressed with the potential of Klocwork's Insight. (Tell us if you have any experience with this tool. We'd love to hear from you at cciufo@opensystemsmedia.com.)

Model: Insight
Published in: *VME and Critical Systems* August 2008

VME Critical Systems EDITOR'S CHOICE PRODUCTS

RSC# 36761

LocoLabs

www.locolabs.com

Flash content has long been a cool (and sometimes annoying) add-on to Web browsing. But that changed when Adobe announced the Open Screen Project, with far-reaching support for embedded flash. No longer simply a browser plug-in, flash is the user interface and main desktop environment in many embedded systems, and developers are scrambling to build devices that support its "write once, use everywhere" flexibility.

In addition to a 1080p video processor, a tiny form factor perfect for handhelds, and Wi-Fi/Bluetooth with ultra-low power characteristics, Calliope delivers excellent flash performance under open source Linux. The flash player runs as a plug-in to embedded Web browsers, directly under the Qtopia desktop, or completely stand-alone.

Our customers use Calliope's processor and I/O modules combined with the developer expansion module and debugger environment to professionally demo touch screens, set-top boxes, digital picture frames, and digital signage – all customized in just days.
– LocoLabs

Pint-sized powerhouse

Designing a dynamic digital signage system or a Point-Of-Service (POS) kiosk? The Green Calliope Engine from LocoLabs is based on a Marvell PXA310 application processor coupled with a Marvell 88DE2710 1080p HD video processor and the Marvell 88W8688 Wi-Fi/Bluetooth combo chip. Other I/O includes USB, audio, a 2 megapixel camera, and an IR receiver.

The pint-sized system (1.3" H x 4.2" W x 2.4" D) runs Linux, Trolltech's Qtopia application framework, a Web browser and flash player, and networking stacks. The basic package docks to an expansion module for debugging or adding custom logic to complete the final design.

Model: Green Calliope Engine
Published in: *Industrial Embedded Systems* Resource Guide 2008

INDUSTRIAL EMBEDDED SYSTEMS Editor's Choice

RSC# 36924

Editor's Choice Speakout

www.luminarymicro.com

Luminary Micro is pleased to have received an Editor's Choice Award for our Intelligent Display Module (IDM). Customers tell us that they love using our Stellaris Graphics Library to quickly build Ethernet-enabled human interfaces for applications from security systems to home/building automation to factory controllers. They also appreciate having the choice to buy modules from us or to modify the open-tooled design for their end application requirements.

When we built the first IDM, we wanted to show how a consumer QVGA touch display and Power over Ethernet (PoE) capability could be combined with one of our Stellaris MCUs with integrated 10/100 Ethernet MAC+PHY to provide a flexible human interface platform. Given the popularity of the reference design kit, the module, and downloads of the open-tooled design from our website, it appears that we met our goal. We have since added a version without PoE and will soon be introducing another version with a larger display. **– Luminary Micro**

Displaying what OEMs want

I've said this before: Unless you're an expert, designing with LCD modules can be a pain. Every LCD module seems to be different, with different interfaces and different software. It can be hard for an instrument vendor wanting to add a display to do so when project schedules are tight. Three companies are trying to make that job easier for OEMs with modules and software.

A 2.8" LCD with a resistive touch screen is powered by an ARM Cortex-M3 in the Luminary Micro Ethernet-enabled Intelligent Display Module. This unit has a couple of twists – it supports Power over Ethernet (PoE) or 24 V DC input, an SD card to expand storage, and four analog inputs. Connectivity via serial or Ethernet and a set of graphics and peripheral driver libraries for the Stellaris LM3S6918 microcontroller make it easy to get started quickly.

Model: Intelligent Display Module
Published in: *PC/104 and Small Form Factors* Spring 2008

EDITOR'S CHOICE PRODUCTS

RSC# 36147

PENTEK
Setting the Standard for Digital Signal Processing

www.pentek.com

The new Model 7151 is a high-performance, high-resolution software radio PMC module. Four 200 MHz 16-bit A/D converters feed a pre-installed FPGA IP core that delivers 256 DDC channels. Particularly well-suited to GSM cell phone monitoring and signal intelligence applications, Model 7151 leads the industry with the best resolution and highest channel density.

With its highly optimized 256-channel DDC IP core, Model 7151 represents an entire software radio front end, boasting a channel density 8x higher than any competing product. It is fully supported with drivers and comes ready to use with the FPGA code already developed and installed. Not only does the 7151 module reduce development time and risks, it also saves designers space, power, and costs in their software radio systems. The decimation settings, input selection, and flexible tuning – all unique to Model 7151 – provide engineers with unprecedented choices to suit specific applications. **– Pentek**

256 DDC channels hunt for GSM signals

Since the introduction of their GateFlow family of IP libraries for FPGAs some years ago, DSP expert Pentek has built its product line around front-end signals acquisition products and FPGAs. Their latest PMC module, called Model 7151 (Pentek is nothing if not devoid of fanfare in their nomenclature), is a variation on the company's tried-and-true theme. They take the fastest and highest-resolution A/Ds they can find – in this case from a vendor who won't allow their name to be revealed! – bolt them to a mux, and flow signals into the biggest and baddest Xilinx Virtex-5 FPGA they can find. The 7151 has some unique characteristics that make it ideal for "simultaneously capturing hundreds of signals spanning a wide range of modulation types, signal bandwidths, and antenna sources."

Pentek told us this translates to: locating, triangulating, and even listening in on insurgents' GSM cell phone calls. Of course, other SIGINT applications arise, too. The card's four 200 MHz 16-bit A/Ds feed an FPGA DDC IP core that breaks up into four banks of 64 DDC channels, a total of 256. Each channel is independently controllable, has a 31-bit tuning frequency setting from DC to fs/2, and can be decimated from 128 to 1,024 in steps of 64. For example, at a 200 MHz sampling rate, the available output bandwidths range from 156 KHz to 1.25 MHz. At the front end, the A/Ds can handle up to 100 MHz bandwidths, a 37 percent increase over previous Pentek modules. In summary, this card is ideal for mating to different antennas and is used to search out a variety of signals. For convenience, Model 7651 is a PCI (desktop) version for lab setups. [***Editor's note:*** *Pentek recently told us that they were expanding their PMCs into the data recorder market – a natural extension for the 7151.*]

Model: Model 7151
Published in: *Military Embedded Systems* June 2008

Military EMBEDDED SYSTEMS ★★★★★ Editor's Choice

RSC# 37053

Editor's Choice Speakout

PERFORMANCE TECHNOLOGIES

www.pt.com

Performance Technologies strives to deliver complete IP-based application-ready platforms, blades, and enabling software to reduce embedded engineers' development time and costs. Recognizing the demand for low-profile, appliance-like platforms for cost-reduced and space-limited deployments, the company launched the MTC5070, a second-generation MicroTCA platform. This award-winning product was designed with the company's application-ready philosophy in mind, including the need to deliver the most cost-effective carrier grade solution that meets competitive price targets associated with MicroTCA-based applications.

Numerous industries are adopting the standards-based MicroTCA architecture, including telecommunications, aerospace/defense, enterprise, industrial automation, and health care. Performance Technologies is proud to be an innovative leader, participating in standards steering committees and offering a purposefully wide breadth of highly integrated building blocks to simplify development and enhance the performance of our customers' applications.

– Performance Technologies

Thin MicroTCA chassis, perfect for Humvee

For the past several years, I've noticed a proliferation of rack-mount equipment strapped down or shock-isolated in the back of Humvees. The reason is that the go-anywhere vehicle often serves as the platform for comms gear or other special-purpose electronic systems. But 4U-sized servers and drawer-sized boxes consume way too much space. The 1U MicroTCA MTC5070 from Performance Technologies seeks to change that with an innovative design meant to house six single AdvancedMC modules horizontally, not vertically. Flow-through cooling and internal baffles, complete with two sets of push-pull fans, allow 40 W per slot, a 300 W PSU, and a slim 1U height that's perfect for managed vehicle-mount installations.

Each of the six slots supports PCIe and Ethernet switching, and SATA/SAS slot-to-slot connectivity is available. An integrated dual 10/100/1000 GbE switch provides inter-box communications, while onboard MicroTCA carrier and shelf managers provide PICMG-style management, IMPI, and remote diagnostics. Performance Technologies offers numerous AdvancedMC cards (such as x86 or PowerPC processor nodes), storage, and video cards. The company's NexusWare Linux distribution meets Carrier Grade Linux (CGL) 4.0 requirements. The MTC5070 1U MicroTCA platform can run off of AC or DC power.

Model: MTC5070
Published in: *Military Embedded Systems* May 2008

Military Embedded Systems ★★★★★ Editor's Choice

RSC# 36463

RadiSys THE POWER OF WE

www.radisys.com

The newly released RadiSys Procelerant CEGM45 COM Express module will drive portable applications to performance levels that were previously possible only with tethered systems. This 95 mm x 125 mm COM Express module brings together 2.53 GHz T9400 Intel Core 2 Duo processing, 8 GB DDR3 memory, 6 MB cache, new SSE4 SIMD instructions, GbE, and multiple SATA ports, providing portable architecture options to performance-intensive test and measurement, portable medical imaging, and networking systems applications.

The RadiSys Procelerant CEGM45 COM Express family supports both the Intel GM45 and GS45 chipsets to provide a wide range of Core 2 Duo processor performance. While the chipsets have the same functionality, the GM45 is validated with the high-performance 2.53 GHz Intel Core 2 Duo T9400 processor, and the GS45 is validated with the Intel 1.86 GHz SL9400 LV, 1.2 GHz SU9300 ULV, 2.26 GHz SP9300SV Core 2 Duo, and Intel Celeron 722 processors.

Additionally, the Procelerant CEGM45 family supports both Type 2 and Type 3 COM Express modules. The Type 2 module pinout is supported by adding IDE to the module to enable seamless processor upgrades for existing Type 2 COM Express users. Type 2 users can keep pace with technology without redesigning their boards for each new processor generation. The Type 3 module drops IDE and adds another GbE port, providing dual GbE in a powerful processing and connectivity module for imaging or communications applications with the future in mind.

RadiSys released its Procelerant CEGM45 COM Express modules simultaneously with Intel's next-generation Core 2 Duo processors to give RadiSys customers immediate access to the latest technology, thus saving time and resources typically associated with new processor implementations.

– RadiSys

Less processor means more value

Lots of us (myself included) tend to get caught up in the rush to put the latest and greatest processor on a small form factor module, pushing for higher performance. But lower price points are also important to many OEMs.

RadiSys recently introduced a new COM Express module targeting more value-priced needs in the Procelerant CE945GM2A. It's based on the trailing-edge Intel Celeron M 440, but it fits. The goal is to bring ETX designs forward with a better processor and new I/O like PCI Express, GbE, USB, and SATA while maintaining the legacy ETX price point.

Model: Procelerant CE945GM2A
Published in: *PC/104 and Small Form Factors* Spring 2008

EDITOR'S CHOICE PRODUCTS

RSC# 36153

www.synaptics.com

Synaptics is proud to be chosen for *Embedded Computing Design's* Editor's Choice Awards. Our contribution to human interface technology brings dynamic touch interfaces to a growing number of consumer electronics products, from phones, portable music players, and GPS devices to notebook PCs, mice, and monitors. These products require innovation and differentiation through industrial design and the use of dynamic gesture motions to create the most user-friendly interfaces.

We are already seeing multiple multimedia applications converging in mobile devices, pushing the requirements of simple and easy-to-use human interface solutions. Capacitive touch screens are gaining share in the mobile market as both customers and end users realize the improved usage and need for Synaptics' ClearTouch portfolio, which cannot be replicated with resistive touch-screen panels. **– Synaptics**

Button pushing gives way to touch sensing

Touch interfaces are becoming more popular on many embedded devices as they eliminate the need for confusing buttons and complex manuals. Technology that improves the human experience is always welcome.

Synaptics' ClearTouch product portfolio includes ClearPad and ClearArray sensors available for consumer electronics requiring transparent, touch-sensitive user interfaces. These sensors are designed for durability, low power consumption, and easy integration and can operate under glass or plastic, resulting in robust devices with slim form factors and sleek industrial designs.

ClearPad provides an intuitive, high-resolution touch-screen interface for today's mobile devices, including cell phones, portable music players, and handheld GPS devices. The sensor can detect gestures such as single-finger tap, double tap, tap and hold/tap and slide, press, flick, and two-finger pinch.

ClearArray supports scrolling in fixed locations over a display and can be used in monitors and kiosk-style devices as alternatives to mechanical buttons. These transparent sensors enable manufacturers to differentiate their products according to their target price points, industrial design requirements, and desired end-user experiences.

Model: ClearTouch
Published in: *Embedded Computing Design* July 2008

RSC# 37291

tangent

www.tangent.com

The award-winning Mini UX from Tangent Inc., a leader in specialized computing devices, takes small form factors to the next level.

Despite it diminutive size, Mini UX is equipped with six serial ports, a bootable CompactFlash socket, and one Mini PCI and supports PCMCIA devices. It's uniquely well-suited for medical, industrial, and other embedded applications, mounted to carts and vehicles or installed in harsh environments. It withstands shock, dust, vibration, humidity, and ambient temperatures ranging from 30 °F to 140 °F.

The design is fanless for silent operation and 7 x 24 x 365 reliability. Mounted on four shock absorbers, the hard drive is rated to 15 *g* of shock resistance. The solid-state version comes with CompactFlash storage that has no moving parts.

Mini UX employs Intel's energy-saving Enhanced SpeedStep technology for longer battery life requiring 25-44 W to operate compared to a typical PC that uses 75-200 W. It can run off of the supplied AC/DC adapter or be wired directly to DC sources ranging from 10-30 V. **– Tangent Inc.**

Disk drives gellin' inside

Shock, dust, vibration, humidity, extreme cold and heat, and electromagnetic interference eat normal boxes for breakfast. The Tangent Rugged Mini UX is designed to take all that and stay up for the rest of the workday.

The rugged design includes a hard drive mounted on four gel-mount 15 *g* shock absorbers. An oversized heat pipe and heat-sink assembly provide fanless convection-based cooling. The system uses just 44 W at 100 percent utilization compared to a typical PC using 75-125 W. It measures 9" x 7" x 2" and weighs less than 4 pounds.

Model: Rugged Mini UX
Published in: *PC/104 and Small Form Factors* Resource Guide 2008

RSC# 32128

Editor's Choice Speakout

VERSALOGIC CORPORATION

www.versalogic.com

The VCM-DAS-3 from VersaLogic is a PC/104 module featuring 16 channels of 12-bit analog output and 24 digital I/O lines. The I/O is designed and tested for extended temperature operation (-40 °C to +85 °C) and is fully RoHS compliant.

Enhanced features include independently software-programmable output ranges; software calibration; the ability to reset to zero scale on power-up; read back of DAC and SPAN codes for simplified programming and setup; and latching 2 mm headers. Legacy features include 8-bit ISA compatibility, jumper-configurable output ranges in groups of eight, and the ability to reset to mid-scale on power-up. Both unipolar and bipolar operations are fully supported.

The VCM-DAS-3 has been well received by embedded OEM system designers of industrial equipment used in process control, data monitoring, and data collection devices. **– VersaLogic Corporation**

The range of outputs

PC/104 continues to see improvements in processing power and I/O capability. Vendors keep pushing the envelope in new I/O modules with more channels, improved accuracy, and smarter calibration features.

The VCM-DAS-3a from VersaLogic is a good example of this. With 16 channels of 12-bit Digital-to-Analog (D/A) outputs and 24 digital I/O lines, it puts designers in control of numerous devices. The D/A features independently programmable-out ranges, software calibration, zero reset on power-up, and read back of DAC and SPAN codes for simpler programming.

Model: VCM-DAS-3a
Published in: *PC/104 and Small Form Factors* Spring 2008

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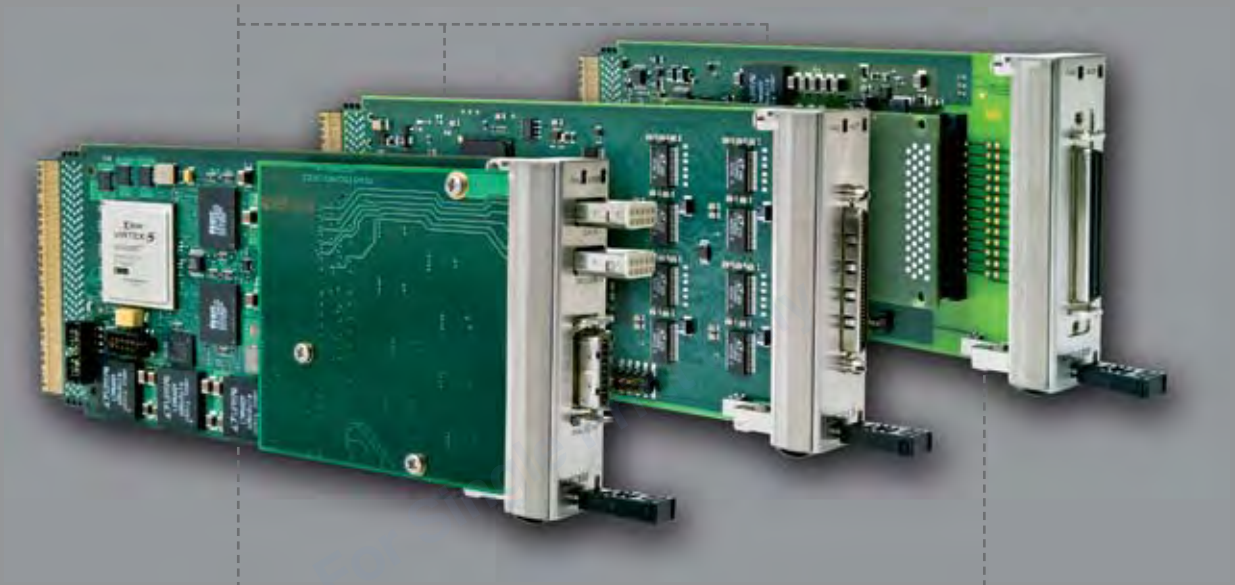

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Ubiquitous computing

Navigating digital convergence with a natural motion remote

By Ian Chen

Traditional remote control devices no longer fulfill the needs of today's digital-driven home entertainment systems. Ian describes the technological advancements needed to develop a more intuitive interface that follows users' natural hand movements.

With the increasing number of multimedia options available to viewers today, a tectonic shift is taking place in the digital home. This transition is more significant and far-reaching than when television expanded from four networks to hundreds of cable channels or when newspapers began posting stories online. Those were changes in degree; what's happening now is a change in kind.

No single medium has a monopoly on home entertainment, news, and information. In addition to traditional TV and cable media, consumers can download free Internet content such as YouTube clips, subscription-based Web programs like Dr. Horrible's Sing-Along Blog, and soon, the video equivalent of podcasts from various sources. Add to that the digitized multimedia already stored on PCs like home movies and iTunes downloads, along with direct movie delivery services from Netflix and other companies, and the home is becoming overwhelmed with a tsunami of inputs. The problem is figuring out how to surf that wave and not drown in the onslaught.

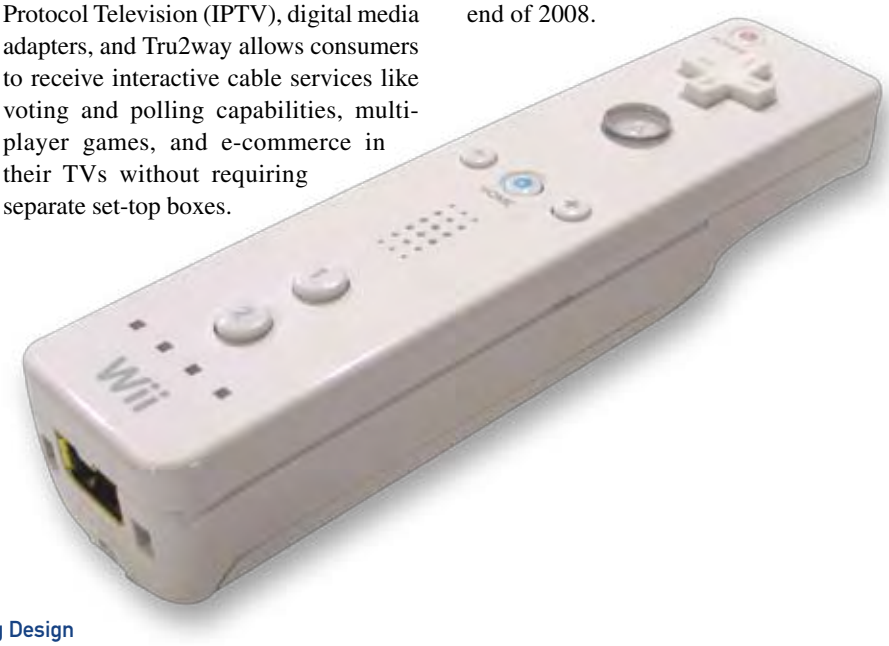
Many consumers are already taking control of their home entertainment programming, and the industry is following suit as companies like Intel and Yahoo hurry to catch up to this new paradigm. Providers of both conventional and Internet media recognize they must compete for consumers' eyes and dollars by offering quality content, easy-to-use interfaces, and a more immediate, tactile user experience. Today's market demands "a user interface that is intuitive [and] allows users to really personalize and customize their viewing habits," remarks Jeff Heynen of Infonetics Research.

Digital TV innovation

Separating content and carrier may create chaos for users struggling to manage different menus. However, unifying middleware for AV equipment such as Internet Protocol Television (IPTV), digital media adapters, and Tru2way allows consumers to receive interactive cable services like voting and polling capabilities, multiplayer games, and e-commerce in their TVs without requiring separate set-top boxes.

IPTV provides these services by delivering digital television via Internet Protocol instead of traditional broadcast and cable formats. It is usually supplied by a service provider using a closed network in competition with TV content delivery over the public Internet, called *Internet Television.* Digital media adapters likewise enhance the home entertainment experience by enabling devices to connect to a home network, retrieve digital media files (music, pictures, or videos) from a PC or other media server, and play those files on a home theater system or TV.

Tru2way is the cable industry's response to user demand. This technology delivers interactive digital cable services over the cable video network, offering interactive program guides, ads, games, messaging, and Web browsing. Major cable operators have committed to deploying the platform in service areas covering more than 90 million U.S. homes by the end of 2008.



Given the capabilities offered by these new digital technologies, it's apparent that traditional up-down-left-right controllers no longer suffice. What's needed is something similar to but more intelligent than a computer mouse – a natural movement input device that integrates various content sources into a single menu.

Out with the keyboard, in with the pointer

Because consumers want an advanced interface that is intuitive and easy to use, a natural movement input device must allow viewers to manipulate images on a TV screen by moving a pointer freely in 3D space, as opposed to moving a computer mouse that navigates in 2D space. This interface may come in the form of a simple device included with set-top boxes and digital media players or sold separately as a virtual handheld computer. In any case, the demand for this type of device is giving rise to a new mantra for home entertainment: deep-six the keyboard; embrace the pointer.

This trend is already gaining momentum as TV gaming is expanding beyond teens playing twitch games to people of all ages and interests participating in social games like those offered by the Nintendo Wii. Furthermore, as computing capacity increases with modern set-top boxes, cable and broadband providers have begun offering a variety of games, including traditional favorites like chess and backgammon. These set-top boxes allow users to play with others on the network without any elaborate equipment and network setup.

One reason why the Nintendo Wii has achieved success in the gaming market is because it offers an advanced user interface that is intuitive and flexible, allowing gaming newbies to pick up any game and play without having to learn how to use thumbs-only controllers. Users can play games and make complex menu selections by moving the input device, which follows even the slightest hand movements.

Refining interface technology

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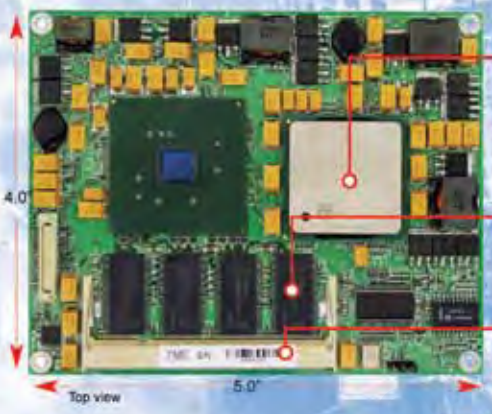

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early adopters have concluded that new technologies are needed to implement a natural motion remote for general consumer electronics. To fulfill the requirements for this device, the new technologies must be:

- **Intuitive and easy to use.** To make the transition from today's interfaces to the next generation seamless for consumers, the interface should be a simple upgrade from conventional remotes.
- **Low power.** The remote should run on household batteries and not require new batteries for at least three months.
- **Self-contained.** The natural movement device should not require unsightly add-ons attached to the TV, such as the Wii's LED strips.
- **Able to work anywhere in the room.** The Wiimote only works when it is positioned within a narrow cone-shaped area in front of the LED strip, thus limiting users' range of motion. The next-generation device should mimic conventional remotes in terms of their ability to function at any angle to the TV.
- **Priced to enable ubiquitous deployment.** To get to consumer price levels, the interface must use inexpensive, commodity sensor elements. Such devices will no doubt cost more at first because they use control algorithms and advanced heuristics with precision analog/mixed-signal capability. But because these devices are built using standard CMOS, they will enjoy the same exponential price declines as other CMOS components.
- **Easy to manufacture.** To keep manufacturing costs low, calibrating the sensors used in the remote should be a simple and automated process.

As choices in the digital home multiply exponentially, simplifying multimedia navigation and control is becoming all the more important. By developing an intelligent handheld natural movement input device, the consumer electronics industry can help guide users through the media-rich, computer-based digital viewing experience. ECD

Ian Chen *is executive vice president of Sensor Platforms, Inc., based in San Jose, California, where he oversees development and marketing of the company's precision analog/mixed-signal products, including navigation, natural motion, and vibration cancellation devices. Ian has BS and MS degrees in Electrical Engineering and an MBA from the University of Illinois at Urbana-Champaign.*

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Data acquisition embedded in the Antarctic ice sheet

By Justin Vandenbroucke

Though physics and electrical engineering are different sciences, the two fields sometimes converge when scientists tackle tricky experiments. Justin presents one example of a project in which embedded technologies are helping researchers gather data at the South Pole.

While most telescopes detect various kinds of light, astronomers are increasingly using other signals to study the cosmos. One of these signals is the neutrino, a nearly massless subatomic particle that can propagate throughout the universe undisturbed, thereby carrying unique information from the farthest and most violent objects in the universe. The challenge facing scientists is to detect these neutrinos on Earth after they have journeyed for millions to billions of years.

One method is to detect the flash of light produced when a neutrino hits a particle of water, ice, or other transparent material. The IceCube neutrino telescope under construction at the South Pole is being developed to exploit this technique.

For the highest-energy neutrinos, a better method is to listen for them. When a high-energy neutrino hits a particle of matter on Earth, it produces a cascade of subatomic particles that emits a shock wave audible in the 10-100 KHz acoustic to ultrasound band. Scientists believe the Antarctic ice sheet is the best place on Earth to build an acoustic neutrino telescope that can listen

for these neutrinos. Toward this end, the South Pole Acoustic Test Setup (SPATS) was installed at the geographic South Pole in 2007 as an R&D project associated with the IceCube experiment.

SPATS comprises four strings of piezoelectric sensors and transmitters installed in holes drilled vertically into the ice. The strings are spaced 125-543 m apart, and the sensors and transmitters are located 80-500 m deep in the ice. The holes are drilled with a stream of hot water that produces a standing column of water into which the strings are lowered. After deployment, the water column freezes back into place around the string of instrumentation. Each string has seven piezoelectric transmitters and seven sensor modules, with three piezoelectric transducer channels per sensor.

This setup posed an embedded computing design challenge: The SPATS research team needed to control, monitor, and acquire data from systems located at an almost completely inaccessible site where winter temperatures can reach -80 °C. Given these environmental conditions, the systems had to be rugged, stable, and cold-rated.

PC/104 stacks take on the big chill

Our research team decided to use PC/104 systems installed in custom-built aluminum junction boxes buried 2 m deep in the ice. Figure 1 shows a SPATS junction box with the PC/104 stack, DiskOnModule, and Ethernet extender visible. Although burying the junction boxes made them unreachable after deployment, doing so provided the advantage of insulating the systems in 2 m of snow. While the winter air temperature at the South Pole is forbiddingly cold, the temperature at 6 feet under is a balmy -50 °C year round.

Figure 1

To meet the requirements for this application, these PC/104 stacks had to include relays to control power to individual instrumentation channels in the ice, Digital-to-Analog Converter (DAC) and digital I/O channels to control the piezoelectric transmitters, and Analog-to-Digital Converter (ADC) channels to read out the sensors and calibration signals from the transmitters. Each PC/104 stack needed 16 relay channels, 7 digital I/O lines, 7 DAC lines, and 35 ADC lines capable of sampling at 150 KHz or higher.

With these requirements in mind, our team designed the systems using PC/104 modules and IDAN enclosures from RTD Embedded Technologies. Each stack consists of one CPU module, one relay module, one slow ADC module, and three fast ADC modules. Additionally, each CPU has two 1 GB DiskOnModule flash disks, with integrated IDE controllers, from PQI Corporation. Though each system only needs one flash module, a second module is reserved as a backup clone to be used if the first fails.

All of this equipment is rated to -40 °C, which is not sufficient for the application. However, the equipment's reliability was verified before deployment by cold booting and operating a system for one week in a freezer at -60 °C.

Besides the four PC/104 systems, referred to as the *string PCs*, our research team installed one master PC indoors at the IceCube Lab, a central control building for IceCube. The master PC and the four string PCs run standard versions of RedHat Linux. The master PC distributes power, timing, and communications signals to each string PC via a custom-built PCI board (one per string). These lines travel out of the IceCube Lab to the string PC junction boxes via copper cable assemblies trenched 1 m deep in the ice over distances up to 500 m. DSL Ethernet extenders from

NexComm enable configurable communication speeds up to 2.3 Mbps.

Studying the propagation of acoustic signals in the ice required a means to measure absolute signal emission and arrival times at different strings with ~10 microsecond precision. We achieved this using an IRIG-B signal generated by a Meinberg GPS clock installed in the master PC. The clock is a PCI card synchronized with GPS via an antenna on the roof. The IRIG-B signal is split out from the Meinberg PCI card and distributed via custom PCI cards to the string PCs, where it is decoded synchronously with sensor and transmitter data to precisely time-stamp all the data.

Embedded computing aids cool research

Our team installed the first three strings in January 2007 and the fourth in December 2007. Each system ran smoothly immediately after commissioning. After 22 months buried in the -50 °C ice (11 months for the fourth string), the four systems continue to perform well despite several sudden and unplanned power outages, some lasting as long as 48 hours. All of the computers have booted normally after the outages, despite their extended time off in the cold.

By logging in to the computers from the North via a satellite link available 10 hours per day, our research team is taking special manual data runs, installing software upgrades, and monitoring the standard data acquisition that occurs autonomously. Exciting data are streaming north from SPATS, allowing researchers to measure the acoustic properties of the ice. We hope to expand this project into a larger experiment that will detect neutrinos from across the universe. Embedded computing will no doubt play a significant role in this next step, as we continue to listen for what neutrinos can tell us about the universe. ECD

For more information on the IceCube Neutrino Observatory, visit: http://icecube.wisc.edu

Justin Vandenbroucke *is a graduate student in the University of California, Berkeley Department of Physics.*

He has spent three summer seasons at the Amundsen-Scott South Pole Station installing instrumentation and data acquisition equipment for both the IceCube neutrino telescope and the SPATS project. Justin holds a BA in Physics from Stanford University. His research is supported by the National Science Foundation Graduate Research Fellowship Program.

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FPGAs power instant on embedded display systems

By Kerry Howell

Embedded systems development teams are increasingly confronted with the challenges of designing instant-on display systems to support end-user requirements. Kerry explains how using nonvolatile FPGAs in embedded designs can help improve system startup speed, integration, security, and component end of life.

Graphics and video display system usage continues to grow, fueled by declining display prices and burgeoning user expectations. Unlike the PC and consumer markets, which are the largest users of display systems, the embedded market has several specific requirements for display systems, including:

- The ability to add intelligence to products. Users have become more sophisticated and expect advanced features.
- The flexibility to adapt to new and evolving standards, especially in regard to system interfaces and different display types and resolutions.
- Viability for 10-15 years. Component end of life requires costly product redesigns.
- Fewer devices needed per design, reducing costs and lowering power requirements.

In addition, many embedded systems must provide immediate information within microseconds of power-on. These systems require many components, which raises costs and lowers reliability. Furthermore, embedded displays based on multichip systems are relatively slow to initialize and display useful information.

While cell phone users may not mind the process of holding down the power button for two seconds and then waiting several more seconds for the system to boot, users that demand instant-on embedded display systems will not tolerate such delays. For example, consider the Ferrari 599 GTB Fiorano, which is equipped with an LCD instrument cluster. It's doubtful that the driver of this $300,000 automobile would be willing to wait 30 seconds while the processor and graphics system initializes before the display can provide data such as speedometer values or oil pressure. In other applications such as an aircraft cockpit or nuclear power control system, startup delays can be disastrous.

Graphics system implementation overview

As shown in Figure 1, a graphics or video controller system contains several components with different inputs consisting of 7:1 LVDS, Camera Link, Channel Link, USB, RGB, video decoders, and system buses. The system also contains some external memory for storing page and video information.

Signals are processed by a general-purpose processor or sent directly to the graphics processor, which may be an Application Specific Standard Processor (ASSP), custom ASIC, or FPGA. Depending on the system, multiple displays might require additional logic to manage the signal information for each display.

Almost all ASSP systems are targeted to the PC and consumer markets and thus sometimes conflict with the needs of the embedded market. PC and consumer products typically have a short life cycle, and product developers anticipate using the latest technology. In contrast, products in the embedded market have very long production and support requirements that cannot tolerate changes forced by a graphics processor end-of-life situation.

FPGAs in embedded systems

Because FPGAs are not specific to the PC or consumer markets, they provide the necessary performance, functionality, and extended life cycle for embedded

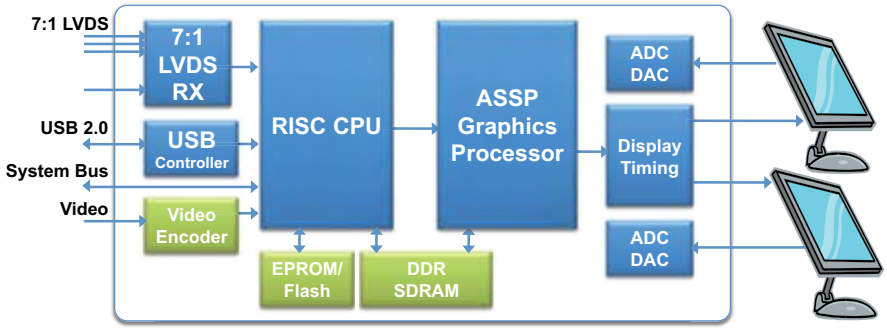

Figure 1

systems. Using FPGAs, designers can create modular designs that offer the flexibility to integrate different IP blocks, depending on the cost and feature requirements. FPGAs also allow designers to include custom graphics accelerators within the video controller so that graphics performance can be optimized specifically for the target system.

Standard video and graphics IP cores for FPGAs are verified designs that are easy to integrate into an embedded graphics display. IP cores also speed system development, enabling designers to concentrate on the application instead of the interface and graphics engines. Furthermore, FPGAs can include the optimal bus and interface standards, allowing designers to choose the best interfaces for the system rather than designing around a predetermined graphics processor interface or bus.

Flash and SRAM unite

Most FPGAs use SRAM technology and lose their configuration during power loss. However, these volatile SRAM FPGAs historically have had higher logic densities and operating speeds than nonvolatile FPGAs. Until recently, the advantages of SRAM FPGAs usually have outweighed the benefits of nonvolatility. That now has changed with the introduction of flash and SRAM FPGAs that provide the best of both worlds: nonvolatile devices with all the features and performance of high-end, System-on-Chip (SoC) FPGAs.

"Instant-on" in programmable devices refers to an FPGA's ability to autonomously configure itself and activate almost immediately. This is possible only in FPGAs that include configuration startup memory inside the device. At power-up, data is transferred from the on-chip flash memory to the SRAM configuration cells that control the device. The key to the instant-on feature is a massively parallel programming data transfer from the flash configuration memory to the SRAM configuration memory.

This instant-on ability is the direct result of a single-die FPGA. The flash configuration memory and SRAM configuration memory are integrated onto the same die, so the parallel load is very quick. The time from achieving VCC to activating the outputs is less than 2 milliseconds.

A modular FPGA-based graphics and video processing IP system design includes a 2D graphics accelerator, video input module, picture-in-picture, scaling, cropping, and positioning, as shown in Figure 2. Project applications operate on the host soft processor that resides in the FPGA. This host processor generates the rendering commands and passes them to the video IP, which also resides inside the FPGA.

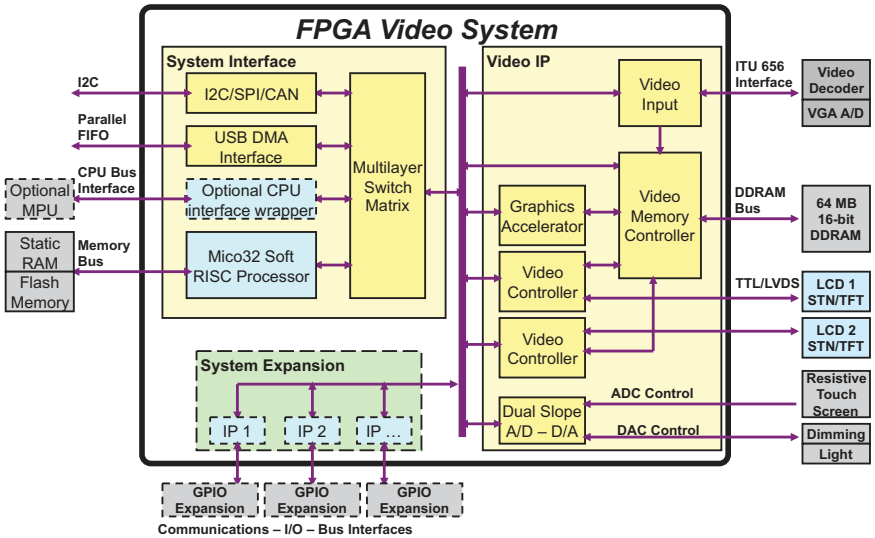

Figure 2

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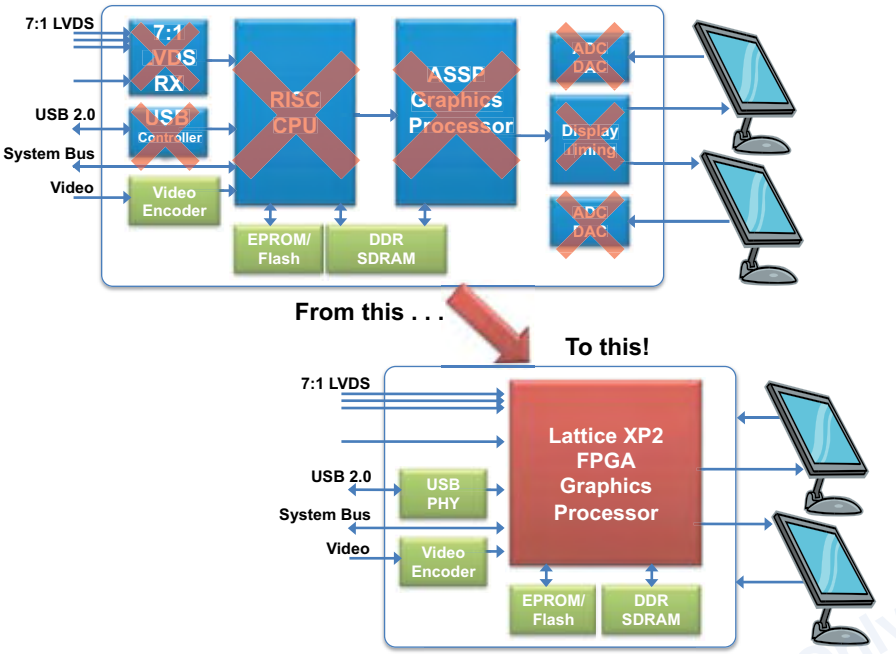

Figure 3

Various I/O interfaces are integrated into the FPGA using the built-in I/O support and commercial IP (see Figure 3), and the host CPU is integrated using a 32-bit RISC soft processor core. The graphics and video controller IP includes support for multiple displays and video standards as well as touch-screen feedback.

Additional system features support embedded applications such as remote client devices, including PCs and cell phones that can connect to the application host processor and remotely review and control the same application as on the local display.

Flexible designs advance display technology

It is possible to integrate almost the entire graphics system into a nonvolatile FPGA. With a very long life cycle, in-system field upgradeability, and adaptability to different buses, interfaces, and displays, this system meets the embedded market's requirements for an instant-on, highly reliable, secure display.

Nonvolatile instant-on FPGAs allow quick design changes during development and throughout the product life cycle. Integrated graphics functions inside this type of FPGA provide designers with the flexibility to offer quick and inexpensive support for current and future graphical display systems. Powerful graphics/video IP coupled with easy-to-implement FPGA SoCs fulfill the market's need for a modular, flexible, and expandable embedded display system. ECD

***Kerry Howell** is a senior automotive marketing specialist for Lattice Semiconductor Corporation, based in Hillsboro, Oregon. He has 30-plus years of experience in developing electronic systems. Certified by Intel Corporation in 1977, Kerry was one of the first distributor Field Applications Engineers (FAEs) in the industry. His 22 years of active FAE work were followed by 7 years managing FAEs and marketing engineering services. Kerry also has an extensive background in industrial control systems and software.*

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