

THE ♦ BRIDGE

The Magazine of Eta Kappa Nu

AUTUMN 2008

Piecing Together **21st Century Communications**

FEATURES

**21st-Century Communications:
Petascale Services, Multi-
service Integration, Grid
Network, and Global Facilities**

4G: The What, Why, and When

**Heating up the TV Landscape—
Internet TV versus IPTV**

**Jeremy Schneider, Young
Entrepreneur and Rising Star**



www.hkn.org

LETTER FROM THE EXECUTIVE DIRECTOR

Roger L. Plummer

Dear HKN members,

2008 has been an exciting year for HKN. Despite the recent economic challenges, the decline in ECE graduation rates, and the yet-to-be-completed merger with the IEEE, we have seen a renewed enthusiasm among the student and professional members encouraging us to continue to provide the best possible services to HKN student and professional members.

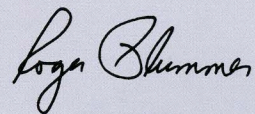
The awards programs continue to recognize the outstanding achievements of HKN members and professionals in the community who have made important contributions to industry and society as a whole. Three new Eminent Members, two Karapetoff award winners, an outstanding student, and 20 outstanding chapters have been recognized in the last year. Please nominate the deserving individuals with whom you are acquainted for an award.

A very successful HKN student leadership conference was hosted by Sigma chapter at Carnegie Mellon University in November 2008. Students had ample opportunities to network with each other and industry representatives. Distinguished speakers were invited to discuss leadership, playing to win in the professional world, entrepreneurial skills, and teamwork. We thank the sponsoring companies and the generous HKN alumni who made the conference possible.

HKN alumni have a variety of ways to interact through Experience, Inc., and new groups on Facebook and LinkedIn. We encourage you to participate in the recruiting, mentoring, and professional networking.

THE BRIDGE is another way to keep in touch and share your professional experiences, challenges, and accomplishments. Please e-mail them to *THE BRIDGE* Editor Barry Sullivan at editor@hkn.org.

Warmest regards,



LETTER FROM THE EDITOR

Barry J. Sullivan | Beta Omicron Chapter Member

The last years of the 20th century demonstrated the life-changing potential of communications technology. While mobile communications and the Internet have technical roots that reach back to the 1960s and earlier, it was the last decade of the old millennium that witnessed the profound impact of broad access to these technologies and the resulting excitement of seemingly boundless business opportunities.

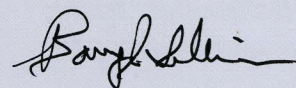
The first century of the new millennium opened with a couple lessons on overblown expectations in the form of the dot-com bubble and runaway spectrum auctions. Even so, there is no doubt about the inclusion of communications among the essential infrastructure elements needed for sustained economic growth. In this issue of *THE BRIDGE*, we assemble a few of the pieces of this evolving infrastructure and the applications it supports as we move deeper into the 21st Century.

The four articles in this issue alternate between examples of communications applications and the infrastructure that enables them. The first is an interview with a young entrepreneur whose business could not exist without the Internet. This is followed by an article on future networks and what they can support.

Network evolution has created new ways of delivering video services, as illustrated by the article on IPTV and Internet TV. Finally, the article on 4G networks describes how the next generation of wireless technology will support a richer mix of services, including video.

We continue to present Member Profiles, offering the opportunity for members to share lessons learned from their careers. If you are interested in contributing an article or a profile, drop me a note at editor@hkn.org.

Warm regards,



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Autumn 2008

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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.

THE BRIDGE is the official publication of the Eta Kappa Nu Association.

Subscription Price: \$15.00 (3 years)

Life Subscription: \$60.00

Ideas and opinions expressed in *THE BRIDGE* are those of the individuals and do not necessarily represent the views of the Eta Kappa Nu Association, the Board of Governors, or the magazine staff.

THE BRIDGE

The Magazine of Eta Kappa Nu

features

6 Jeremy Schneider, Interview with a Rising Star

Today's communications infrastructure is an innovation enabler. A young entrepreneur shares how persistence and hard work pay off in creating an Internet-based business.

12 21st-Century Communications: Petascale Services, Multiservice Integration, Grid Networks, and Global Facilities

Joe Mambretti

Communications technology progressed at an impressive rate during the late 20th century. As described by one of the leading planners of future networks, the changes to come as we advance into the 21st century will be truly breathtaking.

14 Heating up the TV Landscape – Internet TV versus IPTV

by Rob van den Dam

The Internet has changed forever the way we locate and access information. As network bandwidth increases, it will also have a profound impact on how we consume video and the business models for delivering it.

18 4G: The What, Why, and When

by Pradeep Samudra

We have all experienced the value of mobility in the evolution of voice communications. What will the next generation of wireless technology add, and when can we expect it?

departments

5 2008 Leadership Conference

10 Member Profiles

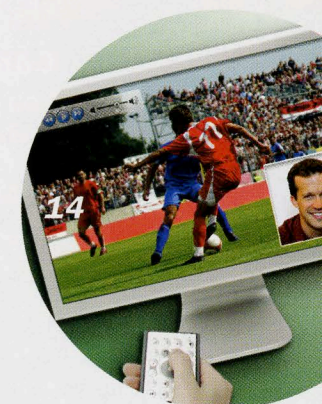
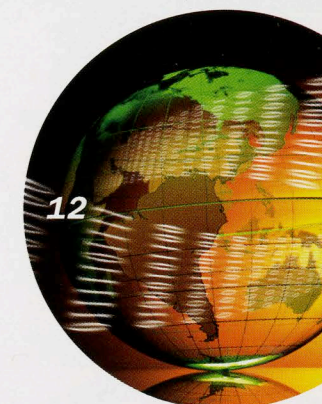
20 Notes from Headquarters

22 2007–2008 List of Donors

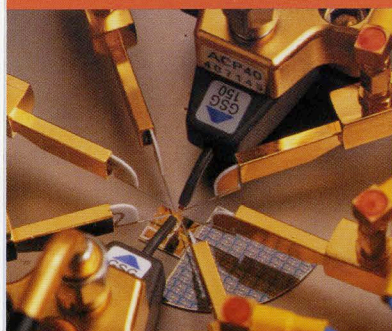
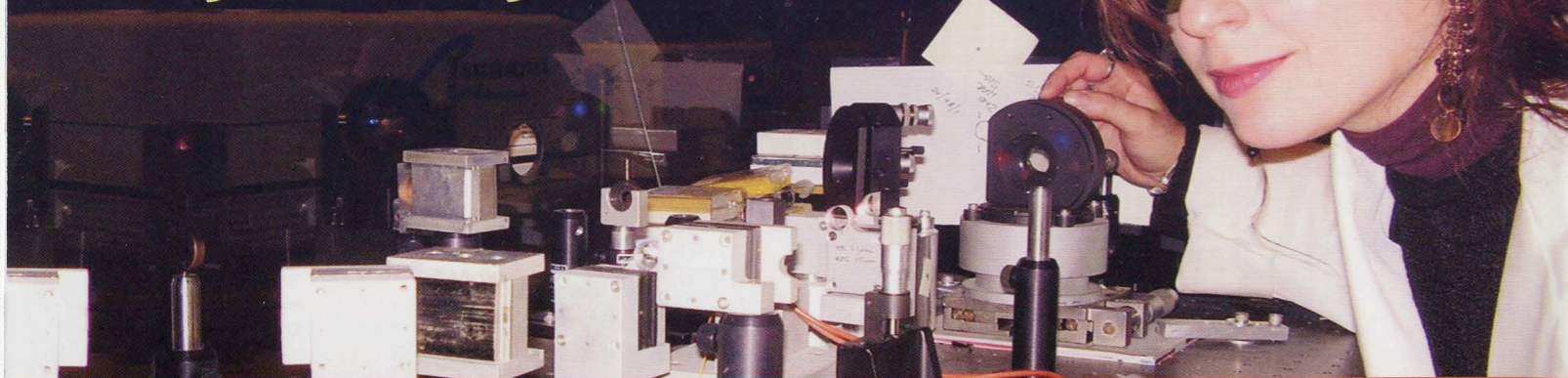
award winners

8 HKN Eminent Members

9 Call for Nominations



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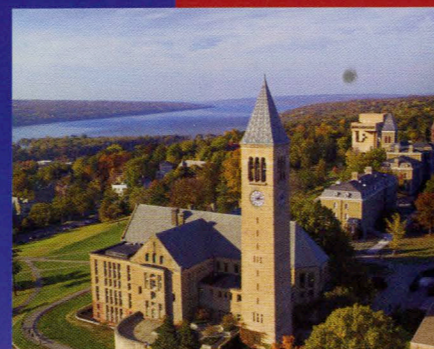
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2008 Student Leadership Conference



Sigma chapter at Carnegie Mellon University hosted a successful national leadership conference November 7-9, 2008. Entitled "In Pursuit of Excellence: Achieving Results through Leadership and Innovation," the conference was met with a high level of enthusiasm by all attendees. Working closely with the national office, Sigma was able to attract 150 students from 27 chapters nationwide to discuss leadership and entrepreneurial skills, playing to win in the professional world, technical challenges, and being a team player.

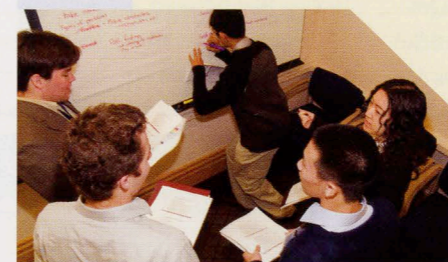
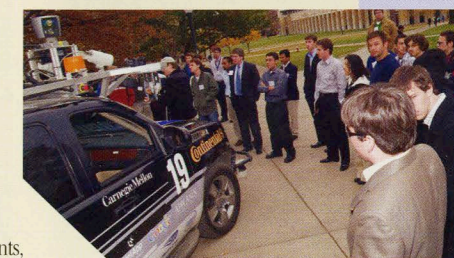
Thanks to the generous contributions of HKN members and corporate partners Lockheed Martin, Bloomberg, Booz Allen Hamilton, Bose, Dynetics, Intel, NVIDIA, and Synopsys, there was no registration fee for the students to attend. For the first time, HKN also offered travel stipends to the chapters. With the financial assistance of HKN and their ECE departments, chapters unable to attend in the past participated.

The Welcome Reception Friday evening provided a networking opportunity for HKN members as well as industry representatives. Saturday was filled with keynote addresses and panels from distinguished speakers such as Glen Meakem of Meakem Becker Venture Capital; Raj Rajkumar and Red Whittaker of Carnegie Mellon University; Joseph Havrilla of MEDRAD; Ron Hodge of Booz Allen Hamilton; Greg Lester of Dynetics; Jane Rudolph of Lockheed Martin; and Mark Kryder, formerly with Seagate Technology.

A conference highlight was the opportunity to see "The Boss," the 2007 DARPA Urban Challenge winner. CMU's Red Team—led by Red Whittaker, who gave the conference's luncheon keynote—developed the completely autonomous vehicle and beat out 11 other competitors in the race for time and safety. The vehicles are run by GPS coordinates through a pre-planned urban course and programmed to handle a variety of situations, including traffic, stop signs, and detours. Relating the successes and failures leading up to the winning design, Whittaker detailed what it takes to be a winner and how to remain optimistic in the face of adversity in order to reach a goal.

Finally, Sunday morning Dr. Bruce Eisenstein, HKN national president, led a discussion among the students regarding the future of HKN and the pending merger with IEEE. In view of the recent economic troubles and the decline in ECE graduation rates, HKN needs to find new avenues to reach out to the student and professional members. The students were enthusiastic and passionate about what they could do to help the organization and each other.

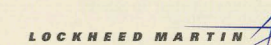
Congratulations to Sigma chapter on a successful conference. For more information about supporting, hosting, or attending a student conference, contact the headquarters office at info@hkn.org. For the conference agenda and more information about Eta Kappa Nu, please visit www.hkn.org.



Host



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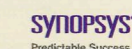
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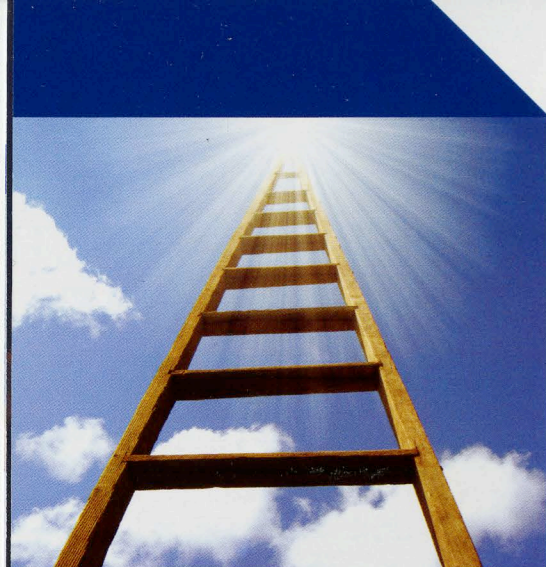


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Jeremy Schneider, Young Entrepreneur and Rising Star

Jeremy Schneider (Beta Epsilon – University of Michigan), a young entrepreneur, shares how persistence and hard work pay off in building a business from the ground up. Faced with a choice at graduation – accept a lucrative job offer from Microsoft or jump into the deep end of entrepreneurship – Jeremy accepted the challenge of developing and running an online rental property company, www.Rentlinx.com. He describes some of his difficulties and victories in the Rising Star profile below, also featured on the Experience, Inc. network. Visit www.hkn.experience.com to see the full interview.

1) How did your first job go? What did you realize about what you would want in your next job?

I've never had a real full-time job. I had four internships in college, the last two being for Microsoft. Microsoft was a great company to work for but it made me realize how much I didn't want to work for a big company. I couldn't deal with my contribution and compensation being so trivial and inflexible in the big scheme of things. I didn't like being just a programmer. I wanted to wear "many hats" and do a lot of different things, so a small company seemed better suited.

2) How did you get from a computer engineering major to this? What was your "big break"? What has been the most defining moment along your career path?

As I was finishing up my master's I had an offer in my hand from Microsoft for a full-time position. It was for a lot of money. I had been living on pasta and skimping on the sauce for 4 years and I could feel the urge in my gut to take that salary and run. But I was pretty sure that money alone wouldn't make for a happy life, so I turned it down and instead started a "custom software" company. I employed the "jump into the deep end" method of entrepreneurship, since I had absolutely no idea what I was doing. I was fairly incredulous that any business in their right mind would send a check to a punk kid who claimed to be starting a company. I found my first client through a family member, and the second was a referral from the first. Sure enough, they both sent me checks and apparently that's how you start a company. Or at least that's how I did.

3) What challenges did you face along the way?

My biggest challenge was lack of focus in the early days. I was basically living job to job and would take whatever work came my way. For the first couple years I was thrashing around with no clear direction or purpose. Eventually, we found our niche, canned all of our other business, built a product, changed the name of the company, and started more directed marketing efforts. We're much better off now that we have a clear focus!

Fast forward a few years and we have a booming site used by over 6,000 property management companies, we're getting nearly 2 million page views each month, have contracts with 2 state governments and over 60 other clients and partners across the US.

4) What happens in your typical day? What excites you most about your job right now? What are you doing that can inspire others?

We're still only a company of two and I'm the sole software developer. I still consider my main job to develop software for the business, but it probably only ends up taking about 1/3 of my time. The rest of the time is spent supporting clients, selling, marketing, wasting time on reddit.com, etc. It's really great to have a huge say in the direction of the business. My partner and I decide on a day-to-day basis what will be the best use of our time... There are no restrictions, we can do anything we want. However, if the company doesn't make money, we don't make money, so it's exciting to have that kind of direct feedback loop.

5) What do you want in your next job?

Well... I'm hoping to never have a real job with a boss again. I retired my resume in college. My task at hand is to keep growing my business. We are planning to hire a third and fourth employee in the next year and convert more of our valuable traffic into US currency. The market is huge and we've barely scratched the surface.

Interview featured on



www.hkn.experience.com



6) Did you ever think you'd end up there? Did you imagine that a Computer Engineering major could end up doing this?


I actually was always hoping to be the "third" person into a hot new startup. It seemed like a good time to jump on. There's already an idea and some revenue, but still small enough where a new person can drastically effect the direction and success of the company. Plus, if it gets huge, you still get rich. However, I didn't find my perfect two person company to join, so I had to man up and start it myself. I paid the price in the first couple years of aimless entrepreuening, but at least now I have sole discretion over the type of candy we stock in the office candy bowl.

7) What is the best advice you've heard so far? How did you hear it? What would you do differently next time? What advice would you give other students starting on a similar path?

I think the best piece of advice I got or could give is this: be persistent. I learned this great piece of wisdom via a quote on an away message on Eric Jankowski's AIM account. It was from Calvin Coolidge and it goes like this:


"Nothing in this world can take the place of persistence. Talent will not; nothing is more common than unsuccessful people with talent. Genius will not; unrewarded genius is almost a proverb. Education will not; the world is full of educated derelicts. Persistence and determination alone are omnipotent. The slogan "press on" has solved and always will solve the problems of the human race".

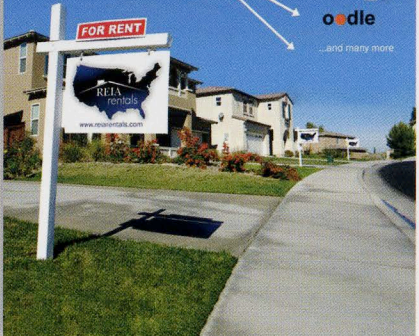
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I think it's especially true when starting a company. Being good at what you do is nice, but can't even compare to the importance of being persistent. A young person starting a company seldom has any idea of the world of hurt they are in for. But if you push today, push tomorrow and keep pushing a little bit every day, you'll eventually succeed. It's tough to know that when you're pushing into the unknown with no guarantees, but I really believe it's true.



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

Three New Eminent Members Inducted

Eta Kappa Nu established the rank of Eminent Member in 1950 as the society's highest membership classification. It is conferred upon those select few whose contributions and attainments in the field of electrical and computer engineering have resulted in significant benefits to humankind.

EMINENT MEMBER

Presented September 2008



H. Vincent Poor

Vince Poor is known worldwide as a distinguished researcher, teacher and innovator. His credentials as a scholar in the fields of communications and signal processing are well established through more than 750 publications, including 10 books. Some of his most innovative work, however, has been in his role as an engineering educator. As the founding director of the Center for Innovation in Engineering Education at Princeton University, he leads an initiative to prepare all students—both engineers and non-engineers—to be leaders in an increasingly technology-driven society. Through the center and his own teaching, Poor has emphasized the need to engage non-engineering students in courses that examine technological issues that shape and are shaped by society, an objective described in his article, "Engineering as a Liberal Art: Taking a Broad View," in the Spring 2007 issue of *THE BRIDGE*.

Poor at a Glance

- > Michael Henry Strater University Professor of Electrical Engineering and Dean of Engineering and Applied Science, Princeton University
- > Fellow of the IEEE, National Academy of Engineering, American Academy of Arts & Sciences, Institute of Mathematical Statistics, Optical Society of America
- > Recipient of the Tau Beta Pi Distinguished Alumnus Award, IEEE Education Medal, IEEE Marconi Prize Paper Award, Technical Achievement Award of the IEEE Signal Processing Society, Distinguished Service Award of the IEEE Information Theory Society
- > Past President IEEE Information Theory Society, member IEEE Board of Directors, Editor-in-Chief of the *IEEE Transactions on Information Theory*
- > Member, Xi chapter
- > B.E.E. and M.S. degrees from Auburn University; Ph.D. degree from Princeton University

EMINENT MEMBER

Presented September 2008



José F. Valdez C.

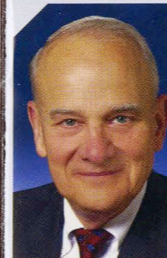
Through the years, Mr. Valdez has maintained a firm belief and a staunch dedication to the notion that engineers are vital to the welfare of all Peruvians and that education, particularly engineering education, is the key. Moreover, he was the first to recognize the need for an accreditation system to ensure high-quality educational programs. Thus, with ardent persuasiveness, he convinced IEEE colleagues in Peru to support the creation of the "Instituto de la Calidad en la Accreditación de Carreras de Ingeniería y Tecnología (ICACIT)," an accreditation association modeled on best practices in accreditation throughout the world. He has served as ICACIT President since its founding. With unwavering energy and commitment to excellence, he has been the driving force in guiding the development of ICACIT. He is revered by the students, engineering faculty, and practicing engineers throughout the country for his experience, his leadership, and his constant steadfast commitment to the improvement of the quality of life for all Peruvians.

Valdez at a Glance

- > Vice Chairman of the Board, Cosapi S. A. Ingeniería y Construcción; Chairman of the Board, Cosapi Data S.A. and Cosapi Soft S.A.
- > Co-founder, Piazza y Valdez Ingenieros (now Cosapi S.A.)
- > B.S. degree from the Universidad Nacional de Ingeniería (UNI), Lima, Peru

EMINENT MEMBER

Presented September 2008



William A. Wulf

Bill Wulf has distinguished himself as a researcher, entrepreneur, thought leader and educator. The recipient of the first Ph.D. awarded by the University of Virginia in computer science, he went on to join the computer science faculty at Carnegie-Mellon University. His research there became the technical basis for Tartan Laboratories, a software company later acquired by Texas Instruments. This combination of academic and industry experience led to positions of national leadership at the National Science Foundation and the National Academy of Engineering, where he became an advocate for repairing and maintaining the innovation ecology. Having returned to academic life at the University of Virginia, Dr. Wulf answers the question of what sustains someone while compiling such a record of achievement with the following quote on his homepage: "I live in mortal fear that someday they'll catch on to the fact that they are paying me to have all this fun."

Wulf at a Glance

- > University Professor and the AT&T Professor of Engineering and Applied Science, University of Virginia
- > Past President of the National Academy of Engineering
- > Former Assistant Director of the National Science Foundation
- > Founder, Chairman and Chief Executive Officer, Tartan Laboratories
- > Fellow of the National Academy of Engineering, ACM, IEEE, and member of the American Academy of Arts and Sciences
- > B.S. and M.S. degrees from University of Illinois; Ph.D. degree from University of Virginia

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 June 30

Member Profiles

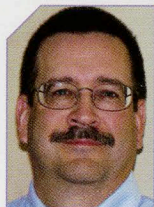


Jennifer Light-Holets
Technical Project Leader
Cummins, Inc.

Career Highlights

The highlights of my career include:

- 1) Opportunities to apply problem-solving skills to address challenging technical questions and customer needs



Robert Johnson
Principal Product
Manager
Oracle

Career Highlights

PTS error recovery project – I was one of the junior engineers developing the power thermal control systems in IBM's mainframe development area. I was asked to come back to help improve our error recovery to extend customer availability. This was completed with a much smaller group than the original design team with reduced time and resources to get the effort completed. A great technical manager



Vincent Forte
Principal Engineer,
Asset Strategy
National Grid

Career Highlights

I have been fortunate to have worked with many great engineers early in my career. These people helped me to flesh out my formal education with practical experiences that gave life to the lessons I had learned in school. I have helped electrify railroads, expand transmission systems, maintain distribution and low voltage general networks. My biggest thrill is seeing city lights and knowing I had a part in making that happen. Most recently I have tried to support young engineers as I was supported. I get a thrill knowing I am part of the

- 2) Informally mentoring junior colleagues and watching their successes.
- 3) Completing my first 6Sigma project, using statistical analysis and team work.
- 4) Leading my first team to complete critical deliverables on-time.

Education and Career

Knowing how to learn new information as technology changes is critical. My education has also proven useful to me in working effectively

motivated our achievement. IBM ServeRAID – I was the chief engineer for two of these host bus adapter (HBA) RAID Adapters for the IBM PC Server group. We developed two of these products back to back in 18 months in the mid 1990s' with a team of 45 hardware and software engineers while supporting existing products in the field. We had a cross discipline team that was committed to our products. Linux partner work – it is a challenge to work with partners on the business side of Linux assisting these companies moving solutions to Open Source Software. With the technical management of partners and internal projects there is never a dull moment.

Education and Career

My control theory work and software engineering courses at both the undergraduate and graduate levels at Purdue were precisely the background for

process of passing engineering knowledge through the generations.

Education and Career

In addition to the Electric Power core curriculum I took nearly all power courses that were offered through electives and also rounded out my education with business oriented electives and art appreciation classes. Initially in my career I found the core power engineering classes to be the most useful, but as my experience grew and I began to lead groups of engineers I found all the classes I took helpful for doing a wide variety of tasks and for relating to my fellows. I also found continuing education offerings useful. These days continuing education is a requirement of licensure, but I did this throughout my career before it was required because I believe an engineer must stay current beyond what experience will give to you. My current responsibilities do not involve heading a department, however I do form and lead groups that are aimed at specific needs and

within a team, organizing and managing my time, and communicating effectively.

Advice to Engineering Graduates

Take advantage of learning opportunities outside of the traditional classroom. Be open to assignments a bit outside of your area of expertise to learn new skills. Participate in mentoring opportunities, both formally and informally, as a mentee and as a mentor.

my work in power and thermal systems design on IBM Mainframes. I trace several of my microprocessor software based product designs back to basics from my education and co-op experience. In my partner development/technical management role – the problem solving skills from my true engineering days helps me work with partners.

Advice to Engineering Graduates

Solving the problem and obtaining the right solution is not enough. Look for the other questions and problems that may arise as well. Why was this problem asked and what other issues might the problem or the solutions lead you or your project or company to. Spend time on the soft skills also. Be able to sell your solution or idea in lay person's terms.

then disband after the need is met. These groups can last from a few weeks to several years, depending on the task. The wide variety of issues addressed in this fashion requires a broad perspective. My experiences and education have given to me a base for this new team approach.

Advice to Engineering Graduates

Never believe you have learned all you need to know. A good engineer is always looking for greater insight not only in the technical realm but also in the arts, business, and interpersonal to name a few. Do not define yourself too narrowly. Do more than technical things. I like to create oil paintings and have also worked with bronze sculpture. I support my art endeavors with my art sales. This provides me a different outlet for creativity, and that helps to keep my mind creative in all I do. One last thing, seek professional engineering licensure early.

Member Profiles



Michael Carey
Bren Professor of
Information and
Computer Sciences
University of California,
Irvine

Career Highlights

I've thoroughly enjoyed each phase of my career. During my time at UW-Madison, we had one of the top database research groups in the world, and I got to work with a terrific bunch of faculty colleagues and CS graduate students. I think the highlight of that part of my career only became clear to me later, however, when bumping into former undergrads and grad students who'd taken my database classes years ago. I've recently come to realize that my most satisfying achievement has been playing some part in launching them on their

own careers. Survivors of my classes have gone on to be successful software engineers, software researchers, industry executives, company founders, and university professors. It's a really good feeling to think that maybe I somehow played a role in their career successes (or at least that I didn't scar them beyond the possibility of recovery).

Education and Career

My undergraduate education had a strong emphasis on problem-solving, and that's certainly helped. However, in grad school, the focus is on learning how to learn – i.e., to learn new things on your own – and I think that was by far the most important part of my education. That allows you to move within a technical area, or even change areas, and pick up the necessary knowledge to be effective in that new area. If you have a limited attention span, as most of us ultimately do, that helps to keep your career fresh and fun.

Advice to Engineering Graduates

I would encourage them to focus on what I just mentioned: Learn how to learn! If your professor gives you reading assignments and then tests you on them without covering them in class, quit whining – he or she is helping you to pick up one of the key skills that you'll need in order to have a long, successful career that won't eventually become boring. College is not (just) about learning the technology of the day – in the software world, programming languages have changed significantly over the years, for example, and in the hardware world we've gone from transistors to ICs to computer chips that are starting to have more processor cores than we know how to utilize effectively today. It's a sure thing that you'll have to track similar changes over the course of your careers, so be ready!



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21st-Century Communications: Petascale Services, Multiservice Integration, Grid Networks, and Global Facilities

by Joe Mambretti

support services and applications at the petascale level, while also providing for multiservice integration and a high degree of service and infrastructure programmability.

Requirements

Today, the majority of communication services are fairly generic. They have a narrow range of quality attributes, they are oriented toward a relatively few major modalities (e.g., voice, data, video), and they are designed for minimal capacity utilization. Future communication services will be significantly more expansive, providing specialized capabilities, a much wider range of service quality, high-performance delivery, and many additional modalities. For example, currently almost all networks, including the Internet, are based on designs that were developed to provide a generalized best-effort service. This approach is highly scalable and serves well the largest number of clients. However, these generic services do not provide sufficient support for many special requirements, including the needs of many emerging advanced applications. In addition, options will have to be provided for supporting selective services and applications with exceptionally high capacity—much beyond that provided generally. Currently, these requirements are being driven by many data and computation-intensive science applications [1].

Various approaches have been suggested as mechanisms to address these needs, including new protocols, specialized provisioning, custom engineering, and appliances based on devices that are designed to solve highly defined, specific problems. However, these approaches tend to be temporary expediciencies, not general long-term solutions. They often add complexity and cost, and they are frequently difficult to manage. For example, a fairly common approach to solving today's problems is providing additional capacity—increasing bandwidth to provide a workable short-term solution. Yet, providing capacity alone does not ensure a fair allocation of network resources among applications contending for

resources. The ineffectiveness of common approaches to a wide range of network service limitations are directly related to basic design restrictions and not to lack of capacity. Many of these limitations are inherent in the service implementation design and exist regardless of capacity. In part, this can be demonstrated through experiments with new protocols [2].

These are a few of today's network issues. However, there are many other major challenges that also must be addressed to prepare for the future. For example, many challenges relate to the Internet. The current Internet is primarily based on textual and graphic content, with minimal multimedia content. The future Internet will have to become a major multimedia platform. The current Internet serves a little more than one billion individuals. In the future, it will have to serve more than three billion. The current Internet design has many inherent limitations that are difficult to address because of the current installed base. The future Internet must provide for significant enhanced services. The current Internet does not support mobility and wireless services adequately. The future Internet will have to support many mobile and wireless applications on a very large number of devices. The current Internet, as implemented, has a number of geographic and edge-device restrictions. The future Internet must be much more ubiquitous, capable of providing virtually any service, at any site, on any device. In addition, there are other major challenges related to federation, heterogeneity, ad hoc networking, context-sensitive core elements, security, and dynamic provisioning.

New Models for Communications

Increasingly, information technology facilities are being designed, developed, and operated using service-oriented architecture (SOA). This approach provides for enhanced services provisioning, segmentation among application communities, management, and cost-effectiveness. It is notable that although many of these activities are based on Web services technologies, other approaches are being developed also. Currently, networking research organizations are developing customizable SOA-based models for communication services design and implementation. These models enable services and applications to be supported with multiple new capabilities, not merely additional capacity, based on a foundation of large-scale distributed infrastructure. For example, SOA allows resources to be customized and fine-tuned through granulated element selection and partitioning. Different sites can be provided with specialized services with defined attributes meeting their precise requirements. They do not have to be limited to subscribing to a general service.

Another set of major complementary trends are those that are oriented toward creating virtualized communication services. Virtualized services remove the restrictions of local implementations and configurations, especially those related to specific types of hardware. Currently, after a period of initial prototype exploration and prototype implementation, virtualization is rapidly becoming a major trend transforming data centers, allowing them to transition from rigid collections of fixed resources to highly flexible customizable platforms that can dynamically respond to changing conditions.

The emerging architectural model for next-generation communications could be considered as one that has three basic components: multiple higher-level processes—for example, those directly related to edge processes; multiple processes related to foundation resources such as those based on virtualization; and a set of middle-range processes

that integrate edge processes and foundation processes [3]. It must be noted that this concept is somewhat of an oversimplification because it suggests a hierarchy. Actually, designers of advanced architecture are attempting to migrate from traditional hierarchical concepts to an approach that is more oriented to a model based on an equivalency of multiple distributed objects.

Implications for Future Communication Services

These architectural trends have major implications for the future of communication services and their underlying infrastructure. SOA, intelligent network middleware, virtualization, and related trends enable a high degree of flexibility in network provisioning, even to the level of providing for programmable networks that can be closely integrated into extended distributed environments.

Traditionally, communication services have been characterized by a relatively few rigidly defined instantiations that have been centrally provided. They have been implemented on a rigid infrastructure on which they have been closely integrated. Also, they are implemented with the understanding that they will be statically provisioned for long periods.

The new model changes these assumptions. The new architecture can be used to support an unlimited number of services, including novel, highly specialized services. It provides

a means to create distributed platforms that can be used as a basis to provide multiservice facilities. Services and facility resources can be partitioned with a high degree of granularity, which allows for more flexibility in capability delivery. The services do not have to be closely integrated with underlying infrastructure. Using this approach, it is possible to create a specialized suite of services that are customized to meet specific needs, even at a few locations and for short-duration implementations.

Summary

The 21st-century communication services will be substantially more powerful and flexible than those that are common today. Advanced trends in digital communication services are being driven by the demand of new services and applications, as well as by the opportunities made possible by innovative architectures and technologies. These trends motivate the reconsideration of all aspects of communication services. Today, multiple networking research initiatives have been established to design, implement, and manage communication services and facilities that may serve as models for future implementations.



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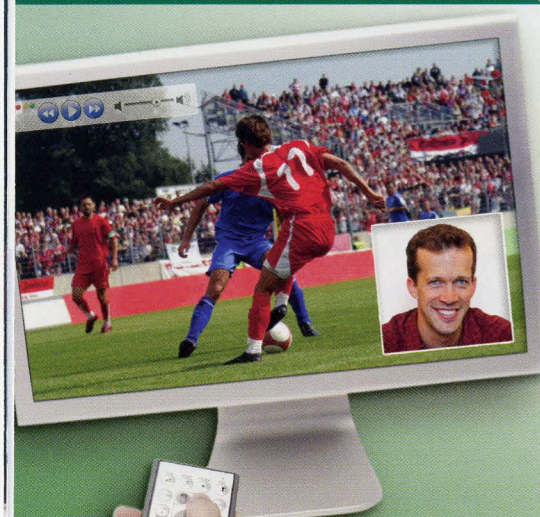
Joe Mambretti

Director, International Center for Advanced Internet Research
Northwestern University

Joe Mambretti is director of the International Center for Advanced Internet Research at Northwestern University, which is focused on advanced digital communications. The Center—created in partnership with major high-tech corporations (www.icair.org)—designs and implements large-scale infrastructure (metro, regional, national, and global). He is also director of the Metropolitan Research and Education Network (mren.org), an advanced high-performance network in seven states. He has served on boards of major corporations, and he is a frequent speaker at communications technology forums. Among his publications is a co-authored book (Wiley), "Grid Networks: Enabling Grids with Advanced Communication Technology."

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Heating up the TV Landscape – Internet TV

by Rob van den Dam

closed secure network. The infrastructure is configured such that viewers can only receive the IPTV provider's own TV channels. IPTV focuses primarily on the TV in the living room, generally a widescreen TV with high image quality. A set-top box (STB) is required to receive the signal. IPTV telecom operators are very uniquely placed to enhance the television experience in the following ways:

- > They can augment their IPTV offerings with a wide variety of voice and data services.
- > They are well-placed to combine IPTV on the TV with the other screens: the PC and the mobile.
- > They have a lot of information about the viewer that they can use to deliver personalized content and advertising.
- > They are able to guarantee a qualitative high end-to-end television experience.

Currently most IPTV services are based on subscriptions and a video-on-demand charge.

Internet TV has the "look and feel" of IPTV, but is delivered over the **open** public Internet, and is delivered over the top (OTT) of existing networks, actually getting a free ride. Internet TV is usually delivered to the PC or another device connected to the Internet, using peer-to-peer technology. Because of Internet TV, OTT providers have the following advantages:

- > They do not have to invest in distribution networks because they use the telecom and cable companies' networks.
- > They offer the same type of interactivity and viewing capabilities as IPTV.
- > They have a global coverage.

However, in contrast to IPTV, the following is true:

- > There are still issues with the video quality, though it is continually improving.
- > Users really need some technical know-how to use it properly.
- > Internet TV is not a controlled environment. There

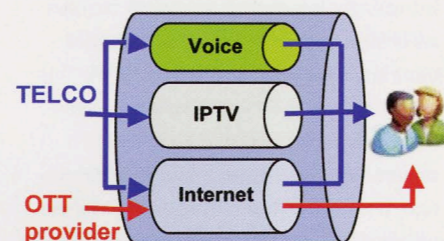


Figure 1

are no guarantees regarding accessibility, availability, or reliability. There is no control over who is allowed to watch which programs and under what circumstances, such as related to distribution rights in different countries.

Internet TV providers offer programs for free; revenue is primarily based on advertising.

Battle for Distribution and Advertising

Clashes appear to be unavoidable. IPTV and OTT providers will certainly be confronting one another in the domain of distribution and advertising.

In terms of the first point, the OTT providers shift the distribution problem to the owners of the networks. IPTV providers invest heavily in upgrading their networks for their own IPTV services (Figure 1); now they must handle the OTT traffic as well, which means additional investments. In fact, incumbent telecom companies face the unique dilemma that as they increase their broadband capacity, they make it easier for OTT providers to deliver the quality of service required for professional TV broadcasting. Of course, that will not be acceptable for the telecom companies. They can respond in different ways, including the following:

versus IPTV

- > Filter the OTT traffic, possibly block specific traffic, and offer higher distribution priority and quality to parties who are willing to pay (more). However, throttling OTT traffic controversially violates the so-called net-neutrality principles, i.e., blocking other parties' traffic to give their own services precedence. This could lead to intervention by government regulators.
- > Find a way to insert themselves into the relationships between the OTT provider and their customers, and make agreements regarding the charge-through of the distribution costs, either to the OTT provider or its customers.
- > Open its IPTV platform to OTT content by making services from OTT suppliers available as separate IPTV channels. This would allow the operators to bring in extra revenue.

advertising; the results indicated that in all the countries involved, the majority of those surveyed were willing to view advertising before or after a good-quality, free video broadcast (Figure 2).

Short- and Long-Term Vision

Over the short term, Internet TV does not represent a real threat to the IPTV providers. IPTV has a clear possibility to establish a strong position in this market before the problems regarding image quality and the ease of use of Internet TV are resolved. But after that, the situation may change. In particular when Internet TV moves to the TV screen, Internet TV can pose a bigger threat for IPTV.

On the other hand, a partnership between IPTV and OTT suppliers is not unlikely, given the following:

- > Telcos can make OTT content available as part of their IPTV services.
- > OTT providers can profit from the IPTV providers' "walled garden" that gives them a better guarantee in terms of quality, control over the distribution, and feedback with regard to volumes, viewing times, and viewer behavior.
- > Telcos can use the OTT channel to collect additional customer data regarding consumers' viewing habits for improving targeted advertising.

Conclusion

OTT Internet TV is currently seen as a marginal threat for IPTV providers. But as bandwidth and QoS will become less of an issue, OTT providers will increasingly develop into mature TV suppliers of on-line live HD programming. Joost, Hulu, Babelgum, and others are most likely just the tip of the iceberg. More of these types of companies will emerge. They will get funding and then fight for customers and advertisers. In the end, it will come down to finding a solid business model. At the same time, also IPTV will mature, finding the right ways and approaches to be successful. Probably there is room for both IPTV and Internet TV, each addressing a particular consumer segment, and the possibility for some sort of partnership is certainly there.

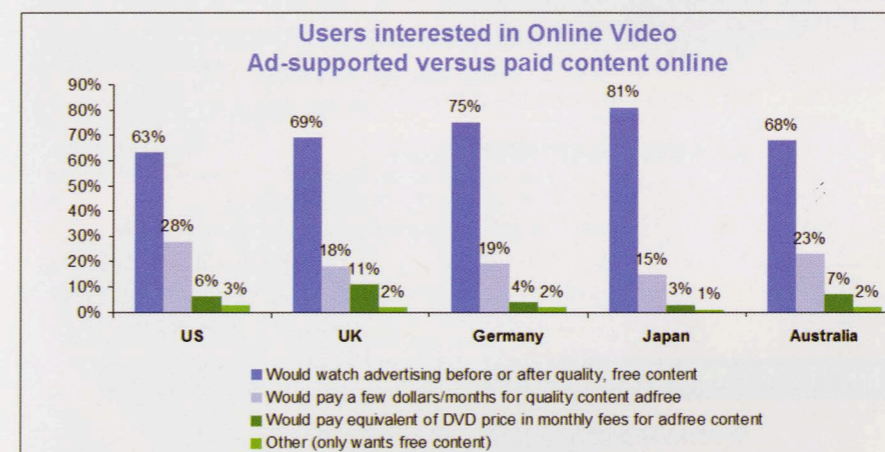


Figure 2

In terms of the second point, the advertising, ultimately it all revolves around the advertising relationships and the possibilities the Internet offers for more efficient targeting. Internet television is currently paid entirely by advertising. IPTV advertising will also become increasingly important for telcos to fund their content, as customers do not expect to pay for all content. In 2007, IBM's Institute for Business Value conducted a consumer survey to evaluate changes in consumers' media behavior. A number of questions were related to



Rob van den Dam

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Rob van den Dam is EMEA Telecommunications Leader at the IBM Institute for Business Value. In this role he is responsible for developing thought leadership, industry outlooks and business value realization studies for the communications industry. He has written numerous articles on telecommunications and media, including "The Changing Face of Communications," "A Future in Content(ion)," "Primetime for Mobile Television," "Cash, Credit, or Phone?" and "Mobile Advertising, Ads on the Move." He has previously spoken at the International Engineering Consortium's Broadband World Forum Europe and Broadband World Forum Asia, the Broadband Connect Summit in London, and CISAC's Television and Radio Broadcasting Conference in Nara, Japan.



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ABOUT THE AUTHOR

Eta Kappa Nu Association Financial Report

For the year ended June 30, 2008 (Reviewed)

STATEMENT OF FINANCIAL POSITION

ASSETS		LIABILITIES AND NET WORTH	
CURRENT ASSETS		CURRENT LIABILITIES	
Cash and cash equivalents	\$248,439	Accounts payable	\$26,779
Membership and contribution receivables	5,342	Accrued Expenses	
Awards inventory	12,409	Directors Compensation	119,034
Interest Receivable	733		
Total current assets	266,923	Total current liabilities	145,813
		LONG TERM LIABILITIES	
INVESTMENTS – at Market Value	679,399	Unearned subscription revenue	429,021
Total assets	\$946,322	NET ASSETS	
		Unrestricted	371,488
		Total liabilities & net worth	\$946,322

STATEMENT OF ACTIVITIES

REVENUE		OTHER INCOME (EXPENSES)	
Memberships	\$106,870	Dividends and Interest	\$31,950
BRIDGE magazine subscription	28,035	Realized gain on the sale of investments	30,426
Merchandise sales (net of \$8,880 of costs incurred)	10,543	Market value depreciation of investments	(119,969)
Contributions	27,071	Investment advisory fees	(5,985)
Sponsorships	5,250		
Total Revenue from Operations	177,769	Net Other Income	(63,578)
		NET LOSS	(129,409)
OPERATING AND ADMINISTRATIVE EXPENSES		NET ASSETS – BEGINNING OF YEAR	500,897
Management fee	119,034	NET ASSETS – END OF YEAR	\$371,488
Awards	9,627		
BRIDGE production	42,157		
Chapter support	6,380		
Directors, officers and committees expense	29,069		
Office and administrative expenses	16,548		
Professional fees	20,785		
Total Operating and Administrative Expenses	243,600		
Net loss from operations	(65,831)		

STATEMENT OF CASH FLOWS

CASH FLOWS FROM (USED FOR) OPERATING ACTIVITIES		Reconciliation of Net Gain to Net Cash Used for Operating Activities	
Cash received from memberships, contributions and program activities	\$175,580	NET LOSS	(\$129,409)
Cash paid for operations	(349,794)	ADJUSTMENT TO RECONCILE NET GAIN TO NET CASH USED FOR OPERATING ACTIVITIES	
Net cash used for operating activities	(174,214)	Investment activity attributable to investing activities	63,578
CASH FLOWS FROM (USED FOR) INVESTING ACTIVITIES		Cash received or expended to	
Investment earnings – net of advisory fees	24,988	Increase in accounts receivables	(392)
Proceeds from the sales of investments	550,332	Increase in inventories and prepaid expenses	(2,732)
Purchase of marketable securities	(362,988)	Decrease in accounts payable and accrued expenses	(94,582)
Net cash from investment activities	212,332	Decrease in unearned subscription revenue	(10,677)
NET INCREASE IN CASH AND CASH EQUIVALENTS	38,118	Net cash used for operating activities	(\$174,214)
CASH AND CASH EQUIVALENTS BEGINNING OF YEAR	210,321		
CASH AND CASH EQUIVALENTS END OF YEAR	\$248,439		

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4G: The What, Why, and When

by Pradeep Samudra

wireless technology rests ultimately with the International Telecommunications Union (ITU), which gave us the International Mobile Telecommunications 2000 (IMT-2000) specifications. IMT-2000 is a term used by the ITU to define globally recognized 3G technologies for use in IMT-identified radio frequency bands. It is important to note that 3G is a term conjured up by the industry to generally include the IMT-2000 technologies and related features and not an official standard per se as promulgated by the ITU.

It is an indisputable fact that the worldwide adoption and growth of wireless has been the fastest technological achievement in the history of mankind. In a span of 25 years, moving from basic analog to high-speed digital while creating a worldwide industry worth half a trillion U.S. dollars is certainly an amazing feat. With these great advancements, we are entering an era known as the third generation of mobile wireless, or 3G. 3G has elevated the basic function of communication to information gathering and, to some extent, entertaining. It has achieved this by providing access to that other concurrent, amazing development we call the Internet, a catalyst for great social, political, and economic change.

Definition of 4G: From the Source

At present, there is no formal assignment to any singular technology that can legitimately call itself 4G, since there is no formal industry group that can do this. This has resulted in some near-term technologies such as worldwide interoperability for microwave access (WiMAX) or 3G long-term evolution (LTE) being called 4G in some quarters.

A case can be made that the authority to define what constitutes the next generation of

ITU's IMT Advanced (IMT-A) is a concept that intends to build on the success of IMT-2000. Given the origins of 3G, it is appropriate to assume that the IMT-A concept should be the foundation for the definition of 4G. IMT-A systems are envisaged to have capabilities surpassing those of IMT-2000 by orders of magnitude. Currently, IMT-2000-based 3G systems generally provide peak data rates of around 1–5 Mbps.

Figure 1 represents the ITU's high-level view that delineates IMT-2000 and its enhanced version versus what is to follow—IMT-A.

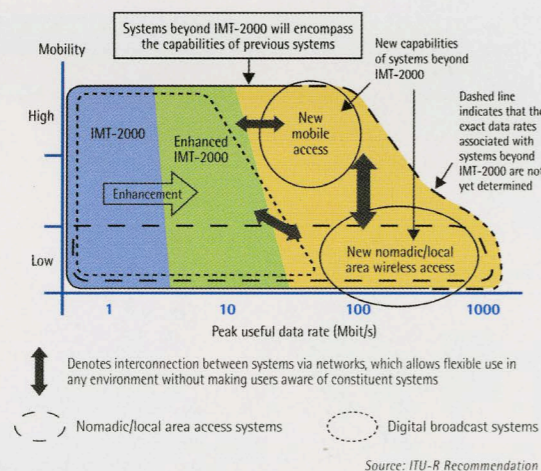


Figure 1 Boundaries of IMT Systems

A Word on WiMAX

Networks based on 3G LTE are expected to be deployed and be service-ready by 2010–11, allowing for a convenient entry for 4G in the subsequent years. By this schedule, there is no room for a 4G network being deployed in the near term. So what about WiMAX, the 4G wannabe?

ITU delegates reached a general consensus in their recent meeting by declaring WiMAX as an IMT-2000 technology. As a result, WiMAX has now gained the coveted status of a 3G technology. While this may seem contradictory to the claims of WiMAX being a 4G technology, it is nevertheless significant that the IEEE standards embedded in WiMAX gain an official standard status from the ITU.

IEEE is pursuing a next-generation version of the technology embedded in WiMAX under Study Group 802.16m. One of the goals is to provide wireless data rates in excess of 100 Mbps. This technology is expected to reach standards status by 2009, and it could clearly be a candidate for 4G.

What Is 4G?

Fundamentally, 4G intends to alter the paradigm of user-network communication via a single device "connected" to a single network. Since 4G is expected to be more than the phone service that 3G at least initially has been, it will necessarily allow all sorts of portable devices onto "the" network, consisting of many cooperating networks of today and tomorrow.

With this definition, 4G can be characterized by the following key attributes:

- > Support for many applications and services—Efficient support of unicast,

Bandwidth	10Kbps	50Kbps	1Mbps	100Mbps
Processor	8086	RISC	GPU/NPU	Multi-core (CMT) and Virtualization
Technologies	AMPS TACS NMT	GSM TDMA CDMA	GPRS EDGE IS-95B	CDMA2000 W-CDMA UMTS HSDPA
Generation	Analog	Digital	Digital Multimedia	Media and TV
	1G	2G	2.5G	3G
	1980s	1990s	2000s	2010s

Figure 2 Evolution of Processors and Digital Signal Processor Technology for 4G

- multicast, and broadcast services and applications relying on them.
- > QoS—Consistent application of admission control and scheduling algorithms regardless of underlying infrastructure and operator diversity.
- > Network detection and network selection—Allows participation in multiple networks simultaneously, thereby connecting to the best network for the application.
- > Seamless handover and service continuity—A "base station" that features intra- and inter-technology handovers, assuring service continuity without a loss in service quality.
- > Technology and topology independence—Service capabilities not constrained by topology or technology limitations.

Who Needs 4G?

The short answer to the "why 4G?" question is "not why, but when?" There are several factors leading to this optimistic view, including the following:

- > Business need and opportunity—The 3G operators are learning that future average revenue per user (ARPU) growth will come from data services.
- > Technology pull—As Figure 2 shows, advances in power and radio receiver technology will likely converge with processor technology to make the solutions viable.
- > Rate of innovation—This will hasten the march toward solving problems related to ubiquity via presence technologies.
- > Disruptive technologies—Disruptive changes occur on unplanned schedules. In the past, disruptions have steered the industry off a predefined, planned path and actually have slowed the pace of growth.

- > Standardization—Use of a higher-layer protocol as transport medium affords intelligence at every stage in the network. Standards in the area of radio technology are likely to help out as well.
- > New revenue opportunities—It is important to recognize the growing cultural acceptance of advertisement-based business models. Tiered services with premium offerings, including advanced features, are also becoming popular.
- > Developments in the wireline world—Compelling video experience in the wireline world will put some pressure on the wireless video experience. The wireline developments will have the potential to drive the requirements for 4G applications.

When Will 4G Be Here?

Notwithstanding the claims made in the industry that 4G will be in use as early as 2008, with the more generally accepted definition of 4G, we can conclude that it will take several years before the "real 4G" can be real. To arrive at a meaningful conclusion as to when that can

happen, it is worthwhile to consider some key developments, including the following, that act as "gates" for 4G, either accelerators or decelerators:

- > 3G reaching maturity and profitability—It may take two to three years before the current data pipes are saturated as usage patterns evolve to take advantage of the increased speeds. This factor is a decelerator.
- > Validation of radio technologies—Several new technologies have been introduced to improve access speeds. If not enough attractive applications or services are made available to take advantage of the higher speeds, the technology can be a decelerator.
- > Cost and availability of spectrum—The WWRF projects a severe shortage of spectrum to fulfill the vision of 4G. This factor is a definite decelerator.
- > Ecosystem development—Developing applications, training support staff, and creating smooth troubleshooting procedures will be "asynchronous" events. It is impossible to assure that all of this can happen in a "synchronous" manner.

Conclusion

In conclusion, considering the complexity and dependence of several "moving" parts that must be harmonized, in all likelihood the true 4G "system" will arrive later than anyone dreamed. With all its challenges, wide-scale availability of 4G is several years away—somewhere in the middle of next decade. It is quite possible that some of the key ingredients will become available in niche markets sooner.

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

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Mr. Samudra participates in strategy planning, business development, product portfolio analysis, and global marketing activities related to wireless business for Tellabs. Prior to Tellabs, Mr. Samudra headed mobile and fixed technology strategy planning, sales, marketing, engineering, and customer support functions as vice president of Broadband Networks at Samsung Telecommunications. His leadership in the development of a multi-terabit IP router and multi-service ATM switch resulted in more than 50 patents and product sales of \$100 million. Mr. Samudra has eight patents and six pending patents in mobile and fixed technologies and has authored more than 15 papers in respected journals.

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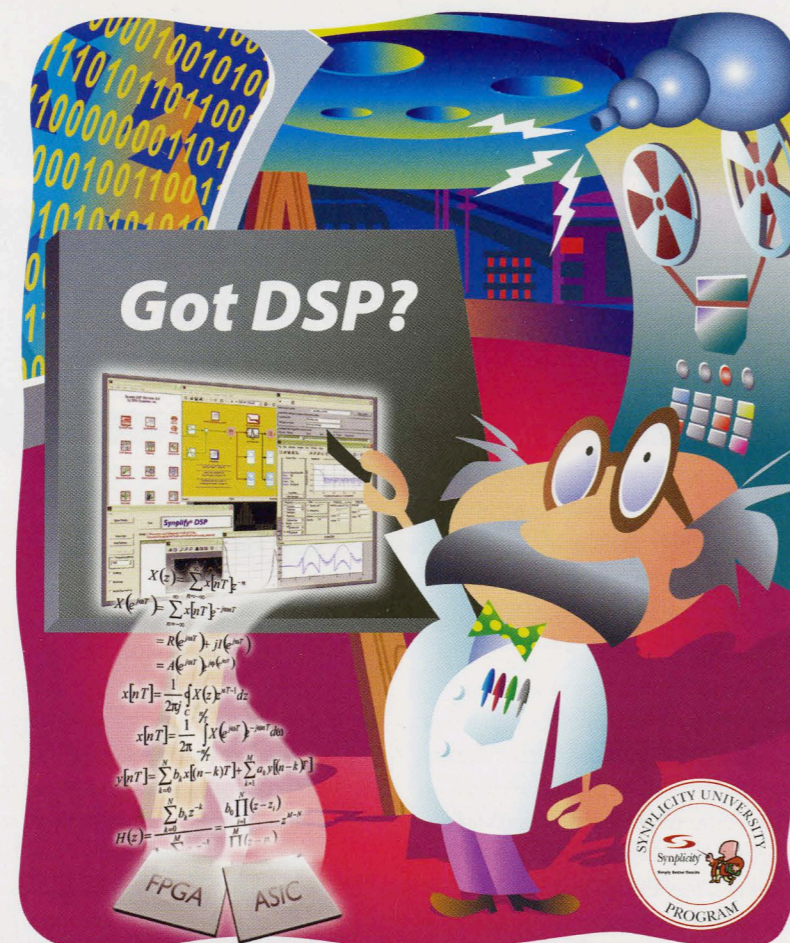
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Notes from Headquarters

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- Order your cords and stoles early for graduation.
- Track your finances carefully. Chapters are required to file a 990 or 990N with the IRS next fall for the 2008–09 academic year.
- Send in the New Member Requisition Forms and dues immediately prior to or following the induction ceremony. Inductees are not considered HKN members and will not have access to Experience or *THE BRIDGE* until HQ processes the paperwork and prints certificates.
- Please proceed with your recruitment and induction process as usual. The IEEE–HKN merger is still under discussion, so no HKN processes have been affected until further notice.
- Update your contact information! As you move, don't forget to change your address at www.hkn.org.
- Join the social and professional networking groups on LinkedIn, Facebook, and Experience.

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



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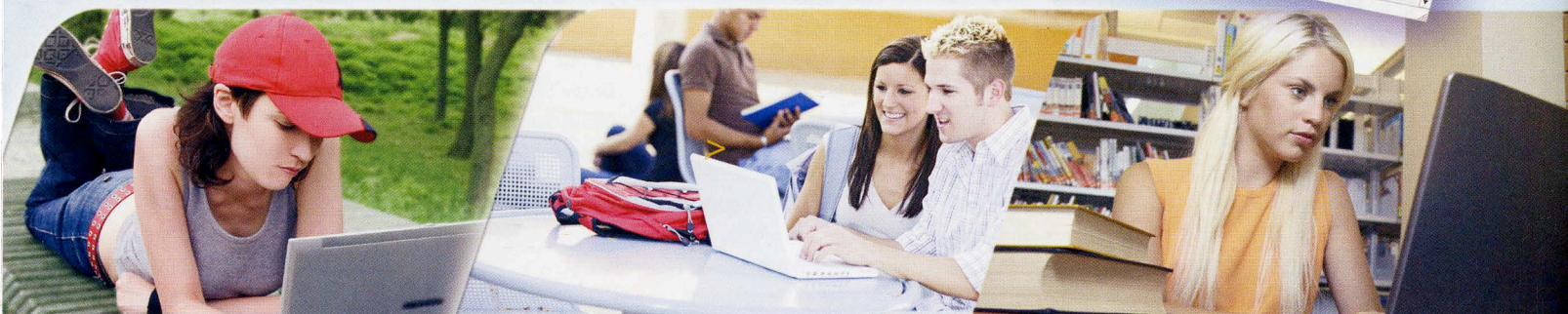
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Career and Alumni Services

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.



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