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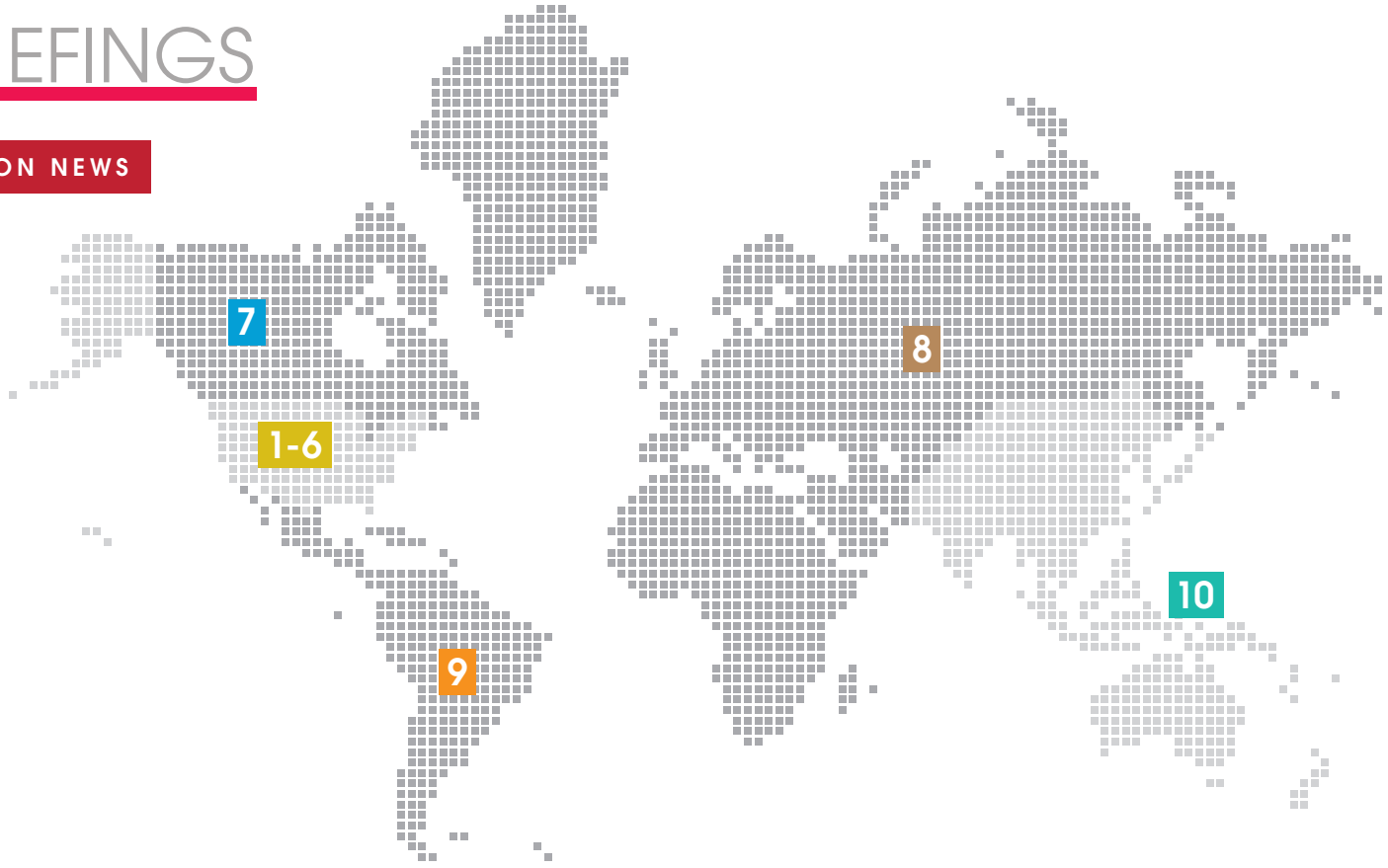
IEEE

The Internet of Things

IEEE members are at the forefront of an interconnectivity revolution

REGION NEWS



REGION 2 EASTERN UNITED STATES

■ Student branch at **Rowan University, Glassboro, N.J.,** forms IEEE Robotics and Automation Society chapter.

REGION 3 SOUTHEASTERN UNITED STATES

■ Student branch at **Georgia Tech** forms IEEE Power & Energy Society chapter.

REGION 4 CENTRAL UNITED STATES

■ **Cedar Rapids (Iowa) Section** forms IEEE Electromagnetic Compatibility Society chapter.

■ **Central Indiana Section** forms IEEE Women in Engineering (WIE) affinity group.

■ Student branch formed at **Concordia University, Chicago.**

■ Student branch at **University of Minnesota, Minneapolis,** forms WIE affinity group.

REGION 5 SOUTHWESTERN UNITED STATES

■ **Oklahoma City Section** forms IEEE Young Professionals (formerly Graduates of the Last Decade) affinity group.

■ Student branch at **Texas A&M University, College Station,** forms IEEE Engineering in Medicine and Biology Society chapter.

■ Student branch at **University of Texas, Dallas,** forms IEEE Industry Applications Society chapter.

REGION 6 WESTERN UNITED STATES

■ Student branch formed at **DigiPen Institute of Technology, Redmond, Wash.**

REGION 7 CANADA

■ Student branch at **University of Ottawa** forms IEEE Photonics Society chapter.

■ **Ottawa Section** forms IEEE Industry Applications Society chapter.

REGION 8 EUROPE, MIDDLE EAST, AND AFRICA

■ Student branch at **Queen's University, Belfast, Northern Ireland,** forms chapters of IEEE Power & Energy and IEEE Systems, Man, and Cybernetics societies.

■ Student branch formed at **University of Cagliari, Italy.**

■ **Kuwait Section** forms IEEE Young Professionals affinity group.

■ Student branch formed at **Universidade da Beira Interior, Covilhã, Portugal.**

■ **Western Saudi Arabia Section** forms joint chapter of IEEE Antennas and Propagation and IEEE Microwave Theory and Techniques societies.

■ **Spain Section** forms IEEE Consumer Electronics Society chapter.

■ Student branch at **Blekinge Institute of Technology, Karlskrona, Sweden,** forms WIE affinity group.

REGION 9 LATIN AMERICA

■ **Bahia (Brazil) Section** forms IEEE Antennas and Propagation Society chapter.

■ Student branch at **Universidade Federal do ABC, Santo André, Brazil,** forms IEEE Robotics and Automation Society chapter.

■ **Colombia Section** forms IEEE Aerospace and Electronic Systems Society chapter.

■ Student branch at **Universidad Manuela Beltrán, Bogotá,** forms IEEE Engineering in Medicine and Biology Society chapter.

■ Student branch at **Universidad Nacional de Colombia, Bogotá,** forms IEEE Communications Society chapter.

■ Student branches formed in Ecuador at **Escuela Politécnica Nacional, Escuela Superior Politécnica de Chimborazo,** and **Universidad Católica de Cuenca.**

■ **Guatemala Section** forms IEEE Young Professionals affinity group.

■ Student branch at **Instituto de Ingenieros de Morelos, Cuernavaca, Mexico,** forms IEEE Robotics and Automation Society chapter.

■ Student branches formed in Mexico at **Centro Universitario UTEG, Guadalajara,** and **Instituto Tecnológico de Ciudad Juárez.**

■ Student branch formed at the **University of Engineering and Technology, Lima, Peru.**

■ Student branch at **Universidad Nacional Federico Villarreal, Lima,** forms IEEE Computer Society chapter.

REGION 10 ASIA AND PACIFIC

■ **Northern Australia** and **South Australia** sections form IEEE Power & Energy Society chapters.

■ Student branch formed at **United International University, Dhaka, Bangladesh.**

■ Student branch at **Beijing University of Posts and Telecommunications** forms IEEE Microwave Theory and Techniques Society chapter.

■ Student branches in China at **Huazhong University of Science and Technology, Wuhan,** and **Nanjing Aeronautics and Astronautics University** form IEEE Power Electronics Society chapters.

■ Student branch formed at **Zhengzhou University, China.**

■ Student branch at **PSNA College of Engineering and Technology, Dindigul, India,** forms chapters of IEEE Computer and IEEE Industrial Electronics societies.

■ Student branches in India at **College of Engineering Chengannur, Cochin University of Science and Technology,** and **THDC Institute of Hydropower Engineering and Technology** form IEEE Robotics and Automation Society chapters.

■ Student branches in Pakistan at **Mohammad Ali Jinnah University, Pakistan Institute of Engineering and Applied Sciences,** and **University of Engineering and Technology** form WIE affinity groups.

SEND US YOUR NEWS The Institute *publishes announcements of new groups once they've been approved by IEEE Member and Geographic Activities. To send us local news, like student branch events and competitions, WIE or preuniversity outreach efforts, or other IEEE group activities, use our form on the Region News page at http://theinstitute.ieee.org/region-news.*

COVER: STUART BRADFORD; THIS PAGE: ISTOCKPHOTO

CALENDAR

March

1–2 Region 10 meeting in Kuching, Malaysia.

3 1847: Birth date of **Alexander Graham Bell** [top], inventor of the telephone.

7 1799: **The Royal Institution of Great Britain** is founded in London. Physicists Michael Faraday and J.J. Thompson, among other famous scientists, would become members.

13–16 Region 3 meeting in Lexington, Ky.

18 1965: Soviet cosmonaut Aleksei Leonov [above, center] is the **first person to conduct a space walk**, remaining outside the *Voskhod 2* capsule for about 12 minutes.

26–29 Region 9 meeting in Bogotá.

27 1845: Birth date of **Wilhelm Conrad Röntgen**, whose discovery of X-rays earned him the first Nobel Prize in Physics in 1901.

April

3–5 Region 5 meeting in Corpus Christi, Texas.

5–6 Region 8 meeting in Budapest [below].

7 1913: The U.S. Navy commissions the **U.S.S. *Jupiter***, its first surface ship propelled by electric motors.

14 1898: Birth date of **Harold S. Black**, inventor of the negative feedback amplifier. He was a Fellow of the AIEE and IRE, IEEE's predecessor societies.

26 1986: One of the worst nuclear disasters in history unfolds at the **Chernobyl** nuclear power plant, near Kiev, in what was then Soviet Ukraine.

May

2–4 Region 7 meeting in Toronto.

5 1961: Alan B. Shepard is the **first American to travel to space**, aboard NASA's *Freedom 7* space capsule.

10 1954: Texas Instruments announces its invention of the **first commercial silicon transistor**.

13 1884: The AIEE holds its **inaugural meeting**, in New York City.

18 1850: Birth date of **Oliver Heaviside** [above], a theoretician in electrical science who wrote Maxwell's equations in their most commonly used form.

Dates of historical events provided by the IEEE History Center. IEEE events are in red.

CLOCKWISE FROM TOP: LIBRARY OF CONGRESS; WIKIPEDIA; ISTOCKPHOTO; NASA

NEWS

Howard E. Michel

Michel Is 2014 President-Elect

SENIOR MEMBER Howard E. Michel was chosen to be 2014 IEEE president-elect in the 2013 election. He received 23 745 votes. The runner-up, IEEE Fellow Tariq S. Durrani, garnered 20 407. The results were made official once the IEEE Board of Directors accepted the Tellers Committee report at its November meeting [see p. 17]. Michel will begin his term as IEEE president on 1 January 2015.

Michel is an associate professor of electrical and computer engineering at the University of Massachusetts, in North Dartmouth. His areas of research include artificial neural networks and distributed-intelligence sensor networks. He is a consultant to the U.S. Navy on embedded instrumentation and system architecture.

He retired in 1994 as an engineering manager after 18 years in the U.S. Air Force. During his Air Force career as a pilot and a research engineer, he helped launch seven satellites and directed launch-base tests involving booster, satellite, and range hardware. He also developed engineering processes for mission-critical computer systems for the U.S. Department of Defense.

Michel was vice president of IEEE Member and Geographic Activities in 2011 and 2012 and Region 1 director in 2008 and 2009. He was the 2010 chair of the IEEE Public Visibility Committee and served on the IEEE-USA Board of Directors in 2008 and 2009.

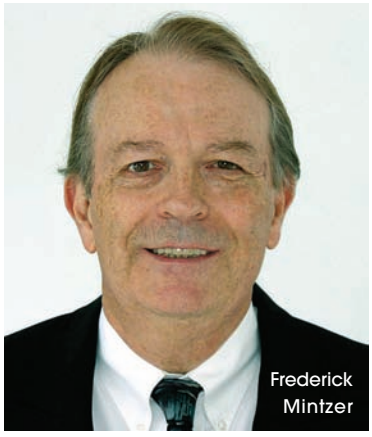
—Amanda Davis

Meet the 2015 Candidates

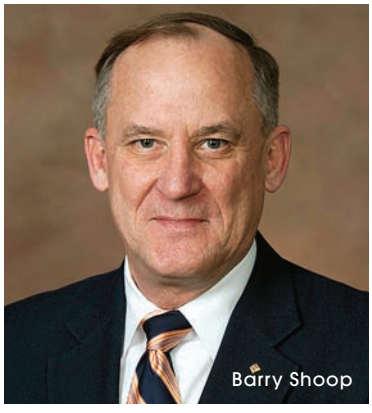
THE IEEE BOARD of Directors has nominated Life Fellow Frederick Mintzer and Fellow Barry Shoop as candidates for 2015 IEEE president-elect. The two men are set to face off in the annual election later this year. The winner will serve as 2016 IEEE president.

Mintzer retired on 1 January after 35 years with IBM. From 2005 to 2013 he was program director for IBM's Blue Gene Watson supercomputer facility and associate director of its Deep Computing Institute, both in Yorktown Heights, N.Y., at the company's T.J. Watson Research Center.

He joined IBM in 1978 and spent the early part of his career there researching signal and image processing. He later managed projects that developed image-based digital library technologies and applied them to projects with a number of museums and libraries worldwide, including the Vatican Library, in Vatican City, Rome, and the Egyptian Museum, in Cairo. From 2001 to 2005 he was senior manager of IBM's visual technologies department, which worked on computer graphics, data visualization, and digital imaging.



Frederick Mintzer



Barry Shoop

FROM TOP: D. CONFAIR/UNIVERSITY OF MASSACHUSETTS; FRANCIS P. GIORDANO; J. PELLINO

Mintzer was vice president of IEEE Technical Activities in 2012 and director of Division IX in 2008 and 2009. He was 2009 chair of the IEEE Employee Benefits and Compensation Committee and has been on several other committees, including the IEEE Nominations and Appointments, Governance, and Investment committees.

In 2009 he served as Region 1 liaison to the IEEE Technical Activities Board. He was also president of the IEEE Signal Processing Society in 2004 and 2005. As president, he helped launch the society's *IEEE Transactions on Information Forensics and Security.*

Shoop is professor of electrical engineering and deputy head of the department of electrical engineering and computer science at the U.S. Military Academy at West Point, N.Y. He is responsible for a department serving 2300 students annually. Shoop joined West Point in 1993 and has held a number of leadership positions, including serving as director of its electrical engineering program and Photonics Research Center. While on sabbatical in 2006 and 2007, he served as chief scientist for the U.S. Department of Defense Joint Improvised Explosive Device Defeat Organization, a US $4.5 billion program that addresses the IED problem worldwide.

A Fellow of the Optical Society of America and the International Society for Optics and Photonics (SPIE), he received OSA's 2008 Robert E. Hopkins Leadership Award, SPIE's 2013 Educator Award, and the 2013 IEEE Haraden Pratt Award.

Shoop served on the IEEE Board of Directors from 2006 to 2010. He was 2010 vice president of IEEE Member and Geographic Activities, IEEE secretary in 2008 and 2009, and Region 1 director in 2006 and 2007. As leader of IEEE's Enterprise Engineering team in 2006 and 2007, he led the transformation of the IEEE Regional Activities Board into the Member and Geographic Activities Board. He has served on the IEEE Executive, Strategic Planning, New Initiatives, Audit, and Fellow committees.

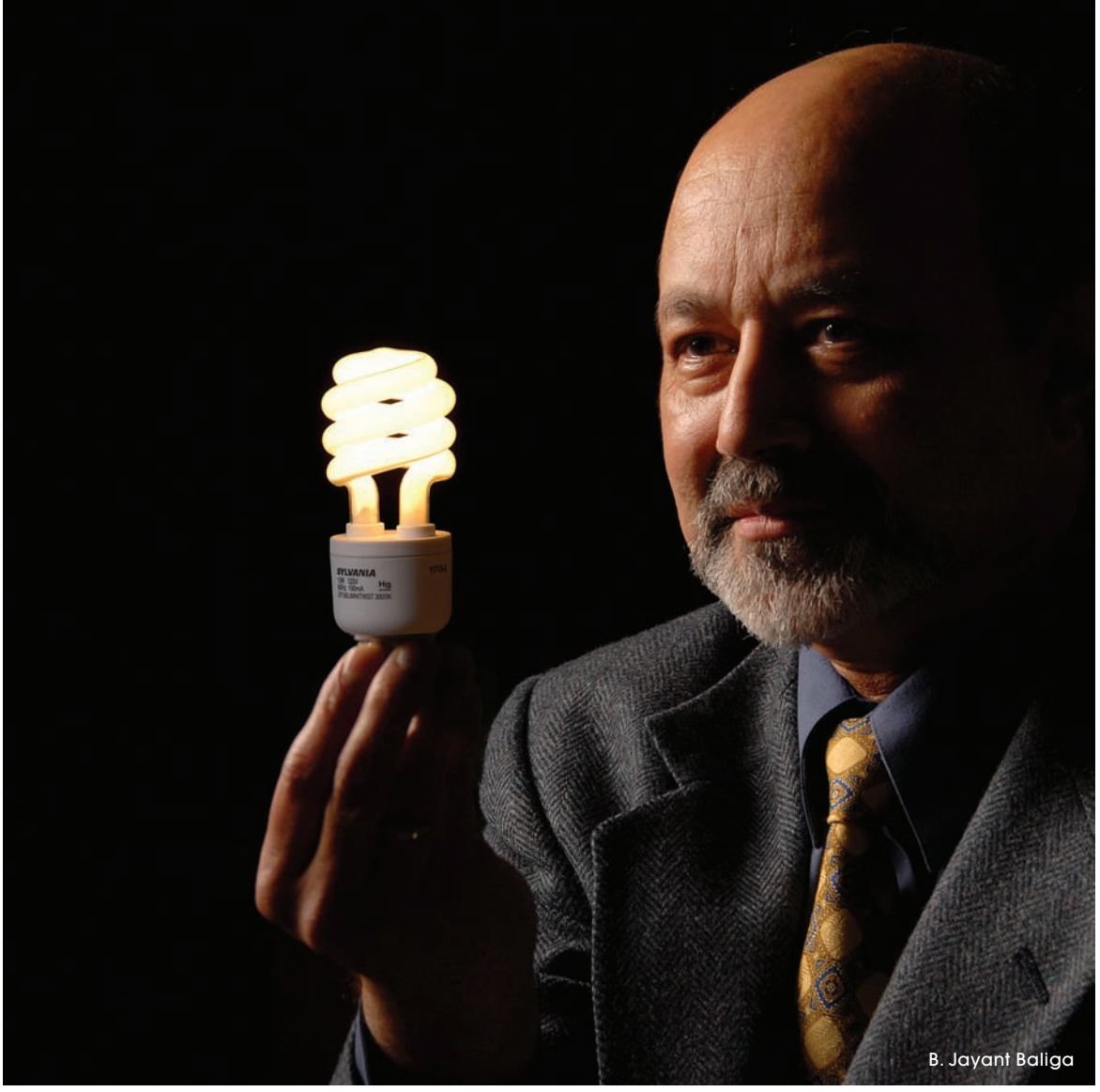
—A.D.

Online

Available 7 March at theinstitute.ieee.org

YEAR-END STATISTICS
IEEE membership hits another all-time high.

BOOKS OF INTEREST
A selection of e-books covers topics related to the Internet of Things.



B. Jayant Baliga

Five Elected to the Board

THE IEEE ASSEMBLY in November elected five officers to the IEEE Board of Directors for 2014.

Saurabh Sinha began his one-year term on 1 January as vice president, Educational Activities. Four other members were elected to serve a second year: Marko Delimar, secretary; John T. Barr, treasurer; Ralph M. Ford, vice president, Member and Geographic Activities; and Gianluca Setti, vice president, Publication Services and Products.

—A.D.

Medal of Honor Goes to Baliga

LIFE FELLOW B. Jayant Baliga is the recipient of the 2014 IEEE Medal of Honor "for the invention, implementation, and commercialization of power semiconductor devices with widespread benefits to society."

While a researcher in the early 1980s at General Electric's Research and Development Center in Schenectady, N.Y., Baliga led the development of the insulated gate bipolar transistor (IGBT). The energy-efficient transistor is used in lightbulbs (like the one pictured above), automotive electronic ignition systems, electric trains, home appliances, and other applications.

Baliga has been a professor at North Carolina State University, in Raleigh, since 1988. There he led the development of other semiconductor devices, including the superlinear silicon RF power MOSFET used in cellphone base station amplifiers as well as TBMS (trench barrier MOS Schottky) rectifiers that act as bypass diodes for solar panels.

Baliga received the 2011 U.S. National Medal of Technology and Innovation for developing and then helping to commercialize the IGBT. Bestowed by the president of the United States, the medal is the country's highest honor for technological achievement.

The Medal of Honor is sponsored by the IEEE Foundation. Baliga is to receive the award on 23 August in Amsterdam at the annual IEEE Honors Ceremony.

—A.D.

CORRECTIONS

"IEEE to Launch Eight New Journals" [December, p. 4] omitted IEEE Life Science Letters, *a digital open-access journal that will cover personalized medicine, synthetic biology, systems biology, and related topics.*

The books listed in "Free E-Books Cover Nanotechnology Applications" [December, p. 15] are not free. Their prices can be found in the IEEE Xplore Digital Library.

The Internet of Things: The Connected Revolution

THE INTERNET OF THINGS, or the IoT, which you are probably hearing about with increasing frequency, is not a second Internet. Rather, it is a network of items—each embedded with sensors—which are *connected* to the Internet. Thus, they can share information with each other in ways that allow for the automation of many tasks, such as detecting traffic congestion, monitoring a patient's blood pressure, or tracking the whereabouts of a package.

For that scenario to be realized, all the items must be able to connect via the Internet, regardless of who manufactured them. The IoT's true value lies in the data the interconnected items share. The IoT might, for example, lead to improved highways, more efficiently run hospitals, and changes in how products are shipped.

But to get to that next level, the IoT has to overcome several big obstacles. It needs more-intelligent sensors that can talk to each other, faster analytic tools to deal with the deluge of data, and common standards. There are also societal concerns, such as how to keep personal information private. These issues are why the IEEE Future Directions Committee, the organization's R&D arm, launched its IoT initiative in January. The initiative's working group coordinates and advances IEEE's work in the area and helped select the topics covered in this special issue of *The Institute*.

We have highlighted some of what's needed to implement a true Internet of Things, including those smarter sensors (see article at right) and ways to protect users' privacy (pp. 8–9). And we've profiled IEEE Fellow Yen-Kuang "Y.K." Chen (p. 14), the associate director of the Intel-National Taiwan University's Connected Context Computing Center, in Taipei, who is trying to identify and address technological barriers to the IoT.

Companies planning to take advantage of the IoT need employees who understand its technology, and that certainly includes data scientists to make sense of all that sensor-generated information. This issue of *The Institute* also covers products, standards, and conferences that could help get them up to speed.

TECH TOPIC

Smarter Sensors

Making the Internet of Things soar

BY KATHY PRETZ

SENSORS, ACTUATORS, and RFID tags have been around for a couple of decades. The identification and tracking they make possible—noting what an object is and where it has been—are being used to manage inventory, monitor machinery, and track packages and livestock, to name a few examples. Minuscule sensors are just about everywhere, including automobiles, cellphones, clothing, credit cards, exercise equipment, gaming consoles, and along highways.

Now the next technological phase is being ushered in: the Internet of Things, a network of objects made possible by the Internet, as well as by Wi-Fi, tablets, smartphones, and apps. Today's mobile devices are outfitted with a host of sensors, including accelerometers, gyroscopes, and microphones, to say nothing of compasses, GPS capability, and cameras—all sharing data wirelessly over the Internet.

Current examples of what the IoT makes possible include controlling home electronics from the office, locating empty spaces in parking lots, checking carbon monoxide levels, and monitoring crops. The IoT's full potential will be unleashed when small networks become one humongous network of products, systems, and machines, extending across the globe.

A TRILLION AND COUNTING

In 2012, about 3.7 million things were connected to the Internet via sensors, according to a report issued at the Trillion Sensors Summit, held last October at Stanford University and attended by representatives of more than 100 organizations from 14 countries. The goal of the meeting was to think up sensor-based applications likely to enter the market in the coming decade. The result was a startling prediction: The number of connected machines and devices will grow to 1 trillion by 2022.

The IoT is expected to affect how businesses operate, including unlocking new revenue from existing products and inspiring new processes. An *Economist* survey of more than 770 businesses around the world found that 75 percent of them are already exploring the IoT and 95 percent expect to be using IoT applications by 2016. The magazine published its findings in June as part of its *Internet of Things Business Index* report.

But as smart as the sensors already are, the success of the IoT depends on their becoming even smarter with, for example, their own IP addresses so they can be identified together with their location, according to IEEE Senior Member Chonggang Wang, editor in chief of the new *IEEE Internet of Things Journal* and a senior staff engineer at InterDigital Communications, in King of Prussia, Pa. Wang's research interests include machine-to-machine communications and developing the architecture, protocols, applications, and other enabling technologies for the IoT.

"Today's sensors generally have resource constraints, including limited computation and storage, short battery life, and the inability to communicate with each other," he says. He points to areas where IEEE can take the lead in making the IoT a reality, including standards, education, and promoting its benefits to business owners and the public.

WHY NOW?

Interest in the IoT has picked up for several reasons. Internet Protocol Version 6, introduced in 2012, extended the number of unique Internet addresses, making it possible to connect trillions of physical objects to the Net. Then there's the ascent of

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cloud computing, which can store the deluge of data the sensors generate, coupled with new analytical tools and high-performance computers to make sense of it all.

Add to that the falling cost of sensors that handle RFID and microelectromechanical systems (MEMS). According to the *Economist* report, the cost of RFID tags fell by 40 percent in the past two years; they now cost as little as 10 U.S. cents each. Meanwhile the cost of MEMS such as accelerometers, gyroscopes, and pressure sensors has fallen by nearly 90 percent in the past five years. And a Wi-Fi router, needed to connect individual devices to the Internet and exchange data, can cost about $10, down from around $200 a few years ago. Finally, the world's mobile devices can now communicate with each other as well as with their owners.

But until certain drawbacks are addressed, the IoT won't reach its full potential, according to Wang. He refers to what is needed using the acronym *SMART*. The IoT, he says, must be:

- *Scalable* and robust and provide custom information at appropriate periods and in suitable data forms, as required by different applications and services.
- *Monitored and managed* easily. If software on remote sensors must be updated, the sensors need to be discoverable no matter where they are. That requires an efficient management approach.
- *Adaptable* to the sensors' changing conditions or context while being able to talk automatically to other sensors.
- *Reliable*. Data uploaded wirelessly to a cloud must be dependably transmitted and reported.
- *Trustworthy*. A mechanism is needed to ensure data are not being manipulated while in transit and that only trusted parties can access sensitive data such as medical information.

A big obstacle holding back greater adoption is the immaturity of industry standards. That is true despite the fact that the IEEE Standards Association has already issued nearly 80 standards applicable to the IoT; more than 40 are under development. (Some of these are listed on p. 13.) The IEEE-SA held a workshop and webinar last year to promote its standards, and more meetings are scheduled this year.

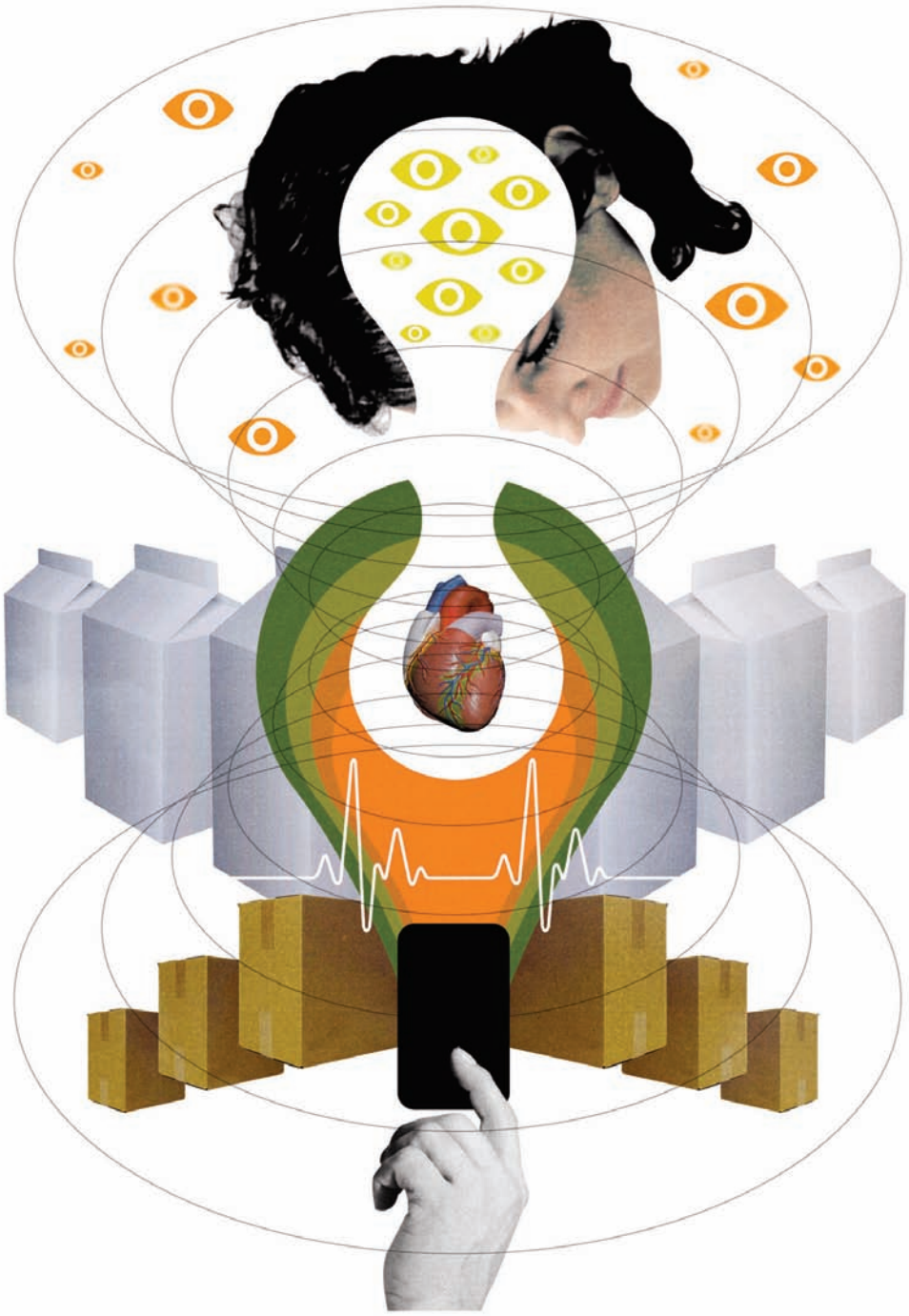
"We need standards so different sensors can talk to each other more easily," Wang says, "and open architectures that can enable and accommodate different applications."

HELP WANTED

Businesses cite a lack of employee skills and knowledge as the No. 1 obstacle to their use of the IoT, according to the *Economist* report.

"Companies moving from research to the planning stage need employees who understand the technology underlying the IoT, such as wireless systems, networks, and sensors," the report states. Who better than IEEE members to address those needs? asks Wang. IEEE is doing just that with its IoT website, conferences, publications, and webinars (see pp. 12–13).

Once companies develop IoT products, consumers and business leaders will need to be sold on their benefits in language they can understand, Wang says: "For non-tech people to accept the IoT, the technology needs to be simple and the user interfaces friendly. But we also need to educate people about its benefits and address their worries about privacy and security. People must be made to feel more accepting of the IoT if it is to be widely deployed."



TECH TOPIC

The Value of Privacy

Safeguarding your information in the age of the Internet of Everything

BY MONICA ROZENFELD

THE INTERNET OF Things promises many advances, such as the ability for consumers to keep track of their energy usage on their phones or receive alerts when milk is running low. Everything, including our homes and our heartbeats, will be monitored to make our lives easier and healthier.

But with the IoT, or what some call the "Internet of Everything," companies are planning to turn information about our every move into valuable market data. Soon, personalized ads—like those that follow online users from one website to the next—are likely to follow us in text messages and on face-scanning screens as we walk down store aisles. Information such as the purchases we make, our genders and ages, and the places we frequent will be collected to inform us—whether we care to know or not—what we might want to buy next. Although some argue that this brings added value by personalizing the shopping experience, others believe such uses of the IoT are invasions of privacy.

"Privacy as we know it will have to be completely redefined," says IEEE Senior Member Raul Colcher, CEO of Questera, an information technology consulting company in Rio de Janeiro. He advises businesses on how to handle privacy and security as the IoT evolves.

"The Internet of Things will create a completely new scenario for

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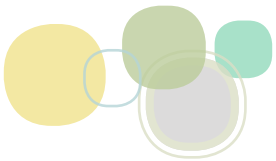
privacy and security that will need to be addressed," Colcher says. He adds that we are already dealing with related issues, including companies collecting information about us from our online activity. But with the IoT, more of our information will be available. We're likely to be sent reminders that, for example, we're running low on shampoo or are overdue for a vacation.



THE FUTURE IS HERE

Many IoT applications are already here. Sensor technology products for smarter homes, for example, can provide families with peace of mind, as their ads suggest. With just a click on a mobile device, users can activate a security system in a home, turn off lights while away on vacation, turn up the thermostat on a cold night while still an hour from home, or lock the front door from the driveway. Signals from all those sensors travel through a wireless network to be stored in the cloud, with the information analyzed and acted upon. And that can sometimes be problematic.

"Who is controlling what's in the cloud? Do I trust my cloud-computing system?" asks IEEE Senior Member Neeli Prasad, vice president at SAI Technology, a developer of mobile cloud network systems in Santa Clara, Calif. "Do I trust the people who have access to my information?"

If privacy is of great concern, individuals may have to become their own service providers, says Prasad. She sees a trend toward home cloud-computing systems in which individuals store their information privately instead of relying on companies. "That way, we can choose what information leaves our homes and becomes part of the public cloud and what doesn't."

Many new products on the market, including the video-streaming service Hulu and the Nike Fuelband, which monitors exercise activity, give consumers the option to sync those products with their social networks and mobile phones, essentially storing that information in cloud systems and databases. Thus, they can share information with the public about what TV shows they watch or how much they exercise. Or not. "Users can deny this option," Prasad says. One example is the recent news that consumers will be able to opt out of Wi-Fi tracking that allows companies to collect information about the places people visit and the purchases they make through their smartphones.

Concern over unauthorized access to private information is not increasing, she says. There is just more of it to worry about. "Sometimes the shadow of a new technology and its applications are scarier than the thing itself," she says. Moreover, not every application is intended to sell us something or observe our private lives. For example, law enforcement can track a missing person by accessing the GPS coordinates in a smartphone. (So can relatives and friends who have security access via a mobile app, such as Find My iPhone.)

A PRECAUTIONARY TALE

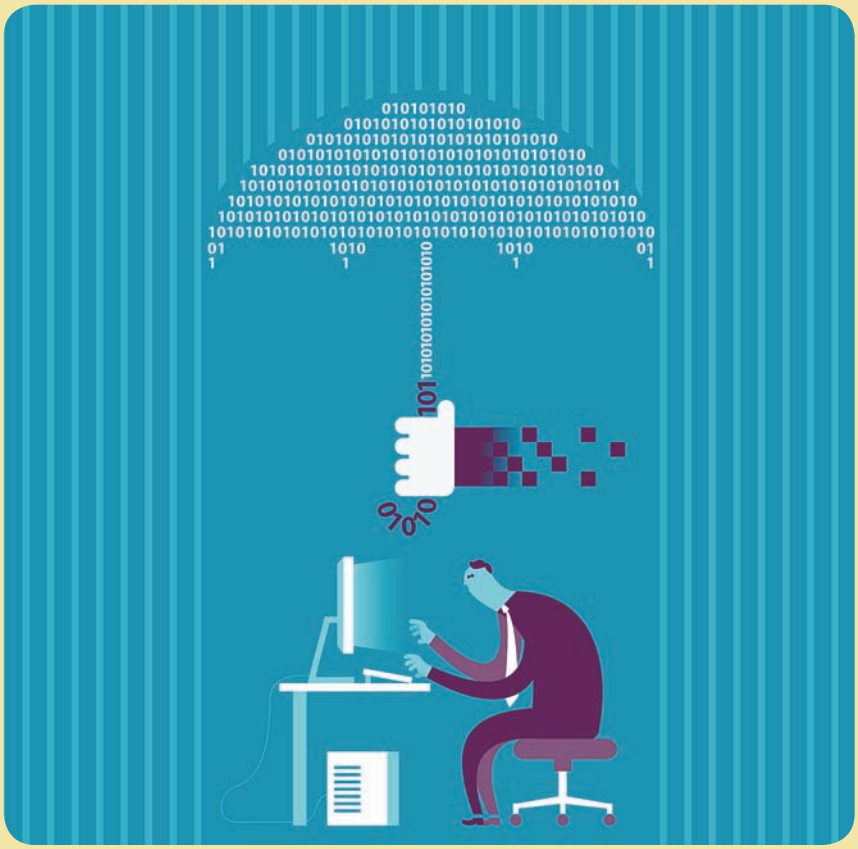
Not all are as optimistic as Prasad about the future of the IoT. While users may have control over who in the general public sees their information, the bigger concern for consumer privacy expert Katherine Albrecht is the question of who owns the data. She is an executive with StartPage, a search engine that does not collect or share personal information, and StartMail, an encrypted e-mail service.

An article coauthored with IEEE Senior Member Katina Michael, "Connected: To Everyone and Everything," in the Winter 2013 issue of *IEEE Technology and Society Magazine*, puts Albrecht's concern bluntly: "[Consumers] may think we're in charge of our shopper cards and our mobile apps and our smart fridges—but … let's not fool ourselves. [The information] is not ours. It belongs to Google, and IBM, and Cisco Systems…and the global Mega-Corp that owns your local supermarket. If you don't believe us, just try removing 'your' data from their databases."

Michael is the associate dean international of the University of Wollongong Faculty of Engineering and Information Sciences, in Australia, and editor in chief of *IEEE Technology and Society Magazine*.

To prepare for the interconnected future, businesses and governments are outlining measures to be taken while new policies are developed. The European Union, for example, outlined such measures in its report "IoT Privacy, Data Protection, Information Security," published in January 2013. One recommendation is to develop privacy-friendly default settings on IoT products and services that would give users more control over what information is shared with others. Furthermore, it suggests that IoT networks give individuals the rights to their own data. In 2012, participants at the Open IoT Assembly—an initiative to envision a future with the IoT—developed an "IoT Bill of Rights" at a two-day conference in London that calls for transparency of IoT processes and the preservation of privacy. It also calls for people to have access to their personal data.

Despite potential risks to privacy, companies are betting their customers will see the advantages that the IoT will bring them, says Colcher. But some groups advocate that consumers have the power to slow down or even stop the advancement of the IoT. Not Colcher. "The inclusion of the IoT all around us is inevitable," he says. "The only thing to do now is to prepare the best we can."



QUESTION OF THE MONTH

Will the IoT Crush IT?

As the Internet of Things becomes a reality, the enormous amount of data collected from billions of devices could overwhelm information technology companies. In a blog post on Wired.com, Mahesh Kumar, the chief marketing officer at the data services company BDNA, in Mountain View, Calif., notes that many IT organizations already have trouble organizing and analyzing existing data. Rather than worry about the number of things to be connected, Kumar warns that the concern should be about the amount and complexity of data those devices will produce.

"IT decision-support systems that are stretched to their limits today may come crashing down as the future arrives," he says. One solution he proposes is that IT companies form partnerships to share resources and knowledge.

What should IT companies be doing to keep up with the expected avalanche of data?

Respond to this question by commenting online at http://theinstitute.ieee.org/opinions/question. A selection of responses, which may be edited for space, will appear in the June issue of The Institute. *Suggestions for questions can be sent to institute@ieee.org.*

RESPONSES TO DECEMBER'S QUESTION

Are Nanotechnology Products Safe?

Nanomaterials are found in the formulations of an incredible number of products, including toothpaste, cosmetics, and baked goods. Global revenue from their sales could reach US $2.8 trillion this year, according to a report by Charles R. McConachie, a consumer and health-care lawyer in Dallas.

The report cites concerns about environmental, health, and safety risks from such products, as well as their potential when discarded for adding toxicity to water systems and landfills. A lot of money is being invested in nanotech research, but the report suggests that not enough is being spent to regulate the products' safety before they reach the marketplace or to develop policies for disposing of them properly.

Do you feel comfortable using products made with nanomaterials?

The following responses were selected from comments that appear at http://theinstitute.ieee.org/nanotech_question.

TOO MUCH, TOO SOON

Uncontrolled use of nanotechnology is not a good thing. It represents the quick development and adoption of a technology that has not been properly evaluated for its long-term effects.

Modern water filters don't catch particulate matter smaller than about 1 micrometer in diameter. Reverse osmosis could possibly eradicate nanoparticles from drinking water, but that won't be economical for most of the public. The chances are slim to none that nanoparticles eventually will be determined "good" for the planet.

We should temper our excitement for this novel technology by acknowledging that we do not understand it. Until we do, we had better put it under lock and key.

—Dave White

TOXIC WASTE

Am I comfortable with products made with nanotech? Yes. Am I comfortable with the processes used to make the products? That is another question entirely. It is not the products themselves that concern me but the controls during the manufacture of the raw materials and the waste streams that emerge.

In finished products the nanomaterials generally bind to the material matrix of the product and no longer behave like nanomaterials. Individual nanoparticles, like the ones found in pottery glazes, have been around since the dawn of civilization. Along with their use have come adverse health and environmental effects, such as poisoning from metal dust and vapor.

—David Meakin

ISTOCKPHOTO

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PRESIDENT'S COLUMN

Coming Next: The Internet of Everything

SEVERAL YEARS ago, I was fortunate enough to become involved with the IEEE Future Directions Committee, first as a member and eventually as chair. Working on where technology is headed, not only in my pursuits but also across the span of our professional community, is incredibly inspiring and rewarding.

In the past, the work of the IEEE Future Directions Committee has breathed life into a number of technical communities. Some of the most recent success stories include IEEE's smart grid, life sciences, transportation and electrification, and cloud computing communities, all of which trace their genesis to the work of this visionary committee.

The charge of the Future Directions Committee has been to anticipate and determine the direction of existing and emerging technologies, identify significant technical issues related to IEEE activities, and spearhead the investigation and development of those technologies by IEEE.

Detecting and nurturing breakthrough technologies is critical to the success of IEEE. It is also important to attract to our activities young professionals at companies developing these technologies or launching new enterprises that will create applications for novel platforms. Efforts have already begun to foster initiatives in green information communications, smart cities, and perhaps one of the most interesting areas of all: the Internet of Things (IoT) or, as some call it, the Internet of Everything.

We are witness to an unprecedented era of connectedness, even in what is still only the infancy of the IoT. Today, networked sensors improve manufacturing processes by providing real-time, machine-to-machine data. In the European Union, the elderly are moving into ambient-assisted living homes, which are smart structures able to monitor a resident's health and daily routine and to warn when conditions move beyond a certain threshold. And all around us, fitness enthusiasts are donning sensor-equipped accessories that send quantifiable biorhythmic data to laptops, tablets, and other mobile devices. Soon we will be living in a new "sensorized" world.

CHALLENGES AHEAD

The IoT envisions a complex, self-configuring, and adaptive system of networks of sensors and smart objects whose purpose is to connect all things, including commonplace and industrial objects. The idea is to make things intelligent, programmable, and more capable of interaction with humans.

The IoT promises to be the most disruptive technological revolution since the advent of the Internet. It is also likely to be the biggest system ever built; projections indicate that more than 50 billion humans and objects will be connected to the Internet by 2020. IEEE recently approved an IoT initiative that includes, among other efforts, the first IEEE World Forum on Internet of Things, taking place this month in Seoul, South Korea [see p. 12].

However, the international IoT community faces many challenges in ensuring that this new phase of Internet development is successful. Some of these challenges are technological, and others are social. Still others are related to the search for effective business models.

Two of the largest technical challenges are guaranteeing connectivity for such a large number of mobile and energy-dependent objects and how to best develop standard protocols, interfaces, and open platforms for creating services. Social issues could prove even more challenging, because they revolve around trust and privacy [see p. 8].

The IoT community is already addressing trust and privacy issues. In June 2012, a two-day event in London culminated in the production and signing of a statement by 85 participants, the IoT Bill of Rights. It focused on key principles and goals for an open IoT: determining the accessibility of data to and by whom, timeliness of access, preservation of privacy, transparency of process, and setting data-licensing provisions.

More recently, of course, the Edward Snowden affair, which involved the release to the media by a former U.S. National Security Agency contractor of an extensive portfolio of classified documents, has renewed the call, from several governments, for a new Internet governance model. This need will become even more acute when the avalanche of data generated and transported by the IoT begins to impact our daily lives more deeply.

Solving this pressing problem will require the establishment of a constructive dialogue between government officials and the Internet community. In my opinion, IEEE can play an important role in solving this intricate global problem.

I urge all of you to involve yourselves not only in IEEE's growing IoT community but also in all of IEEE's continual efforts to identify emerging technologies and support their growth and evolution within our community. Please share your views on emerging technologies and the IoT with me at president@ieee.org.

J. Roberto Boisson de Marca
IEEE President and CEO

CONFERENCES: MARCH–OCTOBER 2014

Upcoming IEEE events cover topics related to the Internet of Things

IEEE World Forum on Internet of Things

SEOUL, SOUTH KOREA; 6–8 MARCH

TOPICS: Sensor and actuator networks, routing and control protocols, security and privacy, localization technologies, data management, social models and networks, and IoT applications for assisted living, consumer electronics, e-health, intelligent transportation, and smart cities.

SPONSORS: IEEE Future Directions Committee, IEEE Sensors Council, and IEEE Communications, Consumer Electronics, Reliability, and Signal Processing societies
VISIT: http://sites.ieee.org/wf-iot

IEEE International Conference on Intelligent Sensors, Sensor Networks, and Information Processing

SINGAPORE; 21–24 APRIL

TOPICS: IoT standards and protocols, cloud computing, data management, big data analytics, crowdsourcing, network scheduling and optimization, fault tolerance and reliability, middleware for sensor systems, sensor network management and control, data mining, and smart cities.
SPONSOR: IEEE Sensors Council
VISIT: http://issnip2014.i2r.a-star.edu.sg

Network Operations and Management Symposium

KRAKOW, POLAND; 5–9 MAY

TOPICS: A track will be featured on the IoT, covering topics such as bandwidth and processing requirements, business models, large-scale systems, management protocols, networks, methodologies, and monitoring techniques.
SPONSORS: IEEE Communications Society and the International Federation for Information Processing
VISIT: http://noms2014.ieee-noms.org/content/special-track-management-internet-things

International Conference on Cyber Technology in Automation, Control, and Intelligent Systems

HONG KONG; 4–7 JUNE

TOPICS: IoT technologies and applications, e-commerce, cybersecurity, wireless communication systems, telerobotics, human-machine interaction, search-and-rescue robots, adaptive and network control, embedded systems, power networks and grids, and sustainable and distributed energy systems.
SPONSOR: IEEE Robotics and Automation Society
VISIT: http://www.ieee-cyber.org/2014

Internet of Things Conference

CAMBRIDGE, MASS.; 6–8 OCTOBER

TOPICS: Mobile IoT, applications and services, device and circuit design, smartphone technology for generating big data, pervasive sensing, architecture and systems design, cloud computing, semantic Web technologies, interface and control systems, and algorithms and data-analysis techniques.
SPONSOR: IEEE Technical Committee on RFID
VISIT: http://iot.mit.edu

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PRODUCTS AND SERVICES

Help With Building the Next Big Thing

The resources you need to tackle the IoT

BY KATHY PRETZ

WITH THE launch of the Internet of Things (IoT) initiative by the IEEE Future Directions Committee—the organization's R&D arm—many have been busy developing a host of resources to get members up to speed on the technology. Here's what's available so far.

WEB PORTAL

A good place to start is the IoT Web Portal (http://iot.ieee.org), which has the latest news about IEEE IoT activities, articles, and information about upcoming conferences and events.

CONFERENCES

How will individuals navigate this new world, share information, and protect their privacy and security? To explore such questions, IEEE is hosting its first World Forum on Internet of Things from 6 to 8 March in Seoul, South Korea. Keynote speakers include IEEE Fellow Chung-Sheng Li, director of the commercial systems department at IBM, who plans to cover how related industries from different parts of the world can come together to help orchestrate a smarter planet. The others are IEEE members Kyungwhoon Cheun, senior vice president of Samsung, and Vida Ilderem, vice president of Intel Labs. The meeting also includes workshops on such topics as IoT application architecture and research, as well as the convergence of social networks and the IoT.

We highlight this and other meetings on the IoT in "Conferences: March–October" [see p. 12].

PUBLICATIONS

The inaugural issue of the online-only *IEEE Internet of Things Journal* is now available in the IEEE Xplore Digital Library. It is sponsored by the IEEE Sensors Council and the IEEE Communications, Computer, and Signal Processing societies. Bimonthly issues will include articles on system architecture, communication and networking protocols, system security and manageability, services and applications, and test beds. Articles will be posted in IEEE Xplore as soon as they are accepted. Coming out in October will be a special issue on the security of the IoT and state-of-the-art applications for protecting data. And in December, another special issue will cover the "Internet of Vehicles."

You can check out IEEE Xplore for articles on the IoT in other journals. Several IEEE Computer Society publications have covered the topic in the past year. There's *Computer* magazine's February 2013 special IoT issue, for example, and the article "Internet of Things and Ubiquitous Sensing" appeared in *Computing Now* last September. The November/December special issue of *IEEE Intelligent Systems* magazine was devoted to what it called the "Web of Things."

TECHNICAL COMMUNITY

If you're working on applications for the Internet-enabled world, consider joining IEEE's free online Internet of Things community, found on the IoT Web portal. Members receive announcements of upcoming conferences, links to news articles, and other information to keep them abreast of developments in the field.

STANDARDS

Setting the Stage for the Internet of Things

Covering a spectrum of applications

BY MONICA ROZENFELD

THE IEEE STANDARDS Association has been developing IoT standards that could lead to improvements in such applications as home monitoring, the smart grid, and electronic medical devices. Dozens of standards are in the works.

IEEE 1888.3-2013

APPROVED OCTOBER 2013

The "IEEE Standard for Ubiquitous Green Community Control Network: Security" defines security architecture, procedures, and protocols, as well as authentication and authorization procedures—all to help avoid unauthorized access and unintended data disclosure.

IEEE 1905.1-2013

APPROVED MARCH 2013

The "IEEE Standard for a Convergent Digital Home Network for Heterogeneous Technologies" supports the interface of home networking technologies, facilitating protocols for seamless integration of new systems and establishing secure connections.

IEEE 802.16p-2012

APPROVED AUGUST 2012

This amendment to the "IEEE Standard for Air Interface for Broadband Wireless Access Systems" specifies the WirelessMAN air interface for wireless metropolitan area networks and provides improved support for machine-to-machine applications.

IEEE 1377-2012

APPROVED MAY 2012

The "IEEE Standard for Utility Industry Metering Communication Protocol Application Layer" covers common structures for encoding data between meters and home appliances for an advanced metering infrastructure that will allow utilities to wirelessly collect information about energy use.

The following standards are under development.

IEEE P1828

The "Standard for Systems With Virtual Components" promotes sharing concepts and work products among virtual world (VW) projects and the integration of resources for VW operation. The standard will be a reference for addresses, interfaces, and protocols among systems, as well as terminology for VW components and systems.

IEEE P1856

The "Standard Framework for Prognostics and Health Management of Electronic Systems" provides a structure that assists in selecting algorithms, methods, and strategies for implementing health prognostics capabilities in electronic systems.

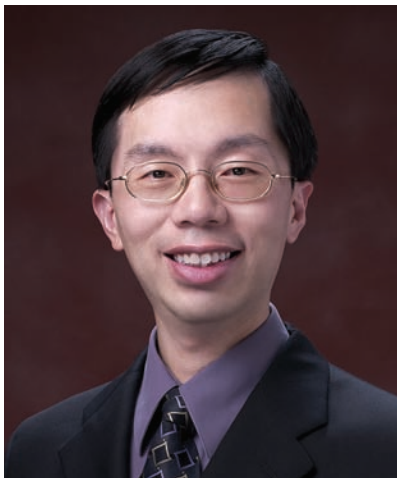
For more information, visit http://standards.ieee.org/innovate/iot.

IEEE

PROFILE

Yen-Kuang Chen: Improving Lives

Crossing disciplines to advance the Internet of Things BY SUSAN KARLIN



EEE FELLOW YEN-KUANG "Y.K." Chen says he got into engineering to help make people's lives a little easier. But it wasn't until he turned his attention to the Internet of Things (IoT) three years ago that his involvement in academia, industry, and volunteering coalesced to expedite his goals.

In 1998 Chen joined Intel Labs, in Santa Clara, Calif., as a researcher in the division for exploratory research in new methods of production. There he pushed the boundaries of computer processing efficiency for multimedia use. Today, his attention is on the IoT—a rising discipline that enables cloud-based data collection, analysis, and communication among myriad devices.

"It's an emerging arena that requires a lot of collaboration across disciplines," he says. "In the future, devices around us are going to collect data to help us do things better. But we need to understand what the data means first and turn that into actionable information."

GROWING INVOLVEMENT

Chen has served since 2011 as the associate director of the Intel-National Taiwan University Connected Context Computing Center, in Taipei—a joint venture of Intel, Taiwan's National Science Council, and NTU. The center aims to identify and address technological barriers to the IoT.

Today, Chen is also a member of the IEEE Internet of Things Organizing Committee and its Internet of Things Working Group. The group is launching a new publication, *IEEE Internet of Things Journal,* and organized the first IEEE World Forum on Internet of Things, being held this month in Seoul, South Korea (see p. 12). In 2012 he was a keynote speaker at the IEEE International Conference on Internet of Things, in Besançon, France, organized by the IEEE Computer Society.

Chen uses volunteerism to connect industrial engineers and academic researchers for IoT solutions. "IEEE is a good place for industry and academia to collaborate," he says. "To fulfill a need in this emerging area, academics have to know what problems the industry faces, and the industry has to know what state-of-the-art technologies exist.

"The IoT is an area that not only can help humankind but can also make money," he adds. "Companies are looking at the multitrillion-dollar IoT market, where technology is being developed with the purpose of helping people. It's an area where creative innovation and business both win."

MULTIPLE DISCIPLINES

Chen earned a bachelor's degree in electrical engineering from NTU in 1992, then did a two-year mandatory stint in the military before getting his master's degree and then his Ph.D. in EE in 1998 from Princeton, where he focused his dissertation on video compression.

Chen joined Intel that same year and got his first taste of working across disciplines on cutting-edge computing. In his initial research there, he looked at how algorithms, multicore architecture, multimedia applications, and software could work together. "Until that time, computer architecture was separate from the application," he says.

He shifted his research in 2010 at both Intel and NTU to troubleshooting IoT obstacles. "A barrier can come from technologies that haven't matured yet," he says. "We're working on how devices can sense the environment efficiently, how they can communicate with each other more effectively, and how the devices and cloud computing can collaborate on analyzing the context of the data and make sense of it all."

Chen holds more than 50 current and pending patents. He has published more than 85 articles and garnered a dozen awards and professional recognitions, including a Best Paper Award from the International Conference on Very Large Data Bases and a Best Associate Editor Award for his work with *IEEE Transactions on Circuits and Systems for Video Technology*.

BALANCING ACT

Nowadays, Chen's life involves an ongoing dance with academia, business, and volunteering. He splits his time between Taipei and Santa Clara, making about five trips a year for his work with the Connected Context Computing Center.

With more than 100 people helping to organize the IEEE IoT conference and dozens involved in the IEEE journal, Chen needed only two hours a week to handle e-mail and phone calls, but he is expecting to make a larger time commitment closer to the conference date.

"The advice I have for balancing a career and volunteer work is to find a project or initiative that aligns with both," Chen says. "I'm lucky that my interests, volunteering, and work all unite in a common goal.

"My involvement with IEEE not only helps the organization and its members, but it also helps my company and my work."

PART-TIME PASSIONS

Ron Kay

Tuning In

PASSION
Building regenerative radios

OCCUPATION
Research engineer

HOMETOWN
Albuquerque

A CENTURY AGO the inventor Edwin H. Armstrong enabled a vacuum tube to amplify an electronic signal through a positive feedback loop. In other words, he developed the regenerative circuit that provided reception to most radios of the 1920s and '30s before more advanced methods took its place. Still, that hasn't stopped IEEE Member Ron Kay from spending the last 15 years building old-time regenerative radios from scratch.

Kay's projects are vacuum tube-driven radios that pick up international shortwave reception in the 5- to 10-megahertz range.

"The trick to making them work is to carefully adjust the amount of positive feedback to the point just prior to oscillation," says Kay, a research engineer who works with lasers at the University of New Mexico's Center for High Technology, in Albuquerque. "If the gain gets too high, you get that squealing sound. It's like tuning a musical instrument."

He has built five regenerative radios so far, all battery-powered with two or three vacuum tubes each. The radios vary in size, although typically they are 19 centimeters long, 8 cm wide, and about 19 cm high. Kay leaves his sets uncovered. "Partly it's because I like to see the individual components," he says. "I see the radios more as sculptural objects. But there are practical reasons, as well. By not having a top, the coil can easily be changed out for a different one, which can tune a different range of frequencies. A top would just get in the way."

Vacuum tubes are readily available if you know where to look. Russia and China still make tubes; the United States stopped making them around 1980. The total cost of new parts could run to US $100, but scouring antique radio swap

INTEL

meets, "hamfests" (ham operator gatherings), garage sales, and eBay sometimes yields used capacitors, inductors, resistors, and tubes for about a quarter the price. "Building a radio to look like a radio of its time period with new parts and a fine wood finish could run many hundreds of dollars" because of the woodworking costs, Kay adds.

Kay got hooked on radios when he was 9 years old, in 1961. He was transfixed by a crystal radio, which runs on power from radio waves picked up by a long antenna. He was especially interested in how a wire-wrapped galena crystal—a form of lead—could receive radio waves. Such radios were made with just a few parts: an antenna (to receive and convert radio waves into electric signals), the crystal detector (to demodulate the signals), a wire coil inductor with a capacitor across it for tuning, and a headset to convert the signals into sound.

As a teen, Kay taught himself to build radio circuits from books. "There is a skill associated not only with building, but also using, these radios," he says. "Anyone can log on to Radio Netherlands from a computer in Albuquerque, for example. But receiving an actual transmission with one of these radios is not so easy. Tuning alone will not get the signal to come in. You must adjust both tuning and regeneration—the amount of positive feedback—interactively to receive a clear signal. It takes some practice.

"It's amazing how well these radios work with such a simple and primitive circuit," he continues. "There are a number of ways to configure the circuit, with either bipolar or field-effect transistors, and I'm looking forward to experimenting with these in the future." — *Susan Karlin*

TOP: RON KAY; BOTTOM: STEPHEN UDOCHUKWU EZE

Ayodeji Omole

Uplifting Words

PASSION
Writing essays and poetry

OCCUPATION
Graduate engineering student

HOMETOWN
Ilesa, Nigeria

ENGINEERING REQUIRES creativity and problem-solving skills, but IEEE Graduate Student Member Ayodeji Omole also likes to channel his more existential side through his essay writing and poetry about the human condition.

"I have a profound urge to help people see how they can become better versions of themselves, and I do this by writing inspiring articles," says Omole, a graduate student originally from Ilesa, Nigeria, who is studying electrical power engineering at Newcastle University, in Newcastle upon Tyne, England. "I also write poems, because I see poetry as a beautiful way of expressing myself and relating to my environment."

Omole spends at least five hours a week writing creative works. He tries to craft at least two articles and one poem every two weeks, then posts them on his blog, *Inspirations Within* (http://inspirationswithin.blogspot.com) as well as on social media websites and Poetry.com. Omole is compiling many of his writings into a book, *You Are Born a Genius,* which he hopes to submit to publishers by early next year.

He began writing in high school in Nigeria, honing his skills by submitting his work to national essay contests. He never won, but his writing improved. In 2009, during his second year at Ladoke Akintola University of Technology in Ogbomosho, Nigeria, he began writing articles for the student-run engineering magazine, *Electroscope*. Poetry soon followed.

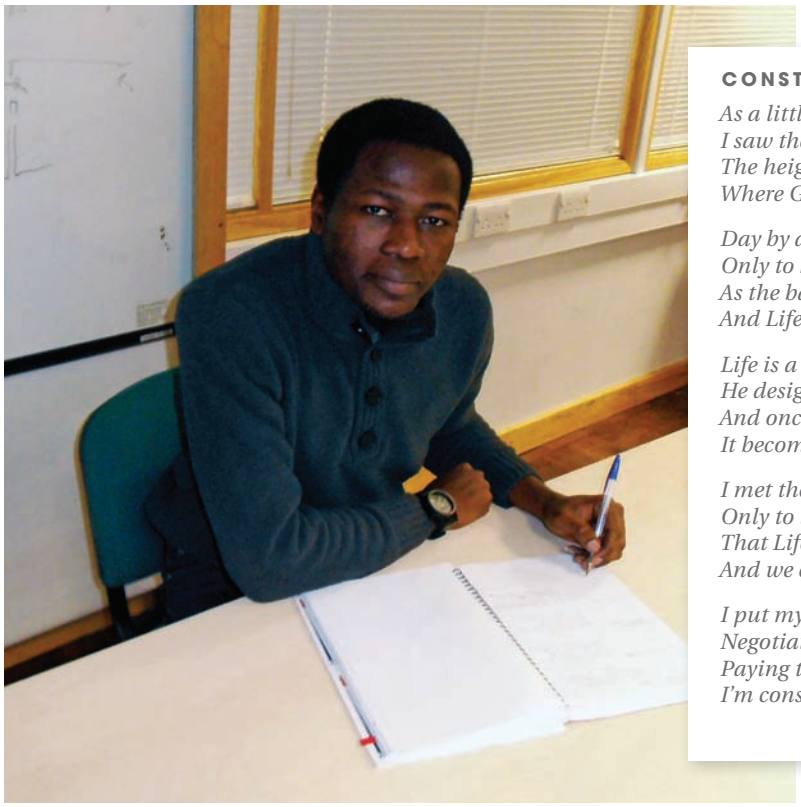
"I expressed my thoughts in short verses that I know now could pass as free-verse poems. Because they didn't rhyme or follow a certain pattern, I never thought of them as poetry," he says. "I was inspired to write my first poem, 'For a Greater Good,' when I lost a close family friend in 2010. I've since written more than 20 poems."

Omole's writings bridge his engineering and esoteric sides, offering logical approaches to ethereal meditations on such topics as destiny, humility, life fulfillment, and making assumptions about people. Some pieces involve lessons he's learned from his experiences, such as the required year of community service in Nigeria's National Youth Service Corps; others tie in spirituality and observations about human behavior.

Omole writes in English, occasionally incorporating Nigerian Pidgin, an English-based pidgin and creole lingua franca (which refers to languages that were developed over time to facilitate communication among those who do not share a native tongue).

"Although most of my pieces do not focus on engineering, being an engineer has shaped my writing," he says. "I am able to present my thoughts in more logical ways, which in turn helps me produce better technical reports in engineering.

"Writing also aids critical thinking, which has helped me a lot in my engineering studies," Omole says. — *S.K.*



CONSTRUCTING YOUR DESTINY

As a little child, I dreamt;
I saw the future where I'll feature
The height I so much desire
Where Greatness seats and dwells.

Day by day I struggled;
Only to begin to doubt
As the battle with Life got tougher,
And Life won't let me choose.

Life is a mean contractor;
He designs what he so desires
And once he finishes,
It becomes a cross for man to bear.

I met the creator Himself;
Only to learn from him, surprised;
That Life is only a negotiator
And we can come to terms.

I put myself together,
Negotiating with Life what I desire,
Paying the price it requires of me,
I'm constructing my destiny.

— *Ayodeji Omole*

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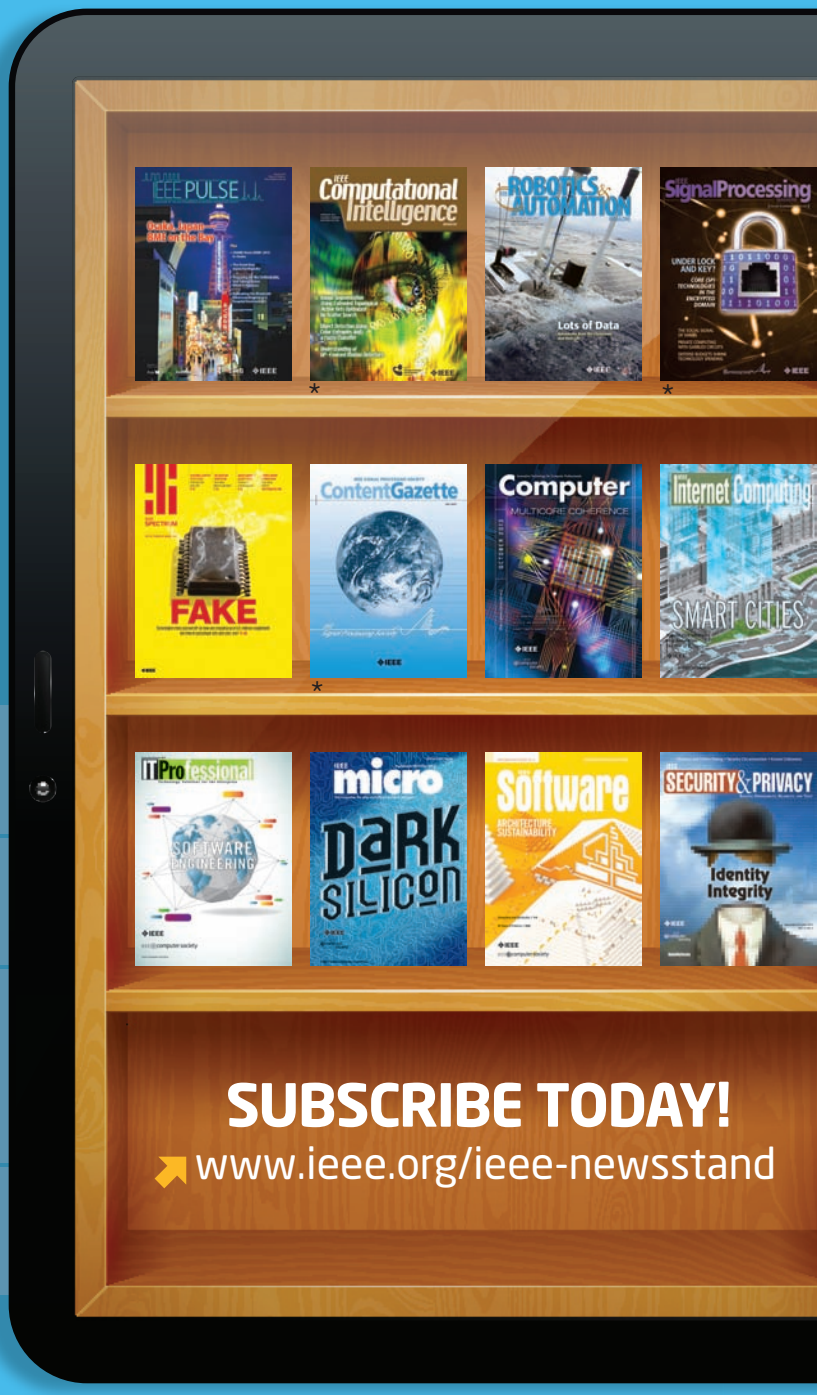

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ELECTION

2014 Election Countdown

A look at open positions and deadlines

ON 1 MAY, the IEEE Board of Directors will announce the names of the candidates to be placed on this year's ballot for the annual election beginning 15 August. Election winners take office in 2015. The ballot includes candidates for IEEE president-elect, who are nominated by the board, as well as nominees for delegate-elect/director-elect openings, submitted by their respective division and region nominating committees. The winner for 2014 IEEE president-elect was announced in November [see p. 4].

The ballot will also include nominees for members-at-large of the IEEE Standards Association Board of Governors; vice president-elect, IEEE Technical Activities; and president-elect and member-at-large, IEEE-USA. The IEEE Board of Directors is also responsible for placing any proposed constitutional amendments on the ballot.

IEEE members who have not been nominated but want to run for office need to submit a petition to the IEEE Board of Directors. The petition must include the necessary number of valid voting members' signatures, and the petitioner has to meet other requirements as well. Petitions should be sent to the IEEE Operations Center, in Piscataway, N.J.

For more information about the process for getting on the ballot, visit http://www.ieee.org/elections or send a request to corp-election@ieee.org.

UP FOR ELECTION THIS YEAR

Chosen by all voting members
- IEEE president-elect

Chosen by members of all technical societies
- IEEE Technical Activities vice president–elect

Chosen by members of the respective technical divisions
- IEEE Division I delegate-elect/director-elect
- IEEE Division III delegate-elect/director-elect
- IEEE Division V delegate-elect/director-elect
- IEEE Division VII delegate-elect/director-elect
- IEEE Division IX delegate-elect/director-elect

Chosen by members of the respective regions
- IEEE Region 2 delegate-elect/director-elect
- IEEE Region 4 delegate-elect/director-elect
- IEEE Region 6 delegate-elect/director-elect
- IEEE Region 8 delegate-elect/director-elect
- IEEE Region 10 delegate-elect/director-elect

Chosen by members in Regions 1–6
- IEEE-USA president-elect
- IEEE-USA member-at-large

Chosen by members of the IEEE Standards Association
- Standards Association Board of Governors members-at-large

DEADLINES AT A GLANCE

15 March Deadline for organizational units to submit slates of candidates to the IEEE Board of Directors for inclusion on the annual election ballot.

15 April Deadline for submitting an intention to file a petition to run for an office on the annual election ballot.

1 May IEEE Board of Directors submits to the voting membership a list of nominees for IEEE president-elect, delegate-elect/director-elect, as applicable, and other positions to be elected by voting members for the coming term. The board also announces whether it intends to put forward any constitutional amendments.

13 June Signed petitions nominating an individual for placement on the annual election ballot must be received by noon EDT USA/16:00 UTC.

15 August Annual election ballots are sent to all voting members on record as of 30 June. Voters may also begin accessing their ballots electronically.

1 October Ballots must be received by 1 p.m. EDT USA/17:00 UTC.

JUAN DARIEN/ISTOCKPHOTO

The Annual Election Results Are In

HERE IS THE IEEE Tellers Committee's tally of votes from valid ballots counted in the 2013 annual election and approved in November by the IEEE Board of Directors:

IEEE President-Elect, 2014

Howard E. Michel	23 745
Tariq S. Durrani	20 407

IEEE Division Delegate-Elect/ Director-Elect, 2014

Division II

Hirofumi Akagi	2227
Hulya Kirkici	1833

Division IV

William W. Moses	2118
Stephen D. Dukes	1930

Division VI

Rob Reilly	1491
Luke R. Maki	861

Division VIII

John W. Walz	3413
Donald F. Shafer	2711

Division X

Kazuhiro Kosuge	3417
Vladimir J. Lumelsky	2255

IEEE Region Delegate-Elect/ Director-Elect, 2014–2015

Region 1

Ronald A. Tabroff	2422
Ali Abedi	1557

Region 3

James M. Conrad	1395
Gregg L. Vaughn	1141
John E. Montague	756

Region 5

Francis B. Grosz Jr.	1426
Robert E. (Edge) Nowlin	1418

Region 7

Witold M. Kinsner	742
Robert L. Anderson	466
Jeremy A. Gates	395

Region 9

Antonio C. Ferreira	1085
Juan Carlos Miguez	446
Cesar G. Chamochumbi	367

IEEE Standards Association President-Elect, 2014

Bruce P. Kraemer	703
Dennis B. Brophy	608

IEEE Standards Association Board of Governors Member-at-Large, 2014–2015

Robert S. Fish	948
Farooq Bari	419

IEEE Standards Association Board of Governors Member-at-Large, 2014–2015

Herbert S. Bennett	735
Glenn W. Parsons	637

IEEE Technical Activities Vice President–Elect, 2014

Vincenzo Piuri	11 172
Douglas N. Zuckerman	9999
James D. Isaak	6988

IEEE-USA President-Elect, 2014

James A. Jefferies	12 745
Peter Alan Eckstein	8381

IEEE-USA Member-at-Large, 2014–2015

Thomas G. Habetler	11 833
Scott M. Tamashiro	9336

ACHIEVEMENTS

Introducing the 2014 Fellows

The Institute congratulates these 293 IEEE senior members named IEEE Fellows for 2014. They join an elite group of nearly 7300 others who have contributed to the advancement or application of engineering, science, and technology. The Fellow program celebrates its 50th anniversary this year.

Amr El Abbadi
D. Brice Achkir
Thomas Lee Ainsworth
Mohammad Showkat-Ul Alam
Kevin C. Almeroth
Gustavo Alonso
Andrea Alu
Bjarne R. Andersen
Bertram Arbesser-Rastburg
Seiichi Aritome
Robert G. Arno
Krste Asanović ć
Phaedon Avouris
Nader Bagherzadeh
Chandrajit Lal Bajaj
Poras T. Balsara
Soumitro Banerjee
Matthew James Barth
William H. Bartley
Evert Bert Basch
Andrea Baschirotto
Elizabeth M. Belding
Carl L. Benner
Randall A. Berry
Nicola Bianchi
Gautam Biswas
Igal Brener
Alberto Broggi
Kent W. Brown
Richard B. Brown
Klaas Bult
Martin Buss
Kathleen Mary Carley
Domenico Casadei
Branko G. Celler
Babu R. Chalamala
Ambrish Chandra
Edward Yi Chang
Shoou-Jinn Chang
Danny Ziyi Chen
Kevin Jing Chen
Kwok W. Cheung
Tihao Chiang
Dmitry Chizhik
Sunghyun Choi
Hean-Teik Chuah
Judson Sidney Clements
J. Edward Colgate
Jorge Cortes
Jan Craninckx
Andres Cuevas
Shuguang Cui
Steven T. Cundiff
Michael E. Cuneo
Anand G. Dabak
Manuel A. d'Abreu
Liyi Dai
Hooman Darabi
Christos Davatzikos
Michael P. De Lisio
Franco De Flaviis
Tobias Delbruck
Sujit Dey
Inderjit S. Dhillon
Donald R. Disney
Rahul Dixit
Minh N. Do
David S. Doermann
Mischa Dohler
Peter Donalek
Joachim Ender
Robert L. Ewing
Paolo Faraboschi
Aly A. Farag
Hector Fenech
Peter Fischer
Mahmud Fotuhi-Firuzabad
Kim R. Fowler
Alejandro F. Frangi
Ichiro Fujimori
Huijun Gao
Phillip B. Gibbons
Garth A. Gibson
Rob Gilmore
James R. Glass
Guang Gong
Antonio González
Ramesh Govindan
Vivek K. Goyal
Helmut E. Graeb
Rémi Gribonval
Sarath D. Gunapala
Yingjie Jay Guo
Bruce A. Gurney
Bjorn Gustavsen
Adolfo Guzman-Arenas
Martin Haenggi
Li Haizhou
Irena Hajnsek
Dilek Z. Hakkani-Tur
Zhu Han
Kiruba Sivasubramaniam Haran
Majeed M. Hayat
Yun He
John S. Heidemann
Fred Heismann
Scott Hensley
Peter Adam Hoeher
Axel Hoffmann
Chris Horwill
Y. Thomas Hou
Hao Huang
Toshio Iguchi
Ilko K. Ilev
Hisao Ishibuchi
Kazunari Ishimaru
Cursino Brandão Jacobina
Ali Jadbabaie
Syed Ali Jafar
Weihua Jiang
Xicheng Jiang
Christopher R. Johnson
Gary R. Johnson
Mohan S. Kankanhalli
Krishna Kant
George K. Karagiannidis
W. Clem Karl
Tanay Karnik
Ursula Keller
Michael D. King
Roger Lee King
Hassan Ali Kojori
Robert Kozma
Hermano Igo Krebs
Sanjay Krishna
Benjamin Kroposki
Jen-Tsai Kuo
Yu-Kwong Ricky Kwok
Sam T. Kwong
Ivan J. LaHaie
Yen-Shin Lai
David H. Laidlaw
Germano Lambert-Torres
J. Nicholas Laneman
Anders Larsson
Byoungho Lee
Daniel Dongyuel Lee
Kwyro Lee
Zachary J. Lemnios
John Joseph Leonard
Bing Liu
Mingyan Liu
Sheng Liu
Angel Lozano
Stepan Lucyszyn
Howard Cam Luong
Robert Magnusson
Mariusz Malinowski
Weidong Mao
Thomas E. Mc Dermott
William Michael McEneaney
William J. McFarland
Thomas A. Mehlhorn
Charles L. Melcher
Daniel A. Menasce
Francisco Mesa
Cecilia Metra
Felix Antonio Miranda
Dariush Mirshekar-Syahkal
Paul V. Mockapetris
Philip K.T. Mok
Paolo Montuschi
Jeong-Sun Moon
Yu Tong Morton
Theodore D. Moustakas
Yi Lu Murphey
Samuel Naffziger
Nathan Newman
Bin Ning
Katia Obraczka
Matthew W. Ohland
Taiichi Otsuji
Andrew L. Ott
Haldun M. Ozaktas
Fernando Paganini
David Z. Pan
Marios C. Papaefthymiou
Konstantinos P. Papathanassiou
Ioannis Paschalidis
Jain Pei
Fatih Porikli
Jinyi Qi
Daniel J. Radack
Padma Raghavan
Faz Rahman
Balaji Sundar Rajan
Umakishore Ramachandran
Jean-Pierre Raskin
William Redman-White
Robert Andrew Reed
Martin Reisslein
Michael K. Reiter
Steve Renals
Daniele Riccio
Martin Richardson
Nick M. Ridler
Norma Weaver Riley
Bradford Pryor Roberts*
Pedro Rodriguez
Simon Rowland
Marcos Rubinstein
Marina Ruggieri
Paul Allen Ryan
Ashutosh Sabharwal
Amir Said
Magdalena Salazar-Palma
Bahgat G. Sammakia
Peter A. Sandborn
Mark Brian Sandler
Guillermo Sapiro
Thilo Sauter
Stefan Schaal
John Keith Schneider
Philip Schniter
Cheryl B. Schrader
Alexander G. Schuchinsky
Steven Scott
Jong-Soo Seo
Jamal Seyed Yagoobi
Cyrus Shahabi
Sanjay Shakkottai
Puneet Sharma
Jiancheng Shi
Shiuhpyng Winston Shieh
Toru Shimizu
Andrei M. Shkel
Sandeep Kumar Shukla
Metin Sitti
Raghupathy Sivakumar
Krishna Moorthy Sivalingam
Dejan J. Sobajic
Emina Soljanin
Jiming Song
Anthony C.K. Soong
Ashok N. Srivastava
Mircea R. Stan
John T. Stasko
Richard M. Stern
Charles R. Sullivan
Senichi Suzuki
Jacobus W. Swart
Srinivas Tadigadapa
Takunori Taira
Hiroshi Takahashi
Migaku Takahashi
Kay Chen Tan
Kazuo Tanaka
Hisao Taoka
Anthony Tether
Patrick Thiran
Keiichi Tokuda
Wen Tong
Elie K. Track
Trac Duy Tran
Wade Trappe
A. Galip Ulsoy
Kerry J. Vahala
Jan F. Van Houdt
Marc M. Van Hulle
André van Schaik
René Vidal
Martin Vlach
Yi Wang
Zhou Wang
Zidong Wang
Solveig Ward
Iram J. Weinstein
Ross Tyler Whitaker
Sarah Kate Wilson
Ed X. Wu
Ya-Hong Xie
Changsheng Xu
Sudhakar Yalamanchili
Rui Qing Yang
Boon-Lock Yeo
Wei Yu
Franco Zambonelli
Guoqi Zhang
Hong Zhang
Ji-Feng Zhang
Yongguang Zhang
Wei-Xing Zheng
Shengli Zhou

**Roberts died shortly after being elevated to Fellow.*

ISTOCKPHOTO

CALL FOR NOMINATIONS

Nominations Sought for 2015 and 2016 Leaders

Volunteers are needed to serve as corporate officers and committee members and chairs

IEEE IS GOVERNED BY volunteer members and depends on them for many things, including editing IEEE publications, organizing conferences, coordinating regional and local activities, writing standards and authorizing their publication, leading educational activities, and identifying individuals for IEEE recognitions and awards.

The Nominations and Appointments (N&A) Committee is responsible for developing recommendations to be sent to the IEEE Board of Directors and the IEEE Assembly on staffing many volunteer positions, including candidates for president-elect and corporate officers. Accordingly, the N&A Committee is seeking nominees for the following positions:

2016 IEEE President-Elect (who will serve as president in 2017)

2015 IEEE Corporate Officers

- Vice president, Educational Activities
- Vice president, Publication Services and Products
- Secretary
- Treasurer

2015 IEEE Standing Committees (chairs and members)

- Awards Board
- Employee Benefits and Compensation
- Ethics and Member Conduct
- Fellow
- Governance
- History
- Nominations and Appointments
- Public Visibility
- Tellers

DEADLINE FOR NOMINATIONS

15 March 2014

WHO CAN NOMINATE?

Anyone may submit a nomination, and self-nominations are encouraged; nominators need not be IEEE members, but nominees must meet certain qualifications. An IEEE organizational unit may submit recommendations for nominees who have been endorsed by its governing body or the body's designee.

A person may be nominated for more than one position, and nominators need not contact their nominees before submitting their names. The N&A Committee will contact them to ascertain their eligibility and their willingness to serve.

HOW TO NOMINATE

For information about the positions, including qualifications and estimates of the time required by each position during the term of office, check the Guidelines for Nominating Candidates at http://www.ieee.org/about/corporate/nominations/nominations_guidelines.html. To nominate a person for a position, complete the online form and submit it to the N&A committee.

NOMINATING TIPS

Make sure to check eligibility requirements on the N&A Committee website at http://www.ieee.org/about/corporate/nominations before submitting a nomination because each year many ineligible candidates are nominated.

Positions for which the N&A Committee makes recommendations represent the uppermost governance levels in IEEE. Volunteers with relevant prior experience in lower-level IEEE committees and units are recommended by the committee more often than volunteers without such experience. For example, candidates for the IEEE Awards Board have a greater likelihood of being recommended if they have already served on an awards committee of a society, section, or region or on another IEEE board.

Individuals recommended for president-elect and corporate officer positions are more likely to be recommended if they have a strong record of leadership and relevant accomplishments within and outside IEEE. Recommended candidates often have significant prior experience as members of IEEE boards and standing committees.

More information about the duties associated with the different positions, qualifications, and eligibility requisites (such as prior service in certain positions or IEEE grade) can be found in the Guidelines for Nominating Candidates.

—Gordon Day, Chair
2014 IEEE Nominations and Appointments Committee