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NOVEMBER 2008

GLOBAL EDN INNOVATORS

Technologists and their innovations in electronics design 2008

INSIGHTS, CHALLENGES, MOTIVATION, and TRAINING

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How can I achieve gains in device density and performance without increasing power consumption?

The Programmable Power Technology capability in Stratix IV FPGAs enables you to optimize logic, DSP, and memory blocks for the lowest power at your required performance. Also, compared to competing devices, Stratix IV FPGAs consume 50 percent less power. You can gain an additional 50 percent power consumption reduction when you migrate your design from Stratix IV FPGAs to HardCopy IV ASICs.

Can 40-nm technology meet the needs of high-bandwidth serial interface applications?

40-nm Stratix IV GX FPGAs feature up to 48 high-speed embedded transceivers with data rates of up to 8.5 Gbps, including hard intellectual property (IP) blocks supporting key protocols and signal integrity optimization features to ensure best-in-class jitter performance. The transceiver blocks support key serial communications protocols including PCI Express Gen1 and Gen2, Ethernet, Serial RapidIO®, GPON, CPRI, OBSAI, HyperTransport™ 3.0, SERDES Framer Interface Level 5 (SFI-5), and Interlaken. These devices offer up to four PCI Express hard IP blocks supporting x1, x2, x4, and x8 configurations, as well as multiple 72-bit high-speed DDR3 interfaces at 1,067 Mbps (533 MHz). In addition, the transceiver and memory interfaces are optimized for superior signal integrity and robustness.

How can I lower my costs and power for volume production?

HardCopy IV ASICs feature package- and pin-compatibility to Stratix IV FPGAs, and the transceiver-based HardCopy IV GX variant has a transceiver block that is equivalent to the one in Stratix IV GX FPGAs. In just 9 to 14 weeks, using Altera's proven turnkey process with full test insertion, you can progress from Stratix IV FPGAs to low-cost, low-power HardCopy IV ASICs in production. Compared to standard-cell ASICs, HardCopy IV ASICs offer as low as one-fifth the total development cost.

How can I increase my design productivity for high-end applications?

A "design once" flow with HardCopy ASICs and their prototyping FPGAs means you don't need to reinvent the wheel. Before design handoff, use one design, one IP set, one methodology, and one tool to create two device implementations—one for HardCopy ASICs and one for Stratix IV FPGAs.

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- Device performance that is two speed grades faster than that of the nearest competitor
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- The highest logic utilization achievable

The Benefits of Stratix IV FPGAs

Selection criteria	Stratix IV advantage
Density	More than 2X larger
Transceiver bandwidth	More than 2X bandwidth (48 transceivers up to 8.5 Gbps)
Performance	More than 2 speed-grade advantage (35% faster)
Memory interface	2 speed-grade advantage (1,067 Mbps)
Power	½ the power

2 speed-grade advantage

2X the density

1/2 the power

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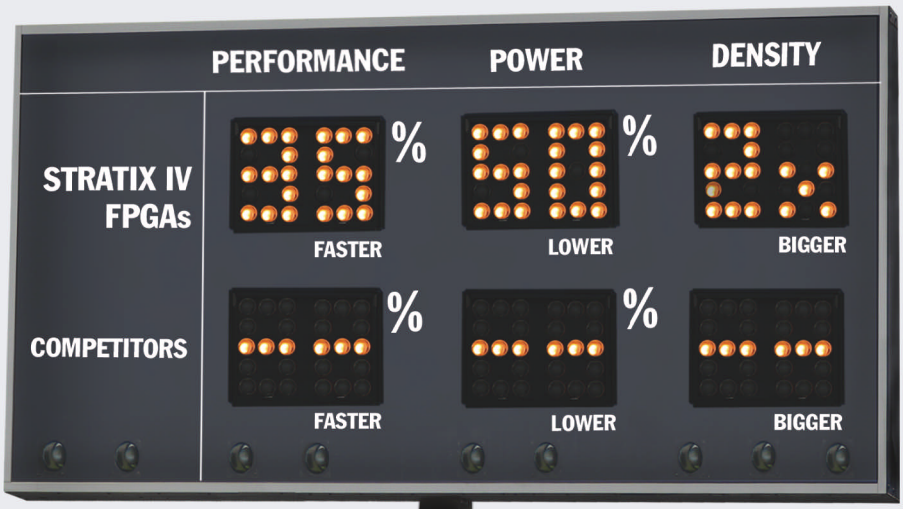

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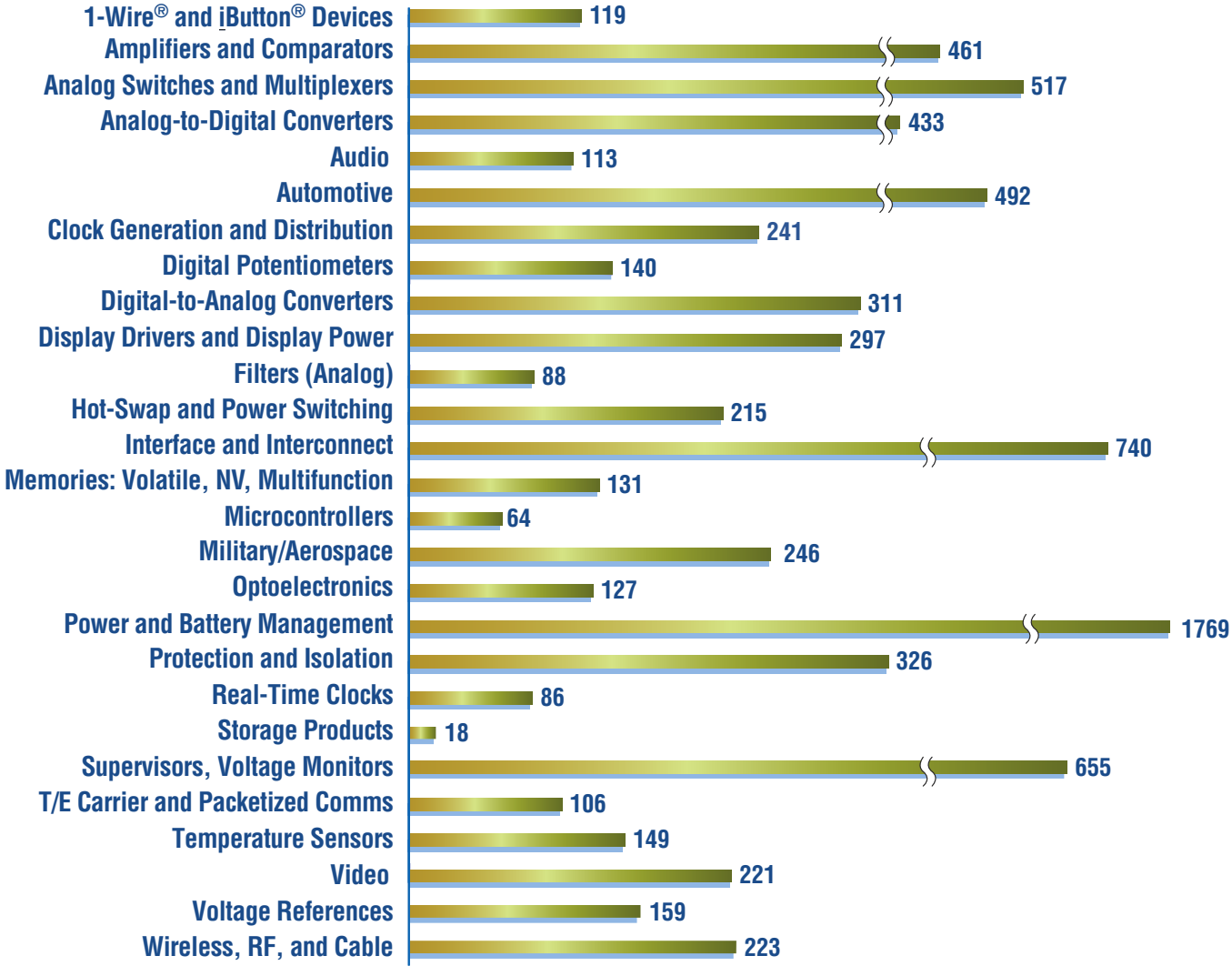

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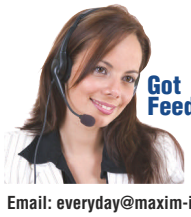

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GLOBAL EDN INNOVATORS

Technologists and their innovations in electronics design 2008

FEATURES

PEOPLE

EDN editors talked to technologists from companies around the globe about innovation in the electronics industry.

Editorial

As design outsourcing matures, **CHALLENGES APPEAR**

By **Ron Wilson,** *Executive Editor*

ARCHITECTS DIVORCED FROM ACTUAL IMPLEMENTATION TEND TO DRIFT INTO NEVERLAND.

THERE HAS BEEN MUCH ANGST about design outsourcing in recent years, most of which has come from US-based designers who have lost or who fear losing their jobs. But as the industry gets more experience with the practice, other problems also emerge. These problems impact not just designers but also the outcome of designs and, possibly, the competitiveness of the companies that outsourced the work in the first place. This situation is due to a natural evolution in the progress of outsourcing.

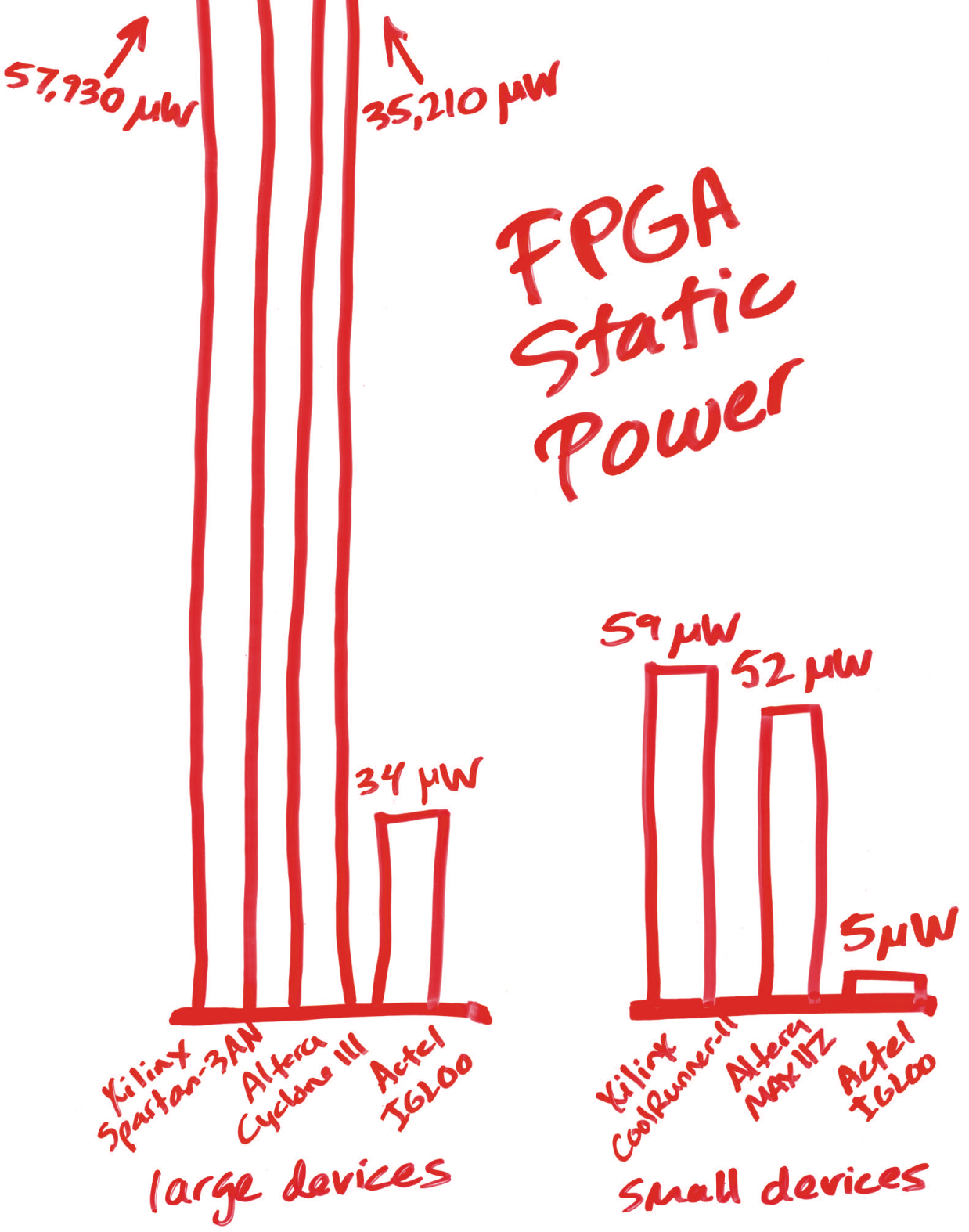
At a Silicon Valley conference last summer, a senior architect for a major US company was discussing the problems he has faced with outsourcing. As design teams on the other side of the Pacific get more sophisticated, the partition between the United States and the—usually—Asian team has begun to shift.

In the good old days, when we were sending only routine bench-level jobs offshore, the partition was at a functional-block or even a task level. The bulk of the design team remained rooted in the United States, with senior US people in control. Only some clearly defined blocks or well-specified tasks, such as logic verification, went to the outsourced team, and the process was tightly controlled.

But as the outsourced teams gain more experience and more senior people, that practice is shifting. The architecture team is often the only one remaining in the United States, and the implementation team resides entirely on the other side of the Pacific. This situation reflects the rapid growth in sophistication and management skill of Asian design teams. But, according to this senior architect, it creates a problem in that architects divorced from actual implementation tend to drift into Neverland. These architects tend to create idealisms that are unworkable in the application or are simply unimplementable. Conversely, implementation management separated from architects tends to lack vital information about the intent of the design—stuff that is difficult to capture in a specification but would strongly influence the design's implementation.

The result, according to this architect, is an increasing risk that designs will come back working perfectly but not doing what the architects had in mind. Instead, the design falls into a morass of miscommunication. Architects lacking recent implementation experience and without the design team leaders sitting across the table from them create a cloudlike palace. The design team, not party to the original discussions about the design requirements, by enormous effort comes as close as it can get: a fortress on a mountaintop. Marketing, meanwhile, wanted a jumbo jet.

The risk here goes beyond mix-ups, reworks, or even failed projects. If US companies allow themselves to become architectural companies without a solid grounding in design, verification, manufacturing, and test, they will run a major risk of becoming uncompetitive as architects, as well. Innovation divorced from implementation becomes a branch of literature, not a phase of engineering.



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A LOOK AT GLOBAL COMPENSATION AND JOB SATISFACTION

By **Rick Nelson,** *Editor-in-Chief*

Engineers contend with technical challenges as salaries pace inflation.

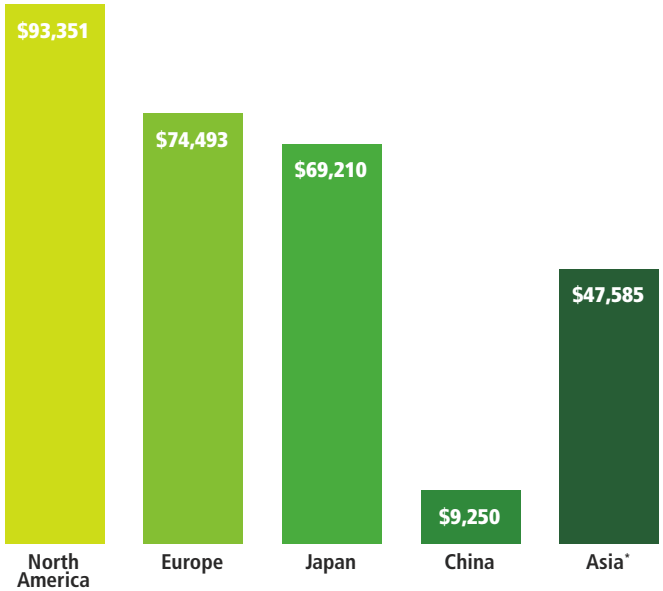
Engineers worldwide reported varying levels of job satisfaction as their salaries struggle to keep pace with inflation, according to a comprehensive study of career trends among electronics engineers. In addition to tracking salary trends, the survey asked questions on topics such as respondents' educational background, how they communicate with global-design teams, what skills they believe are critical in today's work environment, how outsourcing affects them, what concerns they have as they pursue their careers, and their outlook for the future.

Salaries were up in all regions surveyed, with US readers reporting a 4% average increase, which lags behind the recently reported 5.6% inflation rate (**Figure 1**). European readers reported an average 6% increase, which contrasts with a 3.6% inflation rate reported in August for the area using the euro currency and a 4.7% rate reported in August for the United Kingdom.

Readers in Japan reported an average 2% increase, not quite matching the 2.1% inflation rate reported for August, although the Japanese inflation rate reached as low as 0.7% in January. Readers in China reported the highest salary increase, at 9%, which outpaces inflation rates that have ranged during 2008 from a high of 8.7% in February to a low of 4.9% in August.

EDN Asia readers reported an average salary increase of 7.4%. Note that *EDN* Asia serves readers in Hong Kong, India, Korea, Malaysia, Singapore, Taiwan, and Thailand. The online version of this report (www.edn.com/global08) provides salary breakdowns by city and country. Reported average salaries for *EDN* Asia readers ranged from a high of $57,272 in Hong Kong to a low of just under $42,500 in Malaysia and Thailand.

FIGURE 1: AVERAGE ANNUAL BASE SALARY



** Editions of* EDN *Asia, whose readers were surveyed to obtain these results, serve Hong Kong, India, Korea, Malaysia, Singapore, Taiwan, and Thailand. See www.edn.com/global08 for data broken down by region.*

Education worldwide

As for educational background, a bachelor's degree in engineering represents the most commonly obtained educational level, with the exception of *EDN* Europe readers, for whom 35% of respondents reported having a master's degree in engineering, versus 33% who reported having a bachelor's degree in an engineering discipline; 15% of the *EDN* Europe respondents reported having doctoral degrees in engineering, versus 5% of North American respondents (**Table 1**). *EDN* Asia readers appear to have the strongest engineering educational credentials, with 91.2% of respondents having a bachelor's degree or higher in an engineering discipline. The corresponding figures are 86% for US respondents, 83% for *EDN* Europe respondents, 77% for *EDN* China respondents, and 71% for *EDN* China readers. In North America, 25% of respondents reported having degrees in nonengineering fields or having no college degree at all; the corresponding figures are 23% for *EDN* Europe, 20% for *EDN* China, 8% for *EDN* Asia, and 33.4% for *EDN* Japan, with 25% of *EDN* Japan respondents

***EDN*'s second global compensation and job-satisfaction survey** was conducted by Rhonda McGee, director of research, Boston Division, Reed Business Information, with assistance from Wai Chun Chen, publisher, *EDN* Asia, in Singapore; William Zhang, publisher and editorial director, *EDN* China, in Beijing; Martin Savery, publishing director, *EDN* Europe, in Paris; and Katsuya Watanabe, publisher, *EDN* Japan, in Tokyo. The complete research, including a description of methodology, is available at www.edn.com/global08.

reporting having no college degree.

In addition to having the highest engineering education credentials, *EDN* Asia respondents are among the youngest, reporting an average age of 36. Only *EDN* China respondents were younger, reporting an average age of 30. North American respondents are the oldest, reporting an average age of 50, and *EDN* Europe and *EDN* Japan reported average ages of 45 and 43, respectively.

The reported ages roughly traces the average number of years respondents reported having worked as engineers: 18 for North American respondents, 15 for European respondents, 16 for Japanese respondents, five for *EDN* China respondents, and nine for *EDN* Asia respondents. Japanese respondents reported the most stable careers, having spent an average of 15 years with their current employer. In contrast, North American and European respondents have spent an average of eight years with their current employer.

Perhaps reflecting their relative youth, *EDN* China and *EDN* Asia respondents reported having spent only four and five years, respectively, with their current employers. Job change is most prevalent in China, however, with 24% of *EDN* China respondents reporting having changed jobs within the last year. That figure is 11% for North American respondents, 15% for European respondents, 10% for *EDN* Asia respondents, and only 4% for Japanese respondents.

Job security—or lack thereof

Layoffs seem to be a fact of engineering life across all regions surveyed. Japan saw the fewest, with 21% of Japanese respondents saying their company had laid off engineers within the past 12 months; North American respondents reported the highest layoff figures, with 31% saying their company had laid off engineers within the preceding year.

The good news is that companies have also added engineers—European respondents reported the lowest figure, saying 65% of their companies have hired engineers within the last year; *EDN* Asia readers reported the highest figure, with 80.5% of respondents saying that their company has hired engineers within the last year. The hired engineers aren't always in the respondents' locations, however: 30% of North American respondents reported that at least some new hires have been located offshore, with India, China, and Western Europe being the top three offshore locations. Further, 14% of Chinese respondents say their companies have located at least some new hires in other countries, including the United States, the rest of Asia, and Western Europe.

The global scope of engineering projects today mandates effective communications strategies (**Table 2**). An *EDN* China respondent puts it this way: "It is difficult to find an effective

TABLE 1: EDUCATIONAL BACKGROUND

	North America	Europe	Japan	China	Asia*
» Bachelor's degree in engineering	55%	33%	47%	48%	54.9%
» Master's degree in engineering	26%	35%	26%	20%	32.3%
» PhD in engineering	5%	15%	4%	3%	4.0%
» Two-year associate's degree in technical field	14%	6%	4%	11%	5.9%
» Bachelor's degree in nonengineering field	8%	4%	3%	0%	1.7%
» Advanced degree in nonengineering field	4%	4%	2%	2%	0.8%
» Master's degree in business administration	6%	5%	0.4%	3%	3.6%
» Current student	2%	2%	0.3%	3%	0.4%
» No college degree	5%	8%	25%	12%	1.5%

TABLE 2: HOW ENGINEERS COMMUNICATE WITH THEIR GLOBAL DESIGN TEAMS

	North America	Europe	Japan	China	Asia*
» E-mail	91%	94%	93%	63%	92.5%
» Phone	67%	61%	54%	67%	64.2%
» Company intranet	44%	46%	24%	53%	42.0%
» Online forum	10%	14%	5%	12%	9.2%
» Company correspondent	5%	4%	2%	10%	12.4%
» Other	9%	8%	7%	11%	4.7%

TABLE 3: SKILLS ENGINEERS NEED TO GET AHEAD IN THEIR PROFESSION TODAY

	North America	Europe	Japan	China	Asia*
» Digital-design skills	74%	56%	55%	70%	63%
» Software-development skills	68%	66%	50%	60%	57%
» Analog-design skills	66%	53%	71%	65%	53%
» Microprocessor-based skills	61%	52%	40%	54%	48%
» Test-engineering skills	54%	50%	40%	44%	46%
» Control-engineering skills	37%	44%	34%	36%	30%
» Mechatronics skills	30%	38%	25%	27%	22%
» IC-design skills	21%	16%	19%	25%	27%
» Other	15%	15%	9%	3%	11%

** Editions of* EDN *Asia, whose readers were surveyed to obtain these results, serve Hong Kong, India, Korea, Malaysia, Singapore, Taiwan, and Thailand. See www.edn.com/global08 for data broken down by region.*

method to shorten the distance between Chinese engineers and international ones," adding that communication difficulties hinder global cooperation.

Not surprisingly, more than 90% of respondents in North America, Europe, and Japan rely heavily on e-mail as a key communications medium. In China, however, 67% of respondents listed the phone, versus only 63% listing e-mail. Chinese respondents, at 53%, favored company intranets more than respondents from other regions, where the figure ranged from a high of 46% in Europe to a low of 24% in Japan. A smattering of respondents reported using a variety of other communications mechanisms, including VOIP (voice-over-Internet protocol), videoconferencing, and Web-seminar applications; some even reported that the fax remains important to them. Of course, communications technologies aren't currently helpful in breaking down language barriers, a concern that one *EDN* China respondent cited.

Key skill sets

Across all regions, respondents value digital-, analog-, and software-design skills (**Table 3**). In North America, 74% of respondents say digital-design skills are necessary to get ahead in their profession today. Similarly, a majority of respondents in all regions value analog-design skills. Software skills are necessary for only 50% of Japanese respondents, but the topic scores strong majorities in other regions. Test engineering is valued most in North America, with 54% of respondents citing that discipline. In contrast, among Japanese respondents, only 40% cited the importance of test engineering. Across all regions, motion-control skills are important to a sizable slice of respondents, ranging from a high of 38% in Europe to a low of 22% reported by *EDN* Asia respondents. Whatever skills respondents are applying, they are applying them for 44 to 52 hours per week (**Figure 2**).

In pursuit of skills not available in-house or that companies judge too expensive to afford to bring in-house, companies are outsourcing engineering tasks. North American respondents reported that their companies outsource 14% of engineering work; that's closely matched by the 13% figure that *EDN* Europe and *EDN* China respondents reported. *EDN* Japan and *EDN* Asia respondents say their companies outsource 20 and 19% of engineering work, respectively (**Table 4**). Outsourcing can negatively impact even employees who retain their jobs. Reports

FIGURE 2:
AVERAGE NUMBER OF HOURS WORKED PER WEEK

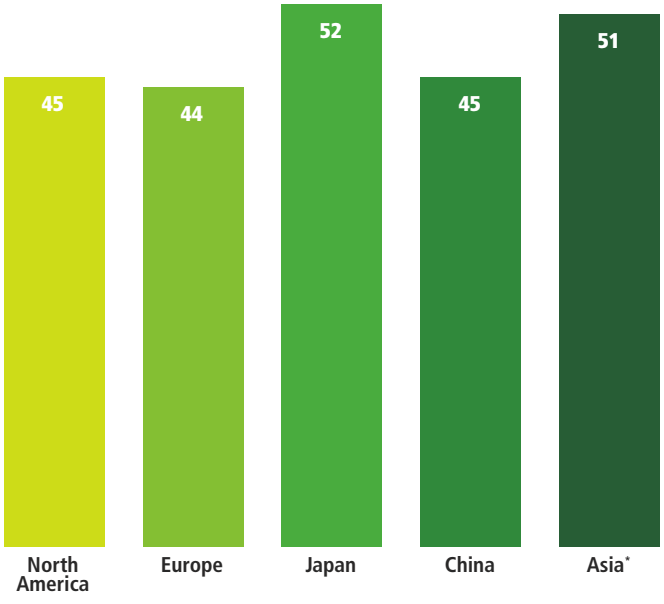


TABLE 4: SPECIFIC ENGINEERING WORK BEING OUTSOURCED

	North America	Europe	Japan	China	Asia*
» Board-based design	32%	41%	33%	19%	30.6%
» Test engineering	26%	36%	29%	21%	25.0%
» Power-systems design	20%	19%	8%	21%	21.0%
» IC design	18%	12%	22%	17%	15.9%
» Processor-based design	18%	16%	28%	19%	14.0%
» Analog design	17%	19%	26%	20%	18.5%
» Communications-systems design	14%	11%	9%	16%	15.6%
» Consumer-products design	12%	15%	10%	14%	14.0%
» Other	29%	21%	10%	12%	20.2%

TABLE 5: MAIN AREA OF CONCERN

	North America	Europe	Japan	China	Asia*
» Keeping current on technology	29%	28%	35%	50%	38.1%
» Job security	27%	20%	24%	21%	33.3%
» Management support	13%	19%	13%	15%	11.0%
» Sufficient operating budget	11%	9%	12%	8%	6.4%
» International outsourcing	6%	5%	2%	0.2%	1.7%
» Company merger or acquisition	5%	11%	6%	4%	3.2%
» Outsourcing	4%	5%	2%	0.5%	1.7%
» Other (client retention, time management)	5%	4%	7%	1%	4.7%

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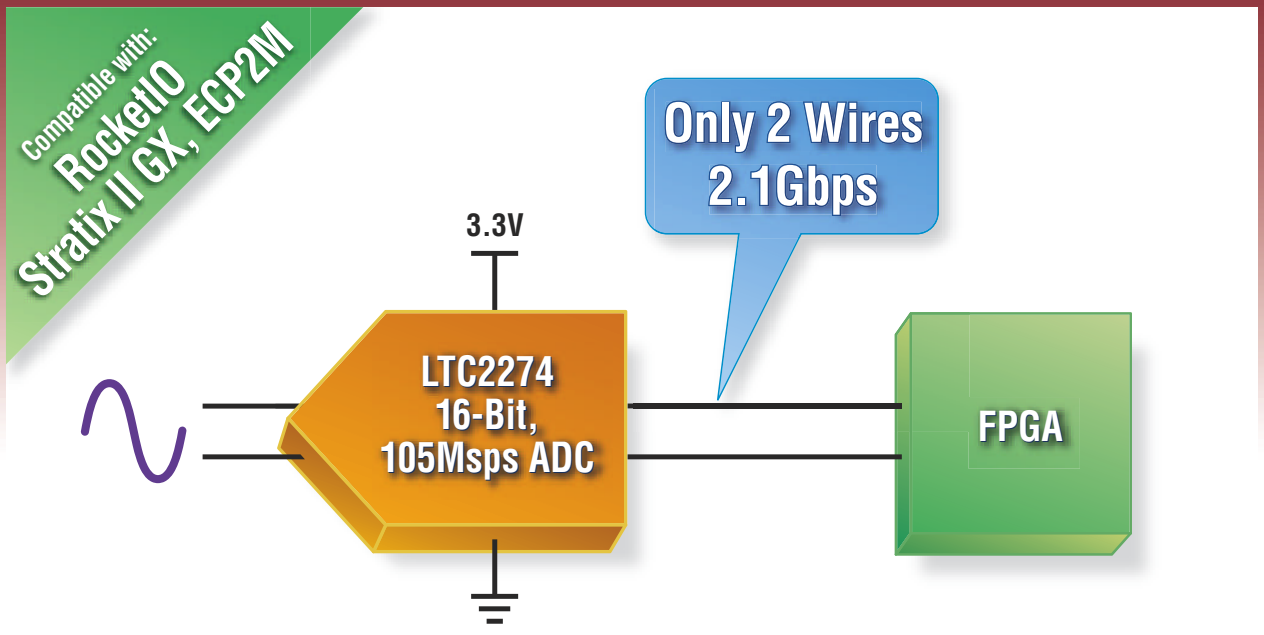
High-Speed Serial 16-Bit ADC



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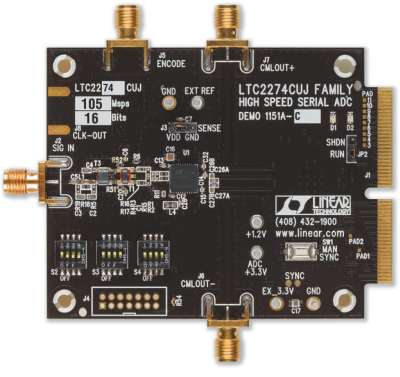

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TABLE 6: PRIMARY DISCIPLINE

	North America	Europe	Japan	China	Asia*
» Test engineering	14%	7%	32%	13%	13.2%
» Analog design	11%	7%	45%	9%	8.3%
» Processor-based design	11%	13%	28%	17%	10.2%
» Communications-systems design	9%	10%	14%	12%	9.1%
» Board-based design	8%	8%	24%	10%	8.9%
» Mechanical engineering	8%	7%	11%	5%	5.7%
» Consumer-products design	5%	8%	12%	11%	10.2%
» Power-systems design	5%	5%	14%	8%	4.7%
» IC design	3%	1%	15%	8%	10.4%
» Other	27%	33%	21%	8%	19.3%

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one *EDN* Japan respondent, "Due to the prevalence of outsourcing, we are beginning to be evaluated by the success of outsourcing and not by our achievement as engineers."

Outsourcing per se is not something that respondents worry about—5% or fewer cited outsourcing as their main area of concern (**Table 5**). Job security is a worry, however. European engineers appear most secure; only 20% of *EDN* Europe respondents reported that job security is their top concern. The figure rises to 38% for *EDN* Asia respondents.

But the top area of concern across all regions is the challenge related to maintaining or growing technical skills; 50% of *EDN* China respondents, for example, cited "keeping current on technology" as their major concern. One *EDN* China respondent cited too much on-the-job pressure; another said, "Competition is intense, and the technology is changing too fast."

The need to develop multidisciplinary skills might be in part driving such concern. **Table 6** shows respondents' primary discipline by region, but substantial numbers are working in multiple disciplines. And many have recently added new areas of expertise. For example, 68% of *EDN* China respondents say they are working on more disciplines now than they were 12 months ago. Japanese respondents reported the lowest figure, with a still-significant 36% saying they have added new disciplines within the past year.

Engineers may be adding new disciplines, but survey results suggest that they don't often advance or transfer laterally within their companies. For example, North American and European readers, who have spent an average of eight years with their current employers, have spent an average of seven years in their current jobs. The most opportunity for job changes within a company appears to be in Japan, where respondents who reported an average of 15 years with their current employers also reported spending just over half that time—eight years—in their current jobs.

The lack of movement within companies may suit engineers just fine. Majorities or pluralities across all regions want to remain on a technical-engineering-career track. For example, 67% of North American respondents and 75% of Japanese respondents wish to do so. The corresponding figures for *EDN* Europe, *EDN* China, and *EDN* respondents are 38%, 26%, and 39%, respectively. Across all regions, becoming a technical consultant is in second place, with moving into engineering management in third place. Joining a start-up in an engineering function takes fourth place. Few—5% of respondents in North America to 11% of respondents in Europe—wish to move into marketing or sales.

Job satisfaction varies widely by region, with 64% of North American respondents and 65% of *EDN* China respondents reporting that they are very or somewhat satisfied with their engineering career. Only 44% of *EDN* Europe respondents reported a similar level of satisfaction, and the figure drops further, to 35% for *EDN* Asia respondents and to 25% for *EDN* Japan respondents. *EDN* Japan respondents reported a variety of reasons for dissatisfaction, ranging from time management to gender discrimination. One reported too little work; another reported not being able to find time for continuing education. Still another writes, "Discrimination against women has meant that my skills are not positively appraised. Compared to the male engineers working at the same level, my salary is extremely low." *EDN* Asia respondents cited long hours, heavy workload, poor pay, lack of growth opportunities, and lack of recognition as reasons for dissatisfaction.

To be sure, many *EDN* Japan and *EDN* Asia readers did report high levels of satisfaction. Says one *EDN* Japan respondent, "I've been given job themes that are rewarding and have received appropriate evaluation." *EDN* Asia respondents reported deriving satisfaction from challenging work and from having the ability to innovate and be creative. In fact, across all regions, those who are satisfied cited technical challenges and the feelings of accomplishment that come with meeting those challenges as key contributors to the levels of satisfaction they feel. Respondents in North America and Europe also value relationships with colleagues more than salary and benefits; salary is more important than relationships to *EDN* Japan, *EDN* China, and *EDN* Asia respondents.

Engineers across all regions also value being recognized for their work. Reports an *EDN* Japan respondent, "I have been given awards by academic societies and have been commercializing the technology I've worked on." But the challenge itself and resulting feeling of accomplishment dominate. A European reader cites the freedom to create as key to job satisfaction. Reports a North American respondent, "I get paid to do what I like." An *EDN* China reader sums up the profession at its best: "Being an engineer brings reputation and respect. And I can have freedom to transform my idea into a design."

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WORLDWIDE PRODUCT INNOVATION DESPITE VARYING STANDARDS

Global companies with products headed to the international stage face complex, confusing, and sometimes-conflicting regulations.

By **Steve Scheiber,** *Contributing Technical Editor*

For a multinational electronics manufacturer, selling products to countries all over the world means contending with an array of conformance standards that can vary dramatically from one country to the next. Even within a single country, the standards constantly evolve in response to manufacturers' growing experience and the realities of political and technical compromise. And, regardless of whether the standards make sense, manufacturers generally have little choice but to follow them.

The challenge divides into three major categories. First, end products must meet the standards in each target country. Can a manufacturer design the product to allow acceptance by all the regulatory agencies? Second, how does a company efficiently and cost-effectively accomplish this complicated task? How can you ensure that new products or new generations of older products will satisfy all of the regulations necessary to qualify for sale? The third challenge relates to the standards themselves. Do they represent an achievable goal, or will conformance cause undue hardship to manufacturers and customers alike? And how can you anticipate changes to the regulations to avoid designing to criteria the industry superseded before your product even hits the market?

Seeing the trends

According to Dan Sullivan, division manager of the product-safety division at TUV Rheinland, for a company that specializes in regulatory compliance, as a whole, meeting standards worldwide has gotten simpler in the past decade. "Generic-product standards, like electrical safety standards for TVs, have been out there for years. They were revised often early on, but, for a long time, they have been pretty stable. Unless there is a significant change in the technology, I don't expect any surprises.

"Ten or 15 years ago, every country wrote its own regulations. When you made a product, you had to [ensure] compliance for the particular country you sold it into. That aspect of the landscape has changed dramatically. Today, countries have adopted international standards and worked them into their own policies. You can now get past the red tape of a single country or national regulatory body much more easily because the requirements are the same or nearly the same from country to country.

"The big unknown is China. China, with its layers and formalities, may not be the strictest country in the world, but [its] standards may be the most difficult to implement. Getting your products approved by China used to require more effort. An entourage of Chinese inspectors would visit your company to examine your designs and manufacturing facilities. Today, the country appears increasingly willing to loosen [its] regulatory requirements to allow more imports."

Among the most contentious of the current standards, the ROHS (restriction-of-hazardous-substances) directive from the EU (European Union) limits the use of numerous materials in manufacturing, including lead, cadmium, mercury, hexavalent chromium, and certain halogen compounds. Conformance timetables depend on the nature of the product. For example, the directive grants exemptions for medical equipment and other critical systems. Nevertheless, the writing is on the wall. Many companies have chosen to move toward compliance before it becomes mandatory. Don Cook, global-supply-chain manager at National Instruments, explains: "The regulation states that test-and-measurement equipment doesn't have to comply until 2012, and it may not be that soon. Still, eventually we will have to meet the standards, so it is to our advantage to take the necessary steps now. Our IC suppliers have already changed their entire product lines to conform to the regulations rather than make different products for different customers. We buy a lot of electronic components since we manufacture our own printed-circuit-board assemblies and have converted our inventory as our suppliers have moved to ROHS compliance. By the time compliance becomes mandatory us, we will already be there."

Even today, however, no standard can be considered universal or inviolate. Stricter regulations out of China are challenging the EU version of ROHS, which only a few years ago represented the gold standard.

So, how can you design products—especially test-and-measurement products—that fit easily into this regulatory quagmire? National Instruments has taken a position firmly on the cutting edge. James Truchard, PhD, president and chief executive officer of National Instruments, shares his approach: "We try whenever possible to meet every standard so that our products work everywhere. Historically, Europe has tried to present the strictest standards. Because we have manufacturing facilities in Europe, we maintain direct contact with the people who control the European standards. That contact allows us to more easily apply those standards to our manufacturing facilities elsewhere."

Similarly, the WEEE (waste-electrical-and-electronic-equipment)

directive mandates reclaiming and recycling many products and product materials rather than disposing of them in landfills or by incineration. Adopting that regulation before it became mandatory made the transition much less painful.

"The WEEE directive also began in Europe, but the toughest version today comes out of South Korea," comments Joel Shapiro, NI's industrial-measurement-and-control-group manager. "So, we have incorporated South Korea's requirements into all our products shipped worldwide. As additional standards come online, we include them in our global-product offerings, as well.

"For us, compliance is not as complicated as it might be for a maker of PCs or cell phones. Our customers can easily configure and change the functionality of their deployed systems. They configure our systems in the software. One customer, for example, is using one of our measurement systems to monitor mercury emissions from a coal-fired power plant. They can easily install a single piece of hardware in several venues and modify the acceptable limits on each system depending on where it is installed. And, because product upgrades often involve only software changes, our hardware generally survives several product generations, so it doesn't get scrapped nearly as often as most consumer products do."

Manufacturers sometimes build the core of a product to work anywhere, such as by incorporating an autoadjusting power supply and other universal features. They may then redesign the aesthetic features for particular markets. For example, apartments and living spaces in many parts of Europe and Asia tend to be smaller than those in North America. Adjusting the form factor for products sold into each of those markets will make them more acceptable to local customers.

Adopting the most stringent version of the standards for all products, wherever the customers may be, may increase costs in the short run, but avoiding the inventory requirements and other logistical consequences of maintaining several product classes helps to mitigate the cost of conforming.

Anticipating future conformance requirements and implementing them now provides other benefits. "Every company wants to be green," comments Truchard. "We all want to be good corporate citizens."

Nevertheless, some companies choose not to adopt the global perspective. "A company whose products are confined to a particular geographic area may choose to address regulations only in that area," says Shapiro. "A manufacturer in Italy who builds test equipment to verify assemblies that are deployed only in Europe doesn't have to care if those products don't meet the Chinese standards. Companies limiting their wares to China or India also tend to make country-specific products. Even a large global company that might have a design center in Germany and a factory in Asia might choose to limit conformance of the final products based on their ultimate destination."

Walking the line

What is the biggest challenge to successful regulatory compliance? "I see the most problems when engineers don't design the regulations into their products upfront," comments TUV Rheinland's Sullivan.

TYPICAL PRODUCT-EVALUATION FLOW

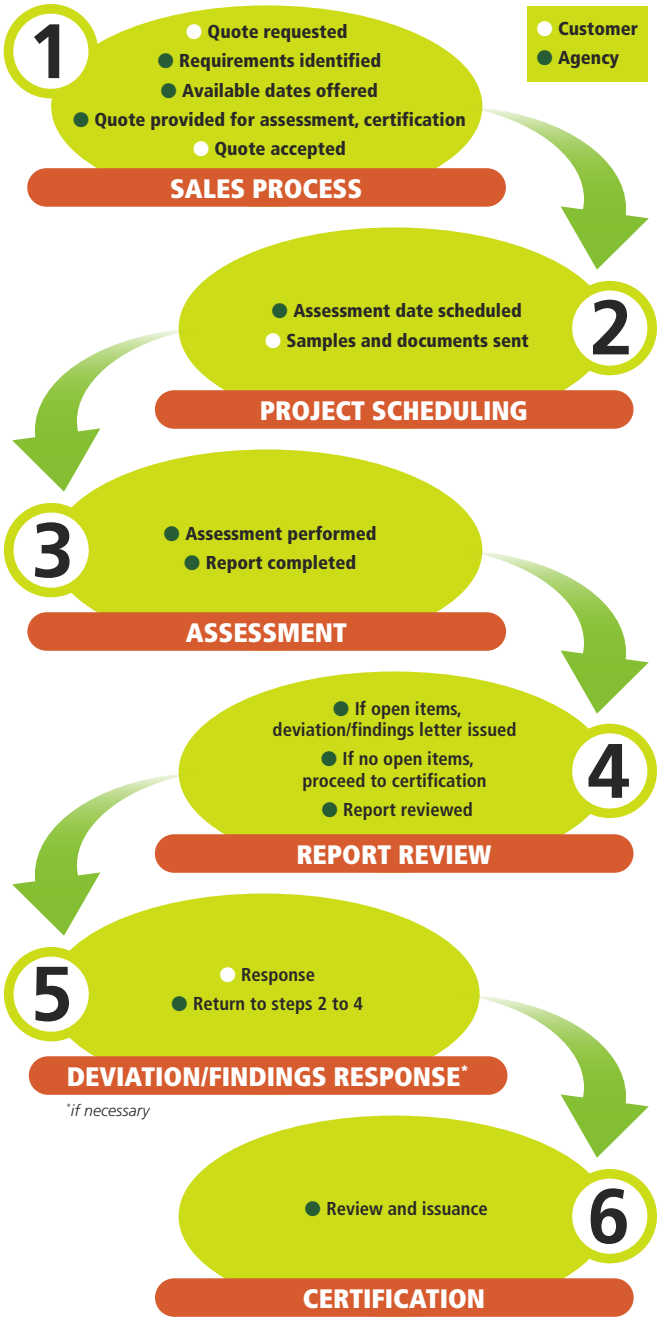

FIGURE 1: **This step-by-step process shows what happens when a product comes under evaluation for regulatory compliance. Step 1 begins with the initial contact with the third-party compliance agency** *(courtesy TUV Rheinland).*

"They may design products specifically for major markets that turn out to be the 'square peg in a round hole' elsewhere. You need to anticipate all the markets that you want to penetrate at the earliest stages of design and incorporate those requirements at that point. Shoehorning them in after the fact becomes difficult, problematic, and expensive. The biggest mistake a company can make is to regard regulatory requirements as a back-end necessary evil rather than as a constraint at the design [stage]. My worst nightmare is the customer who calls to tell me he can't get a container of some product into a particular country because it doesn't comply—and can I please help him." Figure 1 shows TUV Rheinland's normal certification process.

Companies often have to conform to standards from different regulatory agencies even within one country. Medical equipment sold in the United States must meet Federal Drug Administration regulations. Any product that may generate EMI (electromagnetic interference) must conform to standards set by the Federal Communications Commission in the United States and its equivalent agency in the EU. In the United States, the Environmental Protection Agency handles environmental factors.

Sometimes the fact that a product falls under the aegis of certain regulations proves less than obvious. "A printer is simply a mechanical system that uses standard buses to communicate with its host computer," says Sullivan. "Yet, today's printers include radio-frequency devices that give them wireless capability. Incorporating that feature requires that printers, too, conform to standards for radio transmitters that can vary dramatically from country to country. Merely conforming within the European Union represents a significant challenge."

Sullivan recommends that manufacturers find a strong global regulatory partner, either an independent agency or a knowledgeable consultant with good global-network connections, to show them the most efficient path to the core regulatory standards. "Without that kind of help, conformance becomes a daunting task, particularly for smaller companies. Large companies generally have internal resources to help them. But even they sometimes lack the necessary expertise to meet the needs of a particular local market."

Taking a global view

Not all standards that differ by geography spring from regulations or other legal mandates. De facto standards—such as Linux, for example—are more common in Europe than elsewhere. European companies generally base their industrial networks on Profibus and ProfiNet, whereas their counterparts in the United States use Ethernet Internet Protocol. If you make products for either market, you have to ensure that those products conform with the customers' culture and not merely with the regulatory environment. Some standards grow up for economic reasons. High-volume-production facilities in China and elsewhere in Asia tend to discourage testing with "big-iron" testers, preferring a less capital-intensive strategy. Companies selling test equipment have to recognize those trends.

Some standards, such as efforts to reduce greenhouse-gas emissions and their effects on the environment, result from political or social pressures that ultimately affect everyone on the planet. The next generation of worldwide regulations will likely include carbon trading and the push toward recycling and alternative-energy use. "Experts have predicted that carbon will become the most commonly traded commodity in the world," says NI's Shapiro. "Manufacturers have to understand clearly the implications on their factories and their manufacturing processes." **Table 1** shows the current targets for alternative energy as a percentage of total energy use for several states and countries.

Here, too, some companies have already placed themselves ahead of the curve. "We try to be as green as we can," says NI's Truchard. "It's good business. We have established a code of conduct for our suppliers and a global take-back program for product returns. Our customers can request that we take back any product for recycling at no cost to them. We take back electronics through approved third-party houses that have been certified as processing them in an environmentally sensitive manner. Our NI campus gets part of its electricity through wind power. Carbon-trading schemes allow companies that create smaller carbon footprints than regulations require to sell their 'excess' carbon to companies that have more difficulty achieving those limits. The additional revenue stream translates directly to the company's bottom line. Many of these practices are not yet mandatory, but they represent a huge potential, and, in the future, many of them will be part of our effort to present a green global image for the company."

TABLE 1: RENEWABLE-ENERGY GOALS FOR VARIOUS STATES AND COUNTRIES

State/country	Renewable-energy goal as a percentage of total energy (%)	Target year
» Texas	10	2025
» California	33	2020
» United Kingdom	10	2010
» France	20	2020
» Sweden	60	2020
» China (Phase 1)	10	2010
» China (Phase 2)	15	2020
» European Union	20	2020

courtesy National Instruments

Measuring conformance to regulation is itself a business opportunity. "Measurements are key pieces of green engineering across all applications," says Shapiro. "If you are developing renewable energy sources or optimizing equipment to use less energy, you have to perform measurements as a first step. For example, carbon trading requires understanding how much carbon your processes emit. New businesses and whole industries are growing up to measure and reduce that carbon and to keep track of carbon credit transactions."

Sullivan expects the issue of energy consumption to soon take a different direction. "The EU wants to calculate the amount of energy consumed in all phases of a product—design, manufacturing, use, and recycling," he says. "The new EUP [energy-using-products] directive strives to regulate every aspect of a product's energy consumption, including energy spent for transportation between manufacturing facilities, distribution points, and customers, and the

energy required to get rid of it at the end of its useful life." He also stresses the increasing importance of recycling: "If you consider a product's carbon footprint as a cradle-to-grave issue, then buying a hybrid car might not prove environmentally sound if you simultaneously trade in an older car that ends up in some landfill," he says.

To reduce the energy consumption of electronic products, the Energy Independance and Security Act of 2007 has established minimum efficiency requirements for many products. This act soon will include a 1W "standby" rule for external power supplies and battery chargers. That is, when a product is in the idle state, it cannot consume more than 1W of power. "That rule will likely mark the next change in US regulatory requirements," says Sullivan.

The moving target moves away

Part of the current challenge of ensuring that products conform to regulations is that those regulations often seem arbitrary, established by committees with little understanding of their consequences. Just when companies think they have made sufficient plans to conform, the rules change. As a case in point, the EU has proposed revisions to the ROHS directive to further limit human and environmental exposure to such substances. Unfortunately, according to a white paper that IPC (Association Connecting Electronics Industries) recently released, implementing some of those changes unaltered could cripple the electronics-manufacturing industry.

Consider, for example, a proposed ban on halogen-based chemicals such as TBBPA (tetrabromobisphenol(a)), a common flame retardant used in PCB (printed-circuit-board) laminates in some two-thirds of the electronic appliances worldwide. The white paper contends that there is no evidence of harmful effects of the chemical and there is no adequate universal substitute. Besides, the industry is already taking numerous precautions. It is even addressing possible adverse effects of making the chemical, such as by limiting production-plant emissions. According to the paper, "Even the European Union Risk Assessment published in the EU official journal on 18 June 2008 does not support the restriction of TBBPA."

"At National Instruments, we are constantly monitoring the various global directives," says Cook. "For instance, when we recently became aware that Deca-BDE [decabromodiphenyl ether] was no longer allowed as a ROHS exception, we checked into what parts used it. Realizing that it should have been on the original list, many suppliers were already attempting to get rid of it. As we find out about the next element subject to regulation and the one after that, we have to perform the same due diligence to be sure that both the products that we buy and the products that we sell will comply. If companies don't have a process in place to ensure that the next product will be compliant, they had better establish one."

However prepared companies might be, the IPC paper contends that a ban on this material would have significant side effects. Although halogen-free alternatives are available, quantities are limited, and their inclusion would dramatically raise manufacturing costs. Cost aside, these materials have not undergone the rigorous risk assessments of TBBPA, and the phosphorus and other elements that they contain may turn out to be dramatically more toxic than the bromide that they are intended to replace. Some products would not tolerate the substitution at all. According to the paper, the following would be the most significant consequences of such a ban:

- Substitution with a halogen-free alternative would add $211 million per year in additional costs for the material alone.
- The approval cycle for PCB makers would be three to five years and cost $17 million to $21 million more per year.
- Because the chemical behavior of the new material would of necessity be different, the ban would require a redesign of many boards, with unpredictable consequences in both cost and product performance.
- For some products, there is currently no halogen-free alternative. Developing one could take five years or more at a substantial cost in both money and productivity resources. The interim impact on affected products would depend on the regulatory agencies. The paper estimates the cost of these efforts at tens of millions of euros/dollars.
- Products that require additional approvals, such as medical products that need FDA approval in the United States, will require many additional years of testing before receiving that approval.
- Doing away with "all organic compounds containing chlorine and bromine," as another of the proposed regulations suggests, would cause even more havoc. The original ROHS directive banning lead from electronic solder caused considerable pain as the industry scrambled to find a suitable replacement. The new lead-free solders have a higher melting point than their predecessors did and therefore permit much narrower process conditions during PCB manufacture. The proposed revisions to the directive would aggravate the situation. Plasticizers and wetting agents used routinely in solder include compounds that fall under the ban. Most solder fluxes also contain halides, and there are currently no viable alternatives. In addition, the regulation's ambiguous wording could leave manufacturers unsure of whether their processes conform. Finding out that you have violated the directive after the fact could cripple some—especially small—companies.

The white paper insists that demanding that the industry replace compounds that have endured years of validation for their intended use with untried and untested alternatives risks system failures, with consequences ranging from mild annoyance to a catastrophic avionic- or medical-electronics failure.

Companies whose products find their way onto the international stage must contend with a plethora of complex, confusing, and sometimes-conflicting regulations. For some companies, conforming to the strictest of those regulations proves the path of least resistance. Other companies with a geographically narrow market may restrict their efforts to the requirements of their target countries. Nevertheless, everyone must contend with ever-present changes to the regulations and find a way to deal with legal requirements that may complicate the task of cost-effectively making reliable and affordable products.

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GROOMING THE INNOVATORS OF THE FUTURE

Corporate sponsors in the electronics industry are working with General Motors and the US Department of Energy to provide real-world engineering experience to university students.

By **Rick Nelson,** *Editor-in-Chief,* and **Jessica MacNeil,** *Contributing Editor*

Ongoing innovation requires a continuous stream of creative graduates of college and university engineering programs to enter the workforce. To ensure that this stream is available, corporations are supporting STEM (science/technology/engineering/mathematics)-educational initiatives targeting students as early as at the elementary level. To ensure the availability of engineering graduates with real-world skills that they can immediately use with their new employers, however, companies are focusing on university-level programs.

One such program is EcoCar: The Next Challenge (www.ecocarchallenge.org), which has the support of the US Department of Energy, General Motors, The MathWorks, Freescale Semiconductor, National Instruments, and other sponsors, which are lending time, money, and products to the university-level competition (see sidebar "EcoCar competitors").

EcoCar aims to "advance the level of vehicle technology capable of reducing petroleum consumption and greenhouse-gas emissions" and to train the next generation of engineers to address sustainability and transportation issues, according to Connie Bezanson, lead engineer for program planning at the DOE.

To achieve this goal, students from 17 universities in the United States and Canada will spend three years redesigning and re-engineering a Saturn Vue to be more efficient and to have lower emissions. Teams representing the 17 universities converged at The MathWorks this summer for a week of training that kicked off the three-year competition.

The EcoCar competition builds on the DOE's 20-year history of sponsoring AVTCs (advanced-vehicle-technology competitions), said Bezanson, speaking during an interview during The MathWorks' kick-off event. Joining Bezanson were Cindy Svestka, executive technical assistant for power-train/vehicle integration at GM, and Paul Smith, director of North American consulting services at The MathWorks.

With EcoCar, the DOE is looking to train engineers of the future to address the sustainability issues and transportation issues that the country is facing, according to Bezanson. Many of the universities bring years of experience to EcoCar after participating in similar DOE-sponsored AVTC programs, including Challenge X (www.challengex.org) and FutureTruck (www.transportation.anl.gov/competitions/futuretruck.html).

The MathWorks' Smith describes his company as a strong supporter of EcoCar and similar programs. "The MathWorks has a long history of being involved in student competitions as well as a strong bias toward the support of academia. One of our founders [Cleve Moler, chief scientist] comes out of that world and still participates in it actively. Our involvement goes right to the core mission of The MathWorks, which is to accelerate the pace of engineering and science."

During the first year, Smith explains, students will focus on model-based mechanical and electrical design of power-train components and controllers, using tools such as his company's Matlab and Simulink, as well as tools from other competition sponsors. In the second and third years, each team will integrate its design into a General Motors-provided Saturn Vue. The Saturn Vue, says GM's Svestke, platform is appropriate for the EcoCar challenge because Saturn is one of GM's green-focused brands; is amenable to modification in a nonproduction environment; and is a crossover vehicle that provides the function, utility, and economy that GM customers look for as they downsize from large SUVs.

With university-level competitions, the possibility always exists that

As part of EcoCar: The Next Challenge, teams of students representing 17 universities will modify a Saturn Vue. The goal is increased economy and reduced emissions *(courtesy The MathWorks).*

technological breakthroughs could find use in the real world. That possibility is part of the impetus behind the DOD Grand Challenge autonomous-vehicle competition. With EcoCar, however, the primary goal is to instill in the next generation of engineers the knowledge of advanced vehicle technologies that current employees in GM's core businesses might lack. "We have a great hybrid team," says Svetska, "but it will need twice the number of people within the next 10 years." To that end, she adds, the entire competition mimics GM's own global-vehicle-development process. The EcoCar participants are "learning about the GM global-vehicle-development process, and they are learning a passion for alternative-fuel vehicles and hybrid vehicles; that [combination is one] that you really can't find anywhere else."

EcoCar goes beyond the duplication of earlier programs. "One of the key differences between EcoCar and Challenge X," says Svestka, "is that we are pushing forward with HIL [hardware-in-the-loop] requirements for each of the teams. Our sponsors have generously agreed to provide HIL systems" for students to use in the first year of EcoCar competition. "We did have a few Challenge X teams who succeeded" with HIL implementations, she adds, "but it was on the order of four, not 15." Svestka says that the teams that did employ HIL really understood the challenges that they faced from the start, and they got the opportunity to perform lots of iterations upfront to develop a solid control strategy that they could carry forward when working with an actual vehicle.

National Instruments is one company providing HIL, says Paul Mandeltort, NI's automotive-communications-product manager. Mandeltort, a FutureTruck alumnus who used NI FieldPoint controllers in his competitive days, elaborates on earlier team efforts to use HIL: "We had students in the past, before HIL was a hot topic, who developed their own HIL systems using PXI. They actually simulated a lot of their models and controls," he says. "It gave them a nice little edge on the competition."

"I have seen this competition evolve from FutureTruck, where students were given a vehicle and would immediately take wrenches to it," says Mandeltort's colleague, Pete Zogas, NI's vice president of sales and marketing and a long-time sponsor of advanced-vehicle challenges. "Now, it's important that teams work out a strategy" through modeling before working with an actual vehicle. Zogas notes that NI's products have evolved along with the competition. In early competitions, teams used NI's products primarily for testing and diagnostics. "Now, they are much more synergistic with the design side, as well," he says.

HIL modeling represents "a critical step that we hadn't really worked into Challenge X, but we worked very hard to get it into EcoCar," says GM's Svetska. "We think that's gong to be a very big positive for the students, as well as for us." The level of refinement teams achieved with HIL approaches approached that of GM teams working to get a vehicle into production, she said.

Although it won't immediately yield a production-ready vehicle design, the EcoCar program offers many benefits to sponsors in addition to well-trained graduate engineers. Smith says that students tend to stress software in ways that industrial users don't, providing valuable feedback. Bezanson says that engineers at Argonne National Laboratory, which manages the competition for the DOE, can learn from students as the students exercise the lab's PSAT (powertrain-systems-analysis-tool-kit) software.

Ron Stence, a senior systems engineer at Freescale Semiconductor, believes that the competition offers strong opportunities for feedback. "I can look at what 17 teams are doing and watch mistakes happen in a gentler, kinder environment than you would have if you are working at Ford or GM or Chrysler," he says. The student teams "are able to go out and experiment and try things that normal car companies might not be willing to try. I get to see 17 attempts at trying to solve a problem, using radical technologies, such as fuel cells, biodiesel, and ethanol. For Freescale that [insight] is very valuable." In exchange, he says, Freescale provides a financial contribution as well as development kits, compilers, debuggers, and applications support.

The competition provides invaluable opportunities for networking and fosters good will with the DOE, GM, and other sponsors. "We don't normally see guys like Larry Nitz [GM's executive director for hybrid-powertrain engineering] and Bob Lutz [GM's vice chairman of global-product development]," says Stence. "But they come to these events. It becomes a lot easier to share that information when there is a personal relationship; that's a side benefit we didn't anticipate going into earlier programs."

From a technological perspective, the competition provides insight into how teams were using various components from Freescale or other suppliers. "We are not going to judge down if someone uses someone else's microprocessor," he says. "But we are going to say, 'Show us how you are using that processor, tell us how you are using it, what unique functions does it have, what's your CPU loading, how much code did you download, and what did you learn by using it?'" And, because technology is only part of the innovation problem, Stence continues, "What is your plan for when you graduate in about three weeks to transition the schematics and the software and all the data to the next student who will take over for you?"

The DOE's Bezanson notes that the competition's judges will grade teams on both their business acumen and their technical skills. Successful teams will draw on business and marketing students and graphics designers as well as computer-science and aerospace-engineering students. Matthew Doude, a graduate mechanical-engineering student on the Mississippi State University team, reveals that the competition involves more than just engineer-

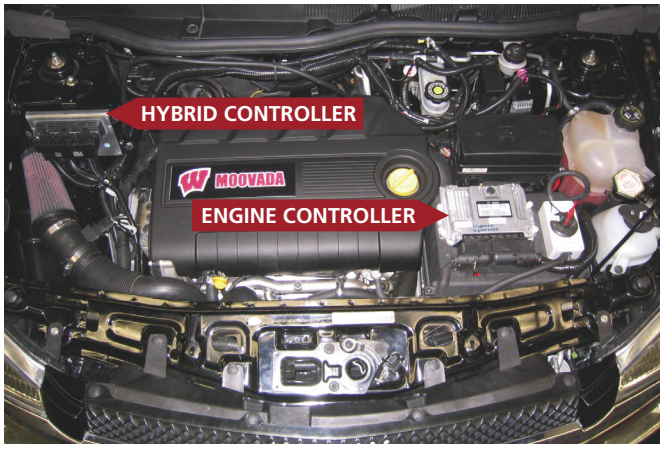
EcoCar competitors

EcoCar: The Next Challenge is a three-year competition including a training workshop at The MathWorks in Natick, MA, where the teams gathered in August. The competing universities are Embry-Riddle Aeronautical University, Georgia Institute of Technology, Howard University, Michigan Technological University, Mississippi State University, Missouri University of Science and Technology, North Carolina State University, Ohio State University, Pennsylvania State University, Rose-Hulman Institute of Technology, Texas Tech University, University of Ontario Institute of Technology, University of Victoria, University of Waterloo, University of Wisconsin, Virginia Polytechnic Institute and State University, and West Virginia University.

ing. He bases that opinion on his team's experience as a defending champion of Challenge X. "Part of the competition is scored on how you outreach—how you tell people about what you're doing," he says. "During Challenge X, we reached more than 250,000 people, … showing people the vehicle on a one-on-one basis throughout the four years of the competition."

Doude was one of four mechanical-engineering students *EDN* interviewed at The MathWorks kickoff event (see sidebar "Students juggle class work, EcoCar efforts"), suggesting a dearth of electrical-engineering majors in the program, and students indicate that recruiting electrical engineers could prove difficult. But sponsors are hoping to change that situation. "The pushback we had based on Challenge X," says Freescale's Stence, "was increase the number of electrical engineers because cars are increasingly microprocessor- and software-based."

"If you looked at the student teams in the FutureTruck days, it was all mechanical engineers," concludes NI's Mandeltort. "Now, … the teams that do really well have a good mixture of electrical and mechanical experts."



For the Challenge X competition, the Rose-Hulman Institute of Technology team employed Freescale processors to implement engine and hybrid controller functions *(courtesy Challenge X).*

Students juggle class work, EcoCar efforts

By **Jessica MacNeil,** *Contributing Editor*

Students constituting the 17 teams participating in the EcoCar challenge bring diverse skills and goals to the three-year project as they balance hands-on EcoCar efforts with class work.

According to Connie Bezanson, lead engineer for program planning at the Department of Energy, participating universities must provide some academic credit for challenge participants, a requirement that works out well for some students, for whom the competition is their main academic focus. For example, Beth Bezaire, a master's student at Ohio State University, will dedicate research hours to the project and plans to do her thesis on some component of the EcoCar project.

For others, the hours they devoted to the challenge are a sacrifice because they receive less class credit for their time. "It is done at our school as a two-credit-hour course, which is not equal to the amount of time that you put into it," says Bob Warden, a senior mechanical-engineering major at Rose-Hulman Institute of Technology.

Through its experience with Challenge X, Rose-Hulman Institute of Technology has created a model-based design curriculum that will be useful in preparing younger students for this competition by giving them experience in the concepts and with relevant programs, such as Matlab and Simulink. Because the EcoCar challenge involves more than just building a car, the students will have more to gain from the competition. Working with a team, dealing with suppliers, and interacting with the media and community are real-life engineering experiences that go beyond the technology.

"I'm really looking forward to the interpersonal skills: working with a team, figuring out how to make a team function well, getting done all we need to get done, and learning those types of skills that you learn from being on a project team, not just from taking classes," says Bezaire.

Learning these skills in a real industry environment is also beneficial because of the people the students have the opportunity to meet. Professionals involved in the program serve as examples to follow, potential future references, and career mentors for the students. "The contacts that you meet through something like this are invaluable," says Matthew Doude, a graduate mechanical-engineering student whose Mississippi State University team comes in as the defending champions of the earlier Challenge X competition.

The environment also enhances the experience because the competitors learn to act in a more professional manner than they would on a campus. "It really helps make some of the younger guys grow up, which is something that is hard to teach unless they realize it themselves," says Warden.

On a larger scale, the competition could benefit everyone as the teams work to develop a more efficient and eco-friendly car for the future. "This is an exciting program because we're [moving] to different types of energy—getting away from oil—and that's extremely important," says Doude. "In the next 10 years, the auto industry will start looking at all these kinds of energy, and that's definitely a reason I got involved in this competition, because now is really a critical time for the industry."

Although some team leaders outlined plans to use electricity to fuel their redesigned Saturn Vues, Howard Mearns, a graduate student on the West Virginia University team, predicts his team would focus on a readily available approach. "We would like to take an approach closer to the technology that's here," says Mearns. "The infrastructure [for plug-in electric vehicles] isn't around yet. If everybody plugged their car in tonight, the grid would crash. There isn't the capacity for that kind of thing, so we'll probably be looking at a hybrid but a full hybrid that you don't see in this market."

Although the students are interested in winning the competition, they see the value participation will have for them, their schools, and the planet. "This is about being a cohesive team," says Bezaire. "This is not a cutthroat competition. We want everyone to learn and to gain a lot out of it."

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JAPANESE AUTOMAKERS FOCUS ON SAFETY

Sensors that monitor conditions inside and outside cars protect you on the road.

By **Sang-Soo Pac,** *Associate Editor*

FIGURE 1 **The Eyesight stereo camera sits above the rearview mirror. The space between the right and the left cameras is 350 mm** *(courtesy FHI).*

Although "green" vehicles are attracting a lot of attention these days because of a growing interest in environmental issues, safety systems are even more important. Vehicles, often weighing more than 1 ton and operating at high speeds, depend on safety features to prevent accidents and decrease damage. Toward that end, Japanese car makers have developed new sensor technologies to monitor both the interior and the exterior of the cars that you drive.

With safety in mind, Japanese engineers have developed systems that use sensors to imitate the function of the human eye. FHI (Fuji Heavy Industries) in May launched one such system, Eyesight, in a model-year 2009 Subaru Legacy. Eyesight uses stereo cameras to enable a precrash brake, which decreases damages from a crash; a sensor that detects obstacles and prevents a car from starting; and a full-speed-range adaptive-cruise-control system that keeps vehicles apart from each other even when they are standing still. It consists of twin cameras, one on each side of the rearview mirror, that use humanlike stereoscopic vision to judge distances and generally keep tabs on the driver (**Figure 1**). The system can help you keep your distance from other cars on the highway, provides a lane-departure-warning system and a wake-up call should everyone pull away from the lights but you, and even keeps an eye out for pedestrians. In contrast to Eyesight's camera-based system, precrash systems using radar detect only the car ahead. Eyesight can detect not only the vehicle directly ahead but also the vehicle diagonally ahead. It also detects bicycles, pedestrians, lane hogging, and swerving.

Eyesight's stereo cameras integrate two monochrome CCD (charge-coupled-device) sensors with 0.3M-pixel resolution. The device uses processed images from the cameras to decipher a vehicle's location. It then indicates the location to the sensor, which starts control of the engine and transmission using a 500-kbps CAN (controller-area network) for communication. Eyesight integrates the stereo cameras and an ECU (electronics-control unit) into one module, dramatically reducing system cost. The stereo-camera unit integrates an ASIC for image processing, a 32-bit microcontroller for image recognition, and another 32-bit microcontroller for control. According to FHI, Eyesight costs approximately 200,000 yen ($1850), which is less than half the price of the company's other driving-support system.

CMOS image sensors for consumer products, such as digital cameras, achieve resolution of several megapixels or greater. On the other hand, the image sensors for monitoring the rear of vehicles use CCD sensors with only 0.2M- to 0.3M-pixel resolution. However, Japanese manufacturers are striving to develop even more advanced image sensors to improve safety. Nissan Motor recently demonstrated an example of such a sensor, the Around View Monitor, on the Elgrand minivan, which the company released in Japan in October 2007. The sensor eases parking by providing greater visibility of the surrounding environment. It synthesizes a bird's-eye view of the vehicle and its surroundings using Sony 3000, ultrawide-angle, 1.3M-pixel cameras on the front, sides, and rear of the vehicle.

Mazda Motor introduced a rear-vehicle-monitoring system in its new Atenza (Mazda6 outside Japan), which it launched in January 2008. When the car is operating at speeds greater than 60 kph (37 mph), this system uses 24-GHz microwave radar to detect vehicles approaching from behind and alerts the driver to the danger of changing lanes. Two sensors near the rear of the vehicle monitor objects that enter the detection area, activating an icon in the driver's or passenger's side-view mirror. If the driver attempts a lane change when an object is in the detection area, the icon flashes, and an audible beep sounds.

In another development, Suzuki Motor and Keio University have co-developed a driver-monitoring system that extracts the feature points of a driver as a 3-D pattern using multiple cameras rather than the 2-D pattern and one camera that many other systems use. The 3-D system combines with a particle filter, which recognizes patterns in temporal sequence, so that it simultaneously detects both the orientation of the driver's face and the direction of the driver's eyes.

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CamSemi *David Baillie*

A UNIQUE, LOW-COST APPROACH to power-supply design

CamSemi's David Baillie discusses how his UK-based fabless-semiconductor company established a global presence.

THE NEXT BIG WAVE IN THE OFFLINE-POWER-CONVERSION SPACE WILL BE IN LIGHTING.

DAVID BAILLIE is chief executive officer of CamSemi (Cambridge Semiconductor), a UK fabless-semiconductor company, which, in 2007, launched its first products in the offline-power-conversion market. The company's RDFC (resonant-discontinuous-forward-converter) controllers target the linear-replacement-system market. *EDN* recently interviewed Baillie through e-mail. A portion of that interview follows. To read more, go to www.edn.com/global08db.

When the founders first launched the company, you proposed making FETs that had the gates etched from the back to make them fast and low-loss. What were the difficulties you encountered in the FET program?

As a fabless company, CamSemi is and will almost always be working with external suppliers. That [situation] gives us real freedom in partnering with companies that are centers of excellence in their technologies, but it also means that technology transfer and maintaining good supplier communications are critical for business success.

The decision to delay introducing integrated-controller and high-performance-switching products has nothing to do with the challenges of working with overseas suppliers. During the manufacturing-development phase for these products, we uncovered batch-to-batch variation that impacted the overall process yield. As a result, we decided to invest further time and resource in the manufacturing-development phase and to accelerate our stand-alone-controller program. This change in strategy was in response to increasing market demands for better, more-cost-effective solutions and to get CamSemi into revenue as quickly as possible, which is critical for any early-stage company.

You have come up with a clever architecture for low-cost power. Is it difficult to keep engineers from going overboard?

I guess it is a trade-off, but we have always worked very closely with our customer base so are well-grounded in developing products that address a real need at an acceptable cost.

Manufacturers face considerable cost pressures. It used to be that the only option for linear replacement was an SMPS [switched-mode-power-supply] flyback [converter], but we have changed that [assumption] with our unique RDFC approach. Now, manufacturers can have a low-cost path to SMPS performance and without having to worry as much about the challenges of EMI [electromagnetic interference] or FCC [Federal Communications Commission] Part 68 compliance.

Which area—process refinement, IC design, applications, sales—seemed to require the most innovation?

For us, the greatest challenge is knowing what the market will want in 18 to 24 months' time. This [knowledge] is fundamental and can come only from in-depth understanding of the end-market dynamics and close customer relationships. And, to help us with this [need], we have worked with customer partners who actively participated in specifying our first two major platform products.

Now that the company is getting established, where do you see the next requirements for global innovation?

The next big wave in the offline-power-conversion space will be in lighting. Incandescent lamps are only 5% efficient and will be phased out over the next five to 10 years.

With the success of your power-supply design that can use lower-cost transistors instead of FETs, do you plan to revisit the project of back-etching wafers?

The work on our PowerBrane technology is continuing, but we took the commercial decision to accelerate the development of stand-alone controllers and to bring those to market first. It is still our intention to launch integrated products.

—Interview conducted and edited by Paul Rako

CriticalBlue *David Stewart*

MIGRATING SOFTWARE into hardware

EDN *talks with David Stewart, founder and chief executive officer of CriticalBlue, about hardware/software co-design, multicore programming, and more.*

ENGINEERS TEND TO GROW IN AN EVOLUTIONARY WAY; THEY DON'T ... SUDDENLY THROW SOMETHING AWAY AND START AT THE BEGINNING.

DAVID STEWART is founder and chief executive officer of CriticalBlue (Edinburgh, Scotland) and has more than 20 years' experience in the EDA and semiconductor industries—10 of which he spent at Cadence Design Systems, where he was a founder and business-development director of the SOC (system-on-chip)-design facility at the Alba Campus in Scotland. This initiative attracted worldwide interest, and the design center grew to more than 200 people in its first 18 months. Before joining Cadence, Stewart was a chip designer at LSI Logic, NEC Electronics, and National Semiconductor. He has served on the board of several technology start-ups and one venture-capital company.

What special challenges do you face when working with customers and employees around the world?
Apart from all the usual challenges of managing time differences, the main issue is in keeping the company strategy and tactics aligned within the different geographies we operate in. In a start-up, things change very rapidly, and sometimes the changes can layer on top of each other such that you forget how much has and has not been communicated out to the field. This [lack of communication] can become an issue where small increments to strategy or positioning are made but not effectively communicated.

What advice would you give to other start-ups about the challenges of doing business globally?
I'd say expand into new markets one at a time. In other words, don't try to do too much at once. Study your markets and see if they are ready yet. You may find that emerging markets—China or India, for example—are more appropriate for your products than the more traditional US and European markets. Finally, get someone on the ground who knows the local culture and activities; they will be invaluable.

What are the biggest challenges that your customers are trying to deal with right now?
We straddle the hardware/software-development and -design boundaries, so we see customers on both sides. In a sense, there's one challenge right there, which has been identified for a number of years as a key issue in that hardware and software has typically been designed separately, and the two disciplines don't communicate well with each other. I don't think that problem has been solved yet, although it's better. At a company level, what I see people challenged with is how to manage the necessary investment in building silicon platforms with getting the most out of those platforms. The biggest implication of that [challenge] is that these silicon platforms need to be a lot more programmable than they were before, so the increasing use of processors [is a concern], of course, but on top of that is layered the issue of power consumption, implying a smaller number of processing elements working together to deliver the same performance at lower power consumption. So, you've basically got two interference patterns here: people trying to move toward more-programmable silicon platforms, but, on the other hand, they are also trying to deal with ... how to continue to increase the performance of the platforms they are building but keep the power consumption under control. It seems like the only answer ... is to use more processors, so you've got more processors, but you've still got software problems. How do you program these things? It's not easy.

How well has the industry dealt with this problem?
I don't think we have dealt with it. In many cases, particularly with respect to the multicore programming, we have expected some new panacea to suddenly appear, and there is a group of people that [has] been waiting for that to happen, and there are other people that are getting on with doing things. What history has taught me is that engineers tend to grow in an evolutionary way; they don't ... suddenly throw something away and start at the beginning. So, a brand-new approach is an interesting idea, but I don't see anybody with much appetite for implementing anything like that at this point. Because, specifically, when the markets are tough and people are being cautious and the economy is not deft, as it is at the moment, then people are much more likely

CriticalBlue *page 32* >

DAFCA *Peter L Levin*

ON-CHIP INSTRUMENTS track malicious RTL

DAFCA's founders take a new approach and discover the company's technology can fill an unexpected market need.

DAFCA TECHNOLOGY IS NOT JUST ABOUT MAKING SURE NOTHING BAD HAPPENS; IT'S ALSO ABOUT ENSURING THAT THE RIGHT THING HAPPENS.

INNOVATION often depends on looking for new applications for current products and technologies. Peter L Levin, founder, president, and chief executive officer of DAFCA, used that approach in focusing the company's silicon-validation technology on the task of sniffing out semiconductors contaminated by malicious RTL (register-transfer-level) logic. DAFCA's founders didn't originally envision RTL-logic criminology as part of the company's mission. "DAFCA's mission is to deliver a framework for on-chip, at-speed, in-system validation with a combination of on-chip dynamically programmable instruments and off-chip software-analysis tools," he says. "We were blissfully unaware … of malicious RTL [logic]." But the interactions with colleagues in industry, academia, government, and the venture-capital community that led to the founding of DAFCA also led to Levin's realization that DAFCA technology could help uncover malicious RTL logic.

A 2005 US Department of Defense report outlines the potential problems malicious code can cause (**Reference 1**). The path that led Levin to awareness of the malicious-RTL-logic problem began at Carnegie Mellon University. There, although he concentrated on applied math, he became interested in EDA and semiconductor design and became close to Rob A. Rutenbar, a Carnegie Mellon professor. Levin and Rutenbar would again cross paths when Rutenbar co-founded Neolinear.

After graduation, Levin served as a professor in the electrical- and computer-engineering department of Worcester Polytechnic Institute (Worcester, MA) and then became research dean in Boston University's College of Engineering. Levin was a White House Fellow and presidential appointee during the Clinton Administration. He also received a Humboldt Research Fellowship, which allowed him to study at the University of Darmstadt (Germany). That affiliation and his fluency in German led Levin to approach Munich-based venture-capital-firm TVM, where he again encountered Rutenbar and, working with TVM general partner Hans G Schreck, helped launch Carnegie Mellon spin-off Neolinear. Cadence Design Systems subsequently acquired Neolinear.

Levin was interested in starting his own company, and toward that end, on a visit to Carnegie Mellon after finishing his White House Fellowship, he got in touch with Miron Abramovici, co-author of a leading text and reference in digital-systems testing and testable design (**Reference 2**). Abramovici brought 22 years of experience at AT&T Bell Labs, Lucent Technologies, and Agere Systems and now serves as chief technology officer of DAFCA. Abramovici worked with Levin in 2003 to raise $8 million in first-round venture financing of DAFCA. Today, the venture investors include ABS Ventures, 3i US, Bay Partners, New Venture Partners, Vista Ventures, and Individuals Venture Fund.

The start-up garnered some media attention, which brought Abramovici's name to the attention of a DARPA (Defense Advanced Research Projects Agency) program manager with whom Abramovici had previously worked. That connection led to DAFCA's making several presentations to other government agencies and to companies that were working on government projects.

"We were beginning to gain traction on the commercial side," Levin says, in which DAFCA technology was detecting accidental problems people had inserted into designs. The DARPA introduction opened the door to an "enormous unexpected market need for the detection and potential remediation of malicious RTL [logic] that was deliberately inserted."

Levin provides a brief outline of how DAFCA can detect erroneous code: "To detect that somebody has inserted a Trojan [horse], that Trojan has to activate and do something that the chip wasn't designed to do or force the chip to behave in a way that lies outside the domain of authorized authentic behaviors," he says. "We insert very small, compact, reconfigurable instruments that you can think of as reconfigurable monitors in the RTL [logic], and your enemy may or may not even know that we are there. … I don't know and I don't care whether this was an accidental mistake or a deliberate intrusion; you are going to use DAFCA to examine the behavior of your device on-chip, at-speed, in-system. From our perspective, it's the same problem."

Levin is careful to distinguish DAFCA from traditional DFT (design-for-test) and BIST (built-in-self-test)

DAFCA *page 32* >

Farnell/Newark *Gary Nevison*

ENVIRONMENTAL COMPLIANCE, 2.0

Farnell/Newark's Gary Nevison discusses several EU environmental regulations that are impacting electronics design across the globe.

NO MATTER WHAT DIRECTIVE YOU HAVE AND NO MATTER WHAT GUIDELINES YOU HAVE, THE CHANGES HAVE TO BE MADE AT THE DESIGN STAGE.

MANAGING LEGISLATION and environmental affairs for UK-based components distributor Farnell and its US-based sister Newark, Gary Nevison is the spokesman and customer interface on design regulations that affect the electronics industry, such as the ROHS (restriction-of-hazardous-substances), REACH (registration/evaluation/authorization-of-chemicals), EUP (energy-using-products), and WEEE (waste-from-electrical-and-electronic-equipment) directives. Nevison recently spoke to *EDN* about materials, substances, and energy-usage restrictions impacting the global electronics industry. Excerpts of that conversation follow.

Have these design regulations bettered the environment?
At this stage, that's not known. While I'd like to think so, there's no clear evidence either way as of yet.

Then why do different governments continue to impose time-intensive and costly materials and substances regulations on electronics design?
The offset of the benefits against costs can be an interesting one. The implementation costs of REACH [in the European Union], for example, over a number of years are expected to be between €2.8 and 5.2 billion. The EC [European Commission] estimates that once REACH is fully in place, there will be 4500 fewer cases of cancer each year and 90,000 fewer allergies per year. Are those savings of life each year worth between €2.8 and 5.2 billion? That's for people to look at and make their own assessment.

It sounds like REACH is the next big regulation.
REACH is big, but it probably isn't as big for the design engineer as ROHS was, and now there's "ROHS 2, the sequel." ROHS was six substances and eight categories of products, but REACH is substances and chemicals pretty much wherever they are used. The design engineer will have to be concerned about obsolescence. The EC expects that 2% of [REACH's] 30,000 chemicals will be made obsolete simply because the manufacturers will not justify the cost of REACH.

Can you define "ROHS 2, the sequel"?
There have been ongoing reviews around the scope of ROHS. The end results that are likely are more product categories falling within scope, more restricted substances, clarity on some definitions, and, finally, a complete review of all 30 exemptions. Certainly what is expected in terms of new-product categories are categories 8 and 9 of the WEEE directive, which are medical equipment and monitoring and control instruments. Those were left out because of lead-free solder issues.

Why is the EC now including those categories?
Once engineers have gotten used to the properties of lead-free solder, the conclusion [by the EC] is that it's no better, but it's no worse, than lead solder. It's just different.

What additional substances could the commission add to the scope of ROHS?
There was a list of 46, which has been reduced to eight. Things like flame retardants and plasticizers are typical examples of what have been under review.

And what's going to happen to the 30 exemptions?
They will only be withdrawn where more suitable alternatives have been found. Over 90% of all equipment depends on at least one exemption [of the 30].

What other regulations are impacting electronics design on a global scale?
EUP is ongoing through 2008 and 2009. Currently, about 20 broad categories are under review, and there are probably about 30 to follow. EUP is all about the energy efficiency of a product from the mining of the raw material through to its recycling and end of life. The whole emphasis of this is at the design phase.

What's your advice to engineers?
They are going to have to be organized. My main advice would be to ensure that they have reliable sources of information. All of these directives in some way, shape, or form will impact the design engineer. ... No matter what directive you have and no matter what guidelines you have, the changes have to be made at the design stage.
—Interview conducted and edited by Suzanne Deffree

GreenPeak Technologies *Cees Links*

GREENPEAK'S TECHNOLOGY targets "green" power

A global pioneer in ultralow-power wireless-sensor and -control networking crafts battery-free wireless networks.

THE ELIMINATION OF THE NEED FOR ONGOING, REGULAR BATTERY REPLACEMENT SIMPLIFIES AND REDUCES MAINTENANCE-LABOR COSTS AND PROVIDES A HIGHER LEVEL OF SAFETY AND COMFORT.

GREENPEAK TECHNOLOGIES is a global pioneer in ultralow-power wireless-sensor and -control networking. The company offers OEM designers a revolutionary communications technology that incorporates energy-harvesting to enable maintenance-free operation in a completely wireless environment. Based in Utrecht, the Netherlands, GreenPeak distributes wireless-transceiver chips and modules in the United States, Europe, and Asia. To find out more about the technology and its international implications, *EDN* questioned Cees Links, an engineer and chief executive officer at GreenPeak. A portion of that interview follows. To read more, go to www.edn.com/global08cs.

Briefly explain GreenPeak's technology and the current applications for it in a global market.
GreenPeak is a fabless-semiconductor company offering wireless and "green" ultralow-power network-communication technology for sense-and-control applications. GreenPeak's new Emerald GP500C transceiver chip and its wireless-sensor-network-communication technologies are based on a unique low-power architecture that can use energy harvested from the environment. GreenPeak's mesh networks can be powered by energy-harvesting devices without compromising performance range, data rate, or reliability. Implementing a GreenPeak-connected network powered by energy harvesting can greatly reduce the cost and difficulty of maintaining wireless-sensor networks.

How do the differing standards, regulations, and wireless-spectrum allocations between regions affect your product designs?
Wireless communication prospers best within the space of industry standards. In addition, standards offer OEMs the freedom to purchase from a larger pool of suppliers. Standards also allow devices from different vendors to interoperate, a feature that is paramount in applications ranging from building automation to industrial automation. For wireless-sensor transceivers, the dominant and probably only real standard is the IEEE 802.15.4 specification.

There have been efforts to use Bluetooth and Wi-Fi for sensor applications. However, in all these reported applications, Bluetooth and Wi-Fi were used in a nonstandard way, in fact weaving the principles of IEEE 802.15.4 in their native implementation. Nowadays, it is widely accepted that the IEEE 802.15.4 offers the best basis for wireless-sensor applications.

GreenPeak is fully committed to development based on open industry standards. Designs using the Emerald GP500C communications controller are fully IEEE 802.15.4-compliant, running in the 2.4-GHz [band], which allows worldwide certification for single products. The GreenPeak technology also supports the open global standards of the ZigBee Alliance.

What is your assessment of the worldwide-market conditions for wireless technology, and how does it affect your product-development plans?
The enclosures for the sensor units used in wireless-sensor networks are often very small. ... As a result, the batteries must be regularly replaced, which creates a real maintenance challenge. GreenPeak has overcome this problem by developing alternative solutions for powering wireless-sensor networks based on a different and low-power architecture that can utilize energy harvested from the environment.

There are other low-power wireless networks in development—based on Wi-Fi, ZigBee, and other wireless-networking technologies, but none offer the levels of connectivity, robustness, minimal power consumption, and ability to function in radio-unfriendly environments that the GreenPeak solution offers.

The Emerald GP500C communications controller greatly reduces energy consumption and enables end nodes to run on energy harvesting. GP500C-driven networks can be truly wireless, free of power cords and free of batteries. The biggest technical challenge is managing the energy consumption without reducing range, functionality, speed, and standards compliance. The resulting elimination of the need for ongoing, regular battery replacement simplifies and reduces maintenance-labor costs and provides a higher level of safety and comfort.

—Interview conducted and edited by Warren Webb

XMOS *David May*

A MULTICORE, PARALLEL approach to computing

XMOS puts multiple processing cores, each with its own memory and I/O system, on a single chip.

MAY VIEWS THE INNOVATION PROCESS AS ONE THAT EXAMINES REAL-WORLD SYSTEMS AND CREATES ANALOGIES OF THEM WITH PROCESSORS OR WITH TECHNOLOGY.

DAVID MAY is chief technical officer of fabless-semiconductor start-up XMOS, based in Bristol, England. Long an advocate of multicore, parallel computing, he was an early recruit to INMOS in 1978, where he was the architect of the Transputer and the author of the Occam language. STMicroelectronics eventually absorbed INMOS and many elements of the Transputer into the ST20 architecture. May later became head of computer science at the University of Bristol, then a co-founder of XMOS.

May originally studied at Cambridge University. "I was one of the first computer-science graduates," he says. His involvement with computation long predated university studies, however. "I was always building and inventing things and first built a calculator based on relays at age 11," says May. By the early 1970s, he was working with robotic systems, and the first microprocessors emerged. "It was immediately apparent how they could work coupled together; it became the first application of distributed computing," he recalls.

Although, in those days, accurately controlling a motor with feedback used the power of a complete computer, May recalls the "obvious" concept of localized control programs with closed feedback loops passing messages around a wider system and mimicking biological systems. This sort of broad-based innovation process appeals to May. In contrast, he says, alluding broadly to the gigahertz race for ever-faster single-processor cores, "Much of what went on in the 1990s wasn't innovation."

Around 2000, May says, it became apparent that there was an opportunity to undertake a new venture, once more based on the ideas of multiple processing cores and communicating simultaneous processes. The XMOS architecture places a number of general-purpose processing cores, each with its own memory and I/O system, on a single chip. The cores have direct support for concurrent processing (multithreading), communication, and I/O. Any processing thread can communicate with any other thread over a fast intrachip-switch fabric or interchip serial links. The architecture supports any language; XMOS added extensions to form XC, a version of C that supports I/O, multicore, and precision timing.

May emphasizes that XMOS' architecture is not a reborn Transputer—although it has more in common with the Transputer than with any other earlier processor. He views the innovation process as one that examines real-world systems and creates analogies of them with processors or with technology. It is also one that is unafraid of reaching back into the past to use or reuse ideas. Despite his academic tenure, however, May says, "I want to see something result from it. Work that ends in an academic paper alone—that's not me."

Perhaps with that thought in mind, May looks back wryly to the innovations associated with the INMOS venture: "Everything was at or beyond the limit. We were pushing the [process] technology as far as we could to get as much on a single die as possible; [Occam] was completely new; the programming model was new. If anything, there was an excess of innovation." By contrast, he says the XMOS venture recognizes that, if it is to capture the attention of the wider base of embedded-computing designers, programming for the XMOS chip must be as familiar as possible. "It looks like C," he says.

May also notes the importance of timing. One of the reasons he feels that the time is right for a switch to a parallel model of embedded computing is that innovations are appearing in a range of disciplines, not only the computing domain. Referring once again to robotics, he notes that the emergence of strong, lightweight materials changes the picture. You can not only precisely compute all of the necessary control actions to perform robotic actions but also execute them in a mechanical environment with low inertia and feasible power levels. He continues to be an advocate of creating systems that are appropriate to the task at hand and no more: "Think lean and mean; small systems and low power are very important."

May aspires to foster the innovation process by making it simple, once again, to quickly and easily explore new concepts by directly prototyping and building things. He would like to see a processor-based environment become "the TTL of the next two or three decades," with the capability for "mass personalization and the potential to produce mass differentiation" leading to a cascade of new and useful products.

—by Graham Prophet

End Note

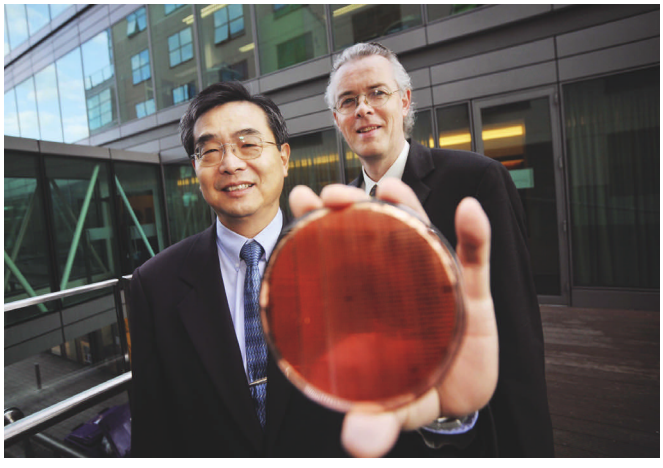
IRISH GOVERNMENT ENABLES FUNDING AND PARTNERSHIPS between universities and industry

How can a relatively small country become a force in key electronics technologies when it lacks a military-industrial juggernaut to power high-tech R&D? Ireland has bet on government funding and the encouragement of university and industry partnerships.

By **Margery Conner,** *Technical Editor*

Ireland's population is about 4 million, with Dublin, at 1.2 million, by far the largest city. Demographically, it's one of the youngest countries in Europe, with more than half of its population less than 25 years of age. Just try walking down Grafton Street, one of Dublin's pedestrian shopping hubs, without spotting a remarkable number of baby strollers. What attracts and holds this young population?

Ireland boasts seven universities, all public, and all providing a university education that's currently free. The Irish government, through its investment arm, Enterprise Ireland, has committed to funneling public research money into its universities and then serving as a conduit to overseas companies as well as homegrown Irish start-ups to provide well-paying jobs to its people.



Fred Lee, PhD, of the Center for Power Electronics Systems at Virginia Institute of Technology, shows off Tyndall's wafer-scale inductors with Cian Ó Mathúna, PhD, of Ireland's Tyndall Institute of University College Cork, during the Power SOC Workshop last September in Cork, Ireland.

Ireland's history of government-driven research goes back a generation, when University College Cork installed a 4-in.-wafer fab. Keep in mind that, back in the 1980s, you could not consider an organization without a foundry a viable player in electronics. Fast-forward to 2008, when the days of "real men have fab lines" are long gone: Keeping up with the Asian foundries is a game that few multinationals, let alone small countries, choose to play. However, Ireland has seized upon at least two technologies that exploit its expertise in silicon-based technologies: MEMS (microelectromechanical systems) and mixed-signal power.

These technologies exploit not only the capabilities of the foundry but also the creativity of the foundry managers and professors. University College Cork's MEMS facility, which the Tyndall National Institute now administers, leveraged its experience with silicon etching to develop silicon microneedles that can more effectively deliver drugs and therapeutic treatment transdermally. These microneedles are examples of MEMS that make good use of older silicon-wafer facilities. The university has licensed the technology to a US pharmaceutical company.

Continuing with the goal of leveraging expertise in growing fields, Tyndall researchers looked for a likely technology driver for the next generation of electronic products and realized that power processing—the conversion, regulation, and delivery of power within a system—could play almost as big a role as digital processing in enabling the products of the future. Tyndall Professor Cian Ó Mathúna, PhD, has argued for years that the direction power would take in systems ranging from servers to cell phones would make necessary a power supply on a chip.

The technology challenges of implementing power supplies on chips include the speed and cost of the switching semiconductors, as well as the size, efficiency, and cost of the power magnetics. With recent advances in viable high-speed switching devices and Tyndall's and others' success with developing microinductors, the timing was right for the Power SOC Workshop, held in September in Cork, Ireland. Conference attendees included engineers from companies such as Intel, On Semiconductor, and Analog Devices, as well as professors and graduate students from the engineering departments of universities such as the Georgia Institute of Technology, Virginia Polytechnic Institute, Stanford University, and the University of California—Berkeley, as well as from Asian and European universities. The attendees could see for themselves the level of research and assets the Irish universities and Enterprise Ireland are willing to invest in a highly targeted technology area. The conference served as a showcase for Irish-government-backed research and the subsequent migration of the research into industry. As governments worldwide struggle with encouraging research and industry, Ireland shows one successful approach.

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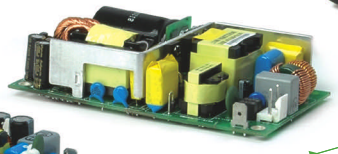

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CEC Level IV- The California Energy Commission has mandated requirements for power supplies used with certain types of products. The most current requirements are the same as the EISA 2007 requirements and are referred to as either “Tier 2” or “Level IV.”

Energy Star- Energy Star is a joint program of the US Environmental Protection Agency (EPA) and the US Department of Energy (DOE) aimed at preserving the environment through energy efficiency. Adapters meeting the Energy Star guidelines are up to 30% more efficient than non-compliant versions and must meet both active and no-load minimum efficiency requirements set forth by the EPA and DOE. Compliance with these requirements is voluntary.

EISA 2007- The Energy Independence and Security Act of 2007 was passed by Congress in December of 2007 and addresses minimum efficiency standards for external power supplies manufactured on July 1, 2008 and after. This law stipulates the energy efficiency criteria for adapters in active mode depending upon their power rating. The stipulated energy consumption for all adapters in no-load mode must be less than 0.5 W according to EISA 2007. Compliance with these requirements is mandatory.

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> **CriticalBlue** *from page 25*

to stick with what they know ... than to throw everything away and make a huge bet on something that's brand-new.

What does CriticalBlue focus on in the multicore and hardware/software areas?

In the hardware/software area, we developed a technology to allow the direct migration of software functionality into a hardware coprocessor. So, in other words, we developed a methodology that allows you to use software to design the hardware, which is something that doesn't really exist at this point. Usually, people make the decision upfront and design a piece of hardware and a piece of software and stitch it together, but there are situations where you have something captured in software. You need to reduce the power consumption or increase the performance; therefore, you need to offload those functions into some kind of coprocessing element, and we've built a solution to enable people to do that.

In the multicore space, we've been doing a lot of work to help people analyze software that they have and figure out how to redeploy it on multicore architectures—for example, a single, standard RISC core and then multiple coprocessors. So, you might look at analyzing some software running on an ARM processor and what you need to do to that software to be able to put it onto multiple coprocessors as well as the ARM.

—Interview conducted and edited by Ann Steffora Mutschler

> **DAFCA** *from page 26*

providers. Unlike DAFCA, BIST providers test the structural, not functional, integrity of a device. In the functional-integrity niche, DAFCA's competition consists of customers rolling their own functional-testing software. DAFCA's advantage is to speed the process, minimize silicon requirements, and—perhaps most important—have analysis software ready to run when a chip comes back from the foundry. Often, says Levin, when a device returns from a fab, semiconductor companies "discover that and they haven't written the software for configuration, operation, and control of those on-chip instruments, and they call us anyway."

DAFCA is growing rapidly and looking to expand into other applications. By press time, the company had racked up 300% of the previous year's total revenue. As for new applications, Levin cites digital-rights management. DAFCA technology, he says, "is not just about making sure nothing bad happens; it's also about ensuring that the right thing happens." *—by Rick Nelson*

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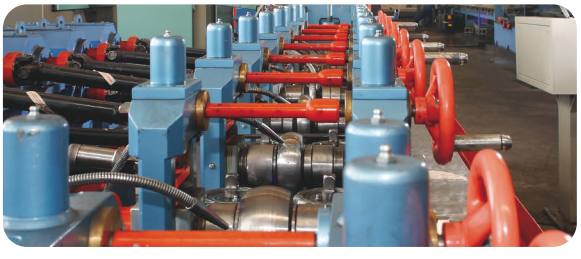

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