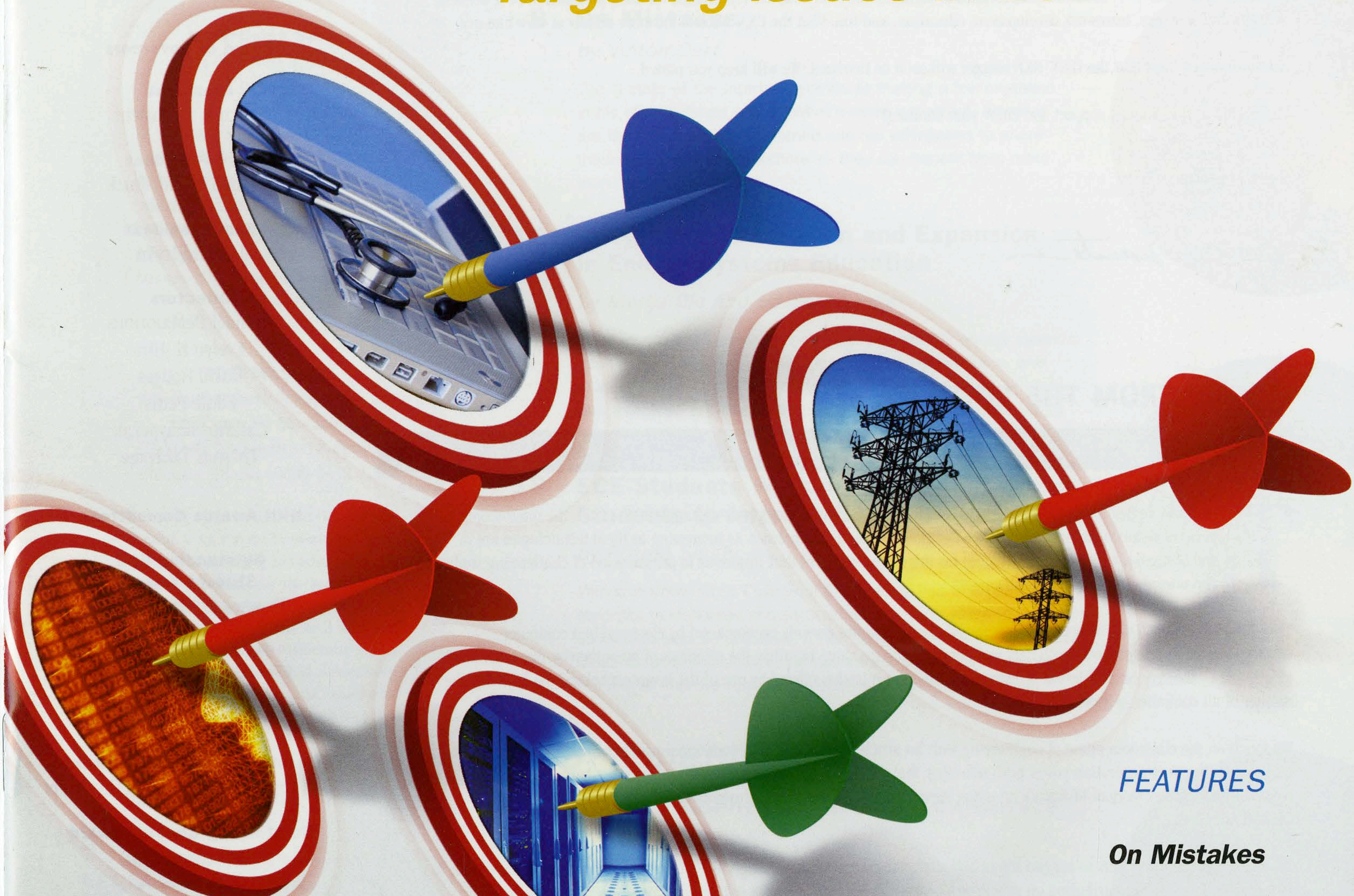
SPRING 2010

THE BRIDGE

The Magazine of Eta Kappa Nu

Taking Aim: Targeting Issues in ECE



FEATURES

On Mistakes

Data Center Virtualization

Integration, Innovation and Expansion in Energy Systems Education

ECE Students Working with Nursing Students to Improve Rural Health Care

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LETTER FROM THE PRESIDENT

Bruce A. Eisenstein | Beta Alpha chapter

Dear HKN Members and Friends:

As we near the end of the 2009–2010 academic year, it is an appropriate time to reflect on some of this year's highlights.

Importantly, our awards program continues to grow. The C. Holmes MacDonald Outstanding Teaching Award has been reactivated and was presented in March 2010 at the Annual Conference of ECEDHA, the Electrical and Computer Engineering Department Heads Association. Also at that conference, twenty-two Outstanding Chapter Awards and two Outstanding Student Awards were presented. Details can be found in this issue of THE BRIDGE.

The Outstanding Young Electrical and Computer Engineer Award has also been reactivated. Nominations are due September 15 and the forms can be found online. Please consider nominating a deserving young colleague.

The 2009 Student Leadership Conference at the University of Michigan, Dearborn was a great success and we thank the Theta Tau Chapter for their overall planning and execution of the event. We are pleased to continue the tradition with Beta Xi at the University of Oklahoma, which will host the 2010 Student Leadership Conference entitled "Engineering in a Multidisciplinary World" on November 5–7, 2010. We look forward to seeing many HKN chapters represented for what promises to be a weekend of leadership activities, teamwork development, education, and fun. Visit the HKN Website for more details at www.hkn.org.

Finally, it is our hope that the IEEE-HKN merger will soon be finalized. We will keep you posted.

Thanks for your continued support and enjoy your summer!

Best regards,

LETTER FROM THE EDITOR

Barry J. Sullivan | Beta Omicron Chapter Member

The technologies covered by the fields of electrical and computer engineering range in size from the microscopic world of semiconductor electronics to the global scale of the Internet. As interesting as these technologies are in and of themselves, it is their potential for improving our lives that inspire us to pursue years of challenging studies and reward us with meaningful careers.

This issue of *THE BRIDGE* illustrates the variety of challenges and rewards encompassed by electrical and computer engineering. An article on how computers and networks can combine to utilize the resources of an enterprise more effectively is followed by the very human lesson of learning from one's mistakes offered by one of the inventors behind the Internet, the mother of all computer networks.

We touch on the classroom phase of engineering with an article on meeting the educational needs of those who will create and operate the next-generation power grid, reflecting that the grid can only be as smart as the people behind it. Finally, we have the inspiring story of ECE students using their mastery of technology to improve rural healthcare delivery in Central America.

We encourage HKN members to suggest topics and share their experiences through full-length articles and member profiles. If you are interested in contributing an article or a profile, please contact me at *editor@hkn.org*.

Warm regards,

Eta Kappa Nu

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Barry J. Sullivan

News and Copy Editor
Michelle Klein

Art Director
Graphic Design
Tina Maraccini

Advertising Sales
1-800-406-2590

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Eta Kappa Nu (HKN) was founded by Maurice L. Carr at the University of Illinois on October 28, 1904, to encourage excellence in education for the benefit of the public. HKN fosters excellence by recognizing those students and professionals who have conferred honor upon engineering education through distinguished scholarship, activities, leadership, and exemplary character as students in electrical or computer engineering or by their professional attainments.

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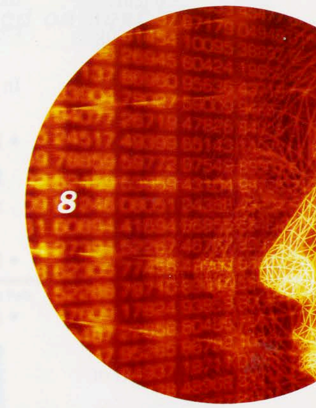
THE BRIDGE

The Magazine of Eta Kappa Nu

features



departments

award winners

2010 HKN Student Leadership Conference

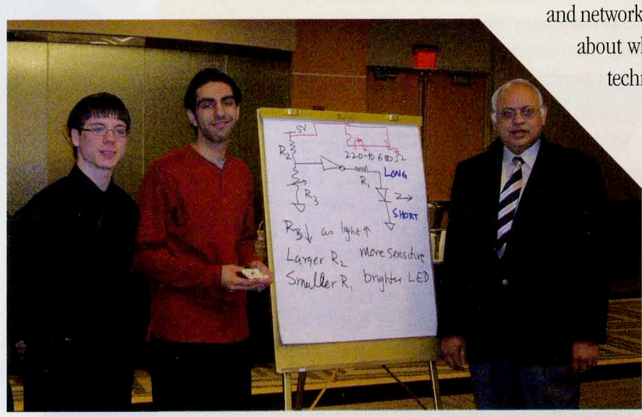
HKN is pleased to announce that Beta Xi chapter at the University of Oklahoma, Norman will host the 2010 student leadership conference November 5–7, 2010.

Entitled "Engineering in a Multidisciplinary World," this year's conference will expose members to opportunities, technologies, and facilities unique to multi-disciplinary engineering at the University of Oklahoma.

In particular, students can look forward to the following:

- Presentations discussing the impact of small businesses on the economy from the perspective that recently brought the innovative businesses of Oklahoma City to the attention of Forbes Magazine
- Hands-on demonstrations showcasing the latest advances and uses of virtual instruments
- A visit to the National Weather Center—home to NOAA's National Sever Storms Labs, OU's School of Meteorology (SoM), and the Multi-Disciplinary (ECE/SoM) Advanced Radar Research Center—to discuss the importance of concurrent Radar and Meteorological technology developments and scientific interactions in realizing advanced weather forecasting and warning systems

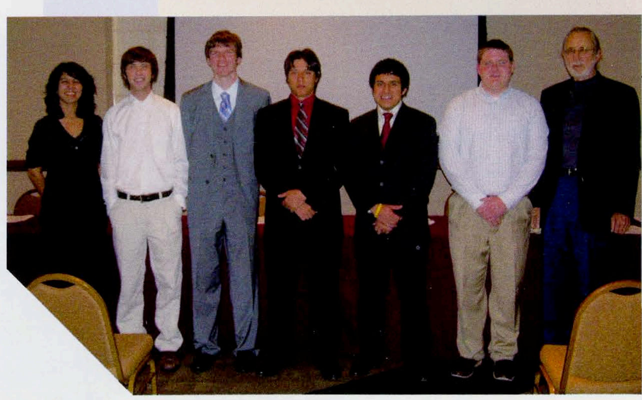
All HKN chapters are invited to send student representatives to interact with each other and network with industry professionals. This is also an excellent opportunity to learn about what other chapters are doing regarding activities, fundraisers, recruiting techniques, and much more!



Additional information on the 2010 conference will be posted on line at **www.hkn.org** as it becomes available. Registration will begin in early September.

Corporate sponsorship opportunities are available. If you are interested in supporting the conference and interacting with the best in ECE, contact Michelle Klein at the HQ office at 1-800-406-2590 or ***Michelle@hkn.org***.

2010



Beta Xi officers (from left to right): Golnoosh Kamali (Recording Secretary), Chris Garner (Corresponding Secretary), Stan Caddell (Treasurer), Juan Herrera (Vice Chair), Jordan Kuehn (Chair), Dylan Powell (Webmaster, Historian, Publicist), and Dr. Jerry Crain (Faculty Advisor).

Data Center Virtualization

by Sukento Sukirya

"Data Center" used to be associated with a large computer room where the mainframes were located. In a modern data center, in addition to mainframe computers, there are other components that make up a data center, such as network, storage, compute, network security devices, application load balancing, racks, cabling, server operating systems, and business applications. In an enterprise, the data center plays an important role in hosting its critical business application and storing its critical data. Hence, it is expected that when an enterprise grows, the data center will grow along with it to support its business needs. Often times, the growth of a data center is unplanned (accidental growth) and in silos, thus creating a lot of inefficiencies. Underutilized and inefficient data centers drive up the maintenance and support cost.

To improve efficiency, an enterprise can leverage virtualization technology to share the data center physical components among applications. Virtualization enables a physical component to be partitioned into two or more logical instances that contain the same characteristics. By deploying virtualization, an enterprise can consolidate several applications to run on the same physical components, thus improving and optimizing its data center utilization. Data center virtualization provides an enterprise with a flexible and a scalable platform for its applications. In addition, a virtualized data center can pave the way for an enterprise to deploy on-demand cloud computing platform in the future.

Data center virtualization has received a lot of attention lately, in particular the compute (server) virtualization area. Server virtualization can provide significant reduction in overall physical server's deployment and can optimize server utilization. However, server virtualization is only one area of an overall data center virtualization strategy. This article will cover network and fabric virtualization in a data center, which will include network switching fabric, network routing domain, application services (application load balancing and firewall) and storage virtualization.

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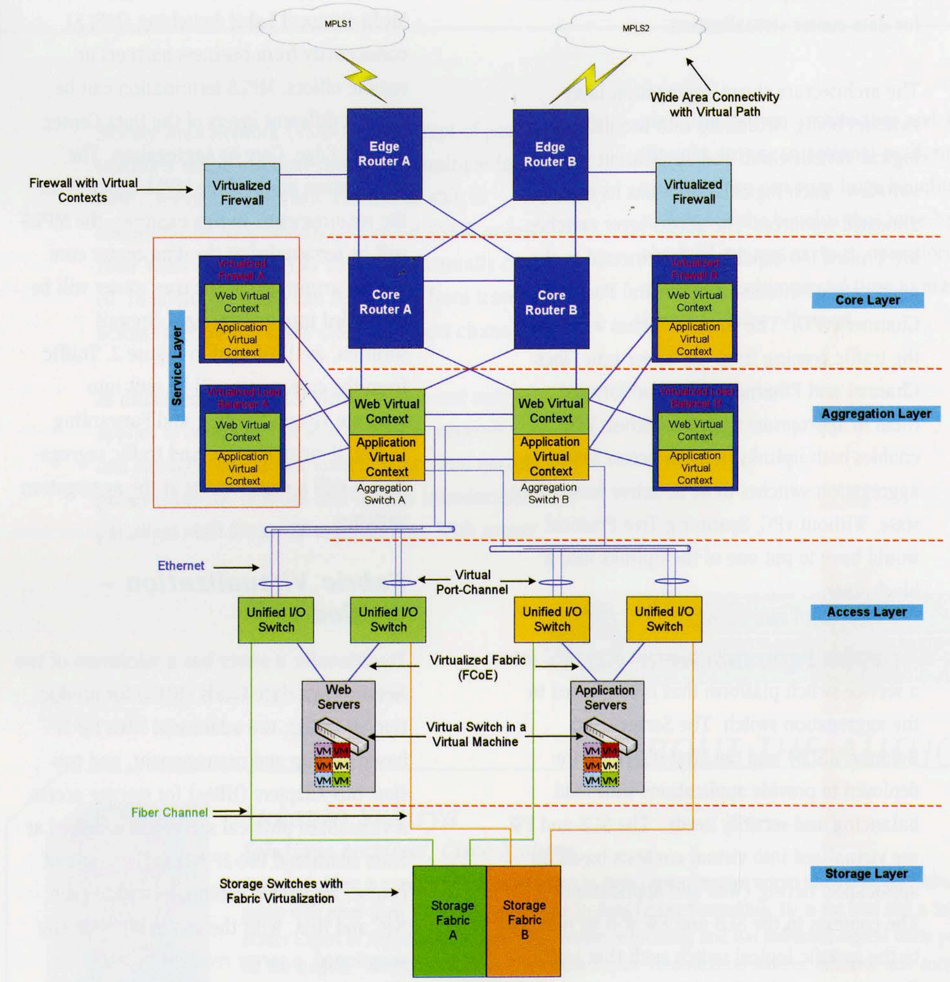

Figure 1 ***Data Center Virtualization Reference Architecture***

(...Continued) Data Center Virtualization

Reference Architecture

There are multiple ways of architecting virtualized data centers, just as there are different virtualization solutions for network, storage and compute. Combining all the solutions by mix and match from all these 3 major components can yield many design options. This article will discuss a reference architecture that is quite common to enterprises to keep the discussion simple. Once the methods and principles of virtualizing data center components are understood, the reader can put together different architecture solutions that will meet an enterprise's requirements. Figure 1 shows an example of a reference architecture for data center virtualization.

The architecture shows aggregation layer switches being virtualized into two different logical switches, web and application virtual switches. Each logical switch has its own allocated resources. The access layer switches are Unified I/O capable and connected to the aggregation switches using virtual Port-Channel (vPC). The access switches will split the traffic coming from the server into Fiber Channel and Ethernet traffic and forward them to appropriate uplink switches. VPC enables both uplinks from an access switch to aggregation switches to be in active forwarding state. Without vPC, Spanning-Tree Protocol would have to put one of the uplinks into a block state.

Application Services solutions are packaged into a service switch platform that is connected to the aggregation switch. The Server Load Balancer (SLB) and the Firewall (FW) are deployed to provide applications with load balancing and security needs. The SLB and FW are virtualized into virtual contexts based on application tiering (Web and Application). The contexts in the SLB and FW will be matched to the specific logical switch such that traffic flow will stay isolated and resources can be allocated appropriately.

Storage fabric is also virtualized to meet specific requirements or business functions into Virtual Storage Area Networks (VSANs). In this example, the physical SAN is virtualized into two logical SAN fabrics, Fabric A and Fabric B.

Data Center Edge Virtualization

There are several segments in the Data Center edge that can be virtualized, such as Business Partners (BP) connectivity and Remote Office Branch Office (ROBO) connectivity. One of the most common virtualizations at the Data Center edge is the Multi-Protocol Label Switching (MPLS) connectivity from business partners or remote offices. MPLS termination can be done at different layers of the Data Center, such as Edge, Core or Aggregation. The termination point of the MPLS depends on the requirements; in this example, the MPLS will be terminated at the data center core. Traffic terminated at the core router will be forwarded into a virtualized firewall solution, as illustrated in Figure 2. Traffic from the core router will be sent into separate Virtual Routing and Forwarding (VRF), if virtualization and traffic segregation is still a requirement at the aggregation switches.

Fabric Virtualization – Unified I/O

Traditionally, a server has a minimum of two Network Interface Cards (NICs) for production IP traffic, two additional NICs for IP-based backup and management, and two Host Bus Adapters (HBAs) for storage access. A virtualized physical server will required at least additional two IP NICs. There are, of course, associated cabling related to each NIC and HBA. With the scenario previously mentioned, a server requires at least four fibers (or Category 5 cables) for IP traffic

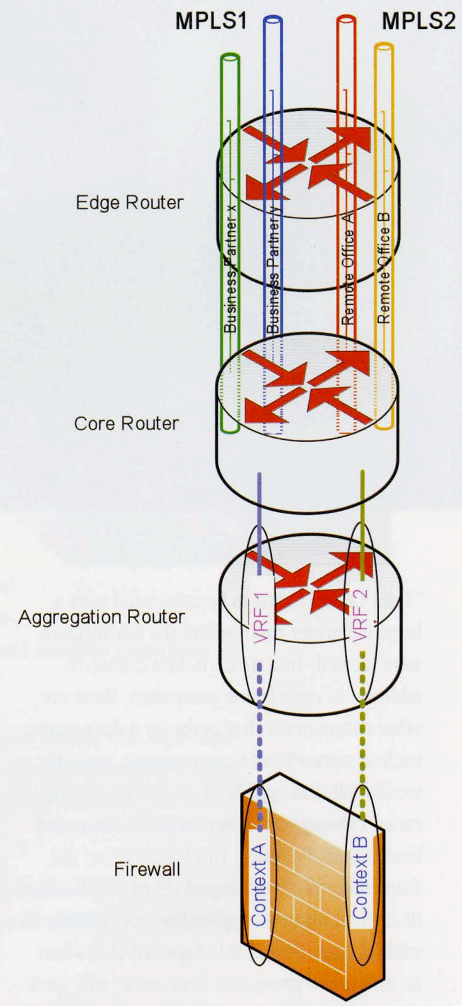

Figure 2 *Wide Area Network Virtualization*

and two fibers for the Fiber Channel storage traffic. In a large server environment, the cost of cabling for all the servers can be prohibitively expensive. In addition, a large bundle of cabling may impede the airflow to the device or the server.

A switch with unified I/O capability can provide the capability to virtualize a physical

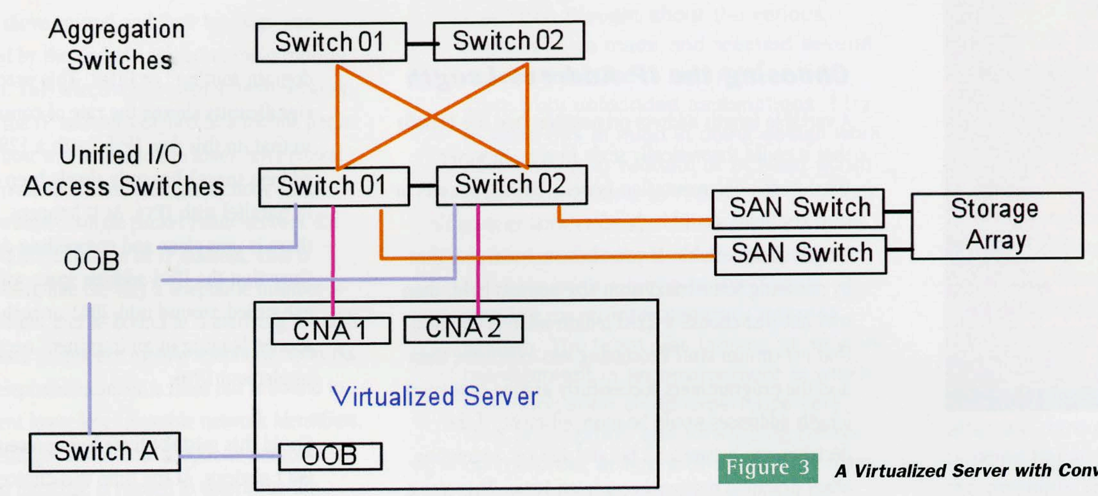

Figure 3 *A Virtualized Server with Converged Network Adapters (CNAs)*

link from the server to the switches to transport both Ethernet and Fiber Channel traffic. Fiber Channel traffic is encapsulated in Ethernet frames (FCoE) to be transported to the switch. At the switch, the Fiber Channel traffic will be extracted and forwarded to the storage switches.

This unified I/O solution can reduce the amount of cabling needed for a server and can simplify server deployment, as shown in Figure 2. To take advantage of the unified I/O capability, the server must be equipped with a Converged Network Adapter (CNA).

Storage Virtualization

The Storage Area Network (SAN) infrastructure must be able to scale to support a few hundred server connections and can scale up to several thousand connections as the data center grows. To meet these requirements, a multi-tiered SAN architecture will be required. The Edge and Core topology is commonly deployed in the data center.

For scalability and redundancy, the SAN design can be virtualized into two independent fabrics (Fabric A and Fabric B). Virtual Storage Area Network (VSAN) is a concept of partitioning a single physical switch into multiple logical SANs. Devices in one VSAN will not be able to communicate with devices in another VSAN, unless Inter VSAN Routing (IVR) zones are manually created. In addition, VSANs can be blocked from traveling across Inter Switch Links (ISLs) and port channels.

As discussed, data center virtualization not only applies to compute, but also applies to network and storage. Data center virtualization that encompasses compute, network and storage introduces a paradigm shift for an IT organization. With proper planning, proven architecture and well thought out organizational realignment, an enterprise can reap huge benefits from it. Some of the benefits that have been observed are cost savings, operational efficiency and improved time to market for new service offerings.

For more on this topic, visit
www.hkn.org/bridge

ABOUT THE AUTHOR

Sukento Sukirya
Solutions Architect, Cisco Systems

Sukento Sukirya is a senior Solutions Architect in Data Center Practice within Cisco Customer Advocacy group with more than 10 years of experience in Data Center Networking. He is the lead and a Subject Matter Expert in Application Delivery and Content Networking and has published several white papers on the subject. He has worked on Cisco Data Center Virtualization services initiative and currently involves in cloud computing technical reference architecture within Cisco.

On Mistakes

by Vinton Cerf

Mistakes happen and we all make them. What's especially important is for engineers to learn from them and to share experiences with others so they can benefit from more than their own mistakes. I am not going to try to make a taxonomy of mistakes nor catalog all the ones I've made (that would take many volumes!). But I think examination of a few of them may be instructive.

Perhaps the most notable mistake I made was in the selection of a 32 bit address space for the Internet. The year was early 1977 and nearly a year had gone by in 1976 during which arguments were made for 32 bit, 128 bit and variable-length addressing for the Internet. Keep in mind that the first design document for the Internet was published in May, 1974 in the IEEE Transactions on Communications. My colleague, Robert Kahn, and I wrote this article in the Fall of 1973. The first "complete" (but not necessarily correct) specification for the TCP protocol was completed in December 1974 (see RFC 675). The first implementations of TCP were done in 1975. By 1976, a second version of TCP was developed and implemented and it was in this context that discussions of address size were undertaken. This was long before any significant deployment had occurred and even before the Internet Protocol (IP) was split from the Transmission Control Protocol (TCP).

Choosing the IP Address Length

A variable length address proposition had the benefit that it could theoretically scale in size. However, there were implementation issues. Parsing packets to find key fields would be harder owing to variable length address fields. If you chose to overcome that by choosing some maximum size address field, then why not just choose a fixed length address equal to that maximum size? Processing was expensive then and the programmers successfully argued that fixed length addresses would be more efficient. If the decision was between 32 bit and 128 bit addressing, other practical matters became an issue. This was a research project and the implementations of the Internet protocols were experiments. An address field of 32 bits provided for 4.3 billion possible terminations. At the time, networks were expensive, wide area (not counting the still new and not widely implemented Ethernets or other local area networks) and few in number. I naively thought that there might be a small number of large scale networks in each country, similar in spirit to the wide area ARPANET. X.25-based networks were also around, but small in numbers (Telenet, Tymnet in the US, Datapac in Canada, Transpac in France, EPSS in Great Britain, for example). An 8 bit field for network ID and 24 bits for host identifier seemed more than enough **for an experiment.** The overhead of 128 bits each of source and destination address seemed incredibly excessive at the time, so, as Internet program manager at the US Defense Advanced Research Projects Agency (ARPA), I selected 32 bits of address space when consensus among the network researchers was not developing. I assumed that if the Internet experiment were successful, then we would design a production version.

Well, the experiment never quite ended. Indeed, by the early 1990s, there was great concern in the Internet Engineering Task Force (IETF) that we would exhaust the 32 bit address space as the network exploded during the "Dot-Boom." This led to the design of IP version 6 ("IPv6") to replace the 32 bit address IPv4 packet format. At the same time, a conservative regime for address allocation and assignment was adopted called "classless inter-domain routing" or CIDR. This practice significantly slowed the rate of consumption so that, to this day, IPv6 (with a 128 bit address space) has only slowly been deployed in parallel with IPv4. As it happens, however, there is now clear and compelling data to show that the IPv4 address space will be exhausted around mid-2011 or perhaps even sooner, leading to an imminent need to implement IPv6.

Could this mistake have been prevented? It isn't obvious. At the time this choice was made, the Internet had not even been officially deployed. That did not happen until January 1983! Until then, only a small number of networks and host computers were running TCP/IP. The rest, on the ARPANET, were running the predecessor NCP protocol which worked very well for the ARPANET but was not well suited to end-to-end operation across multiple, disparate packet networks. It would have been the height of arrogance to assume that this experiment would lead to a new, global communication infrastructure, potentially replacing the long-standing telephone system and requiring more than 4.3 billion unique termination points. At the time, arguing that a 128 bit address space was required seemed to me at least unfounded if not ludicrous. We might have avoided the awkward problem of IPv4 to IPv6 transition if we had chosen variable length addresses but for reasons cited above, we didn't.

TCP Connection Identifier Binding

Another mistake, in retrospect, was to bind TCP connection identifiers strongly to their underlying IP addresses. At the time that IP was split from the original monolithic TCP protocol, it seemed clever to avoid creating another layer of end point identifiers that would simply add to the overhead of an Internet packet. When the subject of mobility was considered, I think I had tunnel vision because we had successfully implemented a mobile packet radio network in the mid-1970s that bound an IP address to a mobile packet radio node identifier. The packet radio nodes could move around and their topology was tracked by the underlying packet radio routing system. This effectively created a mesh network. Since the IP address assigned to a mobile packet radio host was bound to the lower layer packet radio node identifier, changes in node connectivity within a single packet radio network did not require a change in IP address. This is something like the way a telephone number is now bound and re-bound to underlying routable addresses in modern mobile telephone networks. The telephone number is fixed but is bound to different lower level routable network identifiers. Interestingly, for mobile telephone networks, a central database is needed to determine the current network connectivity of a roaming mobile, since only the end point telephone number is available to the calling party. The telephone number has to be mapped to the current mobile network to which the mobile is connected and, eventually, to the base station within that network to which the mobile is currently connected.

When routers became the primary element of Internet networking, this lower layer of network addressing (present in the Packet Radio network, Atlantic Packet Satellite network and the ARPANET) disappeared. Routing was done uniformly on the IP addresses of each Internet device. When these portable or mobile devices moved from one network to another, their IP addresses had to change to reflect their topological connectivity to the Internet. Only later did it become apparent that it would have been useful to introduce a distinct end-point identifier for the mobile device, independent of the current IP address used to reach it in the global Internet. One would still have the problem of mapping the fixed end point identifier to its "current" IP address binding. One could imagine doing this with a system like the hierarchical Domain Name System so that the end point identifier could be found in a distributed way. Of course, the binding of this endpoint identifier would have to be dynamically maintained. There are several proposals under consideration in the Internet Engineering Task Force to accomplish this objective.

Conclusions

I've often thought about the various mistakes I've made and reached several conclusions. One is that a lot of them stem from unfounded assumptions. I try to keep this in mind in doing design work now, hoping to validate or at least scrutinize assumptions to reduce the possibility that I have made some of them in an implicit and unconscious way. A recent example of this came to mind while working on an interplanetary Internet system. The team was looking at network management in an environment in which communication could experience very long propagation and forwarding delays on the order of hours to days. Real time notions such as the familiar Internet "ping" function are less useful when the response cannot be expected for variably long times. The fact that you have just received a packet does not mean that you can return one to the sender as celestial motion may have rendered the sender incommunicado. I have had to remind myself repeatedly that network management in such an environment demands a considerable degree of autonomous functionality in the network nodes because the possibility of responding in real time to problems is foreclosed owing to speed of light delay and discontinuities.

On a lighter note, I recall visiting the famous Leaning Tower of Pisa some years ago. I learned that the builders were extremely cautious in their work, recognizing the risks of the building site. They built one story and waited a decade before putting up the next. It was only after the third or fourth story that the building began to lean and one can see the attempts to correct for this problem. I suppose this falls under the "best laid plans…" rubric. At the least, one can take an engineering lesson from their experience. If you are going to mess things up, mess them up "big time" because then your mistake may become a revenue-producing tourist attraction!!

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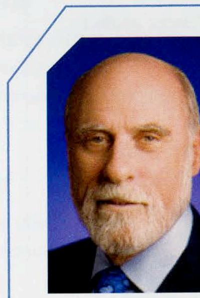
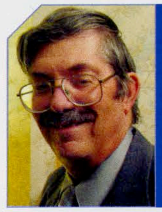
ABOUT THE AUTHOR



Vinton G. Cerf
Vice President & Chief Internet Evangelist, Google
Eta chapter

Widely known as a "Father of the Internet," Vint is the co-designer with Robert Kahn of TCP/IP protocols and basic architecture of the Internet. Their work has been recognized with the U.S. National Medal of Technology and the Presidential Medal of Freedom. Vint has served as Senior Vice President at MCI and Vice President of the Corporation for National Research Initiatives (CNRI). During his tenure with the U.S. Department of Defense's Advanced Research Projects Agency (DARPA), Vint played a key role leading the development of Internet and Internet-related data packet and security technologies. Vint has received numerous awards, including the Marconi Fellowship, Charles Stark Draper award of the National Academy of Engineering, the A.M. Turing Award from the Association for Computer Machinery, the Silver Medal of the International Telecommunications Union, and the IEEE Alexander Graham Bell Medal, among many others. He was recently named an Eminent Member of Eta Kappa Nu.

Member Profiles



James Hagerty

Director of Clinical Engineering
Crozer-Keystone Health System

Career Highlights

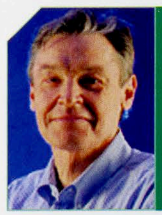
I was hired by Hospital Central Services as corporate manager to develop HCSC-Biomedical Services, one of the country's first clinical engineering shared services. Clearly, developing a company from scratch was a great challenge. Formal engineering education did not focus on management skills, financial skills, or human resource skills needed to accomplish this task. However, engineering education provided a solid foundation of technical and logic skills. These with mentoring by senior management staff made the project a success and gave me the tools to be successful in future engineering management positions.

Education and Career

Engineering education is all about problem-solving. Mathematics and engineering courses are exercises in logical thinking. The content is not as important as the process in achieving an answer. Engineering education taught me the problem-solving skills that have been invaluable in dealing with technological, human, and management issues in a health care environment.

Advice to Engineering Graduates

Don't chase the money; chase the dream. Get involved in work that you are excited and passionate about even if the compensation is not great. The money will come later. Don't let the excitement and passion fade.



Gerald Michael Masson

Professor, Department of Computer Science
Director, Information Security Institute
Johns Hopkins University

Career Highlights

I developed the primary vision and then created the infrastructure for the Johns Hopkins University Information Security Institute (JHUISI). In 2001, I was named JHUISI founding director. JHUISI has a comprehensive research and education agenda which takes a broad, holistic perspective to the pervasive role of information security and assurance in modern society, ranging from the study and application of primarily technical areas such as cryptography, intrusion detection, and network security, to law, ethics, safety, management and privacy, and to health/medical applications.

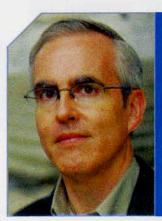
Education and Career

Building educational programs outside of traditional course and departmental boundaries.

I was named the Maryland 2004 Educator of the Year in the administrator category by the Maryland Higher Education Commission for my central role in establishing the Johns Hopkins University Information Security Institute together with designing and developing the MSSI program.

Advice to Engineering Graduates

Teach and engage in research outside the box. It's where all the fun and action are. Let your students define you, not vice-versa.



David Tuckerman

Venture Partner
CMEA Capital

Career Highlights

The first highlight was the opportunity to work at the IBM Thomas J. Watson Research Center as an MIT "co-op" student. I was designing and testing 10-picosecond superconducting logic devices in 1978, at a time when semiconductor technology was still in the nanosecond time scale. The next highlight was my PhD thesis research. I had a very open-minded thesis advisor and an independent source of financing, so I was free to explore nontraditional and interdisciplinary problems. I self-educated myself about heat transfer, and combined that knowledge with silicon micro-fabrication techniques. The result was micro-channel cooling, a significant breakthrough in IC packaging technology. Co-founding a start-up company was the next major highlight. It felt risky and I was working the longest hours in my life, but I learned an enormous amount about entrepreneurship. After 6 years of work we successfully sold the company. The most recent highlight was working at Tessera, another company that went public while I was its CTO.

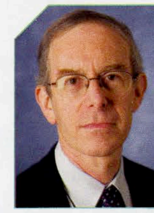
Education and Career

I believe I owe much of my later successes to my MIT undergraduate education. Beyond that, I think the decision to double-major in Physics, in addition to my primary major of Electrical Engineering, was the other key to success. Having that basic physics background enabled me to see the unifying threads in different branches of engineering and quickly pick up key concepts in fields that most people think of as separate and distinct. I think the most significant innovations in technology come from combining insights from disparate fields. I'm not saying that everyone needs to double major in Physics, but every engineer should certainly take several basic physics courses and learn them very well. It will pay big dividends in the long run.

Advice to Engineering Graduates

If possible, go to a school that offers a "co-op" program. If there is no such program, try your best to find summer jobs that relate to engineering. Try to find a professor doing research in something that interests you, and see if you can work part-time during the year. Choose your major and your course selections by what you are passionate about, and not just by what you perceive the current job market to be; no one can predict how job markets will evolve beyond a few years out. The saying 'Do what you love, the money will follow' really is true.

Member Profiles



Andrew D. Zeitlin

Senior Principal Engineer
MITRE Corporation/CAASD

Career Highlights

I led development of algorithms for the Traffic Alert and Collision Avoidance System (TCAS II) for over 30 years. Most projects are long and often unsuccessful, so it was a great thrill to see TCAS certified and implemented in all airline aircraft. It's even better to know that it provides a great contributor to public safety. I like to say that our program's success is measured by collisions that didn't happen; there is no way to estimate their number. The work has often involved collaboration with international experts, and I've found this rewarding in travel and cultural enrichment as well as the technical aspects.

Education and Career

Engineers are taught methods to solve problems, but they also should realize they are being taught how to learn. I found that new areas open up over time and some come to dominate the profession. I began working prior to PCs and microprocessors, which are central to a lot of modern equipment. I have learned to enjoy writing and presenting my work in public, and students should try to do much more of that, as well as including some liberal arts and humanities in their studies.

Advice to Engineering Graduates

Your first assignments may be narrowly focused, but you should gradually widen your gaze to the big picture. Whether your passion remains entirely in engineering or includes business, law, medicine, or other fields, your engineering skills will remain a great asset.

HKN Award Nominations

HKN invites its members to nominate outstanding individuals for these prestigious awards. Nomination details and forms can be found at ***www.hkn.org/awards.***

Outstanding Young Electrical and Computer Engineer

- *Presented annually to an exceptional young engineer who has demonstrated significant contributions early in his or her professional career*
- *Nominations due April 1*

Vladimir Karapetoff Outstanding Technical Achievement Award

- *Recognizes an individual who has distinguished himself or herself through an invention, development, or discovery in the field of electrical or computer technology*
- *Nominations ongoing*

Distinguished Service Award

- *Acknowledges an individual who has devoted time and energy to the Eta Kappa Nu Association through years of active participation*
- *Nominations ongoing*

Outstanding ECE Student Award

- *Annually identifies an ECE senior who has proven outstanding scholastic excellence; high moral character; and exemplary service to classmates, university, community, and country*
- *Nominations due June 30 to the LA Alumni chapter*

Outstanding Chapter Award

- *Singles out chapters that have shown excellence in their activities and service at the department, university, and community levels*
- *Winners are determined by their required Annual Chapter Reports, due October 15 for the preceding academic year*

C. Holmes MacDonald Outstanding Teaching Award

- *Presented annually to a dedicated young professor who has proven exceptional dedication to ECE education and has found the balance between pressure for research and publications and enthusiasm and creativity in the classroom*
- *Nominations due November 1*

Integration, Innovation and Expansion in Energy Systems Education

by Marija Ilic and Ed Schlesinger

State of Current Electric Energy Programs

A convergence of circumstances has put electric energy systems back at center stage for many researchers, universities, and students of electrical and computer engineering. These circumstances include 1) the broad realization that the electric energy system in the United States is brittle and subject to serious problems if it is not upgraded and modernized and 2) the growing interest in and need for the integration of new energy sources including renewable sources with traditional sources of energy.

Many universities, however, are finding themselves somewhat unprepared in the midst of this revived importance of and interest in energy and environment. In particular, they are facing an unprecedented challenge to introduce into what is typically an over-crowded ECE curriculum theoretical fundamentals and applications of electric energy systems that have impact in this changing industry. The sometimes reluctant recognition that something must be done must be reconciled with the belief that one must teach only general principles. Many strongly believe that by the time students are taught how to think and become problem solvers, we have done enough to prepare them for all real-world challenges.

We believe that teaching fundamentals in a system context within an application domain is much more effective. The bridge between the concepts which have historically evolved in the power industry and basic ECE courses has been weak. Consequently, it is almost impossible to expect students who have not taken any power engineering courses to become forward-looking leaders or even to enter the market as members of a qualified new workforce. On the other hand, students who have specialized in traditional power engineering often lack the ability to re-think the industry problems. In short, there exists an educational void, and there is some urgency to innovate and integrate electric energy systems education into existing curricula.

State of the Electric Energy Industry

The electric power system is an old infrastructure, which has mushroomed over the past two centuries as electricity demand has grown. The electric power grid has become a rather complex electric network whose voltage levels range from very Extreme High Voltage (EHV) to the 110V in households. Power plants of various types and a wide variety of loads are connected between ground and the nodes of this network. At the terminals of the power grid many forms of energy conversion take place.

Utilities schedule their own power plants in a stationary feed-forward manner to meet forecast demand and exchange power with neighboring utilities. System operators have pre-defined worst-case plans for managing failures of large equipment. At the same time it is almost impossible to predict worst-case scenarios in a complex network of this magnitude, and consequently customers experience infamous blackouts. A closer look into operations and planning principles reveals the assumptions which ensure such reliable performance; the cost is under-utilization during normal conditions. To prevent blackouts and to increase short-term utilization, it is necessary to rely more actively on on-line monitoring, faster control and computationally efficient and robust algorithms to enable timely decisions as system conditions change. Moreover, since the infrastructure is aging, much of the hardware infrastructure must be re-built and this requires engineering and policy knowledge to decide what is the right way to deploy these systems. At the same time the introduction of two-way communications within the electric energy system immediately also requires the introduction of sophisticated network and software security systems to ensure the reliability and the resilience of this network against attacks and other forms of potential failure.

New challenges brought about by industry restructuring

Recently, functional unbundling of regulated utilities has brought about new challenges. In particular, the power grid owners are required to provide equal access to power producers inside and outside their boundaries. This has created the need for more monitoring, and regional coordination of network congestion. Overall the situation is such that it is no longer possible to forecast conditions based on system operators' knowledge of their own sub-networks, nor is it possible to predict the worst-case scenario at the utility level without better information about the power flows across the region. In addition, some parts of the country have formed electricity markets in which power is traded like any other commodity. This has led to the need for information technology (IT) to coordinate and secure financial trades and physical network operation in near-real-time.

The electricity restructuring experiment has proven to be a much larger challenge than initially imagined. Future leaders are likely going to re-think the fundamental principles of these markets as complex dynamic heterogeneous network systems. This makes the technical problem of efficient and robust electricity services very dependent on regulatory structures, much the same way as is the case in communications networks.

The Newest Challenge -- Pressure to Provide Sustainable Energy

The problem of going green is likely to affect future electric energy systems in fundamental ways. Most of the new types of energy sources are non-traditional, and their models are not household items in engineering textbooks. Most importantly, they are intermittent, and essentially prevent operators from knowing with high confidence the power available to meet demand. There is therefore a need for IT-enabled flexible utilization essential for reliable, efficient, secure and sustainable services.

Objectives for modern electric energy systems programs

The combined industry changes in terms of technology and organization have brought about new complexity from the highest level system to the smallest level component. The consequent burden on new technical leaders is enormous. Most of all, they must be capable of rethinking how to plan, rebuild and operate an infrastructure which has been turned upside-down from what it used to be. To prepare for such major challenge, leaders must understand 3ϕ physics; modeling of complex systems; dependence of models on sensors and actuators; design for desired system performance; numerical methods and algorithms; and IT in its broadest sense.

It should be clear that this is not how power engineering of yesterday was taught. The challenge to the faculty responsible for the development of adequate curricula is equally high. They must introduce conceptual problem formulations; understand how models, sensing, control and communication are different for sample systems: (1) old centralized infrastructure; (2) deregulated industry; and, (3) industry with many distributed sensors, controllers, intermittent generation, and demand-side input.

Modern Electric Energy Systems at Carnegie Mellon

The number of both undergraduate and graduate students with an interest in this area is high and growing partly in response to the increased visibility of the research efforts in this area. It has become impossible to ignore the grass-root pressure from students for developing the area. Students have become genuinely interested in careers in future energy systems; they are drawn to the area to serve society while still doing engineering.

While perhaps too early to claim success, we would like to share the approach taken in ECE at Carnegie Mellon University. From the very beginning the emphasis has been on formulating the electric energy systems problems as complex dynamic network systems, instead of on studying component physics. Viewed this way, smart grid becomes an enabling network for integrating many new physical components. A great deal of effort has gone into novel modeling for "translating" a physical and business system and its objectives into the language of systems, control, sensors, signal processing, computer science and IT including cyber security. Team teaching of both ECE and business and public policy has led to a unique experience of the students as well as providing the expertise needed for this industry. The program is further enhanced by the recent development of an M.S. in Energy Systems spanning all the departments in the college of engineering and including concepts from business and economics and of course the integration of educational efforts with the ongoing research efforts.

Closing Remarks

There exists now a highly unusual window of opportunity to introduce modern electric energy research and education programs. On the educational front it is essential to pose the design and operation of new electric energy systems as the problem of a multiple performance-driven cyber-physical systems over various contextual, temporal and spatial phenomena. This view lends itself to a possible path of truly integrated teaching of future electric energy systems as an excellent real-world example of many concepts taught in more general ECE, policy, economics and business disciplines. Synergic formulations of real-world energy systems based on such a multi-disciplinary systems view is bound to influence future leaders to think holistically.

For more on this topic, visit
www.hkn.org/bridge

ABOUT THE AUTHORS

Marija Ilic
Professor, Electrical and Computer Engineering, Carnegie Mellon University

Professor Ilic's research and education focus on the modeling and control of large complex nonlinear systems with application to electric power systems. While it is motivated by the practical needs of the electric power industry, it is useful to other industries that operate large complex systems whose organization is hierarchical. Most generally, she seeks to improve the technical and economic performance of electric power systems by means of control and communication.

T.E. (Ed) Schlesinger
Department Head and Professor, Electrical and Computer Engineering, Carnegie Mellon University

Professor Schlesinger has served as the Director of the Data Storage Systems Center and was the founding co-director of the General Motors Collaborative Research Laboratory at CMU. He is currently the Director of the DARPA Center for Memory Intensive Self-Configuring Integrated Circuits. In 2001 he received the Benjamin Richard Teare Award for Teaching from the Carnegie Institute of Technology.

HKN Awards

HKN and ECEDHA, the Electrical and Computer Engineering Department Heads Association, hosted a combined ECEDHA-HKN Awards Banquet on March 15, 2010, in Clearwater Beach, Florida, during the 2010 ECEDHA Annual Conference. Nearly 200 department heads, award winners, and distinguished HKN and ECEDHA guests were in attendance. The partnership between HKN and ECEDHA has proven mutually beneficial as the support of the department head is crucial in the success of the ECE students as well as the HKN chapter. In turn, the HKN chapters provide many services to the department including tours, mentoring underclassmen, tutoring, lab monitoring, and much more.

Outstanding Chapter Award

Congratulations to a record-breaking twenty-two Outstanding Chapter Award winners for the 2008–2009 academic year. The awards are determined by a calculation of service hours, recruiting and retention efforts, and the overall report score. Chapters are required to file the Annual Chapter Report each year by October 15 for the preceding academic year.

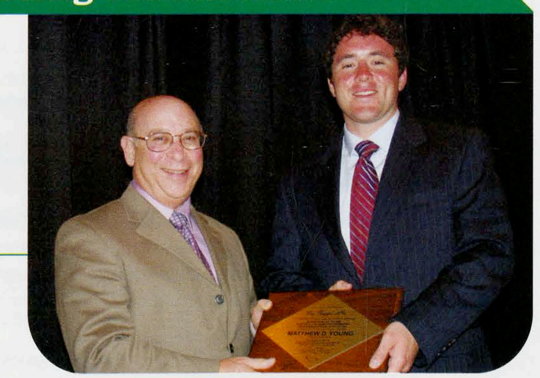
2008–2009 CHAPTER AWARD RECIPIENTS:

Alpha	*University of Illinois at Urbana-Champaign*
Beta	*Purdue University*
Beta Epsilon	*University of Michigan, Ann Arbor*
Beta Mu	*Georgia Institute of Technology*
Delta Omega	*University of Hawaii, Manoa*
Epsilon Beta	*Arizona State University*
Epsilon Kappa	*University of Miami*
Epsilons Upsilon	*Tuskegee University*
Gamma Chi	*New Mexico State University*
Gamma Rho	*South Dakota State University*
Gamma Theta	*Missouri University of Science and Technology*
Gamma Xi	*University of Maryland, College Park*
Iota Gamma	*University of California, Los Angeles*
Kappa	*Cornell University*
Mu	*University of California, Berkeley*
Nu	*Iowa State University*
Omega	*Oklahoma State University*
Phi	*Union College*
Rho	*University of Colorado, Boulder*
Sigma	*Carnegie Mellon University*
Tau	*University of Cincinnati*
Zeta Sigma	*Polytechnic Institute of New York University*

2009 Outstanding Electrical and Computer Engineering Student Award

This award is presented annually to a graduating senior and recognizes outstanding scholastic excellence and high moral character, coupled with demonstrated exemplary service to classmates, university, community, and country. The Los Angeles Area Alumni Chapter administers the program.

Matthew D. Young, *University of Rhode Island*



Honorable Mention

Jill Desmond, *University of Delaware*
Tori Simms, *Missouri University of Science and Technology*

Finalist

Kevin Donovan, *Union College*

HKN Presents Awards

AWARD WINNER Presented February 2010

Karapetoff Award

Gerard A. Alphonse

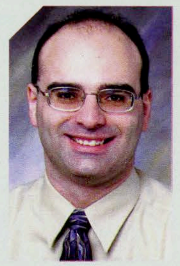
Gerard Alphonse is recognized for his inventions in superluminescent diodes (SLDs) and related devices. In particular, it was his "simple, elegant insight" to angle the SLD beam region, producing a power device that was easy to manufacture. These broadband semiconductor light sources are key components in fiber-optic gyroscopes, low-coherence tomography for medical imaging, and external-cavity tunable lasers with fiber-optic communications applications. His other research activities include original contributions in the development of photochromic cathode ray storage and projection tubes, holography in photorefractive media, broadband acousto-optic deflectors, holographic data storage, ultrasonic imaging for medical diagnostics, videodiscs, optical disc media development. He has also been involved in education and professional service. His commitment to engineering education covers 16 years as adjunct faculty in the Electronic Physics Department at LaSalle University's Evening Division, and served for four years as Department Head. He has also taught electrical engineering courses in Linear Systems, Communications, and Microwave Theory at the College of New Jersey.

Alphonse at a Glance

> Co-Founder and Chief Technical Officer, Medeikon Corporation
> Chief Scientist and Program Manager, Sarnoff Corporation
> Fellow, IEEE; member, Eta Kappa Nu, Tau Beta Pi, Sigma Xi, New Jersey Inventors Hall of Fame; David Sarnoff Outstanding Achievement Awards (4), IEEE Region 1 Award, IEEE Third Millennium Award
> B.S.E.E., M.S.E.E., and Ph.D. (Electrophysics) from New York Polytechnic University

AWARD WINNER Presented March 2010

C. Holmes MacDonald Outstanding Teaching Award



Dimitrios Peroulis

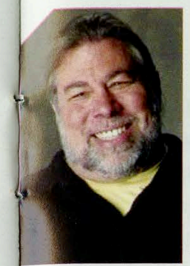
Dimitrios Peroulis has been selected by Purdue students and faculty for several teaching awards there on his way to earning the C. Holmes MacDonald Outstanding Teaching Award. He is credited with implementing new instructional techniques such as interactive virtual laboratories in addition to providing outstanding classroom instruction. His dedication to undergraduate education beyond the classroom is evident in his efforts to engage with students through informal discussion sessions and involvement in his research projects. He has done all of this while conducting an active research program in the areas of RF MEMS, sensing and power harvesting applications as well as RFID sensors for the health monitoring of sensitive equipment, currently leading a group of nineteen graduate students on a variety of research projects.

Peroulis at a Glance

> Associate Professor of Electrical and Computer Engineering, Purdue University
> National Science Foundation CAREER Award, Eta Kappa Nu Beta Chapter Outstanding Teaching Award, ECE Hesselberth Award for Teaching Excellence, ECE Motorola Excellence in Teaching Award, Purdue College of Engineering A.A. Potter Award for outstanding contributions in undergraduate education
> B.S., National Technical University of Athens, Greece; M.S.E. and Ph.D. in electrical engineering from the University of Michigan

EMINENT MEMBER Presented February 2010

Eminent Member



Steve Wozniak

A Silicon Valley icon and philanthropist for the past three decades, Steve Wozniak helped shape the computing industry with his design of Apple's first line of products. In 1976, Wozniak and Steve Jobs founded Apple Computer Inc. with Wozniak's Apple I personal computer. The following year, he introduced his Apple II personal computer, which was integral in launching the personal computer industry. After leaving Apple in 1985, Wozniak was involved in various business and philanthropic ventures, focusing primarily on computer capabilities in schools and stressing hands-on learning and encouraging creativity for students. Making significant investments of both his time and resources in education, he "adopted" the Los Gatos School District, providing students and teachers with hands-on teaching and donations of state-of-the-art technology equipment. He founded the Electronic Frontier Foundation, and was the founding sponsor of the Tech Museum, Silicon Valley Ballet and Children's Discovery Museum of San Jose. His impact is captured in his Heinz Award citation for "single-handedly designing the first personal computer and for then redirecting his lifelong passion for mathematics and electronics toward lighting the fires of excitement for education in grade school students and their teachers."

Wozniak at a Glance

> aka "The Woz"
> Chief Scientist, Fusion-io
> Co-founder, Apple Computer Inc.
> National Medal of Technology, Inventors Hall of Fame, Heinz Award for Technology, The Economy and Employment
> B.S. in electrical engineering/computer science from University of California, Berkeley

Notes from Headquarters

Dear HKN Chapters,
Here are a few friendly reminders from the HQ office:

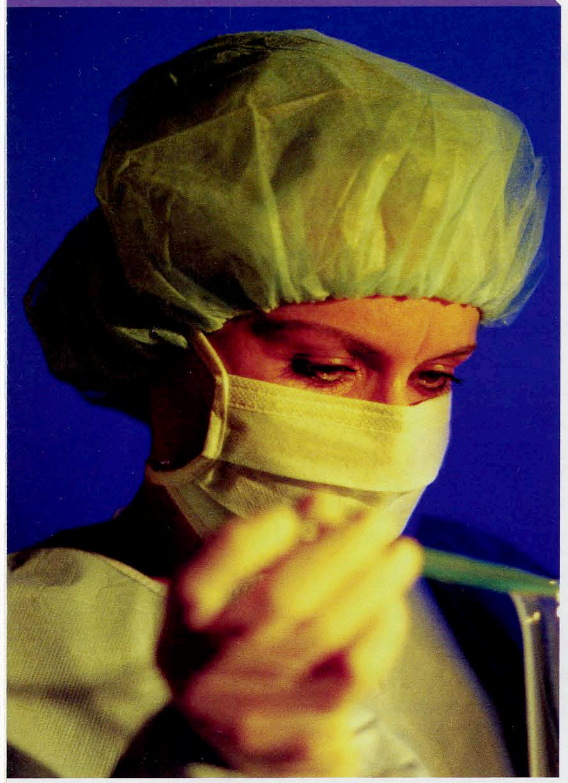
- **HKN HQ moved!** Please download new forms from www.hkn.org and update your contact records as appropriate.

  HKN Headquarters
  233 South Wacker Drive
  Suite 8400
  Chicago, IL 60606-6338 USA

  Phone: 1-800-406-2590
  Fax: 1-800-864-2051
  Email: info@hkn.org
  Web: **www.hkn.org**

- Don't forget to send your New Member Requisition Form and dues for your inductions to HQ. Inductees are not considered HKN members until all of the paperwork has been processed. If you have not received the certificates, HQ has not received the paperwork.
- Update your contact information! Are you graduating or moving across campus? Be sure that your contact information stays up to date. Visit **www.hkn.org** to update your information online.
- Looking for career services? Registration is free for Experience, Inc. **www.hkn.experience.com** Log in to upload your resume, search for jobs or connect with other HKN members. Another free networking group is available on LinkedIn. **www.linkedin.com**
- Nominate an outstanding colleague for an HKN Award! All nomination forms are available online as well as the deadlines for submission.
- IRS reporting – don't forget to submit your 990 or 990N as appropriate by October 15 for the 2009–2010 fiscal year.
- Chapter Reports are due October 15 for the 2009–2010 academic year. HQ suggests that the current officers start this project prior to the transition to new officers. Keep track of your activities throughout the year to make this easier and include more descriptions and photos whenever possible. These reports are used to determine the Outstanding Chapter Award winners.
- ***Save the Date!*** Send a couple of representatives to the 2010 Student Leadership Conference, "Engineering in a Multidisciplinary World," November 5–7, 2010, hosted by Beta Xi chapter at the University of Oklahoma. Conference details will continue to be posted at **www.hkn.org** as they become available and registration will be available in early September.

*As always, the HKN Web site **(www.hkn.org)** is the best source of information, paperwork, project ideas, award information, and upcoming activities.*



ECE Students Working with Nursing Students to Improve Rural Health Care

by Pritpal Singh

Motivation

Enrollments in undergraduate electrical and computer engineering (ECE) majors have declined over the last decade by about 25%. One reason to which the decline in undergraduate ECE enrollments has been attributed is the relatively abstract nature of the electrical and computer engineering fields compared to the other engineering disciplines. Furthermore, the present generation of students is interested in service activities, as demonstrated by the large number of students engaged in organizations such as student chapters of Engineers Without Borders and Engineering Projects in Community Service (EPICS) programs. Finally, ECE departments are showing relatively low enrollments of female students compared to many of the other engineering disciplines, especially biomedical engineering, in which enrollments are typically 50% male, 50% female. While the supply of ECE graduates has been declining, the demand for electrical and computer engineers is growing. It is therefore important for us to find ways to increase the enrollments in the ECE disciplines.

New Program Description

To address these issues, we are developing a new program at Villanova University in which undergraduate students and faculty in the ECE Department are working with undergraduate students and faculty in the College of Nursing to use ECE technologies to improve health care in rural communities in developing countries. The inspiration for this initiative came from the IEEE Humanitarian Technology Challenge initiative, in which IEEE volunteers are developing technological solutions aimed at addressing some of the UN Millennium Development Goals.

Villanova University's College of Engineering has been sending students to Honduras and Nicaragua for the last seven years to perform community service activities. The Honduras project, led by structural engineers in the Civil and Environmental Engineering Department, has been centered on providing engineering consulting on building and construction projects in rural communities. The Nicaragua program has been aimed at designing gravity-fed, clean water distribution systems for members of the rural communities surrounding the town of Waslala. Mechanical engineering students and faculty have led this effort. Most recently, I made a trip to Waslala with some mechanical engineering colleagues to investigate the development of micro-hydroelectric power systems. We now have both electrical engineering and mechanical engineering students working together on a senior design project to design the turbine-generator system, the control system, and a power distribution system for a micro-hydroelectric project.

Over the last five years, nursing faculty and students also have joined the engineering students on trips to Nicaragua. They have conducted health care outreach activities, including health assessments and health education workshops, for the members of the communities surrounding Waslala. While the engineering and nursing students have traveled together on these trips, the students have interacted little after arriving in Nicaragua.

The new effort that we recently launched is to have electrical and computer engineering students and nursing students work together on joint health-care-related projects in rural communities, such as those surrounding Waslala in Nicaragua. Employing small-scale power and communications technology can dramatically improve health outcomes in rural communities of the developing world. Health clinics in these areas often do not have power to provide lighting to perform surgeries at night. In addition, they may employ health-care workers with only basic training, they may have limited health-care records for the community members, and they have limited access to medicines.

Through the use of communications technology based on low-cost wifi networks or mobile, cellular-phone technology, information may be communicated from a remote site to a central clinic in town and can then be analyzed by a trained, health-care professional. A small solar panel with a battery and LED lighting can serve as a self-contained means of providing enough lighting to conduct operations at night. Electronic health-record systems can be used to track the health of community members over time. Finally, power can be used to power small refrigerators to store medicines. Alternatively, communications technology can be used to order medicines from the town.

Clearly, there are many opportunities for ECE technologies to be used to improve health-care outcomes in developing countries. However, the implementation of these technological solutions must be guided by health-care specialists, such as nursing students and faculty. Thus, ECE students and nursing students have a wonderful opportunity to work together on some interesting, meaningful projects in which they can improve the lives of those who are less fortunate.

Student Interest and Next Steps

We have generated significant interest in this new program. Five ECE students—three junior electrical engineering students, one junior computer engineering student, and one graduate electrical engineering student—have already signed up for the program. We also have recruited three junior nursing students. Two ECE faculty members who specialize in computer communications and renewable energy have signed on, as have two nursing faculty.

All the students and faculty are preparing to travel to Waslala, Nicaragua, in May 2010 for a project planning trip. The junior ECE students will then use the assessment trip to prepare a proposal for their senior design project, which they will conduct in the fall semester. The nursing students will obtain academic credit for their work in a Global Community Health course that they take in the spring semester of senior year, as well as in an independent study project. We have prepared and submitted two grant proposals to obtain funding to support this initiative.

We have also started to advertize this program in our Open Houses and have received positive feedback from prospective students. We are hopeful that this initiative, along with other efforts that we are pursuing, will expand interest in the electrical and computer engineering fields.

For more on this topic, visit
www.hkn.org/bridge

ABOUT THE AUTHOR

Pritpal Singh
Professor and Chair, ECE Department, Villanova University

Dr. Singh is spearheading an initiative to use EC technologies to improve health care in rural communities in developing countries. Working with students and faculty in Villanova's College of Nursing, Dr. Singh, Dr. Sarvesh Kulkarni, Associate Professor of ECE, and a cohort of one graduate and four undergraduate ECE students are focusing their outreach efforts on the communities in and around Waslala, Nicaragua, an area that already receives engineering and nursing services from Villanova University.

Eta Kappa Nu Association
233 South Wacker Drive, Suite 8400
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Career and Alumni Services

Job openings, free career posts to other HKN members, resume and interview techniques, and networking opportunities are available through Experience, Inc. Free registration is available on the HKN Web site.

Chapter Administration Forms and Information

Everything needed to establish and run an HKN chapter is available in one spot on the HKN Web site.