2010 Customer Innovation Issue

Xcell journal

SOLUTIONS FOR A PROGRAMMABLE WORLD

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CELEBRATING CUSTOMER INNOVATION

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Design Platforms Accelerate Application Success

Development kits help ramp up new Spartan®-6 or Virtex®-6 FPGA designs

Avnet Electronics Marketing introduces three new development kits based on the Xilinx Targeted Design Platform (TDP) methodology. Designers now have access to the silicon, software tools and reference designs needed to quickly ramp up new designs. This approach accelerates time-to-market and allows you to focus on creating truly differentiated products.

Critical to the TDP methodology is the FPGA Mezzanine Card (FMC) from the VITA standards body. Avnet has collaborated with several industry-leading semiconductor manufacturers to create a host of FMC modules that add functionality and interfaces to the new baseboards, allowing for easy customization to meet design-specific requirements.

Learn more about the new Spartan-6 and Virtex-6 FPGA baseboards and FMC modules designed by Avnet at www.em.avnet.com/drc

DESIGNED BY AVNET

New baseboards for Spartan®-6 and Virtex®-6 FPGAs

- *Spartan-6 LX16 Evaluation Kit*
- *Spartan-6 LX150T Development Kit*
- *Virtex-6 LX130T Development Kit*

New FMC Modules for Baseboards

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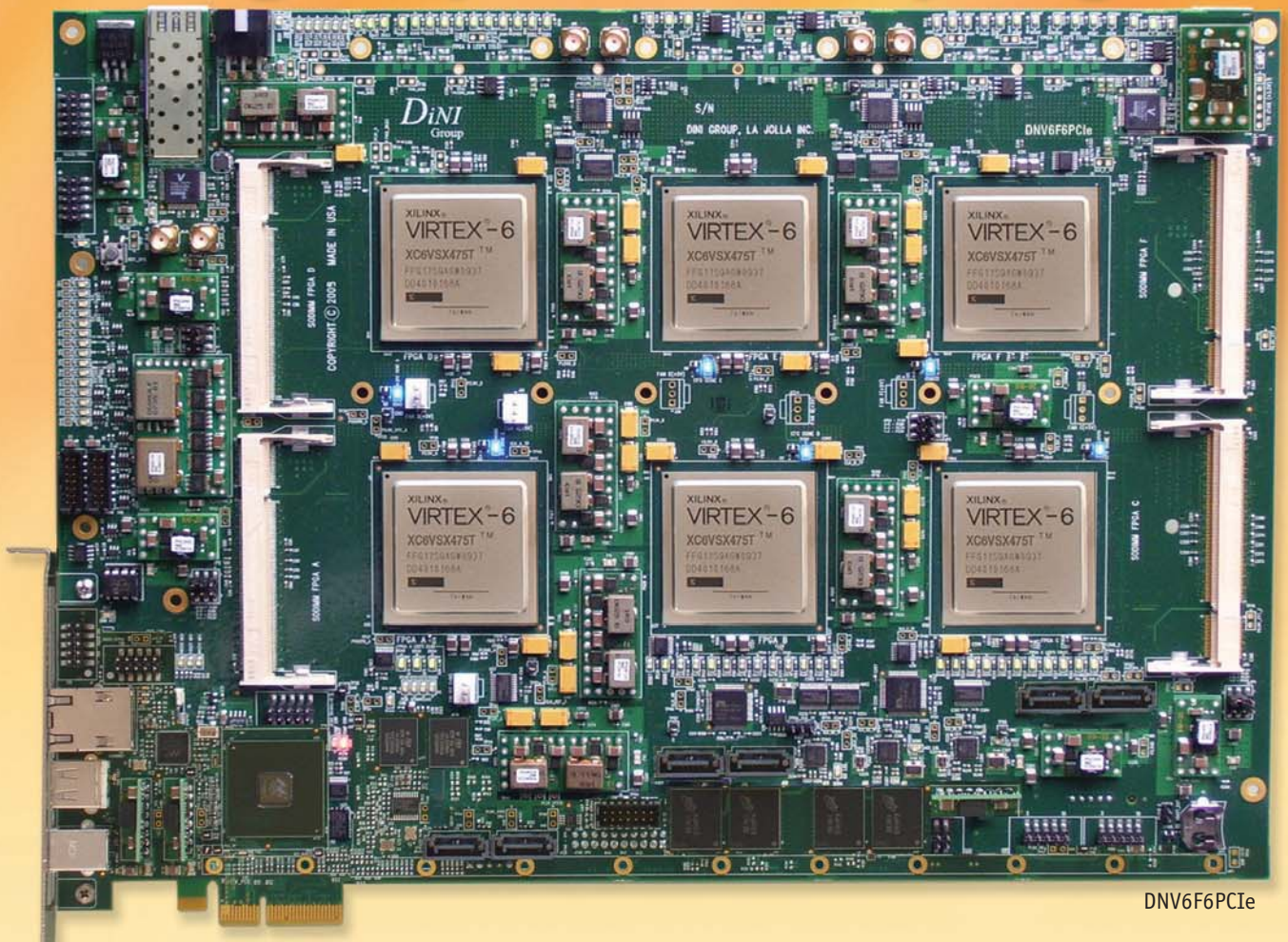
NEW Virtex-6x6 — More Power and Speed for ASIC Prototyping and High Performance Computing



DNV6F6PCIe

Six powerful Virtex®-6 FPGAs, up to 24 Million ASIC gates, clock speeds to 710 Mhz: this new board races ahead of last generation solutions. The Dini Group has implemented new Xilinx V6 technology in an easy to use PCIe hosted or stand alone board that features:

- 4 DDR3 SODIMMs, up to 4GB per socket
- Hosted in a 4-lane PCIe, Gen 1 slot
- 4 Serial-ATA ports for high speed data transfer
- Easy configuration via PCIe, USB, or GbE
- Three independent low-skew global clock networks

The higher gate count FPGAs, with 700 MHz LVDS chip to chip interconnects, provide easier logic partitioning. The on-board Marvell Dual Sheeva processor provides multiple high speed interfaces optimized for data throughput. Both CPUs are capable of 2 GFLOPS and can be dedicated to customer applications.

Order this board stuffed with 6 SX475Ts—that's 12,096 multipliers and more than 21 million ASIC logic gates—an ideal platform for your DSP based algorithmic acceleration and HPC applications.

Don't spin your wheels with last year's FPGAs, call Dini Group today and run your bigger designs even faster.

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Xcell journal

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Celebrating Customer Innovation, From Mars to Antarctica

Ever since Xilinx® introduced the world's first FPGA (field-programmable gate array) to the market in 1985, tens of thousands of design engineers have leveraged the device's flexibility, reprogrammability and ever-growing functionality, performance and capacity to build an impressive array of innovative new products.

Over the past couple of years, I've had the privilege to meet with hundreds of engineers at companies all over the world. It is no overstatement to say that they've used Xilinx programmable chips in the most significant electronics system inventions of the last two decades.

Today, life-saving medical devices, automotive driver assistance and infotainment systems, aeronautics, space exploration, factory precision and safety, surveillance, wireless communications, HDTV and 3-D TV are all being brought to market thanks to our customers' creative use of Xilinx FPGAs.

In this special edition of *Xcell Journal*, we celebrate the magnificent spirit of innovation of the Xilinx design community. You'll get a peek behind the design of extraordinary inventions that are enriching the world we live in, from Mars to Antarctica—and close to home in our everyday lives.

One of the greatest feats in modern engineering is the successful landing and service of the Mars Exploration Rovers (MERs), launched in search of answers about the history of water on Mars. Designers at the Jet Propulsion Laboratory (JPL) used radiation-tolerant Virtex® FPGAs, the state of the art in FPGA space-grade technology at the time, to control the crucial pyrotechnic operations during a rover's multiphase descent and landing procedure. Also, NASA employed Virtex FPGAs on the control board that oversees the motors for the wheels, steering, arms, cameras and instrumentation of the two craft. Remarkably, the twin robot geologists—landing in January 2004 and expected to be operational for only three months—are still returning valuable information six years later.

Equally impressive is NASA's 2009 Invention of the Year. SpaceCube is a tiny, reconfigurable Xilinx FPGA-based computer that could rapidly raise the level of electronic sophistication in space programs worldwide. It's the invention of Gordon Seagrave, a former NASA engineer who designed it on his own time and recruited two friends to help build a prototype and pitch the idea to NASA Goddard officials. After tests in the subzero temperatures of Antarctica, NASA sent the first-generation SpaceCube, which uses four Virtex FPGAs, on the shuttle mission servicing the Hubble telescope. In a real-time simulation, SpaceCube showed it could operate the shuttle's main controls to dock with the telescope. Last November, astronauts secured SpaceCube hardware, including a version that employs a single Virtex FPGA, to a testing rack on the International Space Station. By the end of 2009, SpaceCube had successfully scrubbed several particle hits while continuing to operate at peak performance.

Closer to home, you can walk through almost any shopping mall, bank or airport, and that upside-down iridescent dome you see on the ceiling may well be a Samsung surveillance system under the control of a Xilinx FPGA. In one recent model, Samsung's digital video recorder processes four channels simultaneously on a single Spartan® FPGA equipped with an embedded MicroBlaze™ soft-processor core. The dome camera uses a second Spartan FPGA to calculate multiple coordinates and interface with the DVR.

Samsung systems include high-definition imaging and motion-adaptive dynamic noise reduction to eliminate noise and motion blur. Advanced motion detection sounds an alarm if it senses movement, while automatic digital image stabilization detects and corrects image shake from external vibration such as heavy traffic and wind. Night-vision technology enhances low-light areas to obtain images that would otherwise be too dark to view.

On another front, network test equipment makers are finding ways to repave and enhance the communications infrastructure in support of an insatiable demand for bandwidth, 24/7. Today, data centers at companies like Google or Microsoft, and at major Internet service providers, rely on multiple 10-Gbps links to connect routers and switches that are capable of aggregate speeds of 100 Gbps. The IEEE has spent several years working on the next standard, with the goal of deploying 40-Gbps links between data centers and 100-Gbps links between major Internet nodes. Test equipment maker Ixia has enabled that development with K2, the world's first tester capable of 100-Gbps operation. Thanks to the flexibility and reprogrammability of Xilinx Virtex FPGAs, Ixia can upgrade K2 products in the field to keep pace with changing industry standards.

We're delighted to share these stories and more on the following pages.

The Xilinx design community exemplifies the imaginative spirit that led to the invention of the programmable chip more than 25 years ago by our company's founder and 2009 National Inventors Hall of Fame inductee Ross Freeman. That spirit that is alive and well in today's engineers who—like Ross—have the courage to imagine and create the "impossible."

Moshe Gavrielov
President and CEO
Xilinx, Inc.

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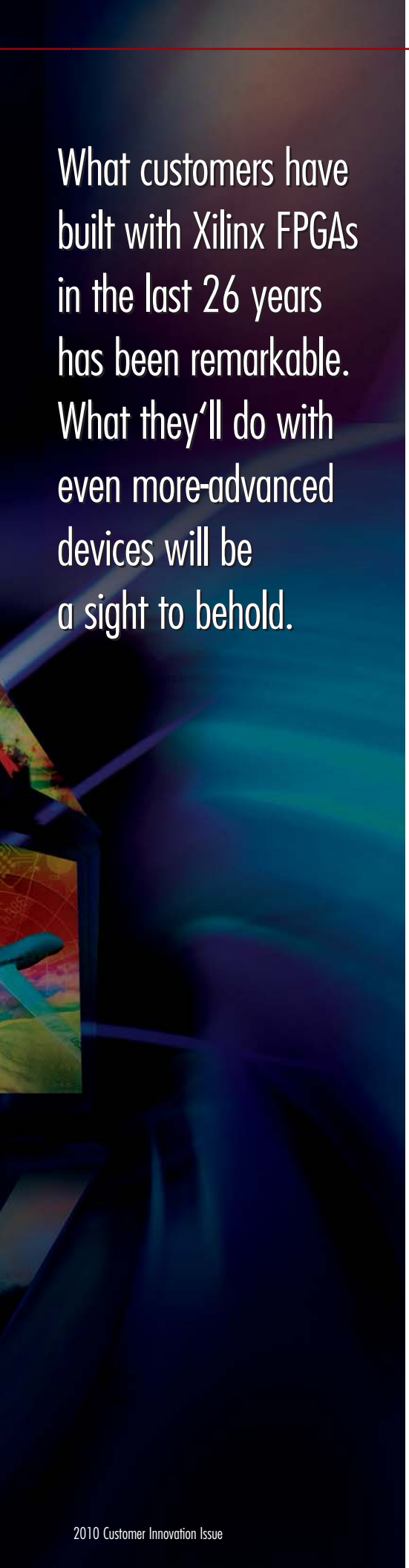
President and CEO
Xilinx, Inc.

PROFILES OF XCELLENCE

Xilinx Customer Innovation: 85,000 to 2.5 Billion Transistors and Beyond



by Mike Santarini
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Customers have created remarkable systems with Xilinx FPGAs over the last two decades. The future will surely be even more remarkable.

As Moore's Law has seen the doubling of IC transistor counts every two years, for over two decades Xilinx has been able to provide engineers with ever-larger, higher-performing FPGAs with impeccable quality (see sidebar, page 15). In turn, these engineers have put these ever-more-advanced FPGAs to a greater number of uses in a growing number of vertical markets. It is no overstatement to say that engineers have used Xilinx® FPGAs in—or at least to prototype or test—some of the most significant electronics system inventions of the last two decades.

Much of the communications equipment that brings voice, Internet and other forms of data to computers and mobile devices around the world includes FPGAs. A growing number of spacecraft searching the far reaches of our galaxy, as well as scientific equipment exploring the infinitesimally small, atomic-level origins of the universe, use FPGAs. Indeed, the number of innovations engineers have created with FPGAs is too numerous to count.

From humble beginnings…

Bill Carter, Xilinx's eighth employee and the engineer who laid out the first Xilinx FPGA, the XC2064, recalls that Xilinx's very first customer was a small company on the East Coast called GTECH, which made lottery machines and, later, slot machines.

"They were selling these games into a lot of different places and to a lot of different customers," said Carter. "Each of their customers needed something slightly different than the competition. They also needed a way to keep the games fresh and change them periodically. For their application, they needed the performance of gates rather than the performance of software to provide that flexibility and speed up the machines—it turns out that time is money in gambling." GTECH represented Xilinx's first big order—from there the FPGA started to gain momentum.

Carter notes that the FPGA rapidly grew in popularity after an article entitled "Two, Two, Two Chips in One," by an engineer named T. Liehe, ran in the Nov. 17, 1986 issue of *Electronic Engineering Times*. "The author was designing a board to allow folks to use consumer-grade videotape to store data," said Carter. "This guy designed an ASIC but his ASIC died, and if he didn't deliver he was going to lose his job. He discovered that he never encoded and decoded at the same time. With an FPGA, he could reconfigure the part and the system at will."

That article made the phones ring off the hook as other engineers became eager to tinker with this revolutionary new device. All of sudden they could program their logic designs into a device and, if they discovered an error or wanted to make a change, they could simply reprogram it—they didn't have to throw the part out. "The term 'revolutionary' gets thrown around a lot, but the FPGA really was revolutionary," said Carter.

Ever since Xilinx commercialized that first device, the company, working closely with customers, has continued to innovate the product its co-founder Ross Freeman invented (see sidebar, "Fulfilling Freeman's Vision"). Consequently, customers have put each generation of FPGAs to increasingly more impressive use.

Where engineers primarily used the first FPGAs as "glue logic" to facilitate communications among disparate chips on a printed-circuit board or to connect products that wouldn't otherwise function together, they can use today's FPGAs—the largest of which pack 2.5 billion transistors—at the heart of an ever-expanding array of systems. Increasingly, these FPGA starts are displacing ASICs and ASSPs as IC design complexity and manufacturing costs continue to rise (Figure 1).

From aerospace and defense to broadcast, consumer, wired and wireless communications, to automotive, industrial, scientific and medical—Xilinx customers are constantly pushing the limits on their FPGA-based designs, continually redefining what

is considered state of the art. These markets are progressing at an ever-advancing pace as customers deliver cutting-edge products in many sectors.

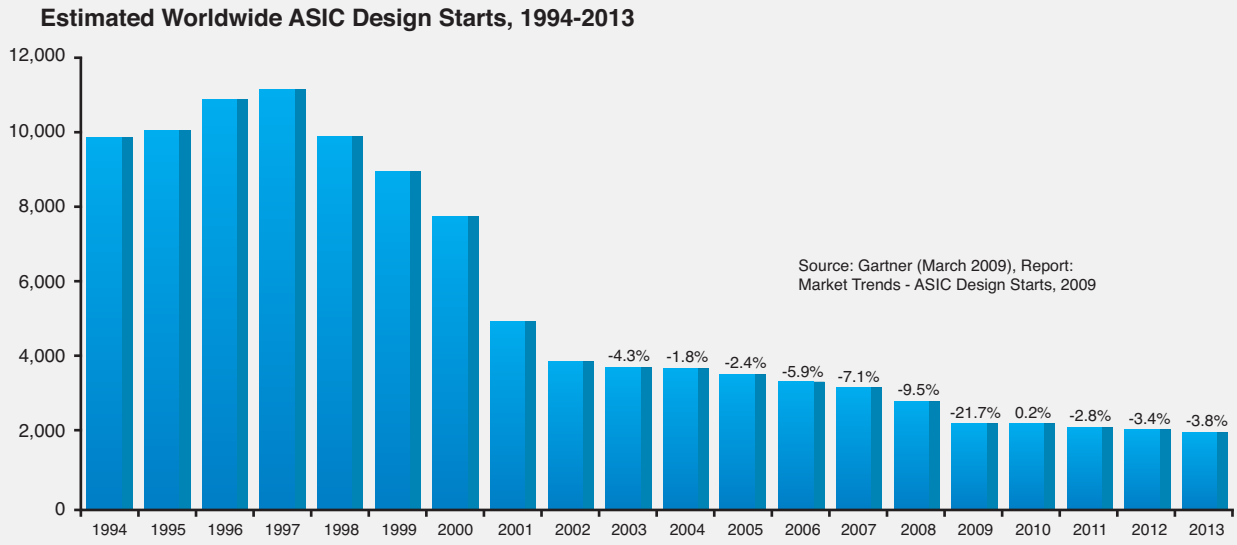
Xilinx A&D Customers: Pushing the Envelope for More Than Two Decades

Just a short 21 years ago, Xilinx established a group within the company to solely serve the unique requirements of the aerospace-and-defense market. Electronics built for this market must withstand the harsh conditions of high altitude and space, including rapid and frequent temperature shifts and exposure to cosmic radiation over long periods. Many of these devices must also be tamper-resistant.

Working closely with its customers, Xilinx has created radiation-tolerant derivatives of most of its programmable devices while also devising advanced encryption technology endorsed by top U.S. government agencies. In addition, the company's unique design software allows users to add redundancy (duplicate blocks) to their designs, supplying additional layers of backup in the event that a problem does occur. This breadth of options allows companies to tailor the amount of protection and resilience to the exact application requirements of their designs.

Over the last 21 years, a large list of defense contractors, government agencies, international agencies and commercial satellite companies have leveraged Xilinx FPGAs for prototyping and, ultimately, deployment of numerous products.

NASA, for example, is using Xilinx devices to explore the farthest reaches of the universe. The agency in recent years has flown Xilinx devices in the Venus Express, Mars Reconnaissance Orbiter, GRACE (the



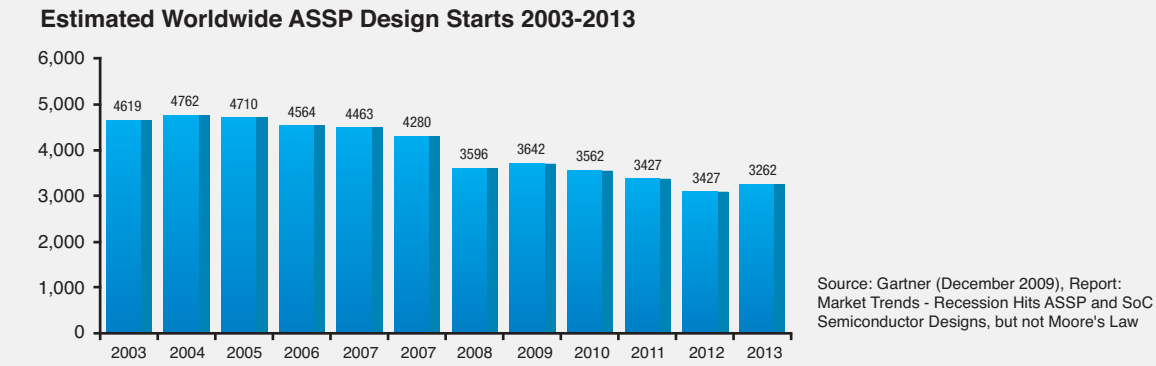


Figure 1 – Mainly due to design complexity and increasing manufacturing costs, ASIC and ASSP design starts have been declining steadily, while FPGAs continue on a growth path

Gravity Recovery and Climate Experiment) and the Mars Exploration Rovers (a profile of the MERs appears in this issue). Most recently, NASA's 2009 Invention of the Year, the highly advanced FPGA-based computer known as SpaceCube, won a berth on the International Space Station. (SpaceCube, too, is featured later in this issue.)

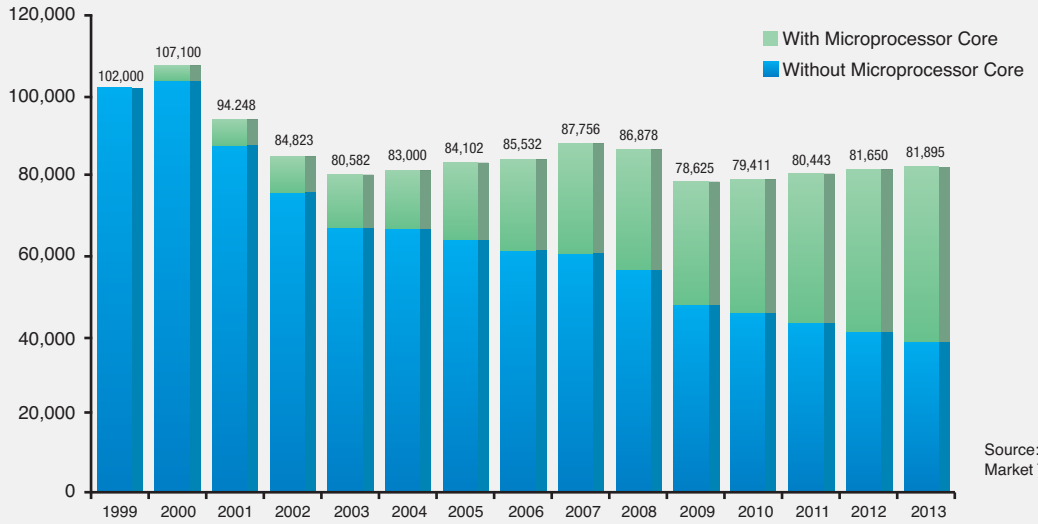
Meanwhile, the U.S. Department of Defense (DOD), NATO and numerous U.S. military contractors have leveraged FPGAs for a number of systems. One of them, SRC (also profiled in this issue), is among the contractors protecting American lives and rapidly bringing innovations to front-line combat troops thanks in part to the flexibility and rapid turnaround of Xilinx FPGAs.

As the United States and its allies come to rely more heavily on electronic communications to coordinate intelligence and military actions across the globe, the DOD and its contractors are finding that FPGAs not only create faster communications equipment for this network, called the Global Information Grid, but also connect the many craft and troops together on the GIG using FPGA-based software-defined radio (see the cover story in *Xcell Journal*, Issue 69).

Yet another fast-moving application in the A&D sector is high-performance computing, which government and scientific bodies use to perform extremely elaborate simulations ranging from warfare to molecular physics. Several companies in this space leverage Xilinx FPGAs' mix of parallel and serial I/O to create the world's fastest and most complex computing machines. Convey Computer is a hot new startup that is expanding the boundaries of supercomputing by leveraging Xilinx FPGAs (read more about Convey later in this issue).

Engineers are giving Xilinx FPGAs plum roles in so many applications that very soon these programmable devices will become the de facto choice in this market. That's especially noteworthy because the advanced research and technologies innovated in this space become commercial technologies later on. To learn more about Xilinx in A&D, visit *http://www.xilinx.com/esp/aerospace.htm*.

Estimated FPGA /PLD Design Starts, 2003-2013



Source: Gartner (March 2009), Report: Market Trends - ASIC Design Starts, 2009

Application	Product Displaced
Security Access Control	ASSP
Security Surveillance	ASSP
Print-Head Interface	ASIC
GPS Anti-Jammer	ASIC
STS12 Framer/Mapper	ASIC
40G Transponder	ASSP
40G Muxponder	ASSP
Image Processing	ASSP
Rear View Camera	ASSP
Instrument Cluster Display	ASSP
Graphics Display Controller	ASSP
1394 Interface	ASSP
Image Processing	ASSP
Video Controller	ASSP
Wireless Radio	ASSP

Application	Product Displaced
Multi Viewer Equipment	ASSP
OC768 Framer	ASSP
DDC and DUC	ASSP
Framers and FECs	ASIC
Cryptography Equipment	ASIC
Storage Crypto	ASIC
40/100G Ethernet Tester	ASSP
Flash Interface for SSD	ASIC
40/100G Ethernet Tester	ASSP
Enterprise Switching – 4 x 40GE LC	ASIC
Edge Router – Core Space/Data Center	ASIC
eQAM	ASSP
CMTS Router	ASSP
Next Gen Switch	ASIC
Security/Firewall	ASSP

Application	Product Displaced
Security Encryption	ASSP
Security Coprocessing	ASIC
100G Muxponder	ASSP
GPON — Traffic Management	ASSP
Switch Fabric	ASIC
Video Switch	ASIC
Print Engine	ASIC
Beam Forming	ASIC
DDC/DUC	ASSP
Custom Southbridge Companion Chip	ASIC
Traffic Manager	ASIC
OC-3/OC-12 Clock Data Recovery	ASSP
1588 Slave Clock Function	ASIC

Source: Gartner 01/06/2010

Xilinx Automotive Customers Drive new Era in Automotive Electronics

Go for a test drive in any of the latest automobiles and it quickly becomes apparent that the automotive industry has moved into an entirely new era. Today, carmakers are looking beyond engine block size and body design to electronics in a quest to differentiate their automobiles from the competition. Xilinx automotive customers are pushing the state of the art in this realm using the specialized XA FPGAs to quickly create innovations and bring them to market.

Where even 10 years ago you could count on one hand the number of electronic or electromechanical systems in an automobile, in today's vehicles, electronic systems are quickly replacing those that were once mechanical and more prone to failure over time. With an ever-progressing array of new electronics-enabled features, carmakers are wooing customers, enriching the driving experience and keeping drivers more informed about what is going on inside and outside their vehicles. Although automotive design cycles have traditionally been very lengthy, in this new age consumer preferences for electronics can change quickly, which means auto manufacturers must add new features fast.

Today, the top luxury automobiles include upwards of 18 Xilinx programmable-logic devices across entertainment, driver assistance and driver information systems. Xilinx customers are using FPGAs to bring customizable dashboards and even the Internet and live broadcasts to automobiles.

They are using FPGAs to coordinate the functions of an array of sensors placed at multiple locations in today's automobiles to simultaneously enable features such as intelligent cruise control, lane-change and blind-spot detection, and even sound a warning if a driver starts to nod off at the wheel (see the cover story in *Xcell Journal*, Issue 66).

Companies like Delphi and PLX (products from both are profiled later in this issue) are two of the many vendors leveraging FPGAs to quickly bring electronic innovations to the automotive market. Because they allow engineers to make design changes up to the last minute or even after the car has been sold, FPGAs are rapidly becoming the logic device of choice for auto manufacturers and their suppliers. To learn more about Xilinx in automotive, visit *http://www.xilinx.com/esp/automotive/index.htm*.

Xilinx Broadcast Customers Make 3DTV a Reality

As consumers enjoy crystal-clear HDTV imagery, stunning 3-D movies and, very soon, 3-D television, the filmmakers and Hollywood studios are usually the ones to grab the plaudits. But it's Xilinx's customers in the broadcast and professional cinema equipment market who actually deliver the goods.

Engineers in this space are the unsung heroes behind the scenes who help keep the public informed and entertained in

ever-more-spectacular fashion. They make the equipment found in news reporting vans, build the television cameras and multimillion-dollar movie cameras, and craft the highly sophisticated systems that route, receive, edit, produce and ultimately transmit signals to the local cineplex, your TV, computer, handheld device and perhaps even your car.

The broadcast market long ago cast aside ASICs in favor of using FPGAs to bring the latest equipment to market at breakneck speed and to customize their products. Xilinx counts among its customers the biggest names in the broadcast equipment business. Because video and audio signals must be as sharp as possible, this equipment must pass signals and data from machine to machine in an uncompressed to lightly compressed format. That means the signals and the amount of data the equipment must handle are quite large. As such, the equipment must be extremely fast and able to adapt quickly to handle various formats of uncompressed signals. Over the last 10 years, broadcast technologies have seen unprecedented advances. As consumers continue to demand clearer, more lifelike images and higher-fidelity sound, the uncompressed data stream will only get larger, requiring even faster FPGAs that can handle multi-gigabit bandwidth.

In recent years, established broadcast equipment companies like Miranda (profiled in this issue) have brought out new lines of equipment to enable broadcasters to transmit 3DTV to your home. Meanwhile, a new batch of emerging broadcast equipment companies such as Dayang (also profiled in these pages) uses Xilinx FPGAs to bring cost-sensitive yet highly innovative and sophisticated 1080p broadcast equipment to emerging markets in China, while stepping up the competition internationally.

Even as the broadcast infrastructure for 1080p and 3DTV is fast emerging, equipment makers are already demonstrating much more advanced technology that could one day bring holographic broadcasts to our living rooms (see the cover story in *Xcell Journal*, Issue 70). To learn more about Xilinx's efforts in broadcast, visit *http://www.xilinx.com/esp/broadcast.htm*.

Xilinx Consumer Customers: Smashing Market Windows

One of the most harrowing markets to play in is consumer electronics. To become a success in the consumer space, your product must be desirable, differentiated and have a reasonable price point. But above all else, you must time its introduction to the market to perfection. In the consumer realm, being first to market is a must, and first to market at Christmas season—when consumers have the funds, or at least the will, to spend—can prove to be a diamond mine.

A trend that is rapidly maturing is consumer customization of electronics—personalizing a gadget by downloading applications. Because FPGAs are both hardware and software programmable, consumer electronics companies are looking to these devices to handle the customization tasks.

Conversely, if you miss that release window for any reason or come out with a product at the same time as your competitors but lacking one key feature, you'll likely have to drastically cut prices just to turn a profit. Consumers today are unforgiving, and word can get out fast if your product falls short—hurting not only the product itself, but your company's reputation as a whole.

Because it can potentially be such a high-volume business, consumer electronics has traditionally been dominated by ASICs and ASSPs. But as design complexity and silicon manufacturing costs have spiraled, it's a far more expensive and riskier proposition to build those ASICs and ASSPs. One misstep in the product development cycle can lead to multimillion-dollar mask respins and missed market opportunities.

As such, more and more companies are turning to Xilinx's low-cost, high-volume Spartan® FPGAs for their next-generation designs. The most successful HDTV manufacturers, for example, have replaced ASSP-based system with FPGA-based models so that they can quickly add unique hardware functionality and thus differentiate their products. This use of FPGAs is growing as TV manufacturers start introducing 3DTV sets, some of which require that users wear 3-D glasses while others do not.

Over the years, customers have leveraged Xilinx programmable devices to build a vast array of innovative consumer products, from robotic vacuum cleaners to Gibson's first-generation digital Les Paul guitar, tailored for zero-noise recording, to a number of handheld devices such as ACS' Elan personal breathalyzer (profiled in this issue).

Use of FPGAs allows Xilinx customers such as audio IP vendor Sonic Emotion (also profiled here) to tailor highly sophisticated audio system technology to the end-product requirements of a number of OEMs. Sonic Emotion's technology assesses the user's room and uses various audio techniques to create true 3-D sound for a hauntingly real experience.

A trend that is rapidly maturing is consumer customization of electronics—essentially, the ability for consumers to personalize their gadgets by downloading applications. The ability to add applications and customize a product not only allows customers to suit a device to their lifestyle, but in some ways forges an emotional bond with the device they have, in essence, created.

Because FPGAs are hardware programmable as well as software programmable, companies are looking to them to handle the customization tasks. With FPGAs, companies can not only add features right up to release time or even offer hardware functionally as well as new software applications after release, they can sell consumers one device and charge them to unlock hardware-enabled performance, functionality or upgrades without requiring they buy a whole new product.

In addition, the reprogrammability and fast-turnaround attributes of FPGAs, along with the breadth and depth of FPGA programmability, make FPGAs an ever-more-compelling technology for consumer products going forward.

To learn more about Xilinx in consumer, visit *http://www.xilinx.com/esp/consumer.htm.*

Xilinx Customers Innovate Efficiency and Safety in Industrial, Scientific and Medical Applications

Engineers in the sector Xilinx calls Industrial, Scientific and Medical create remarkable technologies.

In the industrial space, engineers use FPGAs to create more efficient, effective and safer manufacturing lines. Designers have placed FPGAs in numerous control systems to monitor motor and energy efficiency and wear. When controlling a network of sensors, FPGAs can identify defective products flying down an assembly line far faster than the human eye can achieve. They can even monitor cracks in machinery and halt machines instantly to prevent catastrophic failures or injuries.

A number of companies in the security sector use FPGAs to control enormous networks of smart cameras that can identify threats through various means, including motion detection and facial and thermal recognition, to prevent theft and terrorism. One such innovative company is Pixel Velocity, whose advanced system is installed in major venues including Chicago's O'Hare International Airport (see profile).

Because FPGAs are reprogrammable, the scientific and academic communities use them extensively to teach, create experiments and implement some of the most advanced technologies on the planet today. One such R&D organization that heavily leverages FPGA technology is CERN, home of the world's most advanced supercollider, which scientists are using for a number of experiments designed to uncover the origins of the universe (see profile).

The world's largest medical-equipment manufacturers also use Xilinx FPGAs to create an astonishing array of devices. Engineers at these companies have, for example, leveraged the FPGA's mix of programmability and high performance to cre-

ate several generations of medical imaging equipment such as sonograms and CT scanners, as well as a wide range of diagnostic, monitoring, therapy and home medical/consumer devices. Aloka and Sanarus are two companies that have innovated remarkable technology in the medical space (read their profiles in this issue).

To learn more about Xilinx in ISM, visit *http://www.xilinx.com/esp/ism.htm*.

Xilinx Comms Customers: Repaving the Info Superhighway One Router and Base Station at a Time

Designers in the communications industry created the infrastructure for the Internet and modern wireline and wireless communications. These engineers do the heavy lifting in terms of paving—and repaving—the information superhighway. It isn't an easy task, because at each repaving, they must make equipment that is exponentially faster than it was the generation before.

For nearly two decades, all the leading companies in the wired and wireless communications space have used Xilinx FPGAs to create ever-more-advanced equipment to drive voice and data communication across the world.

Today in wired communications, engineers at network companies are designing

85,000 Transistors and Counting—Fulfilling Freeman's Vision

When Ross Freeman, the inventor of the FPGA and co-founder of Xilinx, showed his invention to a young IC layout specialist and would-be employee named Bill Carter, the first thing that popped into Carter's mind was "Wow, this is one huge waste of transistors," Carter recalled recently. "In those days, transistors were precious and very expensive. The largest microprocessors in the world had around 50,000 transistors and for the time they were considered incredibly complex and expensive devices—every transistor was precious."

Freeman's invention used a dozen or more transistors to do any given function that would only take three or so transistors in an ASIC. "But with the transistors you had in the FPGA, you could create just about any circuit—and you could reprogram the device if you messed up," said Carter. "Needless to say, I took the job and ended up laying out the XC2064, the first FPGA."

Carter, who recently retired from Xilinx, notes that Freeman was a visionary who postulated—quite correctly—that as the semiconductor industry, in keeping with Moore's Law, moved every two years to new IC manufacturing processes, the number of transistors would double and the per-transistor cost of ICs would decrease dramatically. Thus, the value proposition of FPGAs would resonate more loudly with the introduction of each new silicon process technology. That indeed is the case today and will likely hold true into the foreseeable future, Carter said.

That first FPGA, the XC2064, which Xilinx implemented in Seiko's 2.5-micron process technology, consisted of 85,000 transistors to form 64 configurable logic blocks. "It was bigger than most MPUs by a lot," said Carter. By contrast, the latest Xilinx FPGAs, the Virtex-6 family, are 40-nanometer, 2.5-billion-transistor devices that pack well over 100,000 CLBs. But in addition to CLBs, today FPGAs are systems-on-chips equipped with a number of on-chip intellectual-property blocks including DSP slices, SRAM, memory controllers and multigigabit I/O.

Carter points out that FPGAs have a very distinct advantage over any other chip in that they are hardware- as well as software-reprogrammable. This broad reprogrammability allows users to create a design and then immediately test it running in already manufactured silicon. And if the design doesn't work properly or if they don't like it, they can reprogram their FPGAs with a new and improved design. They can even reprogram the device's hardware and software after the product has gone to market and is deployed in the field.

Ross Freeman's mother, Ethel, and brother Fred Freeman accept his National Inventors Hall of Fame award.

Because of all this, and quite unique to the semiconductor market, the value proposition of the FPGA has only become stronger over time and will continue to do so in the future.

For his invention and for this vision, Freeman—who died in 1989 at the age of 45—was posthumously inducted into the National Inventors Hall of Fame in 2009. "He was a remarkable human being, we owe him a lot of gratitude," said Carter. — *Mike Santarini*

equipment that will whiz data from today's top rate of 10 Gbits/second to 100 Gbps, which will in turn give rise to a seemingly endless number of other high-speed products and services that will stream data around the world.

Wired communications companies use FPGAs in multiple systems for just about every generation of communications infrastructure they've created. One of the traditional uses for FPGAs is in routers. Typically, when someone sends an e-mail message or requests to view a Web site, the person's computer sends that message as a packet, which travels through a series of routers to its destination in much the same way as a letter travels through a series of post offices—only faster. Traditionally, routers use an FPGA to read that incoming packet, which can come in many different protocols or languages. The FPGA passes that translated message to a network processor to determine its next destination. It then goes to another FPGA, which actually sends the message to the next router. Increasingly, all these functions occur in nanoseconds.

But as the superhighway progresses, so does the speed. That's why engineers in this space have eagerly embraced today's Virtex®-6 FPGAs, many of which contain multigigabit I/O that allows them to design systems that move signals at 100 Gbps or even more.

As FPGAs continue to advance, it's conceivable that one day soon engineers in wired communications will be able to implement network processing functions directly in the FPGAs themselves, and thereby speed up the routing of signals while reducing the number of chips the system needs to perform optimally. In this market, reliability is a key, as these systems must run 24 hours a day, seven days a week. What's more, advanced users in the communications space employ a technique Xilinx pioneered more than a decade ago that makes it possible to upgrade and update the FPGAs in these communications systems without having to shut them down. To learn more about Xilinx in wired communications, visit *http://www.xilinx.com/esp/wired.htm*.

Complementary to the wired communications sector is wireless. The wireless base stations that stand atop the high points around your neighborhood—some even disguised as trees—are the towers that facilitate mobile phone and data communications. As with routers, these systems receive and send signals across the world and are connected to wired communications networks.

Xilinx quality and customer satisfaction are second to none. The company has consistently received top quality and satisfaction marks from its customers, which include many of the biggest names in electronics:

- Brocade, Quality Excellence Award, 2009
- General Dynamics, Strategic Supplier Award, 2008
- Harmon Becker, Top 10 Percent Semiconductor Supplier Award, 2008
- Huawei Core Partner & Most Valued Supplier Awards, 2008, Gold Supplier Award, 2009
- Motorola, Preferred Supplier Award, 2009
- Sony, Quality Award, 2008
- Spirent, Supplier of the Year, 2008
- Tellabs, Perfect 20/20 Quality Score, 2008
- ZTE, Best Supplier Award, 2008-2009

As in wired communications, the wireless applications space is constantly going through drastic performance upgrades so as to handle larger amounts of data faster. Most countries throughout the world are currently undergoing an upgrade to what even non-tech types know as 3G technology. In this buildout, companies are putting in place a range of base stations, from femto to macro in size, that will facilitate wireless communications.

As carriers constantly upgrade their networks to woo customers and offer more services and applications, they would rather not erect new towers and install new radio equipment every time they want to support a new communications protocol. Indeed, the installation and maintenance costs for these towers can be much more expensive than the systems themselves, and cut deeply into profit margins.

To reduce this cost, engineers who design these base stations are leveraging the FPGA's flexibility to create nimble, future-proof systems called multimode base stations using software-defined radio technology. SDR base stations can adjust on the fly, quickly reprogramming themselves to facilitate the reception, processing and forwarding of a broad range of new and legacy wireless signals.

By using these programmable systems, carriers believe they can not only speed communications but also drastically reduce maintenance costs. Because the systems are FPGA based, they can even upgrade them wirelessly. This is especially important as many companies start developing base stations before the communications standards bodies that define the new network requirements ratify the specifications. To learn more about Xilinx in wireless communications, visit *http://www.xilinx.com/esp/wireless.htm*.

From the FPGA's introduction in 1985 to the present, Xilinx customers continue to create a dazzling array of innovations. In the following pages, you'll see how design groups in different parts of the world have used Xilinx FPGAs to create technologies that are helping to make a brighter future. What they've built with FPGAs over the last 26 years is truly remarkable. What they will do in the future with even bigger and more advanced FPGAs will be a sight to behold.

If you'd like us to consider your Xilinx FPGA-based end-product for coverage in an upcoming issue of Xcell Journal*, send a description and photo of your product to* xcell@xilinx.com

I would like to thank and acknowledge the many people who helped coordinate interviews with customers for the articles in this special issue. I'd also like to thank my friends and former EE Times *and* EDN *colleagues, and now contractors, Jacqueline Damian (the editor of* Xcell Journal*), Brian Fuller, Loring Wirbel and Maury Wright, who wrote some of the profiles on the following pages.* — M.S.

AED Makes Times Square Sparkle

Design services firm creates sophisticated electronics for many of the world's most spectacular billboards.

If you've ever been to New York's Times Square, you've likely been amazed by the vast array of spectacular electronic signs that seem to get bigger and more sophisticated every year. That jump in complexity in systems the advertising business dubs "spectaculars" is due in part to a small but mighty design services company called Advanced Electronic Designs Inc., which uses Xilinx® devices to power sophisticated LED display modules it creates for clients that build these massive displays.

One of AED's latest projects was to design display modules for megasignage specialists Dynamic Digital Displays' (D3) Walgreens project. This multisided, 17,000-square-foot wonder, arguably the most sophisticated electronic display in the world, rises 340 feet high and wraps around three sides of the One Times Square building (the site of the New Year's Eve ball drop).

The signage combines thousands of AED-designed LED panels with thirteen 60-inch plasma displays at the entryway and inside the Walgreens store. From a control room, sign operators can project a single massive moving image or a series of moving- or still-image advertisements. The combination allows the chain to not only display its own logo, but to sell multimillions of dollars' worth of advertising spots to its partners.

"We don't make the completed signs, but we do a lot of the electronic design work for companies who build these signs," said Jason Daughenbaugh, senior design engineer at Advanced Electronic Designs. "Our firm does all of the electronic design and works with our clients' mechanical engineers to make everything fit together in the weather-tight enclosures. We are also involved in the overall sign designs to help calculate the bandwidth and power requirements for these signs. It's very rewarding work—it's fun to go to Times Square, because most of the signs there are ones we've designed."

The ABC ribbon sign, the M&M World sign, JVC's HD widescreen sign and the JP Morgan Chase sign are among the many in Times Square that the Bozeman, Mont., company has had a hand in designing. (In issue 51 of *Xcell Journal*, Daughenbaugh describes in detail AED's design for the JP Morgan Chase sign. See *http://www.xilinx.com/publications/xcellonline/xcell_51/xc_es-tsquare51.htm*.)

For the D3 Walgreens project, AED designed a series of modules, most of which are 15 inches square. Each module includes an LED panel, Ethernet and power cables, and an AED-developed printed-circuit board containing a Xilinx FPGA, which controls the module's LED display. "This particular sign has about 10,000 of those 15-inch modules plus a couple thousand higher-resolution modules for inside the store," said Daughenbaugh. "All the brains behind everything in this sign are the FPGAs. This works out great for us. They are flexible and cost-effective. FPGAs allow us to do firmware upgrades and add features or easily fix bugs, if bugs ever happen."

To create the Walgreens spectacular, D3 assembled and stacked the LED modules into the desired shapes and interconnected them via network switches and an extremely sophisticated network of custom computers. These computers coordinate the modules to run synchronously and seamlessly from a custom-built control room.

AED's patent-pending position-detection circuit uses a wireless link to allow each module to identify its location in the sign with respect to neighboring modules. D3's custom-built control system then uses the video coordinates for each module to enable the system to break up an image and, via Ethernet, send the right pieces of the video puzzle to each display unit. The system transmits 150 Gbytes of information to the array of display modules every 30 seconds.

"It's essentially an extremely large computer monitor," said Daughenbaugh. "You can run pretty much anything on it that you can run on a computer monitor. It's pretty impressive to see on video, but to get the full effect you have to experience it in person."

In Times Square, you literally can't miss it. It's truly spectacular, in every sense of the word.

Xilinx FPGAs control the LED displays in the huge Walgreens sign at One Times Square.

Breath Tester Helps Drinkers Know When to Say No

Aimed at bartenders and party hosts, the Elan personal breathalyzer is accessibly priced at $49.

Back in the day, a party host or a bartender needed a keen eye and a tough demeanor to take away the car keys from a reveler who had overindulged. Often, disagreeable drinkers got nasty about it.

It was that type of situation that Toronto-based Alcohol Countermeasure Systems (ACS), a leading producer of alcohol interlocks and breath-alcohol testers, aimed to solve.

In late 2002, ACS introduced the Elan personal breath tester, developed using a low-cost, low-power Xilinx CoolRunner™-II CPLD. The Elan tester analyzes the electronic signal an individual's breath alcohol produces and converts it into a blood-alcohol concentration level, displaying the test results on a three-digit liquid-crystal display within 10 seconds. The battery-powered tester is roughly the size of a cigarette lighter (3 x 1.25 x 0.5 inches) and costs just $49.

Originally developed for law enforcement purposes in 1976, the ACS product line has since expanded to serve the industrial, public and personal safety markets. With patents worldwide, ACS produces some of the most accurate and reliable alcohol-sensing equipment available.

The accuracy of any breath-alcohol test is dependent upon the relationship between the concentration of alcohol in the blood and deep-lung breath. The accepted ratio that defines this relationship is 2,100 to 1.

In the early part of this decade, the company saw the march of Moore's Law reach a point where it was possible to produce personal breath-alcohol testers affordably, sparking a huge market among bars, restaurants, private hosts and responsible revelers who wanted to know when to say when.

ACS and Xilinx also developed a voice-recognition alcohol breath tester that helps law enforcement officials manage repeat offenders. The Alcolock WR3 device locks the auto ignition, keeping the driver from starting the car until he or she passes a sobriety analysis by breathing and humming into the mouthpiece.

Responding to stricter drunk-driving laws, Florida officials have mandated the installation of the ACS system in the vehicles of some convicted DUI offenders, who must provide a proper breath sample and pass the alcohol test before starting their vehicles. The alcohol interlock stores the data from each test and monitors the use of the vehicle, including any attempts to bypass the system. The voice-recognition feature—enabled by the Xilinx programmable device—deters circumvention by air pumps or other mechanical means by requiring a human breath signature.

A low-cost, low-power CoolRunner-II CPLD resides at the heart of the Elan device.

Since Florida launched its program in 2004, more than 21,000 drivers have participated, making the Sunshine State a recognized leader in highway safety. ACS also partners with other North American and European law enforcement agencies in the deployment of its technology.

While it's difficult—outside of product sales—to pinpoint the impact of personal breath testers like the Elan, the National Traffic and Safety Administration reports that the number of alcohol-related fatalities declined 40 percent between 1982 and 2005. This reduction is attributed to an increase in public awareness and driver accountability.

In addition, ACS has been honored with at least two awards for the life-saving alcohol testing devices it produces.

The Elan alcohol breath tester is available to the public and can be ordered directly from ACS online at *www.acs-corp.com.*

Seeing the Unseen: Aloka's ProSound Alpha 10

Ultrasound machine leverages Virtex-4 SX for high-performance DSP functionality.

FPGAs enable the real-time display of high-definition ultrasound images in the ProSound Alpha 10.

Millions of people worldwide owe their lives to a Japanese company they've probably never heard of that makes a key piece of equipment for physicians and anyone else who needs to peer beneath the surface of things. Aloka Co. Ltd. has been designing and manufacturing ultrasound machines since 1960, building its technology on the shoulders of mid-20th-century innovation.

Today, its flagship ProSound Alpha10 combines a 12-bit A/D digital beam converter, high-powered image-processing channels and probe technology to improve examinations. Beam control provides high resolution and penetration while minimizing image degradation, while user-oriented operability and ergonomics features enable fast and accurate imaging and diagnosis.

Ultrasound—the energy generated by sound waves of 20,000 or more vibrations per second—was first discussed in a 1942 paper on medical ultrasonics by the Austrian physician Karl Dussik.

In postwar Japan, surgeons and experts from Juntendo University, Tokyo, and the Japan Radio Company were studying ultrasound in collaboration with the Nihon Musen Radiation and Medical Electronics Laboratory. Aloka emerged from this work in 1950. The team started its formal efforts in ultrasound imaging in 1952.

Today, ultrasound machines commonly help doctors look inside bodies and catch medical issues before they spread and threaten a life. They also let mechanics check for structural damage on airplanes—among thousands of other applications.

Eleven years after introducing the first commercially available ultrasound system, Aloka in 1971 developed the first electronic linear-array scanning system. It introduced the world to color Doppler in 1983, revolutionizing cardiovascular ultrasound imaging. Through the 1980s and 1990s, the company pioneered intraoperative transducers to pave the way for modern, minimally invasive ultrasound techniques. To date, Aloka has produced more than 200,000 ultrasound machines.

Today's state-of-the-art ProSound Alpha10 uses a technology called Extended Pure Harmonic Detection. This digital pure-beam imaging platform incorporates acoustic technology to improve the clarity of the ultrasound beam formation and signal processing.

The machine is used widely by specialists in perinatology, maternal health and fetal medicine and in large OB/GYN offices, as well as for surgery, breast and general imaging. In 2007, Aloka leveraged the Virtex®-4 SX EasyPath FPGA to bring high-performance DSP functionality that enables a real-time display for high-definition images, incorporating sophisticated features and reducing development lead time.

The designers used the FPGAs primarily to transmit and receive focused data in the ProSound Alpha 10. The ultrasound system displays real-time tomographic images of internal organs for accurate diagnosis. Displaying such high-resolution images requires precise focus of ultrasound beams, which is accomplished through high-speed, high-resolution processing of data received across dozens of channels.

By designing in FPGAs, Aloka could ramp to volume production just 12 weeks after design freeze and avoided the costly system requalifications necessary with ASICs.

"We're now in our 14th year of using Xilinx FPGAs in our products, and we look forward to future innovations from Xilinx as they push for even higher system integration," said Toshiaki Fujiki, assistant general manager of the R&D Section in Aloka's Medical System Engineering Department.

For more information on Aloka's ProSound Alpha10, visit *www.aloka.com/products/view_system.asp?id=12.*

LCD Televisions Get Dynamic Backlight Control

FPGAs are helping companies like ASTRI bring flat-panel TV innovations to market faster than ever before.

TV technology has advanced so dramatically in the past 10 years that today it is hard to find a new television that isn't some form of flat-panel display. One of the companies helping to push TV viewing to new heights and a much broader audience is Hong Kong-based Applied Science and Technology Research Institute. ASTRI has incorporated Xilinx® Spartan® -3A FPGAs into the design of its leading-edge dynamic LED backlight-control technology for flat-panel LCD televisions.

With Spartan at the heart of the system, ASTRI offers its customers—the manufacturers of next-generation LCD TVs—sharper video image quality and lower power consumption than competing solutions. Because Spartan-3A FPGAs are inherently flexible, ASTRI can tailor the technology to the exact power and performance needs of its clients, each of whom demands low cost, competitive differentiation and fast time-to-market.

Dynamic LED backlighting provides LCD TVs with sharper picture quality and overall lower power consumption than the flat-panel TVs of previous generations. ASTRI estimates that retailers sold more than 3 million LCD TVs with dynamic backlight control worldwide by the end of 2009. It expects those numbers will skyrocket over the next half-dozen years, and plans to help its customers gain the lion's share of this emerging market.

Since 2004, most leading LCD TV manufacturers have employed dynamic backlight-control techniques in their products. However, the technology and customer requirements continue to evolve. New entrants to the LCD TV market seek to carve out a competitive advantage over dominant players by getting to market faster, improving image quality and lowering power draw.

"Xilinx Spartan-3-generation FPGAs allow ASTRI's dynamic LED backlight-control technology to become more flexible in meeting different customers' differentiation requirements," said C.J. Tsai, director of the Display System Division's LED program at ASTRI. "In the LCD television market, where the race to develop new products is intense, faster time-to-market is key to business success. Xilinx FPGAs offered us greater flexibility to customize our application with lower system costs, and significantly reduced our product development time. The extensive support provided by Xilinx and the strong technical support offered by its distribution sales team, Avnet Memec China, were the other factors that prompted us to choose Xilinx FPGAs over competing solutions."

The development of the dynamic LED backlighting technology for LCD TVs represents a significant step in the progress of ASTRI, which was founded by the Chinese government in 2001 to perform advanced research and development that would in turn transfer to industry. ASTRI is also tasked with fostering innovation and entrepreneurship via the collaboration of industry and university researchers.

ASTRI is currently focusing on developing expertise in several technological domains, including IC design, communications, enterprise and consumer electronics, and materials and packaging. In the past few years, ASTRI has built a team of scientists and engineers who are already conducting world-class research. The dynamic LED backlighting technology for LCD TVs is just one of the developments that have matured into commercial products, further establishing ASTRI's clout in the greater China region.

To learn more about ASTRI, visit *www.astri.org/en/company.php.*

Spartan-3A devices allow ASTRI to tailor its technology to customers' exact power and performance needs.

CERN Supercollider Headed for Big Bang

Scientists in Europe have launched a controlled experiment to observe conditions shortly after the universe began.

In a circular tunnel complex beneath the border of France and Switzerland, scientists at CERN, the European laboratory for particle physics, are preparing to peer into the origins of the universe, using the laboratory's large hadron collider to re-create the conditions that existed shortly after the big bang.

In a project called ALICE ("a large-ion collider experiment"), scientists are using the supercollider in an attempt to accelerate two streams of heavy lead ions very close to the speed of light and then make the streams collide head-on. They expect the impact will generate an enormous amount of energy and create a temperature of 10^{12}°C—100,000 times hotter than the sun's core.

Scientists also expect the collision will cause matter to condense and briefly create a state of "deconfinement," in which quarks and gluons exist freely without being contained within protons and neutrons. Physicists theorize this was the situation that existed after the big bang.

To track these particles in the state of deconfinement, CERN scientists have created an extremely advanced particle-detection system called the Transition Radiation Detector. The TDR employs numerous Xilinx FPGAs to map and disentangle the trajectories of thousands of subatomic particles emerging from the collision.

The TDR is equipped with 1.2 million analog particle detectors, and converts each of their signals to a 10-MHz, 10-bit data stream. The TDR designers grouped these detectors into supermodules, whose individual analog signals are preprocessed by 67,000 front-end chips that generate a total data stream of 140 terabits per second of raw data. The system preprocesses and compresses this data locally and sends it out on 1,080 optical links, each carrying data at a rate of 2.5 Gbits/s. These optical cables run to racks filled with 90 track-matching unit (TMU) cards, each with 12 optical-to-electrical converters connected to the 12 multigigabit-transceiver inputs of a single Xilinx® Virtex®-4 FPGA.

These XC4VFX100 devices perform the first-level data reduction simultaneously and independently, processing and classifying the trajectory data on the fly. The collection of 120 Xilinx FPGAs, 90 of them in a rack of TMUs, processes the combined data rate of 2.5 Tbits/s. The ALICE designers connected the remaining 30 FPGAs in a tree structure to higher-level modules, where an FPGA at the top of the tree performs the final trigger decision, capturing the important content and filtering out redundant content. With the help of powerful algorithms that eliminate repetitive or irrelevant data, the complete system is capable of fitting and electing more than 20,000 track parameters within a microsecond, while preventing information overload in the CERN data processing and storage systems.

CERN scientists will use the hadron supercollider to explore the origins of the universe.

The ALICE project is just one of many experiments scientists at CERN plan to perform with the supercollider over the coming years. They hope that sister projects Atlas and CMS will be able to produce an elusive particle known as the Higgs boson.

In 1964, physicist Peter Higgs and his colleagues hypothesized the existence of a massive scalar elementary particle, now dubbed the Higgs boson. Physicists have added the Higgs boson to the Standard Model of particle physics, but no experiment to date has been able to confirm its existence.

CERN scientists hope the Higgs boson might explain how elementary particles acquire properties such as mass. This would be a significant step toward the formation of a Grand Unified Theory and an impetus into research in the nature of dark matter and dark energy.

This is an excerpt of an article in *Xcell Journal* Issue 65 by Peter Alfke and Volker Lindenstruth. To read the original, visit *http://www.xilinx.com/publications/xcellonline/xcell_65/xc_pdf/p28_31_65_F_XiWild.pdf.*

Inside the Box, Convey Computer Thinks Differently

Hybrid-core approach to high-performance computing relies on FPGA coprocessor.

The blazing-fast HC-1 supports customized instruction sets optimized for different workloads, such as financial analysis, data mining, seismic processing and bioinformatics.

The effects of the march of Moore's Law show up most glamorously in handheld devices (smaller form factor) and PCs (more performance). But this evolution has had just as much impact on a lower-profile area that once drove Moore's Law almost single-handedly: high-performance computing (HPC).

However, the march of technology that led to a doubling in the number of transistors in semiconductor devices every two years is slowing, a phenomenon that, arguably, is affecting HPC programs even more than mainstream consumer systems.

Microprocessor clock rates have peaked and are actually falling in terms of clock rate per core. Heat dissipation becomes a problem at 125 watts, so processors can't turn up the clock as they pack in more transistors. Single-threaded programs have hit a performance wall.

Performance gains, which once depended on hardware innovation, now look to software, but progress there has proved difficult, largely because parallel programming is difficult. The other hurdle is that as microprocessor makers Intel and AMD add cores, memory-support issues become challenging. For compute-intensive applications, multicore is moving in the wrong direction, many believe.

This performance bottleneck is a problem—one that Bruce Toal, Steve Wallach and Tony Brewer relish. The three computing veterans co-founded Convey Computer in 2007 with colleagues from the former Convex Computer, which HP acquired 14 years ago.

"We like to joke that we got the band back together," Toal says of the Richardson, Texas, company's Convex heritage. (There's no shortage of wit, either: The "Y" indicates that *Convey* comes right after *Convex*, Toal jokes.)

The debut system, the Convey HC-1, is what the company calls a hybrid-core computer. Convey defines the concept as using an FPGA-based coprocessor to optimize the programmable logic for different workloads, extend the capabilities of the main x86 processor for ease of programming and increase memory bandwidth and processing capability. The computer shares virtual memory with the x86 host processor, protecting customers' investments in legacy applications.

A unified software-development environment makes it possible to program the system in standard C, C++ and Fortran. As Wallach says, "The architecture which is simpler to program will win."

In addition, the Convey architecture supports application-specific "personalities"—or customized instruction sets—that are optimized for each application type, and speed up workloads such as financial analysis, data mining, seismic processing and bioinformatics.

This scheme works because Convey has built, using 15 Xilinx® FPGAs, a coprocessor that's integrated with the x86 CPU. Four Virtex®-5 LX330 application engines take on the personality for the application required. The computer relies on the other FPGAs for system tasks such as memory control and bus interface.

The coprocessor is the size of a computer server board—the entire system, including coprocessor and x86 host, is contained in a 2U rack-mountable chassis.

"People have tried innovating with graphics-processing units and FPGAs. Our opportunity was to figure out how you use FPGAs and do something that's not hard to program," Toal said.

The coprocessing functions look like an extended instruction set to the x86, he added. "You can generate code without having to do special directives or strange programming languages," Toal said.

Convey's first customer, the University of California, San Diego, is using the HC-1 in its Project GreenLight, an environmental initiative investigating energy-efficient HPC solutions and ways to boost performance while reducing power, cooling and energy needs.

"Their application on our platform runs up to 16 times faster than on a standard x86 platform," Toal said. "For one rack of our machines, it's equivalent to eight racks or 320 Intel servers. Twenty Convey computers equals 320 x86 machines."

Both Intel and Xilinx are investors in Convey Computer. The unique application of FPGA technology, therefore, is one way to "convey" new performance in an age in which Moore's Law is strained.

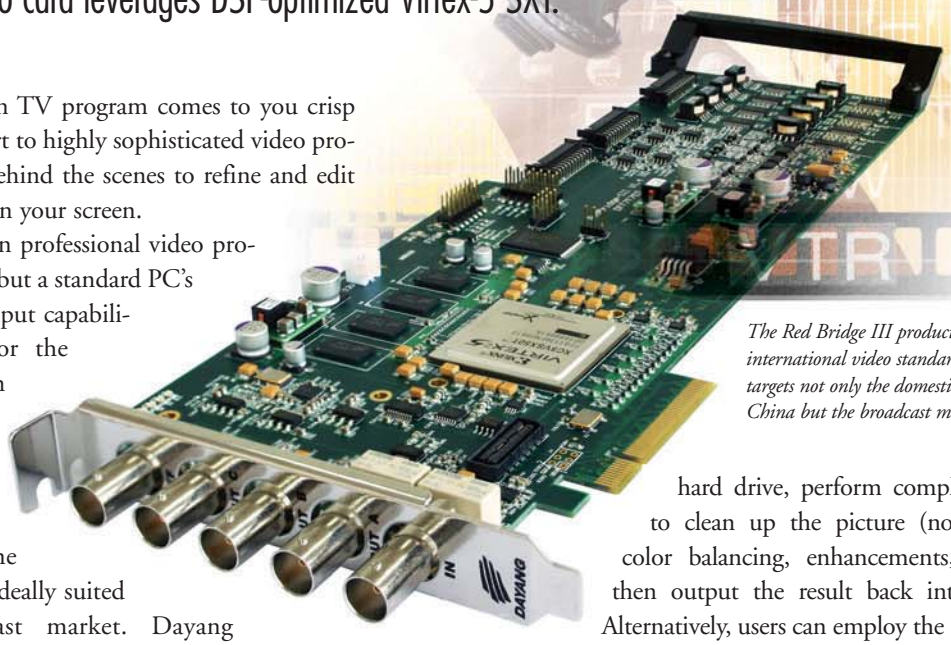
Convey offers further details of its technology at *http://www.conveycomputer.com/conveytechnology.html*.

Dayang Brings Leading-Edge Broadcast Equipment to China

Red Bridge III high-def video card leverages DSP-optimized Virtex-5 SXT.

That sparkling high-definition TV program comes to you crisp and clean thanks in large part to highly sophisticated video production equipment that's used behind the scenes to refine and edit broadcasts before they show up on your screen.

Today, PCs play a huge role in professional video production in the broadcast market, but a standard PC's CPU speeds and storage throughput capabilities are not always enough for the demands of video postproduction professionals. To fill that need, broadcast equipment companies create sophisticated cards that can plug right into a PC motherboard, transforming the computer into a machine that's ideally suited for the professional broadcast market. Dayang Technology Development Inc., a company with a 20-year history of innovation in broadcast equipment design and manufacturing, is one of the vendors producing this leading-edge equipment.



The Red Bridge III product supports many international video standards, meaning it targets not only the domestic market in China but the broadcast market worldwide.

In 2009, Dayang became the first broadcast equipment manufacturing company to bring high-definition (HD) video-processing and I/O cards to the broadcast market in China with its Red Bridge III HD Video I/O Card. The product leverages many features of the Xilinx® Virtex®-5 SXT FPGA.

The Red Bridge III HD is a versatile card that targets applications such as nonlinear editing, broadcast graphics and ingest servers. It features a PCI Express bus supporting SDI and HD-SDI with up to four inputs and four outputs, and includes a 16-bit on-board mixer with zero frame delay. The card supports many international video standards, meaning it not only targets the domestic market in China but the broadcast market worldwide.

The SDI and HD-SDI input/outputs position the Red Bridge III squarely at SDI-based broadcast (SDI is a Society of Motion Picture and Television Engineers standard that defines uncompressed video transmission between equipment; see *www.smpte.org*). Broadcast companies can use it in a modular configuration, in which the processing card interfaces or bridges to other standards in other markets (for example, DVI/HDMI in consumer).

The Dayang card also includes PCI Express, which allows it to serve as a bridge between incoming and outgoing video interfaces and the hard drive on the PC. This allows users to stream raw footage into the hard drive, perform complex algorithms to clean up the picture (noise reduction, color balancing, enhancements, effects) and then output the result back into the studio. Alternatively, users can employ the Red Bridge III HD's PCI Ethernet as a backplane connection—for instance, in a server that has multiple PCI Express cards to support numerous broadcast channels, with each card compressing the image using codec standards such as H.264, MPEG-2 and JPEG2000.

To create this innovative offering, Dayang engineers used the DSP-optimized Xilinx Virtex-5 SXT family of programmable devices, leveraging the FPGA's PCI Express connectivity, high-speed GTP transceivers and integrated DSP slices.

Dayang engineers implemented a variety of critical features in a single Xilinx FPGA. They were able to make the card compliant with the PCI Express standard by implementing a single-slot PCIe x8 bus, built using a hardened IP block from Xilinx.

In addition, the designers leveraged the high-speed transceivers available with the Virtex-5 SXT device as well as its 32-bit MicroBlaze™ soft-processor core, which together provided the performance necessary for bridging HD-SDI to PCI Express connectivity. Dayang also made good use of the device's DDRII memory controller function.

Dayang's engineers used the device's RocketIO™ Gigabit transceivers (running at 3.75 Gbits/second and drawing less than 100 milliwatts) to ensure the card supported multiple protocols, both standards-based and proprietary. The transceivers work seamlessly with integrated PCI Express endpoint blocks. The FPGA device's DSP capabilities enabled HD image processing at the low power requirements necessary for the Red Bridge III HD card.

Delphi Displays Make Chevy Hot Rods Hotter

User-customizable gauges point to reprogrammable dashboard.

Air-to-fuel ratio and outside temperature are among the many metrics drivers can check on the Delphi Reconfigurable Performance Display.

If you happen to own an '09 Chevy HHR or Cobalt SS, or even if you've just gone for a spin in one of these high-performance cars, you've likely experienced one of the automotive industry's first steps into a new era of user-customizable electronics. With those two GM models, the carmaker offers as an option the Reconfigurable Performance Display—a small, built-in TFT-LCD screen that allows users to monitor their car's performance above and beyond the typical gauges found in standard automobiles.

Delphi designed the Reconfigurable Performance Display as a way to enrich the driving experience for sports car enthusiasts who want a more thorough understanding of their vehicle's performance and want to personalize their automobile.

Luis Molleda, software engineering manager at Delphi, said users can configure the RPD to display two personalization areas at a time, switching among more than a dozen gauges to view a variety of performance metrics. Drivers can set up the display to show gauges for speed, horsepower, turbo boost pressure, air-to-fuel ratio, voltage, cam-phaser angles, spark and valve timing, torque, G-force, tire pressure, engine coolant and outside temperature. By turning a rotary knob on the unit, users can further customize each gauge to suit their tastes.

Aftermarket vendors have offered similar displays for years, but users must manually mount those products on the dashboard and plug them into the car's on-board diagnostics (OBDII) port, which mechanics traditionally use to tune new-model automobiles and troubleshoot problems. By contrast, GM integrates the RPD in the driver's side door frame or center console, depending on the car model, and links it directly to the controller-area network bus and on-board diagnostics system.

The RPD signals the beginning of a new era in instrument displays in which configurable wide-area LCDs will replace conventional instrument/gauge clusters in mainstream automobiles, said Lisa B. Cardinal, chief engineer of North America CIMs, MFS and global displays at Delphi Electronics & Safety.

"The Reconfigurable Performance Display is our first product in the market," said Cardinal. "It is an auxiliary display at this point, but really a lot of the ideas and technology will be used as we move forward into offering fully reconfigurable instrument clusters that are used in combination with the traditional gauges you find in today's automobiles."

In the near future, she said, long, narrow, user-customizable LCD panels could replace the clusters of mechanical instruments found in today's cars. "As users gain access to more information in the car, you have to find a safe, convenient, strong human machine interface [HMI] design for the vehicles to display all this information," said Cardinal. "So where we are headed with our future technology is to use a TFT display to display all the instrument clusters and driver information and other information, such as navigation and backup. The driver can actually choose what they want displayed and how they want it displayed—they can personalize their vehicle."

Molleda said Delphi worked with Xilinx and Xilinx partner Xylon to leverage the Spartan®-3 FPGA and the MicroBlaze™ soft processor in the design for graphics processing in the RPD.

"We had very aggressive deadlines and needed to beat the standard timing for automotive development," said Molleda. "That's why we selected Xilinx and Xilinx's IP and design services partner Xylon in developing the RPD."

Over the years, said Cardinal, Delphi has developed HMI and graphics systems for a lot of other automotive products, but not for instrument clusters. With the help of Xilinx and Xylon, Delphi engineers were able to leverage their own intellectual property previously implemented in a microcontroller, mix and match it with Xylon IP, and quickly add new functions to get to market on time.

Molleda said Xilinx also provided his engineering team with comprehensive training, which the group is leveraging to develop even more elegant systems for upcoming models from GM and other customers.

To Build or Not to Build? Dini Prototyping Has the Answer

Dini Group's beefy prototyping boards pack 16 or more Virtex FPGAs.

Xilinx-based systems help customers determine if they should take their ASICs to production.

When it comes to IC prototyping boards, the Dini Group thinks that size matters. Every two years for the last two decades, Mike Dini and his slowly but steadily growing team of highly technical employees have introduced families of ever-larger ASIC and ASSP prototyping boards based on the biggest FPGAs Xilinx® has to offer.

"Our competitors say we just offer 'a bucket of FPGAs,' " said Dini, the founder and president of Dini Group (La Jolla, Calif.). "They mean it as an insult, of course, but I don't take it that way. In fact, it is true. We string together a bunch of the biggest FPGAs on a PCB so customers don't have to do it themselves."

The boards are indeed impressive. Dini's current offering, the DN9000K10, contains 16 Virtex®-5 LX330 FPGAs and can comfortably accommodate 32 million equivalent ASIC gates. Dini's team laid out the board in 26 layers. The company also offers smaller versions of the board as well as several PCI Express-centric models using various mixes of Xilinx's biggest FPGAs. In the works is a new monster board using 20 to 25 Virtex-6 FPGAs that will easily more than double the ASIC-gate capacity of the DN9000K10.

Dini started the Dini Group as a one-man consultancy in the early 1990s after spending many years specializing in PCB design and, later, ASIC and FPGA design at companies like Hughes Aircraft, Genisco Computer and Philips Ultrasound. He created his first customized prototyping boards for each of his services projects. Soon he found that many of his accounts could benefit from using big, general-purpose prototyping boards rather than building the boards themselves from scratch or, at the other extreme, buying extremely expensive logic-emulation systems.

"Our first boards were based on the Xilinx XC4085 FPGAs, but our business really started to take off when Xilinx introduced the Virtex series of FPGAs," said Dini. The success of his Virtex FPGA-based board, followed by a big jump in business with the 2003 release of the 8000K10 board (based on 16 Virtex-4 FPGAs), transformed the Dini Group from a services firm/consultancy into a product company.

"We still do some custom work, such as when customers want daughter cards to prototype the rest of their system design, but we're primarily a product company now," said Dini. Along with the boards, the Dini Group has developed its own methodology to help customers program their ASIC designs into the Dini boards. "Most of the tools are commercial tools in the ISE® Design Suite, but some tools are our own," said Dini. "If a customer needs further help, we help them rather than referring them to the tool or FPGA vendor—we don't leave our customers high and dry."

One would think that the decline in ASIC design starts would hurt sales, but Dini said his business is booming. "Even though there is a reduction in ASIC starts, there isn't a linear reduction in the amount of prototyping," he said. "In fact, companies may not be producing as many ASICs as they once did, but they are still prototyping them like crazy. They are using our boards to tell whether or not they should take the next step and move their ASICs further down the design process and then to production."

What's more, when customers do decide to produce an ASIC, they will often buy many additional boards from the Dini Group and program each of them with their ASIC designs. The customer's embedded and application software groups use these "replicant" boards to start software development while the physical-design and verification engineers are busy laying out the ASIC and getting the design through the fab.

Dini also notes that while his company produces each new generation of board pretty much in lockstep with Xilinx's introduction of new FPGAs, the half-life of each Dini board is roughly 18 months to two years.

"Each new generation of FPGA offers at least twice as many gates," said Dini. "When you are loading your ASIC into a prototyping system, you want to do as little partitioning as possible. The closer you can get to the actual size and speed of the end product you are trying design, the better. Spending a couple of hundred thousand dollars to make sure the hardware design is sound before moving to multimillion dollars' worth of production is a no-brainer for our customers."

100/40-Gbps Test Set Helps Repave Info Superhighway

Ixia's K2 module generates and captures full-line-rate data.

Traffic on the Internet backbone is increasing at a rate that ranges between 75 percent and 125 percent each year. Were auto traffic to swell at such a clip, the highway system would have failed long ago. Fortunately, engineers and computer scientists continue to find ways to repave and enhance the information superhighway. The next advancements are 100- and 40-Gbps Ethernet, and test equipment maker Ixia is enabling that development via the K2, the first 100-Gbps-capable test set.

At first glance, you might assume that traffic growth on the Internet will stagnate as the number of broadband users reaches saturation level. In reality, the rate is likely to escalate. Already the Internet carries significant video traffic. Users can watch live streaming movies from sources such as Netflix or TV shows via Hulu. As content owners move more and more programming online, including higher-fidelity formats such as 1080p HDTV, the traffic growth rate will surpass anything seen before.

Today data centers at companies like Google or Microsoft, and at major Internet service providers, rely on multiple 10-Gbps links to connect routers and switches that are capable of aggregate speeds of 100 Gbits per second. The IEEE has spent several years working on the next standard, with the goal of deploying 40-Gbps links within data centers and 100-Gbps links between major Internet nodes. The group has completed a great deal of work on what will be an addition to the IEEE 802.3 standard, shooting for 2010 as the goal for a final version.

As with prior Ethernet upgrades, the 100-Gbps effort sought to leverage the already installed optical and copper cabling—a virtual necessity for a cost-effective transition that can happen gradually. But this time, the move to higher speeds with backward compatibility hit a roadblock. Installed copper CAT-5/6 cables can't handle the faster speeds, at least with existing transceiver technology. Even existing fiber technology would require the use of multiple wavelengths to carry the stream.

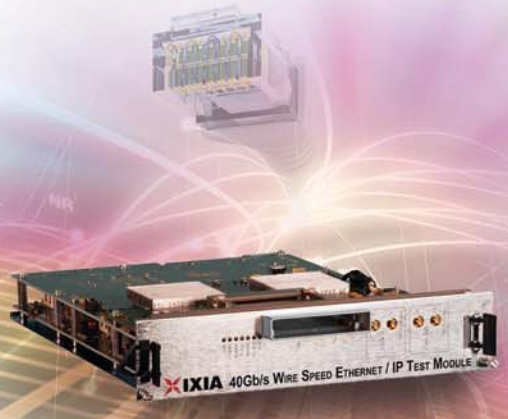
The IEEE group developed a multiple-lane approach to carry the faster traffic, breaking the stream into blocks and multiplexing those blocks across the lanes. The approach allows copper and optical technologies to develop independently as engineers increase the amount a data that a single copper cable or one optical wavelength can accommodate. The approach also brought unprecedented complexity to the physical layer of a network interface.

Companies that make network test equipment, such as Ixia, are inevitably among the first to tackle the challenge of designing circuits to support a new standard, because the designers of network and computer equipment need the test equipment for their work. Ixia broke new ground in the summer of 2008 when it demonstrated the 100 GE Development Acceleration System at the NXTcomm trade show in Las Vegas. A live demo showed the viability of 100-Gbps technology, proving out both the multilane architecture in the physical-layer circuit design and the ability to carry the traffic over an existing cable plant.

Ixia now has a production version of the technology: a module simply called K2 that integrates the high-speed functionality. The module occupies two slots in any Ixia standard XM test chassis. And like all Ixia products, it works at full line rate regardless of packet size. The module can simultaneously generate, capture and analyze Layer 3-7 traffic. Ixia shipped its first 100 GE system in the fourth quarter of 2008. The company also offers a 40 GE traffic generator and analyzer load module.

The K2 design relies extensively on Virtex®-5 LX FPGAs. The reprogrammable nature of FPGAs is essential in a design that must track a changing standard. "FPGAs give us the most flexibility to continuously update our product once it goes out in the field," said Jerry Pepper, distinguished engineer at Ixia. Pepper points out that the Ixia design pushes the limits of the FPGAs in terms of memory and I/O access speeds as well as internal clock speed. The result is the first 100-Gbps test module—available more than a year prior to completion of the standard—that engineers at network equipment and computer system vendors will use to repave the information superhighway, one lane at a time.

Visit *http://www.ixiacom.com/hse/index.php.*



Ixia's K2, the world's first tester capable of 100-Gbps operation, relies on the reprogrammability of Xilinx FPGAs to keep up with changing standards.

Stereoscopic 3-D Multiviewer Rocks the Broadcast World

Miranda's Kaleido-X16 system lets broadcasters smoothly shift from camera to camera.

If you ever went behind the scenes at an older TV studio or took a peek inside a mobile-broadcasting truck at a sporting event, you would likely have seen a broadcast director or operator sitting in front of a jumble of monitors, deciding which video camera feeds to air in which order. Traditionally, broadcasters had to connect each camera to its own monitor, which in turn would link to a control panel or switchboard and to recording equipment. Arranging these monitors was a bit of a task, because they consumed a great deal of space and electricity.

In the late 1990s, broadcast equipment companies launched multiviewer systems that let broadcasters see multiple camera feeds on a single monitor. In 2009, Miranda Technologies Inc. took the technology a step further, introducing its fourth generation of multiviewer system—the stereoscopic 3-D Kaleido-X16, which is pioneering the next generation of TV broadcasting.

Mainly targeting smaller control rooms and mobile-broadcast units, the Kaleido-X16 is designed for 3-Gbit/second stereoscopic 3-D video as well as standard-definition, high-def and analog video.

It packs 16 inputs, two multiviewer outputs and an integrated 16 x 2 router in a compact 1RU chassis. The system provides highly effective stereoscopic 3-D monitoring, with signals that conform to SMPTE-372M or SMPTE-425M Level B specifications.

The scalable Kaleido-X16 complements Miranda's Kaleido-X family of multiviewers and offers seamless integration with the Montreal company's NVISION router family as well as third-party routers. Users can connect multiple Kaleido-X16s and routers to create a powerful, yet relatively compact system of up to 1,152 video inputs and 144 multiviewer outputs.

"The Kaleido-X16 is extremely flexible and customizable," said Alexandre Marcoux, the Kaleido-X16 project manager at Miranda. "A broadcast company will typically air multiple shows and have multiple directors and operators. Miranda built the Kaleido-X16 so that each user can customize the layout of the various inputs in the multiviewer to their specifications, and create presets so they don't have to adjust the screen's layout from scratch every time they start to work."

For example, users can customize the screen's layout to display the same feed multiple times in a screen. They can arrange the feeds in any order, adjust the quality and the size of each feed, or simply display one feed in the full-screen size of the monitor or TV they are using.

"Because we use Virtex®-5 FPGAs in the system, we can also update the system to add new features as they become available," said Marcoux. "The user can update and upgrade their system without having to install an entirely new unit."

Indeed, "The Virtex-5 FPGAs were key to making the X16 a great system," he declared. "In the X16, we merged the functionality of two of our other products, which used Virtex-4 FPGAs."

By moving to the Virtex-5, Miranda reduced its FGPA count by 45 percent compared with the previous-generation Virtex-4 systems. Moreover, "We were able to reduce the cost of creating the unit and drastically lower the power," Marcoux said. "Because we kept the power low, we didn't require a larger fan system, which would have created noise. The Kaleido-X16 is extremely quiet, which is a significant selling point."

Additionally, the Virtex-5 also allowed Miranda to build the Kaleido-X16 to support the 3G/1080p standard for stations requiring state-of-the-art Blu-ray-quality broadcast equipment. "There is a growing demand for stereoscopic 3-D TV content, which means you will need more bandwidth and 1080p to broadcast two images that are slightly offset," said Marcoux.

At last year's National Association of Broadcasters show, Miranda demonstrated the Kaleido-X16 displaying stereoscopic 3-D inputs. The system also picked up two industry plaudits: a Pick Hit award from *Broadcast Engineering* magazine and a STAR award from *TV Technology* magazine.

To read more about Miranda's Kaleido-X16, visit *www.miranda.com* or download the Kaleido-X16 datasheet at *http://www.miranda.com/portal/pdf/Datasheet/Kaleido-X16.en.pdf*.

Tiny FPGA-based Computer Accelerates Space Exploration

Gordon Seagrave's Virtex-powered SpaceCube wins NASA's 2009 Invention of the Year award.

The FPGAs at the heart of SpaceCube let NASA engineers modify its hardware and software functionality even after a mission has launched.

Ever since John F. Kennedy proclaimed the United States would be the first country to put a man on the moon, NASA has made it a top priority to be meticulous in the design and testing of its spacecraft. However, this level of care means that design and testing cycles traditionally take many years and dollars, resulting in mission delays and project cancellations.

So by the time NASA actually gets a craft in the air, its electronics systems may be three to four generations behind commercial electronics. To close this gap, NASA is currently putting a tiny, yet extremely advanced reconfigurable Xilinx® FPGA-based computer system called the SpaceCube through a battery of live tests. If successful, it could rapidly raise the level of electronic sophistication in U.S. and international space programs.

The SpaceCube is the invention of Gordon Seagrave, a former NASA Goddard engineer and self-described perpetual tinkerer. "I was born with a soldering iron in my hand," he said. "Ever since I was a kid, I've loved to see how things worked and see if I could make them better. I love to solve problems and create."

During his many years designing systems for the space shuttle and other NASA programs, Seagrave on his own time began experimenting with Xilinx FPGAs. "On weekends and at night I worked on the SpaceCube schematic," said Seagrave. "With some of my own money and a little covert help from two NASA friends, we were able to build a prototype and then pitch it to officials at NASA Goddard."

The product they designed is highly suited to the quick-turn and high-reliability requirements of space electronics. By basing the system on FPGAs rather than standalone or custom processors, ICs or ASICs, NASA engineers will be able to modify both the hardware and software functionality up until the last minute—and indeed, even after the mission has launched and the craft is in space.

When Seagrave and friends pitched the idea, NASA engineers were initially skeptical. There has been a lot of myth and misinformation about SRAM-based FPGAs in space regarding susceptibility to upsets and even device failures caused by cosmic rays. Xilinx, however, has been serving the aerospace-and-defense industry for 20 years, and in that time has developed several methods for fault mitigation, both in silicon and in device and circuit redundancy and fault scrub.

Seagrave put a mix of these techniques to good use in his design. After a serious round of reviews and ground-level tests, including extensive live tests running in the subzero temperatures of Antarctica, NASA engineers gave the go-ahead for in situ testing in space. In July of 2009, NASA sent the first-generation SpaceCube, which uses four Virtex®-4 FXT FPGAs, on space shuttle mission STS-125 (the Hubble telescope servicing mission). In a real-time simulation, NASA tested whether the SpaceCube could accurately operate the shuttle's main controls to dock with the telescope. It passed that simulation with flying colors and even encountered radiation hits, which it scrubbed without any problems. In fact, NASA engineers were so impressed with the performance that they voted SpaceCube NASA's 2009 Invention of the Year.

Last November, the original SpaceCube and another version that employs a single Virtex-5 FXT FPGA went into space on shuttle mission STS-129. Astronauts secured the SpaceCube hardware to a testing rack on the International Space Station to see how it performed compute functions over time in the realities of space. As of late December, the SpaceCube had encountered several particle hits and scrubbed them all successfully, operating at peak performance.

"We're bringing a new era of electronic sophistication to spacecraft," said Seagrave. "We can do so much more, learn so much more, once we get these more advanced electronic systems into space."

Seagrave is now finishing work on a commercial version of his Reconfigurable Hardware Architecture for Space, which has the potential to decrease the cost of spacecraft design dramatically for the commercial world. For additional information, visit *www.ReconfigurableHardware.com.*

Mars Exploration Rovers Celebrate 6 Years on Red Planet

Staying power of JPL's mechanical geologists has exceeded NASA scientists' expectations.

Radiation-hardened Xilinx FPGAs aid landing and on-surface operation of the MERs' robots.

One of the greatest feats in modern engineering and exploration is the successful landing and longer-than-expected service of the Mars rovers on the red planet.

NASA launched its twin robot geologists, the Mars Exploration Rovers (MERs), on June 10 and July 7, 2003, in search of answers about the history of water on Mars. The first craft, called Spirit, landed on Mars' Gusev Crater on Jan. 3, 2004. The second rover, named Opportunity, set down on the opposite side of the planet on Jan. 24, at the Meridiani Planum, where mineral deposits (hematite) suggested that Mars had a wet past.

Moving from place to place, the rovers perform on-site geological investigations. Their cameras are mounted 1.5 meters (5 feet) high and provide 360-degree, stereoscopic, humanlike views of the terrain. Each MER has a robotic arm capable moving in much the same way as a human arm, complete with an elbow and wrist, and can place instruments directly up against rock and soil targets of interest. In each mechanical "fist" is a microscopic camera that serves the same purpose as a geologist's handheld magnifying lens. The MER's rock-abrasion tool, meanwhile, functions like a geologist's rock hammer to expose the insides of specimens.

The rover's designers at the Jet Propulsion Laboratory crafted each MER to drive up to 40 meters (about 44 yards) in a single day, for a total of up to 1 kilometer (about three-quarters of a mile). JPL expected each rover to be operational on Mars for only three months. However, the robust design has exceeded everyone's expectations. In January, the MERs celebrated their sixth year of operation, returning valuable information about the geological history of the planet. In fact, their most important findings, such as evidence of hot springs or steam vents, came well after that three-month primary mission.

In creating the incredible MER, the JPL team used radiation-tolerant Xilinx® XQVR4000XL FPGAs, the state of the art in FPGA space-grade technology at the time of the design, for both the landing and on-surface operation of the robots.

Specifically, the XQVR4062 FPGAs went into each MER landing craft to control the crucial pyrotechnic operations during a rover's multiphase descent and landing procedure, when the engineers trigger explosives for various stages of the maneuver. This intricate operation included the deployment of a supersonic parachute and reverse thrusters to slow the rover's descent to the surface, along with the in-air release of the rover from the parachute, followed by the precise activation and inflation of several airbags to encircle and cushion the rover as it safely bounced to its designated landing destination.

NASA engineers used the FPGAs at the heart of the Lander Pyro Switch Interface system, which orchestrated the MER's elaborate pyrotechnic sequence to the millisecond. If the flight computer encountered a single-event upset during the entry, descent and landing sequence, the Lander Pyro Switch Interface system would time the pyro events based on the last best estimate and fire them off. Then, when the flight computer came back online, it would get updated timing estimates.

NASA also used XQVR1000s in the MER Motor Control Board, which oversees the motors for the wheels, steering, arms, cameras and various instrumentation, enabling the rovers to travel about the planet's often siltlike surface and negotiate various obstacles.

On-board reprogrammability of the FPGAs also allowed JPL to make design changes and updates right up to launch time and even after the rovers had landed.

The invaluable data scientists are still gathering from the MERs has allowed NASA to better formulate goals for subsequent missions, while inspiring engineers at JPL to design other craft. On July 31, 2008, one of these follow-on missions, the Phoenix Mars Lander, conclusively identified water in Mars soil samples.

Meanwhile, the success of the Mars rovers has led JPL and many other companies to employ Xilinx XQVR and newer Virtex®-II, Virtex-4 and Virtex-5 space-grade FPGAs in a number of missions, including the HiRise Camera in the Mars Reconnaissance Orbiter and the yet-to-be-launched Mars Science Lab, the latest and most advanced generation of the rover, slated for deployment in 2011.

To see a simulation of the launch, landing and deployment of the MER, visit *http://www.youtube.com/watch?v=5UmRx4dEdRI.*

'Virtual ASSPs' Run on Xilinx FPGAs

IP vendor Omiino is a pioneer of what it calls the Virtual ASSP model, offering customized versions of its wired-comms technology programmed on Xilinx FPGAs.

Startup Omiino is filling a gap in the communications market by offering FPGA-based "Virtual ASSPs" as a cost-effective alternative to application-specific standard products for carrier optical-transport applications. The Belfast, Northern Ireland, company provides its full-chip designs to customers as completed FPGA netlists ready for implementation in Xilinx® Spartan®-3 and Virtex®-5 devices.

ASSP vendors are between a rock and a hard place. Production costs are growing with each generation of process technology—the move from 130- to 45-nanometer production saw a 341 percent increase in fabrication costs, according to the Global Semiconductor Alliance—while the useful life of the product is shrinking as standards rapidly evolve. A business model based on increasing costs and declining revenue is clearly unsustainable in the long term.

"What customers need is an approach to developing ASSPs that delivers the performance, pricing and per-unit business model benefits of the ASSP, but with the time-to-market and adaptability of the FPGA. Omiino is unique in being the only vendor able to match the ASSP pricing without sacrificing performance, and in standard, reprogrammable FPGAs. We call our offerings Virtual ASSPs," said CEO Gary Hamilton.

Implementing the designs cost-effectively in FPGAs reduces delivery time and preserves reconfigurability, Hamilton said—the latter is especially important in a world of changing standards, like telecom. "We say retain the programmability, allowing customers to go to market early, and then do field upgrades if they are needed," he said.

In a tough economy, Hamilton said, equipment manufacturers looking to transition from ASSP- to FPGA-based designs must keep a lid on their R&D budgets and lower their product costs. The lack of next-generation off-the-shelf, third-party optical-transport network (OTN) ASSP replacements in FPGA, in particular, is a problem. This is where Omiino's pioneering business model comes in.

Omiino will integrate and verify its suites of "ultracompact" intellectual property (IP), to deliver fully functional, high-performance Virtual ASSPs targeted at cost-effective Xilinx FPGAs. Hamilton said Omiino designs consume 60 percent to 80 percent fewer FPGA resources than conventional ASSP-targeted IP.

Founded in 2007 by a team drawn from tier-one equipment and ASSP manufacturers, the company currently delivers solutions for the Sonet/SDH and OTN markets. "OTN is a very exciting market for Omiino Virtual ASSP solutions because of the volatility of standards and the intense price sensitivity," Hamilton said.

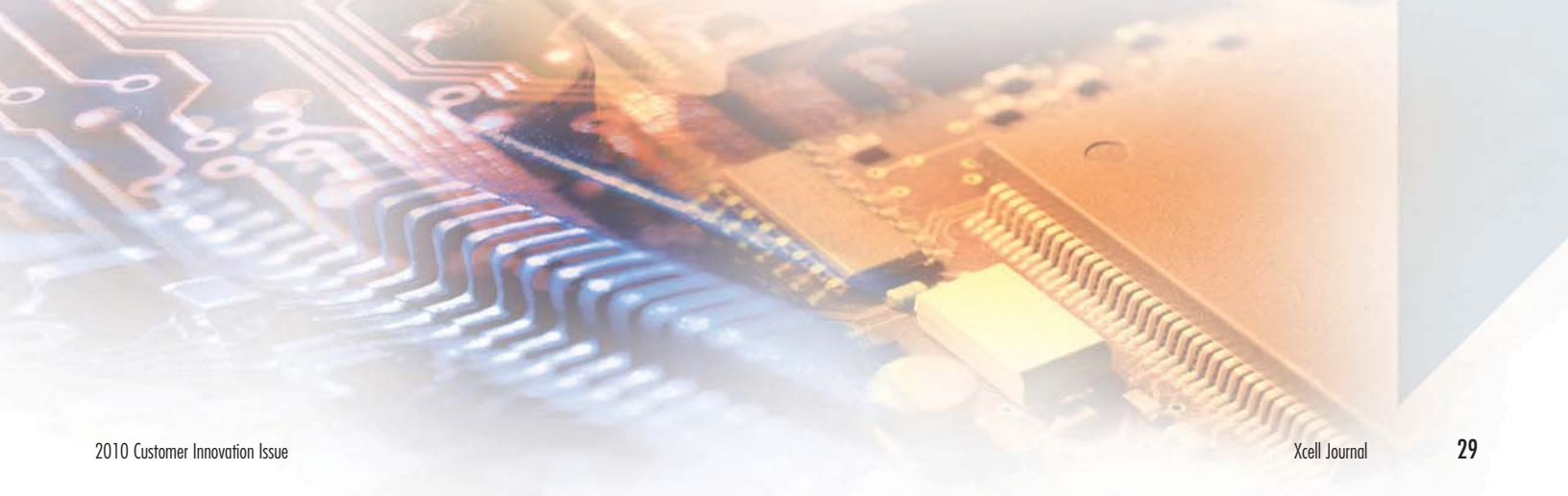
Omiino is developing a portfolio of 40G/100G OTN mappers and framers targeted at switching applications. With full support for G.709 Amendment 3.4, the mapper portfolio offers unprecedented flexibility for managing optical-channel data unit (ODU) traffic.

Omiino's full solution offers the software drivers as standard. Additionally, the supplied on-chip debug tools, OmniTest and OmniSpy, allow the user to view and capture internal device state information or to set up the device and test it independently of external software.

"The OmniTest and OmniSpy tools can dramatically accelerate [development] and reduce costs during integration, verification and field support," said Hamilton. "We have great feedback from all of our customer engagements as they see firsthand the benefits, simplicity and power of the tools."

Besides supplying off-the-shelf products, Omiino is happy to work with clients to customize designs for specific applications.

For further information, visit *www.omiino.com.*



Pixel Velocity Eyes the Big Picture in Advanced Surveillance

FPGAs handle all the processing in Pixel Velocity's advanced cameras—there is no microprocessor or DSP.

Flexible Pixel Video Fusion system tracks suspicious persons, behaviors across multiple cameras in real time.

The next time you are at a security checkpoint in Chicago's O'Hare Airport, look around and you may spot a special kind of surveillance camera. This camera is not a part of the traditional setup in which a security guard tries to monitor dozens of independent screens, each connected to its own video recorder. Rather, it belongs to one the most advanced real-time surveillance networks offered today. The Pixel Video Fusion system employs a series of linked cameras that collectively cover every space in the airport security checkpoints. It can track and record an individual's movement from one camera zone to the next.

The system is the work of Pixel Velocity Inc., an Ann Arbor, Mich.-based developer of wide-area surveillance systems for advanced threat detection and emergency response.

Pixel Velocity was co-founded in 2001 by former researchers from the Environmental Research Institute at Michigan (ERIM), which in the 1980s and 1990s was the world's largest imaging institute concentrating on advanced sensing technologies for defense and environmental applications.

While at ERIM, David McCubbrey, now CTO of Pixel Velocity, specialized in developing automatic target-recognition and sensing systems. In doing so, he developed several ASICs for those systems. Over the years, McCubbrey also became a big user of Xilinx® FPGAs, starting with the XC3000 family in the late 1980s. "When FPGAs first came out, they were in no way able to compete with gate arrays and standard cells," he said. "But when Xilinx came out with the Virtex®-II, we could start to put entire systems on a chip."

When in the late 1990s it looked like ERIM was going to be sold (a portion ultimately wound up as part of General Dynamics), McCubbrey evaluated his options and decided to start his own company. "Around 2000, a light bulb turned on in my head: By using FPGAs I can self-fund developments that in the early '90s took millions of dollars and literally teams of people to achieve with gate arrays and standard cells," he said.

The 2001 startup he co-founded, Pixel Velocity, began its life doing contract research in the medical field. "We implemented Virtex-4 at the time and did some groundbreaking work for cardiac ultrasound," said McCubbrey. The company then spun off the medical group in order to focus on advanced wide-area surveillance systems, delivering the Pixel Video Fusion system in 2007.

"There is a great need in the market for wide-area surveillance and alerts," said McCubbrey, pointing to the 2005 London subway bombings as an example.

"It took literally hundreds, if not thousands, of people weeks to trace the movements of the people who were involved in the bombings, because the authorities had to rely on unlinked, low-resolution, unsynchronized cameras—there was no way to get the big picture," he said. "We created our system to solve that problem for stadiums, airports and anywhere that requires large-perimeter protection and a need to understand activity across multiple cameras."

The Pixel Video Fusion system includes multiple high-resolution digital cameras, servers, interface cards, image-visualization and recording software, and camera-level analytics.

Users can program Pixel Video Fusion to automatically identify certain activities in real time. When the system spies someone performing those activities, it alerts its users and sends them a high-resolution video clip of the suspect individual. Because the high-resolution cameras are connected in an integrated system, security can also quickly backtrack the person's movements and behavior throughout the system's coverage area.

"It's a scalable system thanks to the FPGAs we use in the cameras," said McCubbrey. "Absolutely all of the processing is handled within the FPGA. There is no microprocessor or DSP. And when we install these cameras, they are often placed in areas that are not easily accessible, so we leverage the FPGA's in-field programmability features. That way, if a system needs to be updated, we can simply load a new bitstream to the FPGA in each camera to update it. The system's flexibility and the ability to easily upgrade it at the hardware level, afforded by the FPGAs, is also a message that resonates with a lot of our customers."

In addition to O'Hare airport, Pixel Velocity's system is installed in many stadiums and industrial sites. For more information on Pixel Video Fusion, visit *www.pixel-velocity.com.*

PLX Devices' Kiwi Makes Drivers Green

It's not just the universe that started with a big bang—PLX Devices did too. The Silicon Valley startup can trace its conception to the time when its founder, Paul Lowchareonkul, blew an engine in his souped-up car. That experience led Lowchareonkul to invent a high-tech engine-monitoring product that drivers plug into their car's OBD-II/CAN port to keep track of multiple criteria and ensure their engine is tuned optimally for performance (aka fast) driving.

The DM series of devices, which incorporate Xilinx® FPGAs, have become hugely popular with auto enthusiasts and won PLX Devices high honors at the Specialty Equipment Market Association conference in 2007. The devices nabbed Best New Interior Product and Best New Mobile Electronics awards at the SEMA show, and went on to win a total of 17 global media awards for best new product.

However, the company's ambitious young CEO had a mission to expand PLX's product portfolio into the broader consumer market. Spotting his opportunity when gas prices started to rise, he quickly developed Kiwi, a product for drivers on the opposite side of the spectrum from the performance-car enthusiasts who flocked to the DM series. Kiwi is a device that conservation-minded car owners can use to grade their driving for better fuel efficiency.

Introduced in the summer of 2008, the Kiwi catapulted the company out of the auto-enthusiast niche and into the consumer realm with a green product. The device, named for the tropical green fruit and built around a Xilinx FPGA and OLED display, monitors fuel efficiency and even awards a "Green Score" from 0 to 100 for fuel-efficient driving habits.

"It's a product that you can plug into your car in minutes," Lowchareonkul said. "You plug it in, start driving and the device monitors your driving habits to help you drive for optimal gas efficiency."

The Kiwi keeps score based on four parameters: acceleration, drag, smoothness and deceleration. It includes several modes, one of which allows users to monitor miles per gallon in real time. Another feature keeps track of how much a given trip is costing and how much money consumers are saving by utilizing good driving habits.

The Kiwi comes with several tutorials to train drivers on how to get the most mileage out of every gallon of gasoline. The device also has a USB port so users can download their driving statistics and scores to their PCs. Kiwi is now sold at several retailers, including Amazon.com, Pep Boys Auto Center and JC Whitney, as well as from PLX Devices directly.

Since its launch, the Kiwi has garnered much attention from the media as an innovative product that not only helps reduce gas consumption but makes drivers more aware of how their actions affect fuel consumption. The *New York Times* and *People* magazine are among the dozens of news sources that have devoted ink to Kiwi, and *Popular Mechanics* gave it an Editor's Choice award. The Kiwi and other PLX devices also won a Best New Interior Accessory Product at SEMA in 2008, while Yahoo listed Kiwi as the first product in its 2008 Green Holiday Gift Guide.

For more information on PLX's products, visit *www.plxdevices.com.*

Plug in the Kiwi and get real-time feedback on how your driving style is affecting fuel consumption.

Samsung Is Watching You

Sophisticated security systems make use of Spartan FPGAs.

Samsung's dome camera uses a Spartan-3E with embedded MicroBlaze soft processor to calculate coordinates and interface with a digital video recorder.

Walk through just about any retail store, bank or train station, and chances are you are being watched. Those upside-down iridescent domes attached to the ceiling likely contain a video camera, and if you happen to see the label Samsung on it, there is a distinct possibility that camera is controlled by a Xilinx® Spartan®-3E FPGA.

Video surveillance systems are a key component in ensuring security at train and bus stations, airports, banks, casinos, malls—even our homes. As security risks increase, the need to visually monitor and record events has escalated in diverse use models. As a result, new architectures must provide scalability for cost-effective solutions across an increasingly varied set of video surveillance system requirements.

Samsung has been an industry leader in surveillance systems for many years. Each year it develops increasingly sophisticated systems, including dome cameras. A recent model of one such offering employs the Spartan-3E with an embedded MicroBlaze™ soft-processor core. The Xilinx FPGAs play an integral role in both the digital video recorder (DVR) and the dome camera, providing Samsung with a competitive edge by increasing functionality, reducing development costs and improving time-to-market.

The Samsung DVR processes four channels simultaneously on a single Spartan-3E device. The dome camera uses a second Spartan-3E device, likewise equipped with an embedded MicroBlaze soft processor, to calculate multiple coordinates and interface with the digital video recorder.

Samsung's advanced surveillance systems include an ever-growing array of sophisticated features such as high-definition imaging and motion-adaptive dynamic noise reduction, which eliminates noise and greatly reduces motion blur, for a clear and distinct image.

A feature called the Polygonal Privacy Mask allows owners to outline certain areas, such as windows, doors and entryways, in the camera's field of view. If something or someone enters those zones, the camera begins recording and the outlined "mask" will remain proportional during zoom and image stabilization.

Supplementing that feature, the system also includes advanced motion detection that will, based on the user's preferences, sound an alarm if it detects movement in user-outlined areas. In addition, automatic digital image stabilization detects and corrects image shake from unwanted external vibration, such as oscillations from heavy traffic and wind.

The systems, depending on model and preferences, also come with various night vision technologies. For example, with negative imaging in black-and-white mode, Samsung Electronics cameras can enhance low-light areas and obtain images that would typically be too dark to view, allowing the camera to perform license plate recognition in adverse lighting conditions.

To learn more about Samsung's sophisticated array of security offerings, visit *http://www.samsung-security.com.*

Sanarus' Visica 2 Eradicates Breast Tumors Without Surgery

Cryoablation system offers cool alternative for women with benign fibroadenomas.

New technology from medical-device manufacturer Sanarus Technologies LLC makes benign breast tumors disappear without surgery. The Visica 2 Treatment System uses cryoablation—a technique for eradicating diseased tissue with extreme cold—to target fibroadenomas, a noncancerous (aka benign) breast tumor consisting of glandular and fibrous tissue. Fibroadenomas occur in 10 percent of women.

It is extremely rare for a fibroadenoma to become malignant, but if left untreated, they do tend to keep growing, causing increasing discomfort and anxiety. As such, most women opt to have these tumors removed. Traditionally the only way to excise them has been through a surgical procedure that requires one day of hospitalization. The procedure involves anesthesia, an incision large enough to accommodate the medical instruments, removal of the tumor and sutures to bind the incision. Typically patients need a few days of recovery and possibly pain medication. Many women who have the surgery typically get some amount of scarring, depending on the size of the incision. Patients can also encounter complications from the anesthetics, and in some cases surgically removed fibroadenomas can return.

In 2002, Sanarus Technologies (Pleasanton, Calif.) stepped in to considerably reduce patient anxiety, scarring and costs of fibroadenoma treatment, and more importantly to eliminate the recurrence of these tumors. The first-generation Visica Treatment System has proven highly safe and effective in the seven years since it received FDA market clearance; of more than 2,000 fibroadenomas treated, there have been zero reports of regrowth. But because it used high-pressure argon and helium to freeze the tumors, the system required large storage tanks.

In April 2007, Sanarus released the more advanced and elegant Visica 2 Treatment System, which employs sophisticated electronics to precisely freeze fibroadenomas with liquid nitrogen in a 30-minute nonsurgical, in-office treatment. Instead of big external canisters, the Visica 2 uses a small canister of liquid nitrogen that fits neatly in its chassis.

The compact Visica 2 uses liquid nitrogen to freeze tumors.

To treat patients with the Visica 2, doctors administer a local anesthetic to a portion of the breast, make a tiny incision and, with the aid of a separate ultrasound imaging system, insert a needlelike device called an ICE Probe into the tumor. They then release precise amounts of nitrogen into the fibroadenoma. The system kills the tumor by freezing, and then thawing, the targeted tissue.

The ultrasound imaging device helps the physician precisely control the size and duration of the freeze. The ultrasound provides real-time visualization of the targeted area as it is frozen and allows the physician to confirm that no other spots were inadvertently affected. After doctors freeze the tumor, they remove the ICE Probe, bandage the tiny incision (no sutures required) and send the patient on her way, experiencing only minor discomfort.

Using the Visica 2, the treated fibroadenoma isn't removed; rather, after it is frozen and thaws, it dies and naturally and gradually melts away. According to Sanarus, 69 percent of fibroadenomas ≤ 2 cm in size are softer and less prominent within six months after the procedure; fully 84 percent reach that state at 12 months, while the rate of patient and physician satisfaction at 2.6 years is 97 percent and 100 percent respectively. The company says there have been no reported recurrences of tumor growth in fibroadenomas treated with the Visica 2.

To prototype, design and ultimately deploy this innovative product, designers of the Visica 2 used National Instruments' CompactRIO embedded system (which includes a Xilinx® FPGA). Since its release to limited sites in 2007, the Visica 2 has won fans among physicians and their patients. It also won the Humanitarian Application of the Year prize for 2008 at the Graphical System Design Achievement Awards.

The Visica 2 Treatment System is currently part of a National Cancer Institute-funded clinical trial for the cryoablation of breast cancer.

Visit *http://www.sanarus.com/visica.html.*

Sonic Emotion Brings Audio Immersion to the Masses

Xilinx Spartan-3 FPGAs form the heart of its 3D Sound technology IP.

Coby's sound bar uses the Sonic Emotion technology to deliver 3-D audio from simple stereo input.

Just about everyone would love to have a fabulous, professional-quality stereo or surround sound-system in their home, but many folks can't afford one of that caliber. Even if they can, they typically don't want to sacrifice aesthetics to run wires and a set of speakers (at precise angles) all over the room. Luckily, a small but innovative IP company called Sonic Emotion is helping audio and video equipment manufacturers, including flat-panel display companies, deliver astonishingly realistic and immersive sound systems that don't require extra wires or speakers.

Sonic Emotion is the inventor of a unique technology based on wave-field synthesis that targets a number of audio applications, most notably a new class of stereo systems and flat-panel displays. The company, based in Zurich, Switzerland, got its start developing custom high-end audio systems for large and sophisticated, but sometimes acoustic-unfriendly, venues. In the process, its founders devised an ingenious technology they called 3D Sound and implemented it in a Xilinx® Spartan®-3AN FPGA. The company now licenses that technology to several customers, most notably manufacturers of home audio and surround-sound systems.

CTO Matthias Rosenthal said that even some of the most stunning and expensive flat-panel TVs on the market today fall short in audio, leading many consumers to purchase additional sound systems—or to return their TVs. TV manufacturers and third-party vendors are attacking the problem by introducing audio modules commonly called sound bars that typically line the bottom of a flat-panel display, seemingly inconspicuously, to better the sound.

Sonic Emotion is bringing a high level of quality to this emerging market as well as to docking stations and compact home entertainment systems. Its technology one-ups traditional 2.5-D surround-sound, all-in-one systems by offering an immersion experience for everyone in the room rather than one small, targeted location. The 3D Sound technology automatically generates a perfect sound field by using a room's acoustic properties. It extracts sound sources out of a simple stereo signal and re-creates them at the correct position in the room. This technique achieves the natural reproduction of audio through loudspeakers and realizes an acoustic immersion for everyone in the room.

"Our 3D Sound is a very powerful technology," said Rosenthal. "You don't have to move speakers around a room or even tell the machine the size and layout of your room, and calibrate and designate a small area where the sound experience is optimal. The system employs advanced signal-processing techniques to create total audio immersion and even to make it sound like certain sounds are coming from behind you. You won't believe that the sound is coming from this single device."

As it does when building high-end installations, the company customizes its 3D Sound IP for each licensee with the help of the Spartan-3AN, which adds on-board flash to the FPGA. "We implement very complex DSP algorithms and often have to add custom functions in hardware to suit a customer's requirements," Rosenthal said. "The Spartan-3AN is great for this and it is also very secure, so we can be reasonably sure our IP is protected in this very competitive market."

One vendor already deploying Sonic Emotion's technology is Scott Technology (*www.my-scott.com*). In late 2009, Scott introduced its Zurigo docking station and Phuket and Egg entertainment systems incorporating 3D Sound. None of these products resembles a traditional stereo system. Rather, they look like a piece of modern sculpture. Each system has speakers on multiple sides, allowing it to adjust to a consumer's room rather than requiring the consumer to adjust the room's layout to suit the sound quality of the system. The systems are also fairly compact, so users can move them around the house, taking top-quality sound with them to other rooms.

Another product based on 3D Sound is Coby Electronics Corp.'s latest sound bar. Launched at this year's Consumer Electronics Show, the device plays 3-D sound from simple stereo input (*www.cobyusa.com*). Rosenthal said that 3D Sound will soon appear in a slew of other products due to hit the market this year. The Institute of Microelectronics of the University of Applied Sciences, Northwestern Switzerland, supported the design and implementation of the FPGA architecture. For more information, visit *www.sonicemotion.com*.

SRC Rapidly Innovates to Save Lives, on and off the Battlefield

R&D company relies on FPGAs for fast turnaround of electronic-warfare, radar and comms systems.

If American lives are in danger on the battlefield or elsewhere, chances are the engineers at SRC (formerly Syracuse Research Corp.) are innovating high-tech solutions to protect them.

SRC is a not-for-profit research-and-development organization that for more than 50 years has partnered with the U.S. government to rapidly solve some of the most challenging issues the military faces, on and off the battlefield.

The company, which has roughly 1,000 employees in 12 offices nationwide, is a longtime customer of Xilinx and uses FPGAs to quickly prototype and deploy systems as they are needed. "Nearly all of SRC's radar, communications and electronic-warfare programs use FPGA technology," said Al Lock, director of engineering at SRC.

SIGNAL Magazine cited the company's foliage-penetrating radar, FORESTER, as "holding the potential to change the scope of warfare and possibly creating an opportunity for forces to accomplish what has previously been impossible."

Other products—specifically, the artillery- and mortar-tracking radars known respectively as the Lightweight Counter-Mortar Radar (LCMR) system and Multi-Mission Radar (MMR)—use 360-degree surveillance to provide many inherent advantages to the soldier. The LCMR locates mortar firing locations automatically by detecting and tracking the mortar shell and then backtracking to the weapon's position. The MMR is a highly mobile standalone radar that provides multimission target acquisition in a single system. It simultaneously addresses air surveillance, air traffic control, counter battery and fire control missions.

Additionally, ground surveillance radars, including SRC's SR Hawk radar, use modern technology to address an old problem—perimeter security and surveillance.

Providing arguably the most important support in modern-day warfare, SRC's CREW systems, designed to counter remote-controlled improvised-explosive-device electronic warfare, tackle the most common threat facing U.S. soldiers in Iraq—roadside bombs. Using jamming to thwart a wide range of remote-controlled IEDs, the CREW systems have saved countless lives, both military and civilian.

A large segment of SRC's business specializes in developing proof-of-concept prototype radar and communication systems. These programs leverage the latest technologies in innovative ways to perform their intended mission. As prototype developer, the company faces three fundamental obstacles: schedule, evolving requirements and cost. Typically, it takes a year to go from an initial concept to having a working prototype system.

In 1991, SRC began using FPGAs, recognizing that the programmable devices could improve turnaround time, adapt to changing customer requirements and lower costs. FPGAs allow SRC to quickly develop and build systems, and then incrementally add functionality without the need to physically redesign circuit boards.

"It was a major leap forward that supported our customers' needs to quickly put working systems into soldiers' hands," said Bob Roberts, president and CEO of SRC. "Several prototype systems were so successful that they were quickly transformed into full-scale production systems—more rapidly than ever thought possible before the use of FPGAs—and deployed to the Middle East quickly to help in the Global War on Terror."

By using FPGA-based systems, SRC has been able to swiftly and easily change and enhance system functionality in the field to adapt to the evolving threats that U.S. soldiers face every day. SRC continues to leverage the latest-generation FPGAs to dramatically increase performance while decreasing the size, power and weight of the systems deployed to the field.

In 2006, SRC created SRCTec, an ISO 9001-registered company that provides manufacturing and logistics support for complex electronics systems. With the ability to perform full production manufacturing, it is a business model that can take products from theory to field rapidly—improving delivery time and allowing good communication from the warfighter for future upgrades.

In addition to the technology advancements, SRC and SRCTec are committed to the cause and have worked through extenuating circumstances (including setting up a full-service production company) to deliver systems at surge production rates. Executives point to dedicated employees as the key to the company's success.

The artillery-tracking Lightweight Counter-Mortar Radar system offers surveillance in 360 degrees.