



# The Institute

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SEPTEMBER 2004 VOL. 28, NO. 3



## Standing Up For a Better E-Ballot Box

BY ERICA VONDERHEID

IT WON'T BE ready for this year's U.S. presidential election, but the hope is that it will be ready before the next one, four years hence. We're talking about an IEEE standard that specifies the performance requirements of electronic voting machines.

The standard being developed is the IEEE 1583 "Standard for the Evaluation of Voting Equipment." It is a performance standard, which means it won't specify how a voting machine should be designed or manufactured. Instead, the standard outlines what a voting machine must do—for example, maintain the confidentiality of the voter's choice, withstand hacking, be easy for voters to use, and take into account voters' physical disabilities or language difficulties. The stan- [Continued on page 16]



A voter inserts her voter-identification card into a management terminal that will clear her to use one of the touch-screen voting machines in the background.

# Getting a Handle On Hydrogen

Four societies band together to answer questions about this alternative fuel

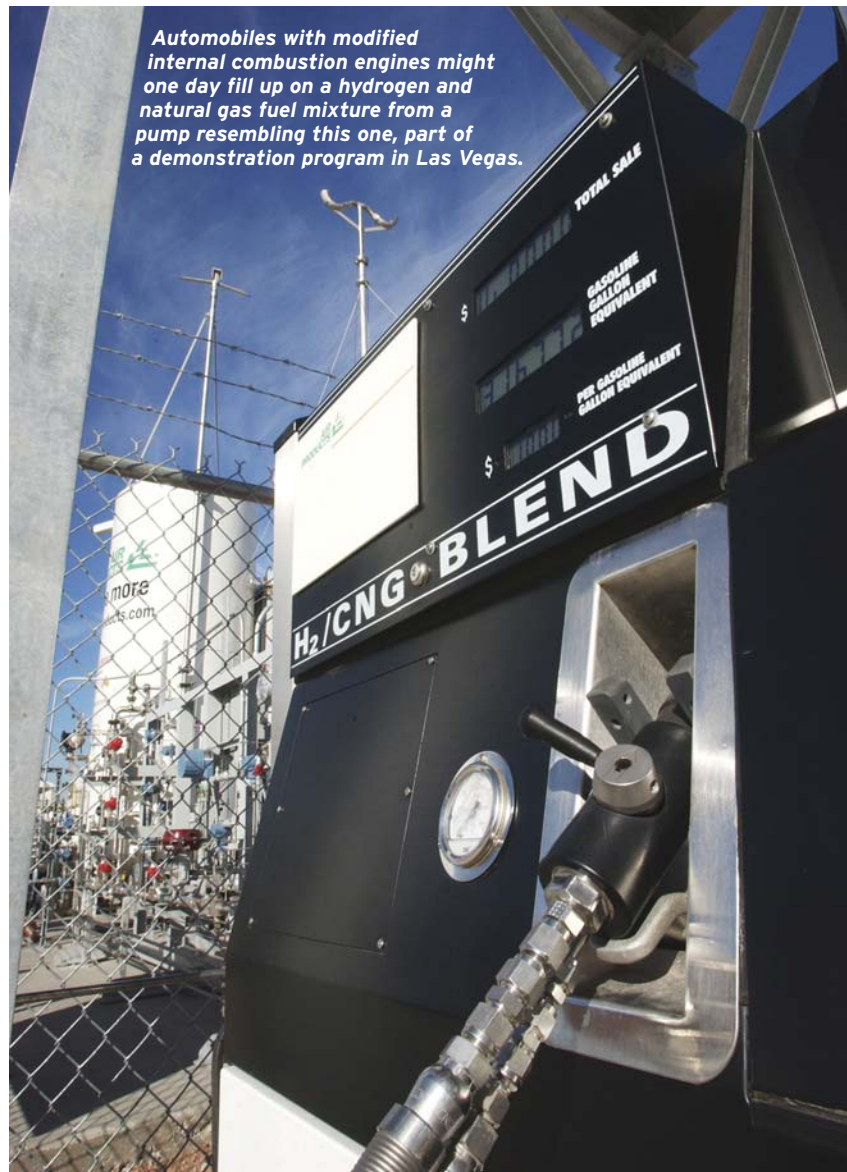
BY KATHY KOWALENKO

Is hydrogen, and a hydrogen economy, the answer to air pollution and the world's dwindling reserves of fossil fuels? The industrialized countries are committing billions of dollars to find out, which is why the IEEE sees a role for itself in educating the movers and shakers of government on the ins and outs of hydrogen.

To help sort fact from fiction, four IEEE societies have united to help policymakers with accurate, objective information about the technology in the hope that they will be better equipped to make sound decisions.

"We know how hydrogen works, we know how fuel cells work, but [the IEEE] has never used that knowledge to take an active role in educating policymakers as to what a hydrogen-based economy will look like," says IEEE Fellow Saifur Rahman. He's the director of the Center for Energy and Global Environment at Virginia Tech University's Alexandria Research Institute in Alexandria, Va., USA. The center investigates nonconventional energy technologies that don't harm the environment.

Rahman belongs to the IEEE Power Engineering Society, which, along with the Industry Applications and the Power Electronics societies and the Society on Social Implications of Technology, plan to publish easy-to-understand articles, hold nontechnical conferences, and [Continued on page 14]



Automobiles with modified internal combustion engines might one day fill up on a hydrogen and natural gas fuel mixture from a pump resembling this one, part of a demonstration program in Las Vegas.

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BY KATHY KOWALENKO

The three contenders for 2005 President-Elect—[from left] James Tien, Michael R. Lightner, and Levent Onural—recently met in Philadelphia to discuss issues of concern to IEEE members and the engineering profession.

## 12 In the Mood for Moog

BY ERICA VONDERHEID

He's collaborated with musical greats like Stevie Wonder, Mick Jagger and Chick Corea, but for IEEE Life Member Bob Moog, his 50-year career in electronic musical instruments is all just an extension of work he did while tinkering as a kid in the basement of his New York City home.

## THE INSTITUTE ONLINE

Find information on these topics and more at [www.ieee.org/theinstitute](http://www.ieee.org/theinstitute) on 6 September.

## More From the Candidates

Read more of what the candidates for 2005 IEEE President-Elect had to say about a president's influence in the IEEE, ways to increase membership, and whether it is better for top leaders to meet in Poland or Piscataway.

**PLUS NEWS** Two new journals coming in 2005: *IEEE Transactions on Industrial Informatics* and *IEEE Journal on Display Technology*.

**HISTORY** The IEEE celebrates the hundredth anniversary of John Ambrose Fleming's invention of the vacuum tube by naming it a milestone in the history of electrical engineering.

**FEATURED CONFERENCE** Oceans/Techno-Ocean, 9–12 November, Kobe, Japan.

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## 1 Getting a Handle On Hydrogen

BY KATHY KOWALENKO

Will hydrogen be the replacement for the world's dwindling reserves of fossil fuel? Amid talk of this new hydrogen economy, four IEEE societies have banded together to separate fact from fiction and explain the technology both to policymakers and the public.

## 1 Standing Up for a Better E-Ballot Box

BY ERICA VONDERHEID

An IEEE standard now in the works will specify how electronic voting machines should perform. The next draft to be voted on is due by the end of the year.

PRESIDENT'S COLUMN

## 6 It's a Global Village Out There

BY ARTHUR WINSTON

Our annual Honors Ceremony in June was a reflection of just how diverse our IEEE community is.

# NEWS

FROM AROUND THE IEEE & THE WORLD

## Amending the IEEE Constitution

**MORE THAN A DOZEN** revisions to the IEEE Constitution have been proposed by the IEEE Board of Directors and combined into a single amendment. The amendment is to be included with the ballot and other materials for the IEEE's annual election being mailed to members around 1 September.

The revisions do the following:

- Reflect the phrasing of the institute's certificate of incorporation.
- Remove reference to the location of the IEEE's corporate headquarters, which remains in New York state in accordance with the certificate of incorporation. New York law no longer requires that the location be specified.
- Remove wording in the constitution requiring that publication activities and the largest membership meetings take place in

the United States, the better to reflect the global nature of the IEEE.

- Allow the distribution of materials and transmission of votes to be sent to members of the IEEE Board of Directors by other means in addition to the U.S. Postal Service.
- Clarify that "full age" in the constitution means 18 years, the age requirement for IEEE Directors and Delegates that coincides with New York state law.
- Modify wording in the constitution to clarify that directors may be elected by all the eligible voting members, groups of voting members, or the IEEE Assembly.
- Eliminate the requirement that at least one member of the IEEE Board of Directors be a New York state resident.
- Remove outdated functions of the IEEE Secretary.
- Clarifies wording to say that the IEEE

## Popov Society Honors Snyder

**LIFE SENIOR MEMBER** and 2001 IEEE President Joel B. Snyder was made an Honorary Member of the Russian Popov Society for Radioengineering, Electronics, and Communications in May, at the society's annual meeting in Moscow. Snyder is shown as he received the recognition for his "great contribution to developing and strengthening the fruitful cooperation between the IEEE and the Russian Popov Society." ●



Board of Directors has a fiduciary responsibility for the IEEE's assets.

Other changes affect editorial and administrative matters, or are made to be consistent with recent revisions in New York state law. The amendment will be adopted if it receives at least two-thirds of all votes cast, and if 10 percent or more of members qualified to vote do so.

The full text of the IEEE Constitution and more details about the revisions can be found at <http://www.ieee.org/about/whatis/bylaws/changesgrid.xml>. ●

## Time to Vote

**THE ANNUAL ELECTION BALLOT** will be arriving in members' mailboxes this month. In addition to the three candidates in the race for 2005 IEEE President-Elect [see p. 8], 40 others are running in 16 contests held in the IEEE's various divisions and regions.

IEEE nominating committees worked to ensure that a diverse group of candidates was selected to represent each region and division. Those on the ballot went through a long and involved process aimed at selecting people who are highly qualified, have the time to devote to their future responsibilities, and are dedicated to serving the IEEE membership.

Only members with paid-up dues are eligible to vote in the annual election. They must return their signed ballots by noon on 1 November or the ballots are invalid. This year, for the first time, members will be able to vote by e-mail as well. Each voting member will receive a personal identification number to ensure the transmission is secure. This PIN, along with instructions on how to transmit the ballot over the Web, will be included in the packet of election materials.

To find out more, visit the candidates' Web sites at <http://www.ieee.org/organizations/corporate/candidates.htm>. ●

## Dues Increase

**BASIC IEEE MEMBERSHIP DUES** will be boosted slightly to US\$116. This is an increase of \$3 over last year's dues and is at about the rate of inflation in the United States.

For U.S. members, the IEEE-USA assessment will increase by \$1, to \$35. There will be no change in student dues; they remain at \$30 for U.S. and Canadian students and \$32 for all others.

Dues for society affiliates will increase by \$1.50 to \$58, as these dues are set at half the basic IEEE dues. A society affiliate is someone who belongs to a professional society other than the IEEE and joins an IEEE society. Affiliates can belong to any number of IEEE societies but are ineligible for benefits or services.

Membership renewal bills will be mailed out in October. ●

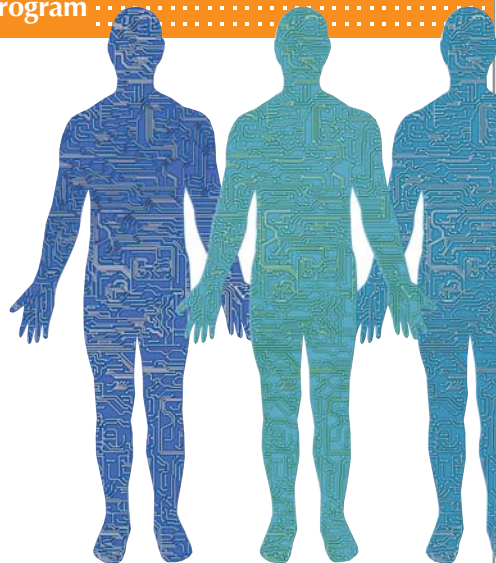
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## Neural Networks Society Changes Name

**THE IEEE NEURAL NETWORKS SOCIETY** has a new name: the IEEE Computational Intelligence Society. "This name is more encompassing and includes the technologies of neural networks, fuzzy systems, evolutionary computations, and other computational principles," says society president Jacek Zurada. The old name covered only one of the society's areas of interest, he explains.

The new name will be unveiled this month on the society's publications, which include *Transactions on Neural Networks*, *Transactions on Fuzzy Systems*, *Transactions on Evolutionary Computation*, *Connections*, its quarterly newsletter, its membership renewal materials, and promotional flyers.

Also, the IEEE Intelligent Transportation System Council will change from a technical council to a society. This change will take effect in 2005 and bring the total number of IEEE societies to 39. ●

—Compiled by Lindsay Elkins

# Is E-Voting Ready for Prime Time?

Several countries use electronic voting machines, but the technology has been plagued, at least in the United States, by questions of accuracy and security fears. What must be done before e-voting is safe, secure, and reliable?

RESPOND TO THIS QUESTION by e-mail or regular mail. Space may not permit publication of all responses, but we'll try to draw a representative sample. Your comments are subject to editing for brevity. Suggestions for questions are welcome. Your answers will appear in the December issue of *The Institute*.

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## Jack of All Trades

Throughout my 35-year engineering career, I have observed that most companies are looking for engineers who can do everything. Just look at the job descriptions in employment ads. When economic times are tough, broadly skilled engineers can be easily moved around within a company.

Companies do hire people with narrow skill sets when they need to tighten their belts, but the higher pay rates and inflexibility of engineering specialists make them stand out as targets for termination.

STEVEN HATHAWAY  
Palm Bay, Fla., USA

## Focus on the Jobs

To get jobs today, you need a broad education, business experience, patent knowledge, leadership skills, and the ability to make a mistake and learn from it.

Many people try to become well-versed in one specific skill or technology, thinking that will get them a job. The problem is that companies don't need such engineers anymore. Stay focused on where the jobs are: national labs, small companies, monetary institutions, and start-ups. Make yourself someone these industries can use. Don't let old ideas of engineering being taught at universities direct your preparation.

JOHN CONKLIN  
Louisville, Ky., USA

### RESPONSES TO JUNE'S QUESTION

## What's Best for Finding a Job: A Narrow Skill Set or a General Background?

### Blend of Skills

Having a broad range of skills has been key to my career in application engineering, sales engineering and management, and marketing management. The blend allows me to seek jobs that require my technical and marketing talents. Other individuals holding similar positions to mine in my company or other companies in my market are either too technical or too nontechnical.

WAYNE G. HARTMANN  
Largo, Fla., USA

### Only Specialists Need Apply?

It's more important to have specific, highly developed skills, than a general, but diversified, engineering background. The day of the engineer seems over, and now technologists and technicians are most in demand. There will always be a need for well-rounded, competent senior engineers, but their numbers are small in any given company compared with all the "worker bees" grinding out products.

GREG BAUER  
Fall City, Wash., USA

### Too Broad a Background

I have a broad background in sales engineering, telecommunications, and IT, but I have been out of work for almost a year and a half. Companies are hiring people who focus on one specific technology. Among the skills most in demand are those dealing with storage area networks, voice-over-Internet protocol, and Internet security.

I've applied for many of these positions and have gotten only as far as a phone interview. On the phone I admit that I'm more of a generalist who can handle broad responsibility, can think fast on his feet, and is not quick to job-hop. It's a good argument, but the hiring managers aren't buying it.

ROBERT A. MORRIS  
Denver

### Tweaking the CV

In the San Francisco Bay area, I don't see employers seeking engineers with broad backgrounds. Qualification for employment seems strongly oriented toward specific backgrounds. Because of this, most engineers I know tweak their curriculum vitae for every opening they apply for. They don't lie or exaggerate experience, but they do emphasize and expand on certain areas.

Most employment now also seems "tool-centric." Everything from chip design to network management uses vendor-specific tools. Employers would rather hire someone already trained in these tools than do the training themselves.

GROVER RIGHTER  
San Francisco

## LETTERS

### IEEE-USA on H-1B Visas

In a June letter [p. 5], Rami A. Kishek wrote that the IEEE's image as an international and professional organization was damaged by IEEE-USA's campaign to lower the cap on H-1B visas. He also hoped that the IEEE "will become more sensitive to its international members."

As a past president of IEEE-USA, I can assure Kishek that the volunteers on the IEEE-USA policy committee are sensitive to the views of all members, both inside and outside the United States. Often we are so sensitive to their opinions that many of our IEEE-USA members are upset that we are not more aggressive in supporting the career and employment needs of those residing in the United States.

For the past several years, U.S. members have experienced the highest unemployment in recent memory. Engineers in the United States have been described as throwaway professionals, and our employers and government seem to want to keep it this way by supporting any and all methods for increasing the supply of engineers here, regardless of demand. I feel an obligation to support policies that increase

the probability that those in the United States will find viable employment.

When IEEE-USA supports jobs for the United States, we are advocating meaningful jobs for all engineers working in the United States, not just those who have been in our country for generations.

LE EARL BRYANT  
Richardson, Texas, USA

### Shortsighted on Oil

In "Getting Smart About Getting Around," about intelligent transportation systems [June, p. 1], the author fails to consider the eventual outcome of our continuing reliance on the automobile. Many long-term analyses tell us that the world's petroleum supply is very low. Whether it will last 20 or 60 years makes little difference from an engineering standpoint. Our job is to figure out how to maximize the petroleum supply we have, as well as how to shift our energy dependence from petroleum to solar energy and wind power.

I find it significant that the greatest squandering of petroleum occurs in the Los Angeles area transportation system.

Los Angeles planners appear to have no intention of developing an overall area mass transit system, but rather are enhancing automobile use, as highlighted in the article.

The IEEE should take the lead in developing solutions for the gigantic social problems we will face in the near future. It is of no help to adopt the apparent attitude of Los Angeles transportation planners, who are primarily supporting the very short-term profit objectives of car manufacturers, oil companies, and automobile insurers.

SHELDON C. PLOTKIN  
Los Angeles

### Seize the Opportunity

Thank you for the article on the FIRST Robotics competition ["Fired Up by Robots," June p. 10]. I am the leader of Team 87, the Red Devils; an IEEE member; and an engineer for Lockheed Martin. I've been involved with the team and FIRST (For Inspiration and Recognition of Science and Technology) for five years, and I have seen the impact it has on the high school kids and, truthfully, the

impact it has on me. Watching these kids get excited each year about what we are doing renews my own excitement and satisfaction in engineering.

I have often wondered why the IEEE itself, though hundreds of its members volunteer, does not take a bigger part in the competition. We are missing an opportunity to find bright young minds that could be assets in electrical and computer engineering. The IEEE should provide funds for scholarships and consider a grant program of some kind to help create more FIRST teams.

GEORGE MARCHANT  
Medford Lakes, N.J., USA

### TELL US WHAT YOU THINK

We welcome letters from readers expressing opinions on matters of interest to the IEEE members and to the technical community at large. Please include your city, state or province, and country.

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# It's a Global Village Out There

One of the more enjoyable tasks of the IEEE presidency is guiding the selection of a theme for the IEEE Honors Ceremony. After all, this is the grand annual event of our organization, when we confer our major medals, and the theme must communicate both the significance of the occasion and what matters most to the IEEE and its members.

I am proud that this year's Honors Ceremony, held in June in Kansas City, Mo., USA, had globalization—the motto of my IEEE presidency—as its theme.

I can think of nothing more important for the IEEE to embrace, now and in the future, than the global nature of our association. Thus, the decision to make globalization the theme of this year's Honors Ceremony was certainly the right one.

That June evening, I observed that the exceptional men and women receiving the IEEE's highest professional honors, along with audience members, represented a microcosm of our global organization. Many were born and raised outside of the United States and indeed are citizens of other nations. In addition, many of our U.S.-based members—myself included—were born elsewhere.

The diversity of our 2004 Medal recipients and our membership reflects the traditions of the IEEE. As I noted in my March column, the leaders who united our two predecessor societies in 1963 deliberately excluded the word "American" from the new organization's name. Still, many perceive today's IEEE as a U.S. organization. Not so. While we are headquartered in the United States, we serve members in more than 150 countries. At present, 37 percent of our membership, roughly 115 000 men and women, are citizens of nations other than the United States.

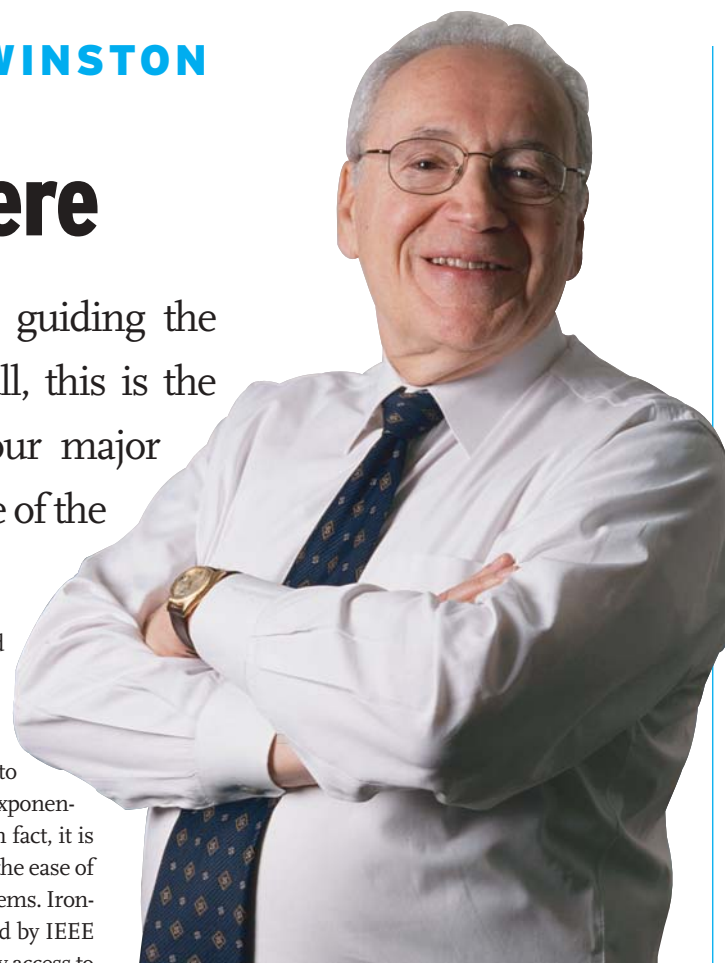
Today, our members find it easier than ever to share ideas, the very essence of the IEEE. Just a few decades ago, we communicated only through printed materials

and telephone wires, but today's Internet and wireless technology bind us together no matter where on the planet we are.

The success of IEEE electronic publications has made important information accessible to members and nonmembers alike, generating exponential growth in the IEEE's international family. In fact, it is easier than ever to be a global organization. But the ease of interconnectivity brings with it a new set of problems. Ironically, the World Wide Web, created and powered by IEEE members, is affecting IEEE membership; the easy access to IEEE publications that the Internet enables is leading some to question the value of enrolling as a member.

Let me draw an analogy to a related situation—the well-publicized battle between the music industry and the millions of people around the world who download free music via Internet file-sharing schemes. Our predicament is similar to that of the music industry. Music and the IEEE's information are both intellectual property, and access to this property is just a click away.

In one critical respect, though, downloading a song is quite different from downloading an IEEE document. For one, you cannot tap your foot to a nanotechnology paper. But more important, the exchange is one-way between a music source and a music downloader. The IEEE offers something that no recorded music source can: the opportunity to participate in the creation of the material and in the process of discovery, invention, and technological



development. All this is possible, not just reading the material after the fact! To carry the analogy a bit further, music-file sharing offers the opportunity to listen to a song, whereas the IEEE encourages you to play in an orchestra.

The IEEE is an excellent model for global collaboration. Our vast resources in education, conferencing, and networking allow members around the world to get ahead of the curve in their professional careers. Our geographic distribution is extraordinary, providing instant global relationships and allowing us to touch upon a vast array of technology interests.

IEEE members are leaders in their field, and each of us helps to drive and shape thought in our place of work. If you believe as I do in the global IEEE, then you have a responsibility to spread the word about why IEEE membership is a valuable professional asset. To borrow a familiar phrase, "membership has its privileges." ●

## The Institute

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# From Outsourcing to Plagiarism: The Candidates Respond

BY KATHY KOWALENKO

**C**ANDIDATES Michael R. Lightner, Levent Onural, and James M. Tien, all running for 2005 IEEE President-Elect, presented their views on issues critical to members at the 16th Annual Candidates Night, hosted by the Philadelphia Section in June. The three will be on this year's election ballot, each hoping to succeed (in 2006) W. Cleon Anderson, who will be president in 2005.

Lightner, Onural, and Tien answered written questions from the audience of about 90 people at the Sheraton University City Hotel in Philadelphia, as well as questions submitted earlier by readers of *The Institute* who did not attend. Topics ranged from the outsourcing of U.S. engineering jobs and the recent ruling by the Office of Foreign Asset Control (OFAC) of the U.S. Department of the Treasury, to the presence of plagiarized articles in the IEEE Xplore document delivery system. Philadelphia Section Chair John Sudano moderated the event. Each

candidate had five minutes to answer each question or group of questions.

Several questions dealt with the outsourcing of U.S. engineering jobs to countries overseas.

**TIEN** said that IEEE members need to understand that each country has to act on behalf of its citizens. But with so many countries and so many different policies, he noted, "There's no way the IEEE is going to have one policy for all of our sections; we can't. On the local level, every IEEE region and section has to support its members." Tien, vice president, Educational Activities, asserted that the IEEE could help its U.S. members stem the flow of jobs by working to create technologies that bring the United States new revenue sources and economic growth. "In the past, engineers have been the engines that helped lift a country's economy," he said.

**LIGHTNER**, vice president, Publication Services & Products, responded that there were two contributing factors behind the issue of outsourcing. The first he called the "commodification of engineering."

"We are no longer viewed as skilled professionals;

we're hired help," he asserted. "The view of engineering as a profession is being challenged. That is the case in other countries, too, but especially in the United States. Changing that position so that we are viewed not as a commodity but as a skilled and necessary part of the economy of our countries is one key thing we have to do. If that view doesn't change ... we're not in good shape as a profession."

The second contributing factor is an issue for IEEE-USA.

"IEEE-USA, as much good as it has done, has not reached the mass of U.S. members," he said. He called on the organization to immediately start an affiliate program for engineers in the United States who are not IEEE members but who are concerned with the issues. This could increase the profession's clout with the U.S. government and could bring changes on particular issues.

**ONURAL** pointed out that the rising rate of technically competent people in low-wage countries around the world is the underlying reason behind outsourcing. A former director of IEEE Region 8 (Europe, Middle East and Africa) who also served as IEEE Secretary in 2003, he said the



institute helps members find jobs through its job site and its continuing education programs and materials.

"IEEE members are more flexible than the rest of the engineering world; they have the edge in coping with changing environments and changing jobs," he noted.

He also said that IEEE-USA is best placed to deal with what he calls the "one-way flow of the labor force across the U.S. border." The domain of the IEEE is the whole world, he added, and therefore the IEEE must stay away from making asymmetric policy statements favoring one group of members over another. If necessary, he said, the IEEE could issue globally applicable statements dealing with employment conditions for engineers worldwide.

**QUESTION: If you had been president at the time, how would you have handled OFAC regulations that prevented members in Cuba, Iran, Libya, and Sudan from taking advantage of member benefits and services?**

**ONURAL** noted that the IEEE must operate within the restrictions and laws of wherever it finds itself. He is experienced with IEEE activities in different countries, and whenever an event is held, he said, he often worries about the IEEE's compliance with local rules and regulations. "Running a conference in a country other than the United States might be more difficult because of financial and tax issues and rules, but we have to learn to respect them," he said.

Onural said he was surprised when he learned that the IEEE was having a problem with OFAC regulations: "I thought our staff and legal advisors had us in 100 percent compliance with the rules of the United States." He noted that the IEEE may or may not like certain restrictions, but it cannot violate them. It should investigate the issue and be prepared to take action—possibly legal action—to correct what it doesn't like.

"We first should try to negotiate and solve our problems with the government authorities," Onural continued. The IEEE worked with OFAC. It took a lot of time but, he pointed out, "that was part of the process. If we don't like the result, we might continue the discussions, take legal action, or—at the political level—put on pressure to change regulations we don't like."

He believes that in this case, the IEEE acted correctly when it took a stand in favor of the free flow of information among scientists, with no restrictions whatsoever.

**TIEN** noted that the IEEE has been living under OFAC for 15 years and doing the right thing. "If OFAC told us we cannot publish papers from members living in those countries, I think that would have been different," he said. "But instead OFAC said we could not edit and help these particular authors write a better paper. We edit because it's good for us too, not just good for the authors."

Tien recalled that when he was vice president of Publication Services & Products in 2001 and 2002, he was instrumental in having the IEEE Board adopt a resolution upholding the IEEE principle of publishing all papers that had been appropriately reviewed. With respect to responding to OFAC, Tien quoted Winston Churchill: "It has been said that democracy is the worst form of government except all the others that have been tried from time to time."

**LIGHTNER** said that, as the current vice president of Publication Services & Products, he is involved in discussions with OFAC. "When we know we're breaking the law or highly likely to break the law, it's incumbent upon us to examine that and understand how to go forward," he explained. "You can agree or disagree with this advice, but you can't ignore what's put in front of you. That is not appropriate for an institution like ours."

The IEEE's goal has always been to support the free exchange of scholarly information, he noted, and to collaborate with colleagues around the world. The tactic the IEEE takes is to work within the confines of OFAC, and if necessary ask it for an exemption.

After much negotiation earlier this year, "we got something pretty good," Lightner said. "The important thing is how we communicated, and the fact that we really were right in what we were trying to do. We were approaching the issue from the moral high ground.

"We were criticized by others in the publishing community, and so we may have looked bad. Going forward, the IEEE needs to be much better at communicating its position to everyone and not be made to look like we have 'mud all over our faces' when we're actually doing the right thing," he said.

**QUESTION: What action do you think is appropriate to take against an IEEE member found to have plagiarized another's work?**

Plagiarism—the act of taking someone's work, like an article, and passing it off as one's own—is nowadays easier than ever to detect, **TIEN** said, noting that universities and high schools have software programs to detect such incidents. "Plagiarism seems like a big problem because it sounds like it's new, but it's not," he said. "The way we detect plagiarism is new and much more powerful. The IEEE must deal with it right away and not let it go on. We ought to let each person know that plagiarism is against our code of ethics."

**"The answer to having more members from other countries is to INVITE PEOPLE IN WITH OPEN ARMS."—ONURAL**

Tien explained that plagiarism and copyright issues are not of great concern in some countries, and he suggested the IEEE encourage those countries to "get their houses in order."

**LIGHTNER** noted that the IEEE has written a new plagiarism policy, along with policies on how to handle the same paper submitted to multiple publications. The IEEE Publication Services & Products Board passed a plagiarism policy in June, Lightner noted. The policy takes into account different degrees of plagiarism—from sloppy writing to authors' names being taken off the original paper and replaced with the names of new authors.

"We have in place what I call the 'Scarlet P,'" Lightner said. "In our electronic database, a plagiarized paper receives a violation notice that is associated with that paper forever. The paper, along with the notice, won't go away. It's not pulled out so it disappears; it's out there for the public to see."

In extreme cases, the Publication Services & Products Board has recommended that a member who commits the violation be brought before the IEEE Ethics and Member Conduct Committee for a hearing.

The IEEE is a highly ethical society and cannot tolerate plagiarism, **ONURAL** stressed. He agreed with Tien that in some parts of the world copyright infringements are a routine part of doing business.

"Therefore, we also have a mission to educate people," Onural said. "The IEEE should do more to raise awareness and to educate people that plagiarism is not acceptable, as well as how to recognize it."

"If somebody detects that his work is plagiarized, it is not an easy matter to fight," Onural explained. "We have

to make it easier for people to come forward and say their work is plagiarized, show proof, and identify the journals so that, in turn, their problem becomes the IEEE's."

**QUESTION: Many members outside the United States do not feel the IEEE represents their interests. What changes would you recommend the IEEE make in products and services, for example, for it to become a truly international organization?**

**LIGHTNER** said that he believes the IEEE is already an international organization, but that the challenges the organization faces are with its nontechnical benefits, which are, fundamentally, only for those in the United States. The IEEE is currently investigating financial, insurance, and credit card programs for members in different parts of the world.

As for access to technical information, he pointed out that "the first thing we're doing correctly is providing Web-based access and working with countries to put together consortia that can afford to buy a subscription to the IEEE/IEE Electronic Library," he said. The next thing to be done is to explore whether members want to have regional Web sites in local languages, not in English. Some experiments with this are taking place in Latin America (Region 9). "I think respecting the reason that people join is key," Lightner said. "We're doing that by adding services that provide localized and culturally sensitive access."

**ONURAL** believes the IEEE is a successful transnational organization, probably one of the most successful, but he questioned whether the membership ratio was at

the desired balance between U.S. members and members from other countries. "We can definitely move the transnational structure of the IEEE to a much better place," he said.

He noted that approximately 35 to 40 percent of IEEE members live outside North America. "The answer to having more members from other countries is to invite people in with open arms," he said. "Make them feel like they are a part of the IEEE, and make it easier for them to get into leadership positions," he continued. "There are volunteer positions in local sections that are easy to get, but there are also other worldwide positions available through societies. We have to make it easier for people living outside North America to get involved at the leadership level, and they will contribute significantly in return."

**TIEN** emphasized that members should be involved globally for the engineering profession and locally to lobby for membership advantages. "And I include getting involved locally not only through their technical societies but also in the regional sense, through their sections," he said.

He noted that the IEEE has failed to help the profession at the global level. "For example, the IEEE does not take global public policy positions," he said. "We should be able to do that within the scope of our profession. Other organizations should come to the IEEE about technical issues and seek our opinion; we're the knowledgeable experts."

Tien suggested that the IEEE issue public policy statements at its corporate level, because that would span cultures, countries, and regions. He believes engineers would support such positions because each would feel that "I've got to go with my profession and help it make the right decisions on a professional level."

# “Instead of continued cost cutting, the IEEE should develop more ways to GENERATE REVENUE.” – TIEN

He sees nothing wrong with IEEE-USA focusing on H-1B visa issues in the United States while other countries focus on their immigration-related issues. “If we want to be global, we’re going to have to deal with issues like immigration,” he said.

**QUESTION: How will you balance the budget so that budget cuts will be unnecessary?**

**ONURAL** said he’d spent a lot of time considering this question and believes the answer to balancing the budget is to increase the IEEE’s efficiency.

The IEEE spends US\$240 million a year and must try to find ways to reduce its spending. “Just by considering simple alternatives to what you’re doing, like checking the price of the things you buy, I think anybody can easily reduce their budgets by 5 or 10 percent and still get the same benefits,” he said.

**TIEN** responded that instead of continued cost cutting, the IEEE should develop more ways to generate revenue. For example, Tien referred to the pilot program now being tested, called XELL (Xplore Enabled Learning Library), which converts short courses given at conferences to courses for online delivery and then makes them available over the Web. He believes that XELL could “rival the IEEE/IEE Electronic Library in terms of revenue.”

**LIGHTNER** agreed with Tien that further cost cutting is not the answer and increasing revenue is key. He pointed out that the IEEE generates 19 percent of its revenue from membership fees, 50 percent from publications, and 28 percent from conferences. But he noted that all three areas face challenges, and he did not necessarily believe the income projections for XELL.

He said the key was working creatively on membership and member products and services. “How do we increase our activities, get more people to participate, and get more companies to purchase our products for our members who are part of those companies?” he asked. “That’s the way we’re going to raise income, and the only way that we’re going to maintain our strength.”

**QUESTION: Do you think the number of IEEE societies [38] is too many, too few, or just about right?**

**LIGHTNER** noted that when he was vice president of Technical Activities and ran meetings with more than 60 people, the number of attendees wasn’t the issue. It was the “asymmetry of membership.” Some societies have 3000 members and others have 100 000, but all have the same number of votes at a Technical Activities Board meeting. The needs of the societies are diverse, Lightner said, and “the impact of changes in product revenue and infrastructure distribution

formulas are also very different. The asymmetry makes effective decision-making and governance very difficult.”

A bigger problem, he noted, was that the societies and the IEEE had no history of strategically halting or combining activities.

“The concern is always on starting something new—a new society, publication, conference, and so on,” Lightner maintained. “We must be able to start new activities, and this includes starting new societies, but we must be willing to stop activities that no longer prove viable.”

**ONURAL** pointed out that no IEEE policy exists that caps the number of societies. He believes the number the IEEE has “is the right number because we have that number today.”

Onural noted that many societies are too small and getting smaller, and some are thinking about merging with other societies or shutting their societies down. But he noted the IEEE does a poor job of promoting its societies. And by contrast, many societies have too many members, ranging from 70 000 to 100 000.

“If it’s right to have such a large membership within a society, I have nothing to say from the IEEE point of view,” he said. “However, if the society’s leadership believes it has too many members and it is better to split its society, therefore creating more societies, I see nothing wrong with that either.”

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**TIEN** noted that the technical societies are responsible for discovering emerging technologies, holding conferences, publishing journals, and providing the IEEE's intellectual property.

"I would like to unleash them even more," he said. "I think in the last three years we've not let them spend their own [cash] reserves. They have to get back to what they do best, which is be entrepreneurial."

Tien saw no problem if the number of societies increased to, say, 80, but did agree with Lightner that there should be a way to "kill off those that are just hanging on."

"I don't think size matters as much, because obviously if we want emerging ones, they'll all be small," he continued. "I don't want size to kill them off before they're born. But we've got to be smarter about the way we grow them or change them or merge them. They've got the 'feel of the street.' They know what's going on. We can't centrally control that, and if we did, I think we'd kill their entrepreneurial spirit."

**QUESTION: When will we get literature from the IEEE that can be read by practicing engineers? Most cannot read IEEE's transactions.**

"Supporting the needs of practicing engineers will require diversifying our intellectual property," **LIGHTNER** said.

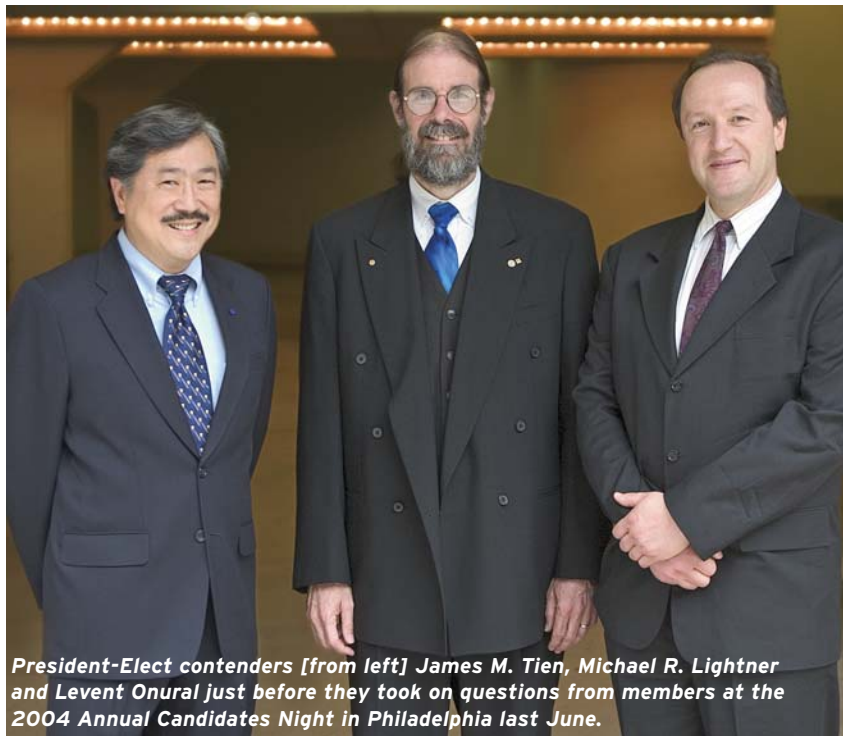
To do this, he believes that journals and magazines should retain practicing engineers to write articles. This is difficult because practicing engineers are extremely busy, they lack support from their companies, and they are not paid to write. Lightner said that the IEEE must either pay these authors like professional magazines do or work with an author's company to demonstrate that the work is valuable—not only for the individual but for the company to appear in a publication as well.

Another solution could be to invest in professionally edited magazines for practicing engineers. "That's what our competitors typically do," he noted. "That's how they succeed. There's enough content from our own IEEE experts and sufficient advertising revenue. But it needs to be managed and written by professional editors. Exploring this possibility is one of the things that's part of the strategic planning effort that's going on right now," he said.

**ONURAL** pointed out that unlike a business, which must maximize efficiency by giving up unprofitable operations, membership operations must be effective, though not necessarily efficient. "Membership organizations cannot give up on fulfilling their mission, but they have to act in an efficient manner," he explained.

In the past, many attempts were made to publish a readable publication for the practicing engineer, he continued. A recent example was the IEEE-USA's *Today's Engineer*, but it didn't survive in print because of its high operating costs. Membership dues would have to be increased to support such a publication, but such a magazine could be helpful to everybody, Onural said.

**TIEN** noted that although many of the IEEE societies have tried to publish practical papers, there have been few submissions for many reasons. "However, we should be proud of our membership distribution; other professional organizations would love to have our large industrial membership," he said. "They do attend our conferences and contribute to our conference proceedings. However, not every IEEE product or service can be useful to every member."



President-Elect contenders [from left] James M. Tien, Michael R. Lightner and Levent Onural just before they took on questions from members at the 2004 Annual Candidates Night in Philadelphia last June.

He believes the XELL product will be helpful to practicing engineers because it will present tutorials, not articles. "They'll learn more than by reading papers they can't understand," he said.

**QUESTION: Why do you want to be president? What can you do that the other candidates can't? And what is your leadership philosophy?**

**LIGHTNER** said he has the ability to make changes and improvements and to solve problems.

**"Supporting the needs of practicing engineers will require DIVERSIFYING our intellectual property." – LIGHTNER**

What sets him apart from the other candidates, he said, was the level of creativity he can muster when faced with problems. "I have an ability to look across different areas of an organization and see where you can bring pieces together to create something new," he said. "I have experience across the society structure and the conference structure. Not as much on the regional side, but I've learned much more over the past year."

He said his leadership style is to bring people together to enable them to be creative and address important problems, while freeing them from the constraints of a particular answer with a particular dollar figure. They can create new solutions and new possibilities, he said, which we can then work to implement.

"My style is one of enabling the power that exists among our colleagues to address the challenges and the opportunities of the IEEE," he said.

Onural emphasized that he is confident when making important decisions and believes his future decisions will be the right ones. "Whenever it's time to make a decision, I will think as a member of the IEEE, not as the president of the IEEE," he said. "Opinions could be different, but if I think in terms of members, then I believe I will make the right decision whenever I'm called upon. You will get confident leadership from me."

**TIEN** said that he had never sought leadership positions in the IEEE, he was always asked to take them on, and his President-Elect candidacy was no different. "Once asked, I have this problem of being unable to say no if I feel that I can make a difference," he said.

Although there were similarities among all three candidates—they're highly competitive, creative, innovative, and dedicated to the IEEE—Tien said his vision of the IEEE is different from the others. "I've always seen the IEEE as my global resource of choice," he said. "It's helped me in my career, and I'd like now to turn around and help other people in the same profession."

In terms of his leadership style, he likened a leader to a servant. "You don't beat people and say 'follow me,'" he asserted. "They'll follow you if they respect you, trust you, and they see you leading by example. I've always been part of the action. To me, the greatest part of being a leader is to be in on the action and work with other people. Not because you say you're a leader, but because you act like one." ●

## ON THE WEB

More questions and answers from the candidates' forum can be found on *The Institute* Online at [www.ieee.org/theinstitute](http://www.ieee.org/theinstitute).

To learn more about this year's candidates, visit the IEEE election site at [www.ieee.org/organizations/corporate/candidates.htm](http://www.ieee.org/organizations/corporate/candidates.htm).

In addition, each candidate for President-Elect has his own Web site. See:

**Michael R. Lightner:** <http://ece.colorado.edu/~lightner/IEEE>

**Levent Onural:** <http://www.ee.bilkent.edu.tr/~onural/PresidentElect2005/index.html>; and

**James M. Tien:** <http://www.rpi.edu/~tienj/IEEE/tien.htm>

# In the Mood For Moog

BY ERICA VONDERHEID

IEEE Life Member Robert (Bob) Moog—a pioneer in the development of electronic music synthesizers—is modest about his 50 years in the industry.

“I never thought of what I did as being all that original,” Moog says. “I put some electronic music modules in a smaller package so musicians could work with it a lot easier.”

A present-day music synthesizer is an electronic musical instrument usually with a piano-like keyboard. In engineering terms, it is a generator of complex, time-varying functions. For a musician, a synthesizer produces a wide variety of tones ranging from mimicking traditional orchestral timbres, such as a cello, to completely new sounds.

Moog was not the first to build a music synthesizer. Before Moog, synthesizers were big and expensive experimental devices found only in research laboratories where work went on to create music electronically. Moog made them smaller and cheaper so that musicians recording in studios or performing on stage could use them. But since that first synthesizer came out in 1965, Moog has been working with musicians to make sure his synthesizers continue to be easy to use.

Moog’s clients and his fellow engineers appreciate all that Moog has done. They disagree with his self-assessment that he didn’t do much.

“Bob designed modular voltage-controlled music synthesizers and combined them with a keyboard in a nice unified system that musicians could afford and readily use,” says Joe Paradiso, an IEEE member and associate professor at Massachusetts Institute of Technology’s Media Laboratory in Cambridge. Each module controls a different aspect of the synthesizer’s sound, such as pitch, timbre, or volume.

“Until Moog came along, we [keyboard players]



IEEE Life Member Bob Moog is well known for his music synthesizers, such as the Micromoog at Two Lines Music, a musical instruments store in New York City.

were hidden in the background playing a piano. He gave us an instrument whose sound could be made loud enough to cut through concrete and frighten guitarists to death,” says Rick Wakeman of the progressive rock band Yes.

Moog’s synthesizers were chosen by the likes of Mick Jagger, Stevie Wonder, Chick Corea, and hundreds of other musicians. And though Moog may be fairly modest about his work, others have wanted to sing its praises. In celebration of the 50th anniversary of his first company, R.A. Moog Co., a documentary film by director Hans Fjellestad will premier in selected theaters this month. And in May, New York City’s B.B. King’s Bar and Grill hosted Moogfest, a tribute to Moog by artists such as Wakeman and Keith Emerson of the rock group Emerson, Lake & Palmer.

**BASEMENT BEGINNINGS** Moog was in the musical instrument business for more than a decade before he introduced his synthesizer. He got into the business in 1954, when he teamed with his father to launch R.A. Moog Co., which sold kits for making theremins. The theremin was invented in 1917 and is said to be the first electronic musical instrument.

Growing up in the Queens section of New York City, Moog was a natural tinkerer and spent many hours in the basement of his home, often fiddling with electronics projects to avoid practicing the piano. As a teenager, Moog built a theremin, which has a pair of antennas—the classic model has one vertical and one horizontal antenna—that can sense the proximity of the player’s hands. The instrument also has a beat-frequency oscillator that generates audio signals, gated by a voltage-controlled amplifier, all housed in a wooden box. Played by moving the hands around the horizontal antenna to control volume and around the vertical antenna to control pitch, the instrument creates a ghostly, wailing sound akin to that of a violin. Musicians such as Pamela Kurstin and Lydia Kavina—who is a distant relative of the theremin’s Russian inventor—continue to record and perform on the instrument.

Moog attended New York City’s Bronx High School of Science and Columbia University, where he became a student member of the IEEE in 1955. He went on to Cornell University, in Ithaca, N.Y., to obtain a doctorate in engineering physics in 1965. His approach to engineering was determined at Columbia.

“Early in engineering school, the dean of students said to the new class that an engineer is anybody who can do for two cents what any damn fool can do for three cents,” Moog says. “I realized that was a fundamental truth for me. That’s what I was going to be. I was going to be someone who was going to worry about what things cost.”

Throughout his doctoral studies at Cornell, Moog continued to sell theremins and theremin kits. It was this work that propelled him into the next phase of his career.

“Making theremins put me in touch with a lot of musicians,” Moog says. “I began making synthesizers because I saw musicians needed them.” His work on synthesizers became an extension of his tinkering with electronics in his basement in Queens.

Moog unveiled the first Moog Modular System at the Audio Engineering Society Convention in October 1964. An analog instrument, it had several components, including a keyboard, oscillators, and filters, that could be hooked together in various ways. Demand for Moogs jumped with the 1968 release of Wendy Carlos’s ground-

breaking album, “Switched-on Bach,” which featured classical works performed on a Moog synthesizer. In 1970, Moog introduced the Minimoog, a less expensive and more compact synthesizer than the modular system.

“Part of the reason Moog synthesizers have been so successful is because musicians are not usually all that wealthy,” Moog says. The first Minimoogs sold for \$1195. Musicians really took to his products.

“Musicians like my equipment because it sounds good and the controls on the front panel make musical sense,” Moog says. “I think analog instruments in general—our instruments even more so—have a different way of interacting with users than digital electronic instruments.”

Moog left Moog Music in 1977—the company continued to make instruments under the Moog name until 1986—and founded Big Briar in Asheville, N.C., USA, to develop new electronic instruments. Big Briar changed its name to Moog Music Inc. in 2002 after Moog regained ownership of the Moog trademark. Moog’s company currently sells theremins and electronic instruments such as the Moogerfooger, an analog effects device that can impart a wide variety of synthesizer processing to musical instrument sounds. His



**Bob Moog [left], in this 1999 photo, has worked with many musicians, including Keith Emerson of the 1970s progressive rock group Emerson, Lake & Palmer. Emerson was one of the first musicians to tour with a Moog Modular System, seen in the background. An early Moog Modular System, from 1965, is shown with its foot pedals [right].**



company also recently released the Moog Piano Bar, a device that sits above the keyboard on a standard acoustic piano and senses how fast or hard the musician plays the keys. The Piano Bar then digitizes the signals and uses them to create a wide range of instrumental timbres, or formats them into a data stream for use with other electronic music equipment.

In 2002, Moog introduced a new version of his classic Minimoog, called the Minimoog Voyager, based on a renewed interest in his old work.

“The Minimoog we’re making now has all the capabilities of the 1970s model, plus it can store and recall settings and has circuits for making new types of sounds,” Moog says. “It’s all in a package that’s the same size as the original Minimoog. Taking inflation into account, it sells for less than it did in the ’70s.”

But the classic 1970s Minimoog, still in demand because of its distinctive “grungy” sound, is sold in vintage music instrument stores and online auctions.

**ANALOG-TO-DIGITAL CONVERSION** Bob Moog’s pioneering work in the 1960s opened the door for today’s electronic music industry. Dozens of companies such as Korg, Roland, and Kurzweil manufacture digital synthesizers. Many of these modern digital synthesizers strive to replicate the sound of older, analog instruments, like the Minimoog. But it’s not easy.

“The sound his synthesizers create have their own personality that artists and composers like and is hard to reproduce digitally because the old analog [synthesizers] aren’t very stable,” says Leigh Landy, director of the Music, Technology, and Innovation Research Group at De Montfort University in Leicester, England. “These machines produce warm sounds thanks in part to the way the musician can manipulate the dials and faders. The sounds seem more ‘acoustic’ these days than do the sounds of many synthesizers, which can seem rather clinical.”

But modern electronic instruments are challenging the very concept of musical performance. This is because of an industry standard known as the musical instrument digital interface (MIDI), which can connect dozens of electronic instruments through a computer. Music is controlled basically by passing messages between different pieces of software, explains MIT’s Paradiso. With MIDI, musicians can take different samples of music—ones they play on a synthesizer, electric guitar, or other electronic instrument—and string them together to create a finished, and unusual, composition. “With a laptop, anybody can sit in their room and make music,” Paradiso says. “And if they’re talented and they can afford the software, they can compose very good computer music.”

Many musicians, such as the techno artists the Chemical Brothers and Moby, do just that. Moby composed much of his 1999 album “Play” on a computer in his bedroom. Paradiso reports that it’s not unusual to go to a concert and see musicians pull out a laptop, using the computer keyboard as a piano keyboard to play the latest piece they created on a computer, and have the sound produced by a synthesizer.

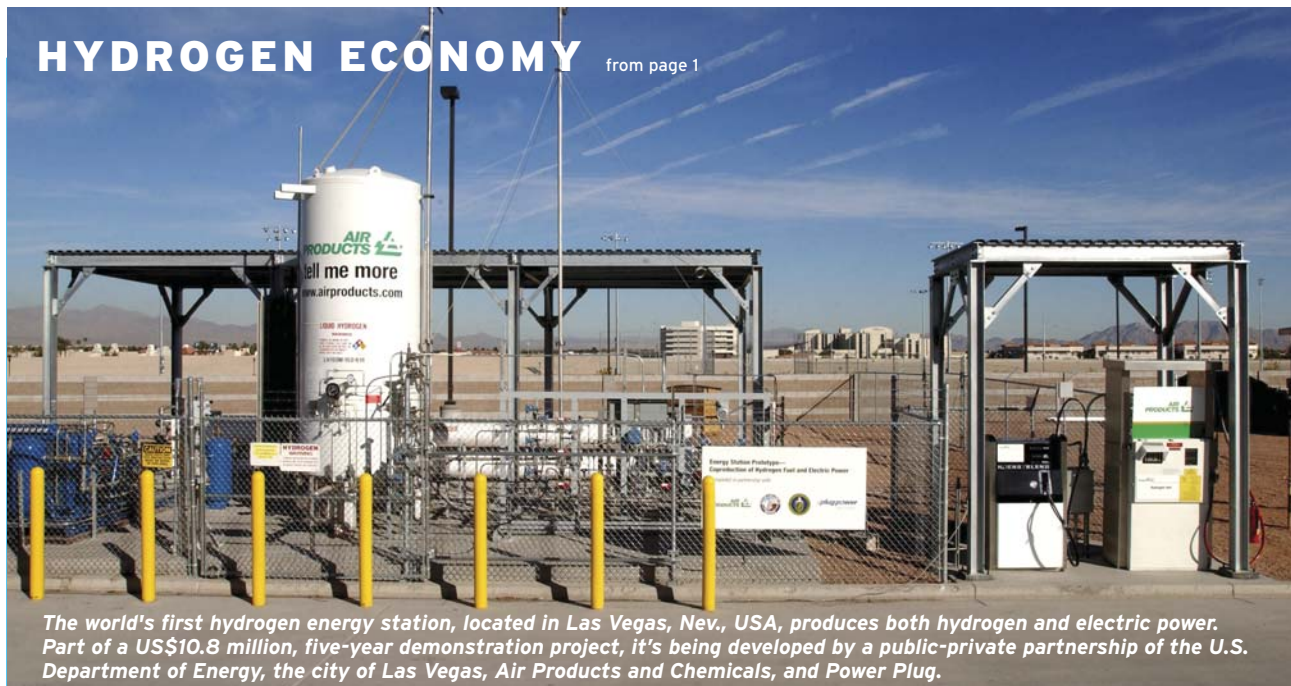
Paradiso sees the future of electronic music as instruments that learn from the musician, rather than the musician learning the instrument.

“I think one of the Holy Grails is the instrument that evolves and changes as you grow as a musician,” Paradiso says. “It works with you to teach you how to play it better.”

Bob Moog, now 70, is moving forward as well and continues to refine his synthesizers and develop new equipment that could, he hopes, be the next Big Thing.

“What I find exciting is knowing what you’re doing could be a new resource for musicians who will use it and say ‘Oh, wow!’”

## HYDROGEN ECONOMY from page 1



The world's first hydrogen energy station, located in Las Vegas, Nev., USA, produces both hydrogen and electric power. Part of a US\$10.8 million, five-year demonstration project, it's being developed by a public-private partnership of the U.S. Department of Energy, the city of Las Vegas, Air Products and Chemicals, and Power Plug.

host online forums to explain the many facets of hydrogen technology and how the technology might affect society.

The IEEE has already published hundreds of articles on hydrogen, but, as Clint Andrews of the Society on Social Implications of Technology notes, they are almost all too technical to be understood by nonengineers. Hence, the presidents of the four societies decided over a year ago that it was time to take a still more active role.

"The IEEE as an institution isn't good at wrapping its arms around new technology, so the societies' presidents tried a new approach and picked hydrogen as a technology in which the institute should have a stronger presence," says Andrews, an IEEE Senior Member and a professor in the Edward J. Bloustein School of Planning and Public Policy at Rutgers University in New Brunswick, N.J., USA. He does research on a variety of energy and environmental-planning and policy topics.

Andrews notes that the multisociety approach will also provide new learning opportunities for those working on hydrogen projects. In particular, he envisages that working together could result in "an intellectual exchange among researchers and decision-makers in public policy, as well as with private industry leaders."

In April, the four societies sponsored their first conference, "The Hydrogen Economy: Its Impact on the Future of Electricity." The conference, in Washington, D.C., considered technical and policy issues surrounding hydrogen systems. The audience of mostly business people, engineers, lawyers, and government officials heard speakers from Europe, Japan, and North America explain the intricacies of hydrogen production, the delivery infrastructure it requires, and public policy concerns. Among the organizations represented were the Hydrogen Energy Systems Society of Japan, NASA's Lyndon B. Johnson Space Center, and the European Commission.

"The conference was very successful, especially as an intersociety collaborative



Honda Motor Co.'s hydrogen-fueled FCX, powered by a latest-generation fuel cell from Ballard Power Systems Inc., seats four, has a range of 270 km on a tank of fuel, and can reach speeds of 150 km/h. Honda is leasing some 30 FCX cars in Japan and California.

effort," Andrews says. "We invited speakers to present a range of viewpoints in nontechnical language so people could understand the controversies, the areas of widespread agreement, and what needs to be done next."

**HYDROGEN 101** Rahman, who was the chair of the April conference, says that one of his most important chores these days is to find venues for explaining the basics of a hydrogen economy. "When you hear diverse viewpoints about hydrogen, you begin to ask questions and so you need a place to go to for answers," he says. And he wants the IEEE to be that place. Accordingly, the four societies have developed a Web site that acts as a forum for discussions of the hydrogen economy. The site, at <http://www.ieee.org/power/hydrogen>, deals with hydrogen production, storage, utilization, and infrastructure, as well as with the basics of how hydrogen produces electricity.

Hydrogen is by itself not a source of elec-

tricity. It must be combined with oxygen in a fuel cell, where a dc voltage is produced, along with water vapor. That's hydrogen's big advantage: the only byproduct is water vapor. There's no carbon monoxide, nitrous oxides, particulates, or the whatnot that make the internal combustion engines in most motor vehicles and power generation in electric power plants so polluting.

But obtaining hydrogen is a problem. Though it is the most abundant element in the universe, it is locked up in chemical compounds, most notably as hydrogen oxide, better known as water, or in the hydrocarbons of (dirty) fossil fuels. To tease out the hydrogen from these compounds requires electricity, which would nowadays most often come from polluting energy sources like oil, natural gas, and coal, which many are trying to get away from.

**CLEAN OR DIRTY** The premise that hydrogen will cut air pollution or reduce dependence on oil is somewhat flawed. Hydrogen may not produce emissions

when it is applied to generate electricity, but using oil or coal to produce the hydrogen does.

"If we switched everything to hydrogen today, we'd be generating more pollution than ever," Andrews says. "We'd be doing the opposite of what we intended."

That's why using renewable energy, from wind or solar power or from the conversion of green plants into energy sources, is the only way to reduce total emissions, according to both Rahman and Andrews. Wind turbines could generate electricity for splitting water molecules into their associated hydrogen and oxygen atoms. Solar panels could generate electricity to be used for the same application.

**PIPES AND PUMPS** And that's not the end of it. "Big infrastructure investments would have to accompany any widespread use of hydrogen," Andrews says.

For example, to use hydrogen in your home to, say, cook your food, a new set of pipelines would have to be laid, because existing natural gas pipes would become too brittle. Or containers would have to be developed for holding hydrogen under pressure so the gas could be carried from where it's produced to where it's used. New hydrogen pumping stations would have to be built or existing gasoline stations modified to provide hydrogen so a car could drive up for fueling. Fuel cells would have to be designed to provide electricity where it's needed. The range of applications is huge: fuel cells would have to be scaled to power anything from a laptop computer to a car to a home to an office building.

One of several nontechnical background documents that the societies have posted on their Web site discusses what



The hydrogen economy may see trailers like this transporting hydrogen to "gas" stations where vehicles could fill up. Built by Powertech, a research division of BC Hydro, the trailer holds carbon-fiber reinforced tanks in which hydrogen is stored at a pressure of 87.6 million newtons/sq. meter.

has been accomplished in the Canadian province of British Columbia, which has made headway in building a hydrogen infrastructure. Senior Member James Gurney spelled it all out in an article, "Building

a Case for the Hydrogen Economy," that appeared in *IEEE Power & Energy* [March/April 2004], a magazine published by the IEEE Power Engineering Society.

Through its program BCHydroGEN

(pronounced BC Hydrogen), the power company BC Hydro, in British Columbia, is working with the Canadian government and a number of hydrogen-related industries to build several infrastructure projects at BC Hydro's R&D facility in Surrey, B.C. There are operational gaseous hydrogen and natural gas fueling stations, as well as vehicles with converted internal combustion engines that run on a fuel mixture of 51 percent hydrogen and 49 percent natural gas.

**KNOWLEDGE NEEDED** In many countries, as in the United States, federal government structures may regulate energy policy, but it's left to state and local officials to implement the policy in their areas. And most have a lot to learn about hydrogen.

In the United States, for example, IEEE-USA could act as a resource for federal government policymakers to provide them with advice from experts in the field. Locally, energy experts could help educate their state and local government representatives about the technology. According to Andrews, his home state of New Jersey announced in July that it would fund a Hydrogen Learning Center. It tapped Scott Weiner, director of the Center for Energy, Environmental, and Economic Policy at Rutgers University and one of the speakers at the April hydrogen economy conference, to manage the center.

Many of those who attended the meeting in April plan to call on govern-

ment leaders and urge them to devote more tax money to research and development on hydrogen technologies that use renewable fuels.

The IEEE Standards Association also has a key role in moving the hydrogen economy forward. While there are several standards that cover fuel cells, few exist for pipelines and other components.

"There is not much yet in the way of standards for the electrical parts of the hydrogen economy, so there's room for IEEE to be a player there," Andrews says.

To Andrews the future of hydrogen depends on experimentation—taking small gambles and learning from them.

"We should plant lots of seeds and see which ones take root. If hydrogen takes root, it is going to grow just like the electricity sector and the natural gas pipeline industry grew over the last century," he says. "Electricity was first applied to serve Wall Street, and it then jumped to various cities. It took decades before it got out into the countryside. Hydrogen will probably evolve the same way, and IEEE members should be there, helping it grow." ●

**FOR MORE INFORMATION**

Visit [www.ieee.org/power/hydrogen](http://www.ieee.org/power/hydrogen).

There you'll find abstracts of the papers presented at the April hydrogen economy conference, a discussion forum, and related articles.

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dard will also define the levels of electromagnetic interference the voting machine must withstand. Such interference could be caused, for example, by mobile electronic devices brought into the polling place.

Once IEEE 1583 is accepted by the U.S. Election Assistance Commission (EAC), it will be the law of the land, and all voting machines used in federal elections will have to meet the standard.

"We're not saying what kind of technology a voting machine should use," explains IEEE Member Stephen Berger, a member of the IEEE 1583 working group. "The standard stops well short of anything that would lock in one kind of approach to voting over another." The standard presents requirements that voting machines must meet, Berger continues, yet the requirements are general enough to cover any computerized voting machine, including touch-screen devices and optical scanning machines. Punch-card, lever, or other mechanical voting machines will not be covered, however.

The EAC is a new government agency charged by the U.S. Congress with developing technical guidelines for voting

machinery. IEEE 1583 is the first in a number of election standards. The agency must also develop standards for ancillary equipment such as central tabulating equipment and software for registering voters. However, guidelines for how voting equipment should be tested will be incorporated in IEEE 1583. Another task is to develop guidelines for the various activities involved in running an election, which include registering voters and counting ballots.

**DOING BETTER** The idea for the IEEE standard originated with members of the IEEE New York Section. Chagrined by the problems with punch-card ballots in the 2000 U.S. Presidential election, they believed that a standard for electronic voting machines that could replace punch cards would be the best way to apply the IEEE's technical know-how



**The IEEE 1583 e-voting standard will specify performance guidelines for electronic machines that will replace mechanical machines such as this lever-actuated device still in use in New York City.**

and influence. A group of engineers headed by Berger came together in mid-2001 to brainstorm how to improve voting equipment. Given the importance of the issue, the IEEE Standards Association (IEEE-SA) decided that it would sponsor a standard for such equipment—the first instance where an IEEE society did not take responsibility for a standard's scope and content. After taking several months to enlist experts and

get organized, Berger's group began working with the National Association of State Election Directors, whose members are responsible for the voting machines and voting procedures in each state, and the U.S. Federal Election Commission (FEC), which oversees how U.S. elections are funded.

The IEEE was not alone in its concern for the security and performance of voting machines. In October 2002, the U.S. Congress passed the Help America Vote Act (HAVA) which included money—US\$2.3 billion this year—for the states to spend on replacing old punch-card and lever-actuated voting systems.

The act, which called for setting up the EAC, also required that a representative from the IEEE sit on the commission's Technical Guidelines and Development Committee (TGDC). The committee will write standards for the ancillary election equipment.

"We were very flattered that Congress saw that we had a contribution to make and gave us a permanent place to make it," says Berger, who represents the IEEE on the committee. Though the act creating the TGDC was passed in 2002, the com-

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The IEEE standard will encompass touch-screen voting machines such as this one being used in Tallahassee, Fla., USA.



In time, the IEEE 1583 might be modified to apply to electronic voting machines used outside the United States, such as this one in Sheeri, India.

mittee had its first organizational meeting only last June because of the time it took to choose its members.

The IEEE 1583 working group's first task was to look at existing election-equipment standards, including those issued in a two-volume set by the FEC in 1990. These standards hadn't kept pace with newer technology such as touch-screen machines or machines that print out a paper record for the voter to double-check before leaving the voting booth, notes Herb Deutsch, chair of the IEEE 1583 working group.

The FEC standards deal with how the machines must be built and says nothing about the software that voting-equipment manufacturers later developed. The FEC standard is a performance standard, as is IEEE 1583, but it covers the hardware and software involved in an election with a very broad brush.

Shortly after the IEEE's working group was organized, it provided more than 30 pages of comments on the FEC's 1990 electronic voting machine standard, which was being updated. The IEEE con-

sidered ways that electronics could keep each vote confidential and make the machine easier for the voter to use than punch-card or lever machines. Berger reports the FEC adopted most of the IEEE's recommendations. The working group then used them as a jumping-off point for its own standard.

**REACTING TO COMMENTS** The IEEE 1583 working group reached its first milestone in August 2003 when it completed its "Draft Standard for the Evaluation of Voting Equipment." The draft was sent for voting to all working group members—more than 200 people from eight countries—and the IEEE-SA.

The working group, which meets about every three months, is composed of IEEE members and representatives from voting-machine manufacturers, standards groups, disability advocates, and other professional organizations. The latter include the Information Systems Security Association, whose members are experts on hacking a computer system and guarding against it, and the

U.S. National Association of Radio and Telecommunications Engineers, whose members contribute their expertise on electromagnetic interference.

The 257-page standard was not approved, which is not unusual for a first draft. But along with the balloting, the working group received more than 1000 comments on the draft standard, including suggestions for changes. The group's next job was to address the comments. Berger says the second draft of the standard may be ready for another vote—and more comments—by the end of the year.

Not everyone agrees, however, with how the standard is being developed. Some critics feel the standard may do more harm than good. David Dill, an IEEE Fellow, professor of computer science at Stanford Uni-

versity in California, USA, and a member of the IEEE 1583 working group, is uncomfortable that representatives from voting-machine vendors dominate the group. The group could endorse a standard whose guidelines are good for their companies, and not good for voters, he says.

"I have serious reservations about the appropriateness of the IEEE standards process for something that is as important as the foundation of democracy," says

Dill, who was also a co-editor of a special issue of *IEEE Security and Privacy* magazine devoted to e-voting [see "Magazine Tackles Security of E-Voting," right].

Berger reports, however, that the working group is taking heed of such criticism. It delayed release of its second draft standard by a year to provide enough time for the comments to be considered and, when desirable, to be worked into the draft. One result was that requirements for equipment that provides a voter-verifiable paper receipt were added.

According to Berger, the standard could also be of value outside the United States. "Other countries may want to adopt the standard, and if there are differences in their election laws or practices we might develop amendments to accommodate them," he says. He notes that in some European countries, votes are not anonymous—a voter's name is attached to each ballot—which differs from IEEE 1583's confidentiality requirement. Representatives from Europe and Asia are participating in the IEEE 1583 working group and could develop

## Magazine Tackles Security of E-Voting

While the IEEE Standards Association comes to grips with developing a standard for electronic voting, the IEEE Computer Society sought to explain the technology—and security safeguards—that e-voting requires. *IEEE Security & Privacy* magazine, published by the Computer Society, devoted its entire January/February 2004 issue to several aspects of e-voting security.

"It was important to bring e-voting security to the attention of a technical audience and show that it is more than just a political problem," says IEEE Fellow David Dill, professor of computer science at Stanford University in California, USA.

Dill was co-editor of the e-voting issue with Member Avi Rubin, a professor of computer science at Johns Hopkins University in Baltimore. They were asked to put the issue together by the magazine's editorial board after the pair published a paper in July 2003 in the *Johns Hopkins Information Security Institute Technical Report* showing how easy it is to tamper with the code from a voting machine.

*IEEE Security & Privacy's* special issue includes an overview of the problems with election security and provides suggestions for fixing them. Another article describes a classroom project at Rice University in Houston, where one group of students tried to hide malicious code in the software of an electronic voting machine while the other group had to detect it. Those charged with detecting the hacks, which could have changed an election's outcome, found only two of three that had been inserted. The exercise illustrates how easy it is to alter election results and how difficult it can be to detect, says Rubin.

Rubin also notes that each major computer security conference over the last year or so has organized a panel discussion on e-voting. This includes the IEEE Symposium on Security and Privacy held last May in Oakland, Calif., USA.

For more information on e-voting, visit the IEEE Virtual Museum's exhibit on the history of vote-recording machines at <http://www.ieee-virtual-museum.org/collection/tech.php?taid=&id=2345869&kud=1>.

their own ideas for voting equipment in their countries.

To learn more about IEEE 1583, visit IEEE-SA at <http://standards.ieee.org>.

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# Making Networking as Simple as 1-2-3

BY CAROL GOODALE

**J**EFF COLVIN HAS A not-so-secret strategy. And he revealed it in his seminar “The Secrets to Successful Networking,” delivered earlier this year to the IEEE Consultants’ Network of Silicon Valley (CNSV) in Sunnyvale, Calif., USA. Colvin’s strategy turns traditional ideas of career networking upside down.

Colvin, cofounder of Link, a management consulting group in San Jose, Calif., USA, says people should approach networking as a three-step process. What’s more, he says, instead of concentrating on what others can do for you, be the first to extend a helping hand and start building the connections that will in time help you.

Networking is much more than just a way to find a new job, Colvin says. Developing an effective network of contacts can help you with your personal needs as well, such as finding a reliable auto mechanic or after-school activities for your child. Networking can happen in all kinds of settings, from business mixers and meetings of professional organizations like the IEEE to high school reunions and family picnics.

And though you might not meet someone who could help you find your next job or buy your product, notes Colvin, “that person might have a spouse, neighbor, or client who could.”

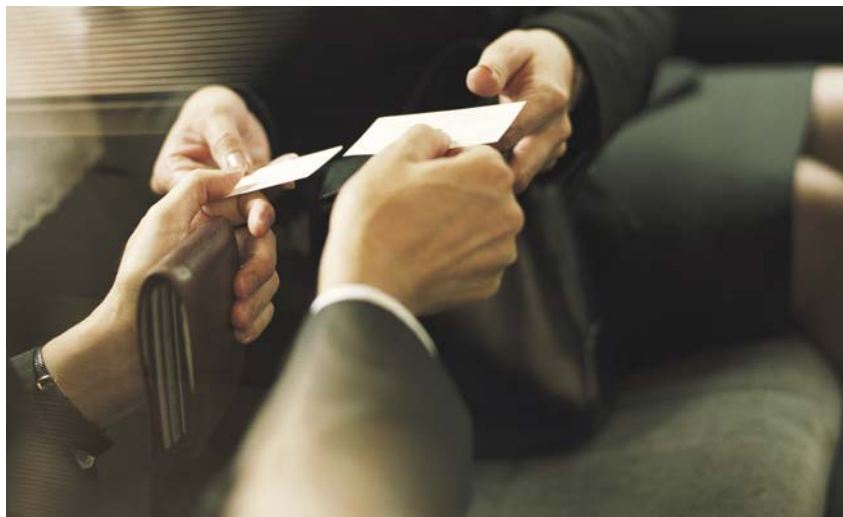
“Today, more than ever, networking is who you know and who knows you,” Colvin says. “Whether you’re seeking information, a new career, customer contacts, or smarter ways of getting things done, the most efficient way to get there is by leveraging your relationships.”

And says IEEE Member and research engineer Ken Doniger, who attended Colvin’s seminar in Silicon Valley, “Networking broadens my horizons. It allows me to consider myself as working in an industry, rather than for a single company.”

But forming relationships with new people isn’t easy. That’s where the benefits of having a tried-and-true procedure come in. Colvin has created a three-phase approach built around a central premise: sidestep your own nervousness by fulfilling a need of the other person before asking for anything in return. “Very few people are natural-born networkers,” Colvin explains. “Others need a process.”

**PREPARATION IS KEY** “Before the Event” is Phase 1, the preparation stage.

First, look over the event materials and figure out who you want to seek out. It



could be people working in a specific industry (power engineering), those with a particular job title (software project manager), or someone who has a particular skill (technical writing).

Then you need a tool kit. Your so-called tools include anything you can offer another person at the meeting. It could be knowledge about the topic being discussed, feedback you’ve heard about the speaker, or even a related Web site you can recommend.

Another attendee at Colvin’s presentation, Senior Member Ciaran O’Donnell, includes a directory of members of the IEEE Consultants’ Network of Silicon Valley in his personal tool kit. O’Donnell, founder of Joseph Media Tools, an electronics systems consulting business in Santa Clara, Calif., USA, uses this tool to recommend appropriate contacts for people he meets, depending on their particular interests. Another tool he has is his ability to share information about the IEEE.

Colvin further recommends that you be able to give a one-minute description of your career, should you be asked about yourself. Focus on your successful achievements, not on the job title.

**LEARN TO LISTEN** Phase 2 is known as “During the Event.” Probably the hardest part of meeting someone new is to enter a group conversation. How do you do it? Simple, says Colvin: walk up, extend a hand, and introduce yourself. Then just listen to the conversation. Listening is the most important skill at this stage because it’s how you identify the needs of others. The back of a person’s business card you’ve just received is an ideal place to jot down ideas about how you can help.

And how do you disengage? The same simple way. Put out your hand, say “It was nice to meet you. I’d like to meet some of the other folks,” or “I need to get something to

eat (or drink),” or “I look forward to talking with you again soon.”

**AND THEN THERE’S FOLLOW-UP** “After the Event” is the third phase. It can take place at home. Sort through the business cards you’ve gathered, discarding some and keeping others for follow-up.

But don’t shove them away in a drawer, to be forgotten. Instead, create a database, either on your computer or even with a pen and paper, listing the names, contact information, and their needs. Within the next 24 hours, send an e-mail to at least five people. Re-introduce yourself, and, based on the notes you made about a need they expressed, suggest a solution. That might be as simple as a Web site they could visit.

Initially, Colvin’s approach seems like extra work, says O’Donnell. But in the end, he finds he spends more quality time, and less quantity time, in networking.

O’Donnell adds that strategically choosing his networking opportunities has also helped. In particular, he focuses his efforts on the IEEE. “At IEEE meetings, I get involved in technical discussions, and I learn more about new areas. This is information I can use to pass along to others.”

To contact Jeff Colvin, call +1 408 927 8324 or visit <http://www.linklic.com>. ●

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# Offering Consultants a Helping Hand

IEEE Consultants' Networks help members find the next client, charge the right fee, and write ironclad contracts

BY PEG GALLOS

For members who turn to consulting for a living, the IEEE offers a host of products and services to help them run their businesses. Perhaps most useful are the IEEE Consultants' Networks where consultant-engineers can meet and discuss the trials and tribulations that many in one-person operations would otherwise face on their own. The networks also organize educational programs that offer help with both technical and business problems. And, of course, the networks offer that prerequisite of so many successful careers—networking.

**GETTING STARTED** "IEEE members and nonmembers alike can join the networks, which are local alliances of independent consultants," says Gary Blank, vice president of IEEE-USA's Member Activities, a full-time consultant himself in electronic

Staying on top of technology gets its share of attention, with talks by experts on topics like system design and home automation. But perhaps overshadowing all this is the networking so endemic to professional meetings. Don't forget that this offers the possibility of being tipped off to a potential client by another consultant too busy to take on the extra work or whose expertise is different from what's sought.

The local networks meet regularly. Some may even publish their own newsletters that offer additional tips. Many have Web sites that post information such as a directory of the people in their network along with each consultant's technical specialties.

There are 31 networks in the United States including places like Long Island, N.Y.; Chicago-Rockford, Ill.; and Phoenix, Ariz. Networks also have been formed in Canada and India. Overseeing these groups is the IEEE-USA sponsored Alliance of IEEE Consultants' Networks (AICN), which helps members who do

specializes in analog systems. Running a one-man shop of his own suits him just fine, Weitman says. He prefers his independence and has no interest in becoming an employee.

Weitman's group has about 50 members and meets the first Wednesday of each month. You must be an IEEE member to join. Not all networks require membership; many nonmembers join once they see the value of the Consultants' Networks, according to Blank.

Weitman values the colleagues he's gotten to know through the group. Not only does he count many of them as his friends but he knows he can call on them if he needs help—for a free consultation—on one of his projects, a favor he will readily return. "I know who specializes in what," he explains.

Weitman is pleased with how well the network operates on a local level, and he would also like to see more opportunities for consultant-engineers to meet on a national level.

survey, the most recent year for which data is available, is based on responses received from some 400 consultants.

The report breaks down the minimum and maximum hourly rates charged in different technical areas based on factors such as each respondent's years of engineering experience and years of consulting. It also presents figures on the consultants' average gross annual earnings.

The 2004 edition of the survey is expected to be released shortly.

**FINDING CLIENTS** The consultants' network offers help finding clients, too, with the IEEE-USA Consultants' Database, which matches consultants and potential clients. For an annual fee of US\$75, members can post a profile describing their practice, areas of specialization, and other key facts about their business. Some 500 consultants are registered.

Organizations with a problem to solve can search the database for a consultant who looks right for their job. A questionnaire-based search engine filled out by the searcher helps the process along. Companies can also post their own open assignments that can be viewed at no charge.

**PUT IT IN WRITING** It's always wise for a consultant to spell out in a contract the services to be provided and the fees to be paid. But knowing what to put in a contract is not easy; it's certainly not intuitive, especially for someone just starting out.

That's why a sample contract has been put up on the AICN Web site, compiled by experienced consultants who combined their greatest hits—that is, the best parts of agreements they've used successfully over the years. It functions as a template that covers things like the work to be done and basics like fees, expenses to be reimbursed, the billing schedule, and who owns the intellectual property. All you, the consultant, must do is tailor the contract to the needs of your client and the job. And then, of course, you get busy and perform the work. ●

**FOR MORE INFORMATION**  
The Alliance of IEEE Consultants' Networks and local consultants' networks are discussed in detail on the IEEE-USA Web site <http://www.ieeeusa.org/business/>.

## HELP COMES IN MANY FORMS

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- If it turns out that consulting isn't for you, you could try to find your next job at the IEEE Job Site at <http://careers.ieee.org>.

control systems and an IEEE Life Senior Member. The groups hold seminars on such topics as finding the next client, knowing how to charge the right fee, and writing an ironclad contract, he says. They will also tackle how to market consulting services, discuss legal and tax matters, and provide pointers on setting up a Web site of your own.

not yet belong to a network find one to join or start one from scratch. The alliance also sponsors educational workshops and works with businesses to encourage them to use independent consultants.

Irwin Weitman, an IEEE Life Member, has been participating in the IEEE Long Island (N.Y.) Consultants' Network for 20 years. An electrical engineer, he

**SETTING FEES** Perhaps a self-employed consultant's biggest problem is figuring out how much to charge for services. That's where the report of AICN's Consultants' Fee Survey can help. It lists the going rates for consultant services throughout the United States, information compiled every two years from a national survey AICN conducts. Results of the 2002

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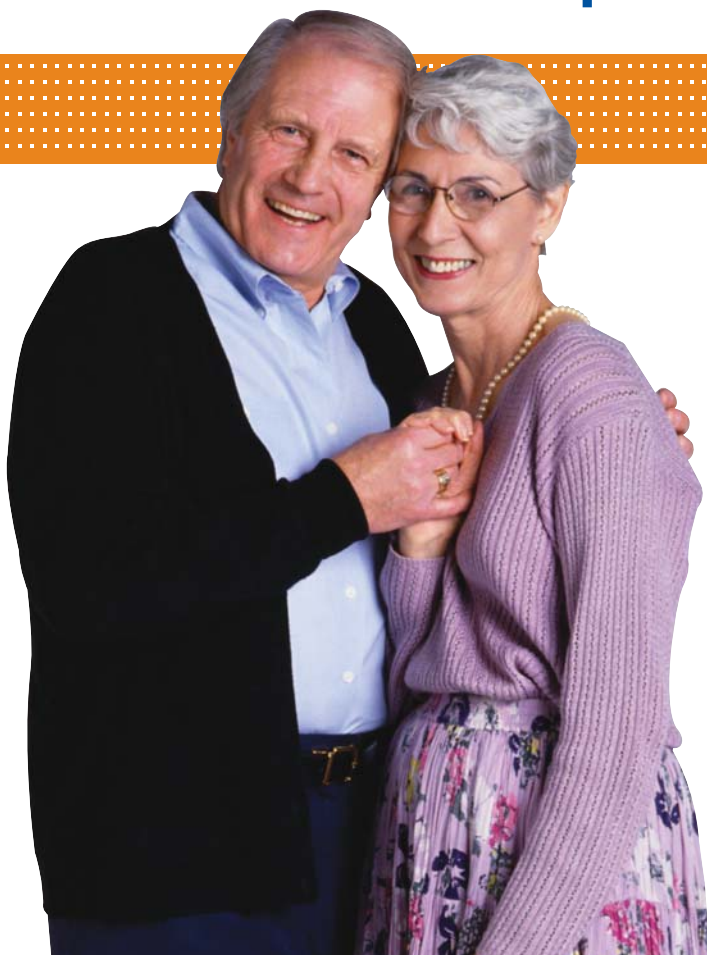
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# Companies Play New Role in Standards Development

BY ERICA VONDERHEID

WHEN A NEW IEEE standard for rechargeable batteries was announced in April, few people realized it represented a new way of doing things—developing standards, that is. For the first time, the IEEE Standards Association (IEEE-SA) had opened its standards development process to formal participation by companies, instead of by individuals alone.

The IEEE-SA Corporate Program supplements the IEEE's traditional approach where individuals draft and vote on standards independent of the company they work for. By contrast, the Corporate Program uses new procedural rules allowing companies to participate directly in the development of standards and giving each company one vote during the balloting stage—when a standard is approved or rejected.

“The new corporate standards development program grew out of discussions with industry leaders about the value of IEEE standards, especially their importance as the cornerstone of innovation,” says Karen McCabe, senior manager of marketing at IEEE-SA. Companies wanted a more direct role in the IEEE standards-writing process. They wanted an alternative to the input of individuals in the IEEE process and to standards developed by consortia—groups of companies developing products and providing lobbying, research, and product testing.

The new procedures were first followed in IEEE 1625, “Standard for Rechargeable Batteries for Portable Computing,” released earlier this year.

IEEE-SA procedures now allow companies and individuals to write and vote on a standard. The object is to have many opinions and technical interests represented in the balloting group. Before a vote is taken, a certain percentage of the working group members must agree on the wording of the standard. However, anyone may challenge the standard before or even after its release, and their objections will be considered.

“We are not moving away from individuals developing standards,” says Mary Lynne Nielsen, senior manager of strategic programs at IEEE-SA. “This [company participation] is merely an extension of the IEEE standards process.”

The Standards Association began admitting corporate members in 1998. Benefits included complimentary membership in the Standards Association for any of their employees, and discounts on IEEE Standards' Online subscriptions. Corporate membership dues are based on a company's annual revenues.

Currently IEEE-SA has 40 corporate members including large companies like Intel, Lucent, Motorola, Panasonic, and Siemens, and smaller companies like Wild-Packets Inc. Corporate members, like any other interested company or individual, can choose to work on any standard and have their engineers attend working group meet-

ings in person or via conference calls. Corporate members on the IEEE 1625 working group included Compal Electronics, Dell Computer, Hewlett-Packard, Motorola, and National Semiconductor.

Developing a standard can take up to four years. Standards-developing consortia sprang up some two decades ago to speed things up. Nielsen believes that corporate involvement in writing IEEE's standards will speed the IEEE process because of what the companies can deliver: funds for services such as project management, meeting planning, and developing a Web site through which a working group communicates. Indeed, it took only 15 months to complete the standard for

rechargeable batteries.

Three other standards relying on corporate involvement are in the works. IEEE P1896 will establish protocols for transferring data among storage devices, IEEE P1800 will update a previous standard on language used in hardware design, and IEEE P1621.1 will characterize oscillators based on organic transistors.

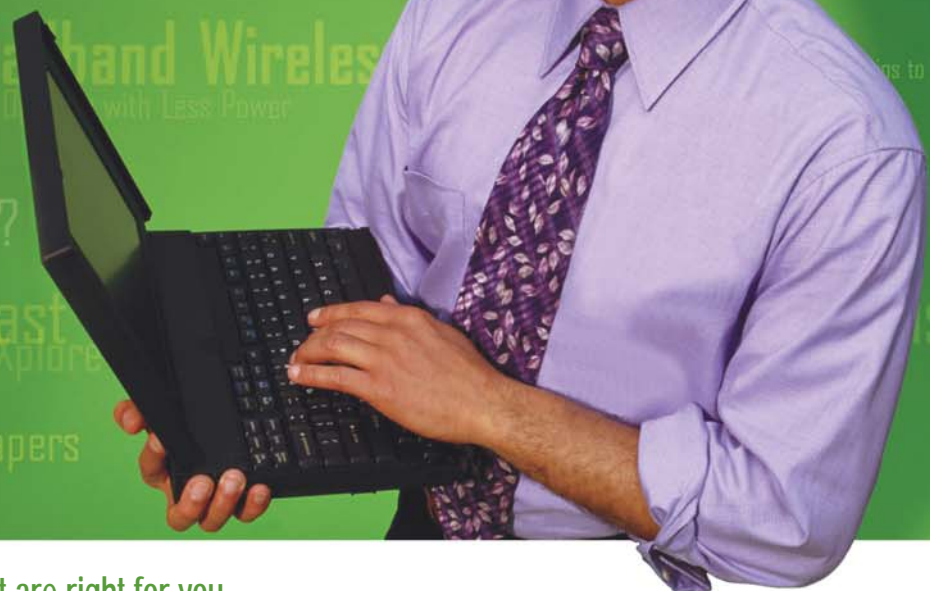
For more information on the IEEE-SA Corporate Program, visit <http://standards.ieee.org>. Write to [corp-stds@ieee.org](mailto:corp-stds@ieee.org) with any questions.

## SOME OF THE IEEE-SA CORPORATE MEMBERS



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## MEMBER RECOGNITION

# Nakahara Receives Top UK Honor

BY LINDSAY ELKINS

FOR NEARLY 20 YEARS, IEEE Life Fellow and former member of the IEEE Board of Directors Tsuneo Nakahara has been a driving force behind the collaboration in science and technology between his country, Japan, and the United Kingdom. The UK recognized his efforts in June by awarding him the title of Honorary Commander of the Most Excellent Order of the British Empire.

Sir Stephen Gomersall, the UK ambassador to Japan, presented the honor to Nakahara at the British Embassy in Tokyo. The medal and title recognize individuals for their achievements or service to the United Kingdom.

The Order's citation noted Nakahara's work with the UK-Japan High Technology Industry Forum, where leaders discuss issues of critical future technology. Through his work with the forum, many substantial links between large and small companies in the two countries have been forged, such as those between Dunlop Tire in Birmingham, UK, and Sumitomo

Rubber Industries in Kobe, Japan.

"Dr. Nakahara, in all your work you have demonstrated a true commitment to the furthering of UK-Japan relations," said Gomersall at the award ceremony. "We greatly value your support, and this high honor is a token of our country's thanks and respect."

As vice chairman and later the executive advisor to the CEO of Sumitomo Electric Industries in Osaka, Japan, Nakahara counsels the company's leaders about technology projects, such as the development of high-temperature superconductor power cables for commercial applications. His advice also led Sumitomo to expand its manufacturing and sales divisions in the UK.

Nakahara admits that when he first learned he was being honored, he did not understand the award's significance.

"One day the representative of the British Consul visited me at the Sumitomo Electric headquarters in Osaka," Nakahara tells *The Institute*. "He said, 'Would you kindly agree to the reception of the Honorary Commander of the Most Excellent Order of the British Empire?' After he explained that the honor

was for my contributions to building the high technology relationship between the United Kingdom and Japan, I gratefully accepted," Nakahara says.

Nakahara joined Sumitomo Electric Industries in 1953 after one of his college professors recommended him to the company's managing director. Following a year of training, he became a production engineer for communication cables. He was in charge of manufacturing coaxial cables, then a new communications technology from England, and he established the standards for the cable's production and quality control.

When the company decided to diversify beyond manufacturing wires and cables a few years later, Nakahara convinced management that it needed a research department to create new technologies and develop a broader product line. While working in research, he developed various high-frequency transmission systems employing coaxial cables, wireless and wired communication systems, and television broadcasting antennas.

Nakahara became manager of the re-

search department in 1964. Projects included work on computerized vehicular traffic control, automated freight car identification, and a system to detect obstacles on railroad tracks.

Nakahara was later transferred to a new cable plant in Yokohama to work with one of Sumitomo's biggest customers, Nippon Telegraph and Telephone Corp. The project led Sumitomo into the optical fiber business.

But Nakahara returned to Sumitomo's headquarters

in Osaka to become general manager of its R&D groups. He was put in charge of optical electronics projects and, later, of superconductors. His groups' work led Sumitomo to become a top manufacturer of optical-fiber components and high temperature superconductor wires and cables.

Nakahara is still active in various organizations, including the IEEE, where he served as Region 10 director from 1993-94.

To read Nakahara's oral history, produced by the IEEE History Center, visit [http://www.ieee.org/organizations/history\\_center/oral\\_histories/transcripts/nakahara.html](http://www.ieee.org/organizations/history_center/oral_histories/transcripts/nakahara.html).



UK ambassador to Japan Sir Stephen Gomersall congratulates Tsuneo Nakahara [right] on his being named an Honorary Commander of the Most Excellent Order of the British Empire.

## IN MEMORIAM

# Harold W. Lord, Inventor

BY ALAN LORD

HAROLD W. LORD found great success in his professional career, winning numerous awards for his work and receiving a total of 97 patents. He was a quick thinker who attacked problems in a hands-on manner. As his son, I saw his work firsthand and enjoyed the benefits of his expertise, for I followed in his footsteps and became an electrical engineer.

My father expressed an early interest in all things electrical, experimenting with a small transformer when he was 11 years old. In high school in El Centro, Calif., USA, he showed his classmates how to view the bones in their hands—with a spark coil from a Model T Ford connected to a transformer that powered a small X-ray tube. He used the tube with a handheld fluoroscope that he had borrowed from his family doctor.

Harold graduated from the California

Institute of Technology in Pasadena, USA, in 1926 with a bachelor's degree in electrical engineering. He began his 40-year career at General Electric Co. in Schenectady, N.Y., USA, where one of his first inventions was the timing circuit used to control

the power-on time of a line welder. This was of commercial value to GE in its manufacture of refrigerators and was also used by the Ford Motor Co. in fuel tanks for its Model A. Up until then, spot welding was used for gas tanks on the production line, and after a time, the welds would leak. Line welds were much more reliable, and his invention earned Harold a patent and GE's Charles A. Coffin Award in 1933 for "signal



contributions by employees toward the increase of GE's efficiency or progress in the electrical art." By the end of 1937, Harold had 31 patents with GE.

During World War II, GE lent Harold to the U.S. War Department (the forerunner of the Department of Defense) to assist in the development of a pair of radar systems. One was a warning system in the tail of an aircraft that detects approaching missiles and initiates defensive tactics. This effort led to Harold's development of a special transformer winding known as Lord-type winding. In the second assignment, Harold helped the U.S. Navy design the Mark V IFF (Identification Friend or Foe) system, to determine whether an aircraft was friendly or not. The basic designs of both systems are

still used today.

Our family enjoyed some technological firsts because of my father's job at the GE research lab. Harold and my mother, Doris, had the first dual-control electric blanket, sewn by Doris and with the wiring and control built by Harold. We ate the first turkey ever cooked by microwaves, and my mother tested one of GE's first fluorescent lamps. It was

**HAROLD W. LORD: 98**

**DIED:** 7 June 2004

**EDUCATION:** Bachelor's degree in electrical engineering from the California Institute of Technology, Pasadena, USA

**CAREER MILESTONES:** Employed by General Electric Co. from 1926 until his retirement in 1966. Continued to take on consulting work until 1977. Awarded 97 patents

**VOLUNTEER ACTIVITIES:** Chair of the Science and Electronics Division of the American Institute of Electrical Engineers (one of the IEEE's predecessor societies), and technical vice president for science and electronics, 1962

**AWARDS:** IEEE Magnetics Society's Achievement Award, 1984; IEEE Centennial Medal, 1984; IEEE Millennium Medal, 2000

installed over her kitchen sink.

Harold Lord was an inventor who made great contributions to our society and to our way of life. Before his death he made a generous gift of more than US\$100 000 to the IEEE History Center. With this donation, the center can expand its efforts to preserve, research, and promote the history of electrical and information technology.



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