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The Sky's the Limit

Table of Contents

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Calit2@UCI
G.P. Li
Director

Shellie Nazarenus
Assistant Director
Marketing and Outreach

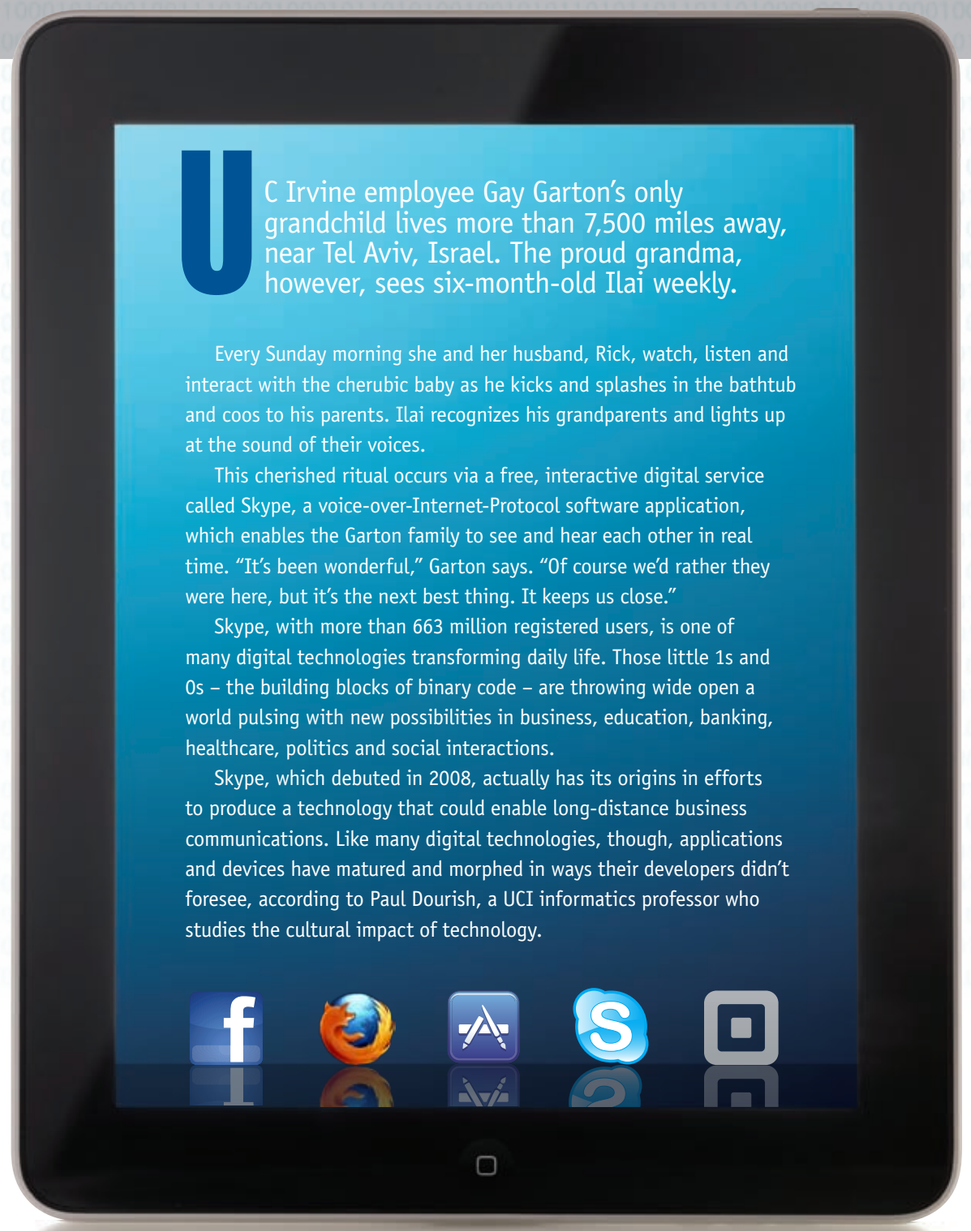
Stuart Ross
Assistant Director
Research Development

Shellie Nazarenus – Executive Editor
Anna Lynn Spitzer – Managing Editor
Michael Marcheschi – m2design group
Mike Delaney – Meridian Graphics

Calit2
University of California, Irvine
4100 Calit2 Building
Irvine, CA 92697-2800
(949) 824-6900
www.calit2.uci.edu
info@calit2.uci.edu

connected 24/7

by Anna Lynn Spitzer



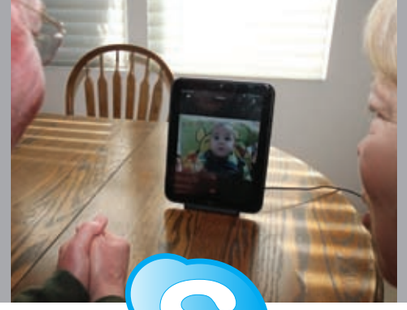
UC Irvine employee Gay Garton's only grandchild lives more than 7,500 miles away, near Tel Aviv, Israel. The proud grandma, however, sees six-month-old Ilai weekly.

Every Sunday morning she and her husband, Rick, watch, listen and interact with the cherubic baby as he kicks and splashes in the bathtub and coos to his parents. Ilai recognizes his grandparents and lights up at the sound of their voices.

This cherished ritual occurs via a free, interactive digital service called Skype, a voice-over-Internet-Protocol software application, which enables the Garton family to see and hear each other in real time. "It's been wonderful," Garton says. "Of course we'd rather they were here, but it's the next best thing. It keeps us close."

Skype, with more than 663 million registered users, is one of many digital technologies transforming daily life. Those little 1s and 0s – the building blocks of binary code – are throwing wide open a world pulsing with new possibilities in business, education, banking, healthcare, politics and social interactions.

Skype, which debuted in 2008, actually has its origins in efforts to produce a technology that could enable long-distance business communications. Like many digital technologies, though, applications and devices have matured and morphed in ways their developers didn't foresee, according to Paul Dourish, a UCI informatics professor who studies the cultural impact of technology.



Six months ago, **Gay Garton** became a grandmother for the first time. Ilai is a cherubic, happy little boy who lives with his parents near Tel Aviv, Israel, about 7,500 miles from Garton and her husband, Rick. But thanks to Skype, the Gartons see their grandson every Sunday morning, interacting with the baby as he is fed, bathed and cuddled. "Of course I wish they lived closer," Garton says, "but this technology is the next best thing. It keeps us close and we feel like we're part of his life."

"For a long time we developed technologies purely with this idea of utility and efficiency in mind," says Dourish, who was involved in this effort 20 years ago as a researcher at the Rank Xerox EuroPARC.

"But we don't know what those products are when we finish designing them in the lab. They only really become something when they're out in the world. What people do with them is what gives them meaning."

In the last five to 10 years, he says, people suddenly started to think about their technologies in ways that eclipsed efficiency. "People want an emotional connection; they want to be connected to people they care about. The uses are much more about personal experience."

In today's connected world, those personal experiences often overlap with workplace demands. Studies show that the majority of information-economy professionals striving for success believe they must be accessible 24 hours a day, seven days a week.

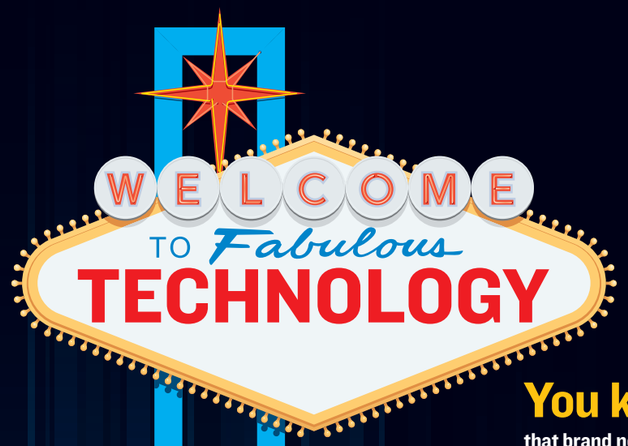
Melissa Mazmanian studies mobile communication technologies from a sociological and organizational studies perspective.

"Many people are deeply engaged in professional and personal lives simultaneously," something that wasn't the norm 20 years ago, says the assistant professor of informatics.

(continued, page 4)

Dourish studies technology's cultural impact: "Products only really become something when they're out in the world. What people do with them is what gives them meaning."

photo: Paul R. Kennedy



You know it when you see it:

that brand new gadget or app that makes your heart beat just a little faster. Here are several contenders, some of which were announced at this year's Consumer Electronics Show in Las Vegas and others that are already on the market:

- **Multi-screen TV applications that allow for seamless sharing of broadcast content, video and data on multiple screens throughout the home. Watch that Netflix movie while you wander from room to room.**
- **Cable and satellite service-provided video conferencing. Turn your big-screen TV into a teleconferencing hub and video-chat with Aunt Bertha in Buffalo.**
- **Television service-provider gaming opportunities. Now showing on your TV: Angry Birds!**
- **High-bandwidth Ethernet in cars. Avoid the "are we there yet?" refrain and keep the kids occupied on the Net.**
- **A device that converts 2D images and video into 3D in real time. Most new TVs will have 3D capability this year but content is still lacking; go ahead, create your own.**
- **A "car that cares." A dashboard equipped with an information/ entertainment system that wirelessly connects to health-related smartphone apps and portable medical devices. Put down that Big Mac and get healthy while you drive.**
- **A watch that monitors heart rate, optical blood flow, body temperature, skin response and more. Strap it on and get in touch with your inner self.**
- **Fifty-five-inch organic light-emitting diode (OLED) televisions make watching TV almost like viewing it in person. And they're incredibly thin – only about 4 mms deep – and lightweight: only about 17 pounds. No more installation appointments; you can hang it on a wall all by yourself.**
- **Connected TVs. Television sets are serving as huge computer monitors, featuring voice-control and touch-screen options, all your apps and a high-speed Internet connection. Watch YouTube, stream Pandora or buy a book on Amazon, all from your TV screen.**
- **Big is the new small in cell phones. The Samsung Galaxy Note features a 5.3-inch high-definition screen (compared to the iPhone's 3.5-inches), Gorilla® Glass to prevent scratching, and a stylus-type device for jotting notes or signing contracts. You no longer need to carry both a smart phone and a tablet.**
- **Ultrabook: a super-thin laptop. About the size of a MacBook Air but about $100 less expensive, it features a 5+-hour battery life, less than seven seconds to resume from hibernation and a Windows operating system. Bring on the "I'm a Mac; I'm a PC" debate.**
- **WikiPad, an Android, glasses-free 3D tablet with an attachable video game controller. Play your favorite games in 3D without looking like a bespectacled geek.**

Jesse Perez is a finance manager for a local company that advocates for quality family time. "My iPhone allows me a lot of flexibility," says Perez, who often attends his children's school performances and other activities. "Ten years ago, before we had phones with Internet connections, if you were out of the office you never knew what you would find when you returned. Now, you can keep an eye on things and deal with emergencies if they arise. It makes family life a lot easier."

Fierce competition in the knowledge-based economy, combined with the ambiguity associated with knowledge and managerial work, has led to an expectation of 'round-the-clock availability. "When you reply to your email at 10 p.m. it shows a level of dedication that can become a proxy for being good [at your job]," Mazmanian explains.

A recent study of more than 1300 international professionals showed that 80 percent of them are monitoring their jobs a minimum of 85 hours each week; the remaining 20 percent monitor around 70 hours a week.

Surprisingly, it's often peer pressure, not the boss's expectations, fueling the frenzy. "People expect constant connectivity because they're all trying to succeed and be considered a good colleague. Now that we have the capacity to be connected all the time, what are we saying if we choose not to be? In the professional zone that can be particularly problematic."

Mazmanian sees a new social dynamic emerging. "These demands affect our ability to focus on each other and have engaged conversations, both with the people on the other end of the email and the people in front of us. We've become used to partial engagement with each other."

Parents, once shackled to the office during business hours, now attend their children's school assemblies and sporting events – mobile devices firmly in tow. But at what price? Says Mazmanian, "You've got to wonder: how many times are they checking email? Are they able to engage in the game? Does their child see them as halfway there?"

Mazmanian sees personal and professional lives often overlapping: "It is incumbent on all of us to understand these dynamics so that we … can make informed decisions."

photo: Michelle S. Kim, University Communications

The blurring of boundaries between work and personal time is an example of what Dourish calls "context collapse," a loosening of the cultural norms that dictate behavior in specific milieus. One driver, he says, is social media, in which people from various segments of life tend to coexist in the same space.

His 750 Facebook "friends" include current and former students, professional colleagues, family members and personal friends. "I used to be able to hold my home life and my work life in separate places to some extent," Dourish says. "Somehow, things have become very different."

But he believes those boundaries are in constant flux, and the opportunities created by technology provide ways to supplant the burdens. "I can maintain multiple email accounts and that helps me separate things every bit as much as it might accidentally integrate them," he says with a shrug.

"There's always been a certain tendency to associate with technology this idea that the world is going to hell in a handbasket. And similarly there is a utopian narrative that technology is going to save us. The truth is always somewhere in between."

Adds Mazmanian, "I think it is incumbent on all of us to understand these dynamics so that we, as individuals and as a society, can think through what's going on and make informed decisions."

There's no question that opportunities are flourishing. Online classes connect interested learners with elite universities. Oppressed citizens mobilize to overthrow autocratic governments. Complete DNA analyses require nothing more than a saliva sample and a small fee. Businesses purchase services from the cloud instead of investing in expensive equipment, and collaborate face-to-face from far-flung locales.

It is not hot-off-the-press news that technology facilitates distance collaboration. The telephone and telegraph revolutionized communication two centuries ago, supporting the emergence of large companies with multiple locations.

But today's advances in instant communication – teleconferencing technology, email and online communication tools like Skype and instant messaging – allow business and research teams around the world to work together in ways that until recently were relatively untested. Informatics professors Judy and Gary Olson study the socio-technical perspectives of people collaborating across distances. Observations from the field and data from experiments in their Hana lab – Hana means behavior in Hawaiian – focus on understanding the social practices that contribute to success in these endeavors.

(continued, page 6)

photo: Paul R. Kennedy

A Wave of the HAND

Co-workers don't have to be hundreds of miles apart to benefit from interactive collaborative tools. Sometimes, colleagues in the same room need to contribute input on a project simultaneously.

Computer science associate professor Aditi Majumder (foreground, above) is developing technology to support those co-located collaborative user interactions. Using gestures or laser pointers, multiple users can move items around on a display, enlarge them, zoom in, open personal windows and create diagrams with multiple colors, working together simultaneously at interactive speed.

While interactive displays themselves are not groundbreaking, Majumder's system is different because it uses a series of plug-and-play projectors, each containing a camera and computer; and a distributed architecture, which runs the same algorithm on every projector. This distributed approach is more efficient, accurate and responsive than systems that rely on a central processor because each projector handles only a small part of the data.

The algorithms on each projector can be easily downloaded, similar to an iPhone app, and the displays scale easily to allow any number of projectors. Regardless of display size, multiple users can interact simultaneously, with minimal latency.

The distributed architecture operates in much the same way as a social network, says Majumder. Instead of relying on one central source of information, each projector operates independently, yet shares necessary information with its neighbors.

"When a user opens a window, it may span four projectors so each has to communicate with the others to interpret the user's intentions and react to it appropriately," she says. "It's how [co-located] people interact – they're very local, yet together they achieve something very global."

Now Majumder is working to bring the distributed computing concept to pico projector-embedded cell phones. Picos are tiny projectors that are expected to become as common in mobile phones as cameras; they can create full-sized displays for viewing videos, photos and presentations, and displaying files. Because they're so small, however, they are less powerful, projecting only 10-30 lumens of brightness (compared to 3,500 lumens in a full-size projector) with a resolution of .25 megapixels. (Full-size projectors have a resolution of 2 megapixels.)

Using the distributed architecture, the picos will be able to communicate with each other and combine to produce brighter, sharper displays. If two phones (or three, four or more) come close enough to each other, their displays will either overlap, providing brighter viewing, or tile, which increases the resolution.

She is also using the technology to move files from one phone to another with just a gesture, via a Bluetooth mobile network.

Soon, business associates will be able to view PowerPoint presentations on the fly or transfer files without using a USB connection. "As soon as their phones get close to each other they will detect each other," Majumder says. "It's a very easy interface."

photo: Eva Lempert

While instant communication can be empowering, it also presents obstacles. Judy (pictured in monitor) and Gary Olson seek to understand social practices necessary to create successful distance collaboration.

"Once you start collaborating at a distance, you cross cultural boundaries," Gary says. "Being sensitive to differences in international collaborations is a very tricky thing."

Numerous hurdles must be leapt. "People who have never met are more likely to mistrust each other or misattribute intentions," Judy adds. "There are miscues, misinterpretations and lots of misunderstandings. So you have to do team building and extra clarification. It's hardest when your workdays don't even overlap; then you have to be extra careful about everything."

The Olsons, who have studied approximately 500 collaborations over the past 20 years, used their data to develop a tool called "Collaboration Success Wizard." Funded by the National Science Foundation, the Web-based service asks distance collaborators a series of questions in five categories about the nature of their work and the technology they're using. Based on the teams' responses, the wizard identifies potential problems and makes suggestions for improvement.

Google has introduced a series of collaborative tools based in the cloud, which enable multiple users to simultaneously edit documents, share files and synchronize changes. These Google Apps are used by thousands of organizations around the world; Judy and Gary Olson laud their capacity to simplify distance collaboration.

"When you work together you also want artifacts; you want to get the diagram out and draw on it," Judy says. "These tools can enable this. People thought it would be chaos, but it's not; everybody loves it."

The frequency and reach of international collaborations has caused Google to experiment as well with a tool that changes voice into text – a version of closed captioning – during teleconferencing. The Olsons' research has indicated a need; language can be a significant stumbling block.

"One person we interviewed said he understood about 25 percent of what went on during teleconferences," Gary says. "But with closed captioning, suddenly his comprehension went way up because he could deal with the printed language in ways he couldn't with voice."

Nicole Landreth has been a hairstylist for eight years, steadily growing her clientele. Last fall, she became self-employed, leasing her stylist's chair, scheduling appointments via text messaging, and offering credit and debit payment options through a smart phone device called Square. "For customer convenience, I needed more than just cash or check." She wasn't certain how clients would react but so far the app has been a success. "My clients thought it was the weirdest, coolest thing they had seen," says Landreth. "Nearly 90 percent of them are comfortable using it."

Square

While interactive technologies impact us all, perhaps nowhere has technology's reach been more life-changing than in underdeveloped nations. In sub-Saharan Africa, for example, villagers are using mobile phones for personal banking. New services are being added to older technologies like text messaging with dramatic results.

Kenya, Tanzania and Afghanistan are three of the countries where mobile phone-based money-transfer services have taken off. These countries lack electronic payment infrastructures, taken for granted in much of the world but expensive to construct. Mobile services, however, require only cellular towers and access to the cloud, both of which are readily available. And mobile phones are abundant; almost everyone has access even if they don't own one.

Now, instead of relying on bundles of currency, villagers trade their cash with a local money service provider, who loads monetary value into their cell phone accounts, allowing them to text payments to others as remittance or in exchange for goods and services.

Bill Maurer, a UCI cultural anthropologist, directs the university's Institute for Money, Technology and Financial Inclusion. Founded in 2008 and funded with $6.13 million from the Bill and Melinda Gates Foundation, the institute supports research on mobile technology for providing banking and financial services to people in developing countries.

Cultural anthropologist Maurer says online payment systems can come with a price. "The real challenge may not be the technology, but the willingness … to have a genuine conversation about consumer rights and the duties of private providers."

photo: Michelle S. Kim, University Communications

Lois Reed always has had an adventurous spirit so it came as no surprise when the 90-year-old Minnesotan recently befriended family around the country via her new Facebook page. "I'm not sure how I got there, it was purely accidental on my part, and I don't know what I'm doing but it's kind of fun." Reed is no stranger to online technology, using Skype to call her son who winters in Mexico. She adds, "I like seeing my nieces and nephews on Facebook. I only hope I don't accidentally shut someone off or unfriend them."

Chris Van Dusen worked in sales for 10 years, during which time he relied on electronic devices and new technology to keep him organized and efficient. Nearly two years ago he started his own business, i-FFICIENCY, to help clients learn to do the same. "Many people get overwhelmed by the limitless choices available so my quest is to help them find the best fit. How do all the pieces of the puzzle fit together to make life more streamlined? This is what I want to communicate with my clients."

Maurer says that in Kenya, where a mobile money service named M-PESA was launched in 2008, nearly half the population now sends money by mobile phone. Kenyans used to transfer money by sending it to neighboring villages with bus drivers, who collected up to 20 percent for their services. M-PESA, by contrast, costs just pennies on the dollar.

A smiliar service is being embraced by dating couples in Afghanistan for other reasons. In a society where courtship can be difficult, mobile money transfer allows them to send monetary gifts to each other, easily and discreetly.

More developed nations, including Japan, Korea and Singapore, also are using smart-phone payment systems. In 2011, consumers around the world spent $60 billion using mobile payment devices, according to a CBS News report. That figure is expected to increase to $170 billion by 2015.

In the U.S., Google has rolled out a mobile phone-based application called Google Wallet, a virtual billfold that stores payment cards and retail offers on the phone and online. The system utilizes a near-field communication chip in the phone that lets users pay by tapping the device against a store "reader."

Another digital service called "Square" allows merchants to accept credit card payments via a nickel-sized card reader that plugs into their cell phones. The application also offers a hands-free way for customers to pay using location-awareness technology and online bank accounts linked to their Square accounts.

Local currencies, a form of barter that replaces money and keeps trade within a specific community, have been around since the Great Depression. Born of economic downturns when people couldn't afford basic goods and services, some are now going online, thanks to advances in technology.

Bernal Heights, an insular neighborhood in San Francisco, this year became the first to take barter one step further. Two technology-minded residents created a complementary currency system debit card that earns users credits for additional goods and services when they swipe it at local businesses.

Credit and debit cards allow users convenience and an instant record of their transactions. Most of us don't stop to think, however, about who else has access to that transaction data. In the last 15-20 years, the payment industry has begun to capitalize on the inherent value of that information, giving rise to credit scoring and targeted marketing.

And our affinity for technology's conveniences comes with a price. "People's sense of intimate connection to the technology has mushroomed in a way that we didn't predict or were ready for. But we need to think about these things and have a conversation about them," Maurer says. "We need to stop and think a minute about what's really free and what's not free."

For Maurer, these systems raise important questions about consumer protection. "We can contest a fraudulent credit card charge, but new payment systems are murkier on consumer protection," he says. "The real challenge may not be the technology, but the willingness of stakeholders in industry and government to have a genuine conversation about consumer rights and the duties of private providers."

Digital systems of all kinds are fast becoming commonplace. We "like" things on Facebook, buy groceries and clothing online and connect with our colleagues on LinkedIn. That convenience and sense of instant connection has other consequences as well.

Privacy, for example, and the value of the data. "Certainly the Googles and Facebooks of the world imagine they can make a whole lot of money selling data to advertisers," Maurer says. "Every time Google makes money off of my click history, should I get something for that? I'd be happy to give up my privacy if I got a chunk of what these companies are making off me."

Dourish, the cultural technologist, sees technology's downsides as part and parcel of the manmade process that created them. "Technology doesn't just fall out of the sky; it's produced by people, organizations, social forces and cultural expectations," he says, "and it always speaks back to those. The technology creates both problems and opportunities."

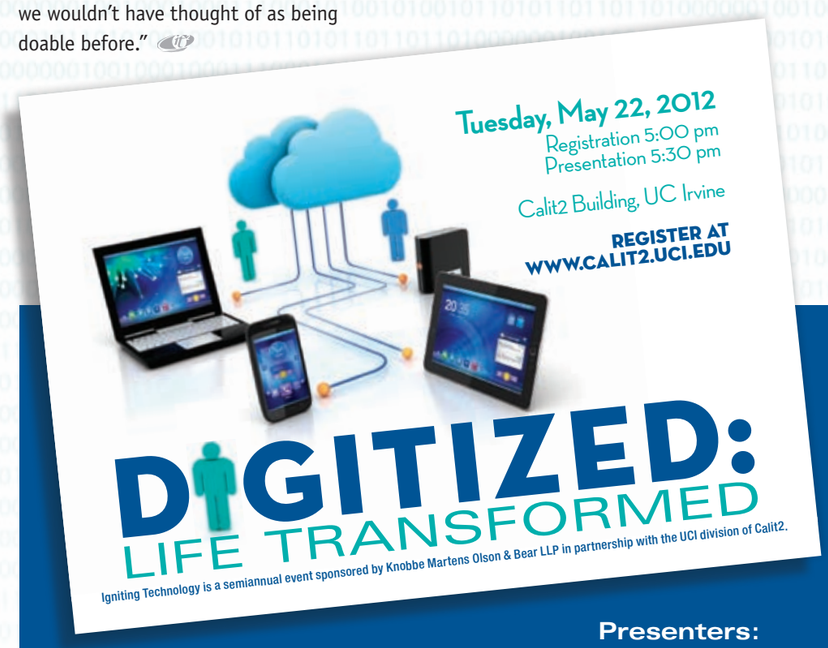
In each generation, it also has a way of creating questions about its social benefits.

"We have a long history of looking back nostalgically about 100 years and saying 'wasn't it lovely back then?' There's documented evidence of people upset about the arrival of the Penny Post service in Great Britain because they were afraid it would stop people from visiting with each other in person," Dourish says. "We've been here before."

From political mobilization to instant communication to enhanced global understanding, though, it's hard to deny interactive technology's limitless potential.

"I think it has given us different kinds of ideas of our potential," says Dourish. "There is a global awareness and a much more intricate pattern of connection. And it enlarges our perspective. I can think about my country and my hemisphere in different kinds of ways because I am connected to them in new ways.

"There are all sorts of things we may think about as being doable now that we wouldn't have thought of as being doable before."



Presenters:

Michael Carey, Bren professor of information and computer sciences, will share his expertise on cloud computing and the implications of "big data" for businesses and individuals.

Maneesh Goyal, general partner, MergerTech Capital, will discuss how social/cloud computing and mobile/wireless platforms can be used to enable personalized health and fitness applications, as well as point out what investors are looking for in this startup space.

Mimi Ito, research director for the Digital Media and Learning Hub, will explain how a highly successful Chicago-based digital learning center for youth can and should be replicated in Southern California.

Scott Mainwaring, senior researcher for Intel Labs Interaction and Experience Research, will talk about the next big social computing trends on the horizon.

Bill Maurer, director of the Institute for Money, Technology and Financial Inclusion, will present the development and usage of digital currency and mobile banking in developing nations, and the potential market opportunities for businesses and entrepreneurs.

FOUR-CAST:

CLOUDS

by Shellie Nazarenus

Cloud computing is one of the hottest buzz terms in technology. The concept, which reflects a historic shift in the IT industry, is spreading rapidly as more computer memory, processing power and apps are hosted in remote data centers, or the "cloud."

Four UCI researchers have slightly different perspectives on the trend.

Mike Carey, computer science Bren chair and professor, characterizes himself as an 'inside-the-cloud kind of guy' who seeks to understand data management needs and challenges. "I am a plumber," he says. "I work inside the cloud, essentially asking questions like, 'If you were building data management for cloud computing, what would the facilities look like?'"

From a business perspective, the cloud offers **Don Patterson**, an entrepreneur involved in several startups, an ideal infrastructure and computational resources. "It's just so much faster and cheaper to do your proof of concept in cloud computing," explains Patterson, who as an informatics associate professor, studies ubiquitous computing and interactions. "Things are so fluid in these startups and we can't afford to buy a new server every time we shift direction."

Computer science professor **Nalini Venkatasubramanian** and her Ph.D. student **Reza Rahimi** look at the cloud from an infrastructure perspective, particularly as it applies to mobility. "Our view comes from using the cloud as an enabling infrastructure for running a whole bunch of applications that are becoming more and more popular with mobile devices." She points to the notion of mobile cloud computing as "fulfilling the dream of anywhere, anytime access to resources without limits."

These experts, of course, have varying answers to a common set of questions.

How would you describe cloud computing?

Mike: Cloud has become a synonym for a pile of machines in a room that can be allocated on demand for different purposes. It's about having services and storage elsewhere, off in this mysterious cloud, that you can rent instead of buying and maintaining it yourself. It also gives you economies of scale, and you can choose how much computing and storage you need.

Reza: Cloud computing is a metaphor for the Internet because it is stuff that is done in the network outside of your own machine. Think of the Internet as accessing things from outside; in essence, that is cloud computing but it's also storing, computing and getting services.

Don: Cloud computing involves a number of different infrastructures, billing models and applications that all treat computing as something you just use on demand. When you need electricity, you don't go out and buy a generator, you just plug into the wall and you pay for what you use. So when you buy a server, it's like buying a generator. But when you use the cloud to get computational power, it's more like plugging into the wall to get electricity.

Nalini: People generally think of these clouds as huge data centers. I think increasingly that the cloud computing infrastructure is not just for businesses who have big computing needs, but it can be for you, me and anybody else who needs computing and access to resources and services-on-the-go, perhaps through a phone-based interface or application.

How does a business or consumer get started?

Don: A business should consider it if they find themselves spending too much time and money maintaining their infrastructure and that's taking away from what they really should be doing. At that point they should start investigating cloud computing and determining what computational needs – applications, storage, email services – they can move there. I don't think consumers will be making a decision about whether or not to use the cloud the same way as a business. Consumers are going to gravitate to those cloud-based experiences based on appeal; the offerings and features of a cloud computing interface will just be more attractive in many cases, even if the consumer doesn't realize how the cloud is involved.

Reza: From a user perspective, it depends on what you want to implement and what services you will use. There are three different types of cloud services. One is "software-as-a-service," like Google apps and Gmail, where the user doesn't manage or control the underlying infrastructure but just uses the application capabilities the cloud provider is offering. Then there is "platform-as-a-service," Windows Azure for example, where the user can deploy and control his application on the cloud. The third is "infrastructure-as-a-service," such as Amazon or Rackspace, where the user can access computational resources like storage and database management.

What are the benefits?

Mike: Price, service management and availability. What's driving cloud computing for consumers is that a lot of it's free; it's Gmail, Facebook, other things that are essentially paid for by advertising. So you get a lot of functionality for nothing if you're willing to entrust information about yourself to cloud service providers.

Nalini: The cloud offers a sort of pay-as-you-go model. I think that is an important benefit. Whether you are a small company or a big company, or you have a small task or a big task, the types of resources you need over time vary. If you are the IRS, for instance, the closer you get to tax day the more resources you will need but other times you may not need as much.

Any disadvantages?

Reza: Privacy and security are generally the two concerns that everyone points to. But I also think a potential problem could happen when a cloud computing vendor goes out of business. So availability and performance must be considered. You put all your information in the cloud – all your data, computation – and what happens when the provider disappears? The question becomes: where is my data and how do I get it back?

Don: You don't really know what's happening to the data that is in the cloud. When you agree to store all your data in a cloud you hope that the people who are storing it for you are acting in your best interest. But that may not always be the case, especially if you are getting something for free. There is a popular axiom: if you are not paying for the product, you are the product. There are ways companies can leverage all this data, and some of those ways may not make a person comfortable if he knew about them.

How did the concept of cloud computing originate?

Nalini: This concept of being able to use external resources for facilitating localized applications has been around since the early days of distributed computing. The concept that you can use services and resources that are very, very far away has been around for 30 or 40 years. In the early stages it was used for very specialized domains that needed large computer storage infrastructures and it required some expertise to use the system. It took quite a while to make this sort of a commodity resource available to every end user.

Don: There are a bunch of trends that make cloud computing good sense now. One of the reasons it became practical is that we have these mobile devices with really good interfaces and network connectivity that enable us to tap into these incredible cloud resources. We can share enormous amounts of data across users without needing to load it on individual devices, and we still get a really great experience.

Mike: The way computing terminology works is that we tend to find a trend and then that's what we are all doing. So I think everybody is finding 'cloudy' things about what they are doing to some extent. But Amazon was definitely out in front with the current cloud concept. They started out doing online books, then branched out to enable people to offer products via their own little stores through Amazon – sort of a cloud of stores if you will. To do this, Amazon had to build an infrastructure that could provision resources for a lot of different purposes. Now they are taking that infrastructure and offering it as a cloud computing service; others, such as Microsoft and IBM, are following suit.

Will the cloud enable applications that previously were considered impossible?

Don: The movie "Avatar" required a petabyte of data – that's a thousand terabytes – in order to keep all of the models, graphics, renderings, movie files, etc. and that wouldn't have been possible without the cloud. Think about it; a petabyte of data for a three-year project wouldn't be practical to build and to scale as the movie-makers progressed. "Avatar" was a movie that needed the cloud in order to be produced.

Nalini: I am sure the cloud has a big role to play on a grander scale for global sustainability and providing societal-level, resilience-type information. The cloud infrastructure is huge, just like the global infrastructure, so from an assimilation perspective it can enable the pooling of resources to better understand these vast challenges and potential applications. As technologists, we look at the cloud as benefiting consumers or individual companies but I think it can make big scientific challenges more feasible to address.

How did cloud computing pique your research curiosity?

Reza: I am looking at how to use cloud computing for rich, end-user mobile applications, particularly for developing image processing and optical character-recognition applications. For example, a tourist visiting a foreign country sees a sign he can't read. So he can take a picture of it with a mobile device, send it to the cloud, where it gets translated, and have it come back with an understandable message. You may not have a very sophisticated language interpretation application on your cell phone because of its limited resources; this type of computation would work better on the cloud.

Mike: I am interested in the big data trends that are happening because of cloud computing. I have always been interested in the plumbing aspects of building databases and making them run fast, and how you design good algorithms that work efficiently with large volumes of data. Cloud computing affords a lot of curious challenges in this regard, especially if you think about how you scale to really large volumes of data – all the tweets, status updates and other applications – that potentially could be merged and analyzed in interesting ways.

What does the future look like?

Reza: For the end user, the terms 'processing' and 'storage' are going to be non-existent. I think cloud computing will provide the infrastructure for pervasive computing. Eventually, users will no longer need to install anything and they will get every computational service they need on the cloud. And, just like you have your wireless carrier bill, you will have your cloud service bill.

Nalini: I believe that the future lies in the seamless merging of mobile, pervasive and cloud computing infrastructures. We are looking at end devices that are small, not capable of running big computations and don't have a lot of storage. So the notion of a tiered cloud is on the horizon. All of these different clouds – public, private, local, distant – combined with different types of cloud infrastructures – for storage, for computing, for services – will enable access to all of these resources and services anytime, anywhere.

Don: I think the future is good. A lot of efficiency can be gained by consolidating IT and development resources in these cloud computing infrastructures. I think we are going to be pushed there because of economic pressure. The privacy stuff is definitely manageable and I don't think there is any reason why technically or socially it has to be a threat to put stuff in the cloud.

Mike: Cloud computing is more than a fad, but there are still some challenges. We are going to need to work on how to secure data. If you put data in a database system, you want to be able to query it. But if you encrypt it, you can't query it in the same way. Suppose the info in a remotely-stored customer relations database is an encryption of the actual data because you don't want the cloud server to see it; you can't find customers in a range of zip codes since the values are encrypted. Or take a big pharmaceutical company doing patent searches in the cloud: they do not want to tip off competitors with their queries. The future of cloud computing for data depends in part on how well we solve the question of how you can put data somewhere else and still get at it effectively.

Entertaining Solutions

by Lori Brandt

Most people know that an old refrigerator or lights blazing in an empty room can run up an electricity bill.

Not as many know that the new household energy hog is the growing number of consumer electronics, in particular, those boxes that serve as cable and satellite TV receivers. Ubiquitous in today's media-centric homes, set-top boxes are always "on." They can operate at near-full power, day in and day out, even when the consumer is not watching or recording a show.

Set-top boxes are part of the "plug load" – devices that plug into an electrical socket – including cell phone chargers, televisions, computers, printers, tablets, digital video recorders, cameras and more. Alone, these items may not use much energy, but multiplied, they add up. The average household, which contained only four or five devices 20 years ago, now has as many as 50.

The California Energy Commission is looking to the California Plug Load Research Center (CalPlug), established last year and housed at Calit2, for leadership. The Commission has awarded CalPlug a $1 million research grant to support development of energy-conserving solutions and industry standards, starting with set-top boxes.

Calit2's Irvine division Director G.P. Li serves as the center's interim director. Through collaborations with industry, commerce and government, he says, CalPlug plans to assist in developing future efficiency standards and incentive programs for manufacturers and retailers.

Twenty-one CalPlug student researchers, from engineering, computer sciences, business and social sciences, are organized into six teams evaluating plug-load energy use and seeking solutions.

The electricity required to operate all the set-top boxes in the U.S. is equal to the annual household electricity consumption of the entire state of Maryland and results in 16 million metric tons of carbon dioxide emissions, according to a Natural Resources Defense Center fact sheet.

"Set-top boxes and digital video recorders consume astronomical amounts of energy, and may now be one of the largest consumers of electricity in the average American home," writes U.S. Sen. Dianne Feinstein. In a letter to CEOs of America's largest cable and satellite providers, she urges them to phase out inefficient set-top boxes and provide models that reduce utility bills. "These boxes cost households $3 billion annually in utility bills, with $2 billion of that expense incurred when boxes are not actively in use."

The U.S. Environmental Protection Agency's ENERGY STAR program launched a set-top box program in 2009, with an improvement target of 40 percent for ENERGY STAR models over traditional set-top boxes. Revised guidelines, effective last year, require an additional 30 percent average reduction.

"Set-top boxes involve multiple stakeholders – manufacturers, service providers, utilities and customers – and present real operating challenges for improving efficiency," says Matt Malinowski, a consultant who works with the EPA on the ENERGY STAR program. "CalPlug offers a neutral environment where everyone can work together."

"We know there is great potential for improving the efficiency of these boxes and reducing the cost of operating them," explains Bradley Meister, a senior mechanical engineer at the Commission. "It was important to find a center that could stay on top of what is possible in energy efficiency and pull together the major players, as well as look at human behavior."

CalPlug recently hosted a day of workshops and demonstrations to build collaborations. Nearly 60 experts gathered, including television service providers, set-top box and microelectronics manufacturers, utility and public agency representatives and academic researchers.

DIRECTV representative Steve Dulac was there, showing off his company's new energy-saving, multi-room HD-DVR architecture that features remote user interface technology found in Samsung Smart TVs. DIRECTV, recognized by the EPA three years running for excellence in energy-efficient product design, intends to continue its momentum.

"We hope to build on our success through ongoing collaboration with other CalPlug workshop attendees," Dulac says.

CalPlug is currently measuring the power consumption of a variety of set-top boxes and exploring design alternatives to reduce energy use. Because two-thirds of the energy used by the boxes is consumed when they are off, researchers are looking at the potential of employing a light sleep mode and a deep sleep mode.

"The challenge is designing a sleep mode that quickly wakes up and reconnects, so the box can still receive updates from content providers and customers don't suffer unacceptable interruptions of service," says Arthur Zhang, CalPlug's technology manager. "Our goal is to make design recommendations that achieve significant differences in power consumption, are feasible for manufacturers and are user-friendly."

"We are confident that our work with CalPlug can contribute to increased efficiency in set-top boxes," adds Li. "We want to lighten the load – on families' energy bills and on long-term damage to our environment."

1	Fan/Air Purifier	100 kWhr/ $25
2	Laptop	200 kWhr/ $50
3	Monitor	200 kWhr/ $50
4	Tablet	10 kWhr/ $2.5
5	Game Console	50 kWhr/ $13
6	Home Theater System	300 kWhr/ $75
7	Game Console	50 kWhr/ $13
8	TV	300 kWhr/ $75
9	Blu-ray Player	50 kWhr/ $13
10	Laptop	100 kWhr/ $25
11	TV STB (2011)	92 kWhr/ $23
12	TV STB (2007)	125 kWhr/ $31
13	TV STB (2005)	230 kWhr/ $58
14	Tablet	20 kWhr/ $5
15	Desktop Computer	250 kWhr/ $63
16	Monitor	100 kWhr/ $25
17	Printer	200 kWhr/ $50
18	Heater	100 kWhr/ $25

All data is based on annual estimated usage
Dollar figures are based on a rate of 25 cents per kWhr

The cost to a homeowner of keeping electronic devices like these plugged in and ready to use approaches $600 a year.

photo: Paul R. Kennedy

LEARNING GETS smart

Today's children and teens, described as "Generation I" or "digital natives," were born after the Internet had become a staple in our lives. They grew up with Google, Facebook, email and texting, not to mention digital cameras, online gaming and instant connectivity, and they can't comprehend of a world without computers.

As they scroll through Facebook, watch YouTube videos or play "Words with Friends," they're probably not thinking about what they're learning. But for UCI cultural anthropologist Mizuko (Mimi) Ito, these forms of new media, and the ways in which young people utilize them, provide a blueprint for designing new learning environments.

Ito believes new media and technology activities for children and teenagers ultimately can lead to improved academic and career prospects.

by Anna Lynn Spitzer

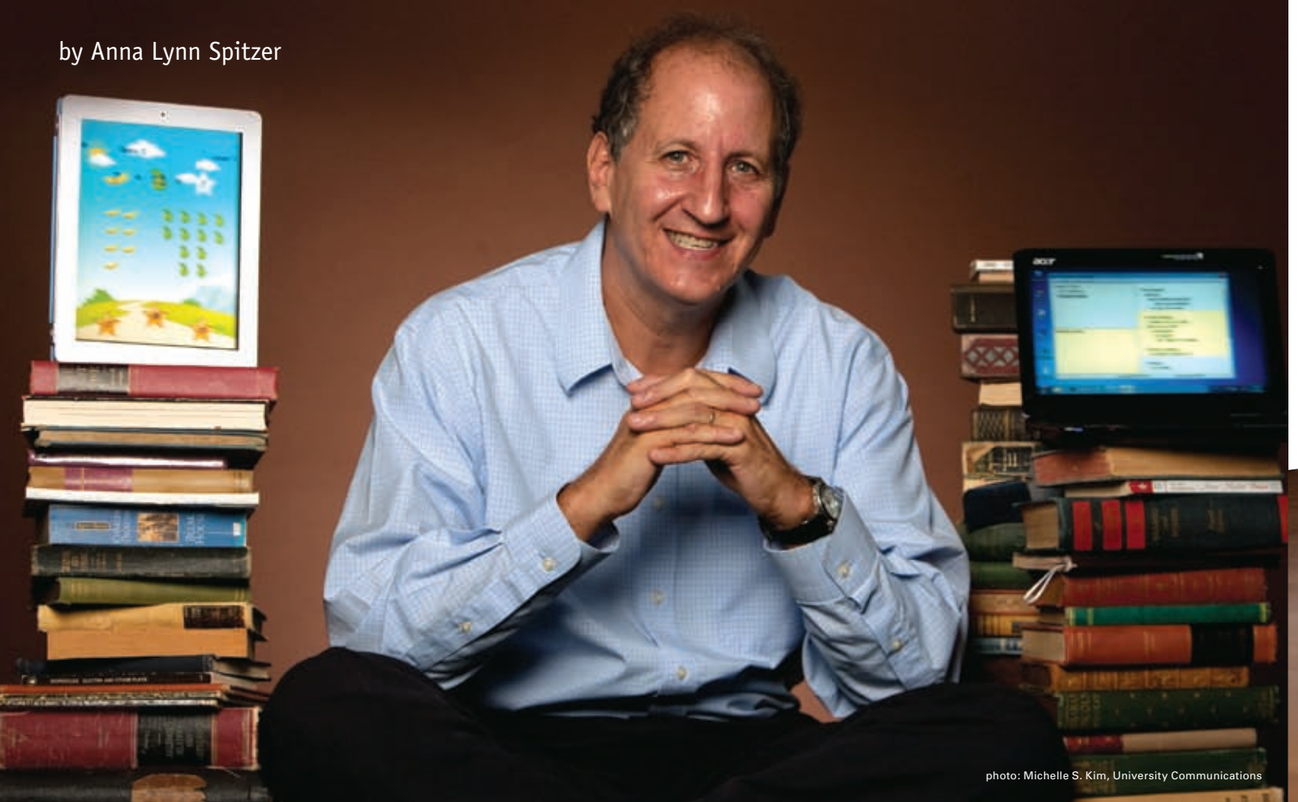


photo: Michelle S. Kim, University Communications

Her early work focused on understanding how kids learn in informal contexts, and now "we're trying to take that and connect it to the kind of learning that matters for their future success," she says.

Her research informed the design and implementation of a center that offers digital experiences to high school students. YOUmedia — a Digital Library Space for Teens, is headquartered in Chicago's Harold Washington Library. Funded by the John D. and Catherine T. MacArthur Foundation, the 5,500-square-foot space is outfitted with computers, digital editing equipment, music keyboards, gaming consoles and video cameras, and is staffed by adult mentors who provide guidance and support. Forty thousand kids each year drop in to hang out with their friends and use the equipment.

Ito says even those who use the space exclusively to play video games or surf Facebook are benefiting. "They're getting exposure to a range of opportunities and interests that they wouldn't otherwise have exposure to," she says.

But the kids who are more deeply immersed in the technology are producing "really amazing, creative things." And because the program incorporates an online support mechanism, all the users can connect to their mentors even when they're not physically in the space.

"It's broadening access to an interest-based community and caring adults," Ito says. "These mentors can frame those interests in ways that advocate for the young

Warschauer (opposite) says access to digital media is crucial to education. "If we're serious about learning how to gather, interpret and produce knowledge, it needs to be part of schools."

Goldberg (left, below) and Ito believe the power of digital technology transcends the classroom and can be a stepping stone to future career success.

photo: Paul R. Kennedy

"Increasingly we're looking at a more robust mobile world enabled by technology, so learning happens anywhere, anytime, anyplace – pretty much all the time, even when one is not paying attention to [it]."

"You don't solve a problem just by throwing computers at it. Integrating technology into any kind of social system is not just an engineering issue; it is a human and social issue."

Undergraduate student Rachel Ulgado (above) is a member of Gillian Hayes' research team. At a recent participatory design workshop for teachers, group brainstorming resulted in a flow chart to inform design of a tablet application for classroom use.

In 20 years, predicts education professor Warschauer, 95 percent of schools will provide a digital device for each student.

people in career pursuits or school or other places that really matter for future opportunity."

Contact with technology is crucial for learning in today's world, according to David Goldberg, director of the UC-wide Digital Media and Learning Research Hub located at UCI. "Increasingly we're looking at a more robust mobile world enabled by technology, so learning happens anywhere, anytime, anyplace – pretty much all the time, even when one is not paying attention to [it]," he says.

Two studies conducted recently in India provide corroboration. School-age girls working in the fields, who were not formally schooled, were given cell phones embedded with English-language learning games. On their breaks, the girls played the games, picking up in the process language skills they would not otherwise have learned.

The second project placed screens connected to computers on the streets in publicly accessible areas. The screens displayed basic, elementary-level learning programs and games, and by attracting the attention of street-children who lived nearby, imbued a rudimentary level of schooling.

"The use of not-terribly-sophisticated technology is providing basic functional education to populations that don't otherwise have access," Goldberg says.

In more developed countries, interactive technologies are changing classroom methodology. In many schools, teachers no longer stand in front of the class lecturing about history, math or science. Instead, kids interact with mentors in online communities, scientific labs or corporate offices. They build multimedia presentations with classroom peers on mobile devices, communicate via Skype with soldiers in Iraq, write blogs, create spreadsheets and analyze data.

"While critically interpreting information was always important, it's certainly much more important now," says education professor Mark Warschauer, author of "Learning in the Cloud: How (and Why) to Transform Schools with Digital Media."

Warschauer researched a middle school in Maine that he calls an outstanding example of how to incorporate new media in an experiential learning program. The school's curriculum included 10-week interdisciplinary research projects on thematic issues, which were supported by laptops and online resources, digital cameras, camcorders and specialized software.

One project on the state's civil rights movement incorporated interviews with civil rights leaders and research on original documents. It culminated in a 200-page book written by the students that was available for download, as well as a five-part video that showcased their learning process.


photo: Paul R. Kennedy

Hayes advocates for teacher participation in technology design. "If we're not designing [devices] with teaching in mind then we're not going to accomplish anything."

"These are the kinds of things having access to the Internet can accomplish," Warschauer says. "Could you do that without technology? Possibly. But you could do it 20 times easier with it."

He cautions, however, that technology is no better than the strength of the program that incorporates it. "You don't solve a problem just by throwing computers at it. Integrating technology into any kind of social system is not just an engineering issue; it is a human and social issue. It takes good pedagogy, good assessment and good curriculum. And all these things take a lot of time and effort."

One school in New York City seems to have achieved this ideal. Called Quest to Learn, it brands itself as "a school for digital kids… a community where students learn to see the world as composed of many different kinds of systems." Funded in part by the MacArthur Foundation, it utilizes online interactivity and peer-based gameplay in its curriculum, as well as a highly collaborative approach to problem-solving.

And its students fare better in standardized testing than the mean average in the city's schools.

Most schools are not quite as digitally progressive yet, but Warschauer believes adopting technology across the board is essential in our information economy. "There's no adult in the world who's involved in knowledge production who doesn't make use of digital media to find and analyze information, interact with people, and write and edit. So I think it's safe to assume if we're serious about learning how to gather, interpret and produce knowledge, it needs to be a part of schools as well."

The trend appears to be gaining traction. The ratio of students to computers in schools is about 3:1 now, down from 14:1 two decades ago. Warschauer predicts that in 20 years, 95 percent of all schools will have a digital device for every student. "It's not going to be so much a question of how we afford to do it but how can we afford not to?" he muses.

When technology is incorporated into classrooms, it changes the teachers' roles. "The teacher has to become something other than an expert," Goldberg says. "He/she has to become more of a facilitator, a kind of conductor."

"If you're a teacher who believes in hands-on learning and you can't go out to the ocean because you live in Iowa, you can use technology to simulate the ocean and run experiments."

Informatics assistant professor Gillian Hayes works with teachers to design classroom management tools and advocates for teacher involvement in technology research and design. "If you don't teach the teachers how to use these technologies and we're not designing them with teaching in mind, then we're not going to accomplish anything," she says.

One of Hayes' doctoral students, Meg Cramer, collaborated with teachers to create "Reflect with Me." The tablet-based tool allows groups of students in digitally connected workspaces to create multimedia collections and pass elements of those collections to each other or to other groups. Hayes calls it a "mash-up" model. The teacher can monitor the groups' progress from her tablet, and both teacher and students can "rewind" the experience to see how it was accomplished. The system also allows the students to see who has "borrowed" pieces of their presentation and to learn the importance of proper attribution.

"Getting credit for what they've produced is really important," she says, and empowers them to continue creating. "It's not unlike the sort of high that adults get from their Wikipedia articles being read."

As is often the case, new technology can create resistance. "Throughout history, every time a new technology comes in place there's always this sort of dual reaction," says Hayes. "A portion of the population believes this new thing will completely revolutionize education and another portion says it will be a disaster."

The trend, she says, began with slates in the classroom and extended through the inclusion of television, computers and now, mobile devices, in education.

"Technology itself is not transforming education but we're starting to see that different kinds of pedagogical approaches can be enhanced with technology.

"If you're a teacher who believes in hands-on learning and you can't go out to the ocean because you live in Iowa, you can use technology to simulate the ocean and run experiments."

Experts generally agree that the next big shift in the technology landscape will be the imminent explosion of smart mobile devices.

In education, mobile technology facilitates the life-as-a-lab approach by accompanying students into their environments, whether it's a biology field trip, a visit to the museum or just a night at home.

"It's unrealistic that we expect students to learn from these technologies during the school day and not take them home at night. It's not how people learn," Hayes explains.

And the constant connectivity afforded to young learners when inexpensive, smart mobile devices give them access 24/7? "It's going to be a game-changer," says Ito. "It's really going to change what we think of as knowledge and information environments."

CONFRONTING challenges

by Anna Lynn Spitzer

Digital technology has turned the traditional business model on its ear(nings).

One need look only as far as Kmart, Borders, Blockbuster and Kodak to see once-powerful stalwarts of the American economy that failed to understand the power wielded by this influential tool.

UC Irvine's newest research center, the Center for Digital Transformation, has set its sights on understanding the changes inherent in this new information economy and helping businesses avoid a similar fate.

Housed in the Calit2 Building and led by director Vijay Gurbaxani, the Center for Digital Transformation brings together experts in all areas of business and society to investigate this powerful paradigm. "There is lots of talent on campus – amazing people doing amazing work," Gurbaxani says. "We want to pull all of these people together in a way that makes a huge impact."

He hopes members of the business community will be active participants of this "open-source" approach to research. "We want to use digital technologies to build this collaborative."

The center focuses on addressing business models and strategies, organizational structures, management theory and the core economics of the information age.

Gurbaxani says information technology continually changes and businesses must keep changing as well. "What are the challenges confronting U.S. competitiveness? What do companies need to deal with and what do individuals who want to succeed in this new economy do? We want to focus on the transformative impact of technology," he says.

The information economy differs from the manufacturing economy in two significant ways, according to Gurbaxani. Information is what he calls non-rivalrous. "If I manufacture a hammer and I give it to you then I no longer have it; only one of us can use it productively at a time. But with information, when I share my ideas in a conversation, we both can leverage the ideas. Knowledge is cumulative. We can each contribute a little bit and get a lot out," he says, citing Wikipedia as one example.

Secondly, the information economy brings with it extreme economies of scale, where the cost of replication is next to nothing. "If you have one payroll/HR system running somewhere, 10 divisions of a company can use the same system for nearly the same cost as running it in one division."

The center will focus on four major themes: digital economics, the digital services marketplace, digital business models, and big data and analytics.

"We have created a really rich research agenda," Gurbaxani sums up. "We want to generate and disseminate knowledge that helps business, governments and society adapt and leverage the possibilities enabled by emerging digital technologies."

For more information about the Center for Digital Transformation, contact Maureen Vasquez, mbvasque@uci.edu *or join the center's LinkedIn group (UC Irvine Center for Digital Transformation).*

photo: Bob Peterson

Behind the $cenes

Funding awards are always greeted with great fanfare. But funding sponsors make grant awards in response to written proposals, and that work gets less attention. Real work it is –writing, rewriting, editing, budget and space negotiations, team meetings and forms.

At the time of this writing, Calit2 is involved in several faculty proposals still pending; together they provide a snapshot of the institute's varied interests and the cooperative work that proposal submissions require.

Motivating Wellness

Calit2 initiated and submitted a proposal to engineer devices that would help motivate people to improve their health and wellness. The proposal includes faculty members from pediatrics, dance, electrical engineering, geriatrics, nursing, neurology and sociology. The Technology and Engineering Center (TEC) staff prepared the proposal budget; Calit2 staff edited and prepared biosketches.

The effort included some last-minute drama. At submission time, nearly 5 p.m., it was discovered that the last page of text had not survived conversion to PDF format. Fortunately, the Sponsored Projects staff knew the government rules well enough to secure an allowance for post-deadline correction. Lead faculty were G.P. Li (PI), Mark Bachman, Jutta Heckhausen and David Reinkensmeyer.

Specialized Manufacturing

Calit2 assisted UCI's engineering school in a major proposal to develop desktop manufacturing units that could combine multiple new technologies for distributed manufacturing of specialized parts. Such a development could return manufacturing leadership to the U.S. The team, led by Marc Madou, included 13 UCI faculty and 20 faculty at six other institutions in a bid to establish a national center at UCI. Some of the team members began developing the ideas years ago, and this proposal began in earnest in 2011.

A pre-proposal to the government was submitted in May and won approval for full submission by fall; the reviews provided useful suggestions for the full proposal.

The next round of meetings began in December; professors at all the institutions were busy with early drafts over the holiday break, and faculty from four of the institutions met at UCI in January. Office of Research and Calit2 staff contributed to general editing and formatted more than 40 biosketches. TEC center prepared the UCI budgets, compiled budgets and forms from the subcontractors and edited several sections.

The engineering dean contributed funding for travel and outside reviewers; faculty members from different universities met to write and plan while abroad at a conference. The proposal included a sponsor-required spreadsheet – in this case more than 1100 entries – detailing the researchers' co-authors, former students and other collaborators.

Equipment Enhancements

Two new equipment proposals for the Calit2 Building were submitted. Both instruments are needed by many UCI faculty members and are unavailable locally; if funded, UCI could become the regional center for materials characterization research.

In the proposal for a combined X-ray photoelectron spectrometer and scanning auger microprobe, the decision to submit and the choice of lead faculty were made only three weeks before the deadline. The proposal text was developed and prepared by School of Physical Sciences faculty and research development office, which also prepared budgets, biosketches and additional paperwork. The proposal was formally submitted through Calit2, which would be responsible for equipment operation and maintenance. PI Reginald Penner worked with Calit2 to review available lab space and equipment placement; other lead UCI faculty members were John Hemminger, Matthew Law, Marc Madou and Regina Ragan.

The other proposal is for the purchase and customization of a computerized tomography system. The PI, Lizhi Sun, did most of the proposal writing but other faculty and Calit2 staff reviewed and edited. Co-PIs were G.P. Li, Timothy Rupert and Lorenzo Valdevit.

After the Fall

Finally, a proposal from three UCI faculty explores a newly emerging field called "collapse informatics"– the study of sociotechnical systems for preparation and adaptation to societal collapse, with a focus on IT applications. Calit2 staff helped edit and prepare biosketches; TEC staff prepared the budget and collaboration documents. UCI faculty members were Bill Tomlinson (PI), Bonnie Nardi and Don Patterson.

Multidimensional Effort

Clearly, research writing and budget calculations are only part of the effort. Sponsors often require other documents and separate forms, as well as letters to confirm commitments or express general support. Madou's proposal, for example, consisted of 35 pages of text and bibliography accompanied by 173 pages of budgets, biosketches and forms. At UCI, the Sponsored Projects staff reviews all final proposals. They are the stalwarts who have to cope at the last minute with everyone else's planning lapses.

Perhaps not all of these proposals will be funded; the supply of solid proposals is always greater than the available funding. But these professors persist – refining their ideas, extending collaborations, continuing background research and reaching out to other potential sponsors. Successful efforts serve as templates for future efforts; some of Calit2's largest grant awards were won with the second or third proposal.

Through such determination, these faculty members (and many other Calit2 affiliates) have established new collaborations and showed the world that UCI is competitive on all fronts. Even out of the spotlight, their efforts deserve our appreciation.

[Bits and Bytes]

by Shellie Nazarenus

Government Relations

In January, UC Irvine's government and community relations office hosted a meeting of their UC colleagues at Calit2. As part of the session, Irvine division Director G.P. Li provided the group with an update on the institute's activities, highlighting the status of the 10-year review by the UC Office of the President. Li was also asked to share Calit2's experience with opening TechPortal, the technology business incubator on the building's second floor. Calit2 is one of four Governor Gray Davis Institutes for Science and Innovation scattered among nine UC campuses, designed to fast-track commercialization of research discoveries. "We think of TechPortal as an innovation corridor," Li explained. "It has the infrastructure to support new businesses and is the gateway to other shared resources on campus." After his presentation, the group made stops at several labs in the building.

Popularity Driven

Out of the Calit2 Building and into the pages of *Popular Science*: research affiliate Garnet Hertz's OutRun project gained additional notoriety with a spread in the magazine's February issue. OutRun is a mixed-reality game platform that combines a classic arcade driving game with a real-world electric vehicle, resulting in a truly drivable video-game system. The player maneuvers the vehicle using the custom-built computer-vision system in the car's windshield that projects the surrounding environment as an 8-bit video game. OutRun's mainstream press debut follows stops at art and design, and gaming festivals along the West coast, as well as a stint abroad on display at Denmark's NEXT Festival. "It's nice when projects start taking on a life of their own," Hertz said. "Popularity allows a project to disseminate, but the complexity is a way for it to be memorable and have impact."

HOW 2.0

Tips, Tricks, Hacks and Do-It-Yourself Projects

Building a Drivable *OutRun* Game

THE FUTURE OF FUN

YOU BUILT WHAT?!

Mobile Gaming

An engineer puts an arcade cabinet on wheels

H2.0

HOW IT WORKS

DESIGN

CONTROLS

SAFETY

62 POPULAR SCIENCE • FEBRUARY 2012

FEBRUARY 2012 • POPULAR SCIENCE 63

The Human Impact

There was a lot of small talk going on in the Calit2 auditorium last November, as a group of experts offered their views on the latest in micro- and nanotechnology research at UCI. The semiannual Igniting Technology presentation, sponsored by IP law firm Knobbe Martens, focused on real-life applications that are being advanced by nanoscale innovations. Considered an emerging technology, the field of nano science holds great promise for advanced diagnostics, targeted drug delivery and even cellular-level analysis and repair. "Nanoscale is a rapidly-advancing field; we hope someday to be able to build advanced nanotechnologies," said Phil Collins, UCI associate physics professor. Collins told the audience that progress in scanning electron and atomic force microscopy is accelerating efforts. "These tools, critical for viewing nanoscale structures, were not available in the 50s, 60s or 70s; that's why nanotechnology is happening today."

Point of care diagnostic chip from lab of Prof. Elliot Hui. Image credit: Transon Nguyen

Empowering Health with Technology

Improved health and well-being took center stage in February at the 3rd International Symposium on LifeChips. More than 100 people from academia and industry gathered in the Calit2 auditorium to exchange perspectives and progress in the converging field of engineering, biosciences, physical sciences and medicine. The symposium was divided into three themed sessions: miniaturized diagnostics, biomedical microdevices, and health and wellness systems. Each session was moderated by one of the LifeChips program graduate student fellows. "LifeChips refers both to our program at UCI, as well as a type of universal research and teaching paradigm – one that embraces the overlap between life science and technology that naturally occurs at microscopic scales," said Mark Bachman, the symposium co-organizer. Nearly three dozen graduate students have been immersed in LifeChips training, learning skills to develop technology used to identify new drugs, advance stem cell research, and improve scientists' understanding of tissue, organs, cells, DNA and other basic components of life.

Donation Upgrades Lab

A Calit2 startup gave back to the institute last fall when the young company made a software donation valued at $75,000. Hiperwall, Inc.'s newest version 2.0 software, coupled with Calit2's existing hardware, gives UCI one of the largest video wall systems in the country to demonstrate, test and research innovative visualization technologies. "The Hiperwall team is pleased to be able to contribute to the ongoing success of Calit2. We're proud, that while we're still in an early growth phase, we are able to make this donation to the university," said Jeff Greenberg, company CEO. With the latest system enhancements, the building's second-floor Visualization Lab has the ability to display more than 235 million pixels of live data across 84 LCD monitors. Hiperwall, Inc., launched in 2008, is a spinoff from an NSF-funded research project that started in the lab several years earlier. The company has since hired several students and scientists who were involved in the early-stage research.

Conference Showcase

Virtual reality and 3D interfaces were the primary topics of week-long IEEE concurrent conferences in early March. The international gatherings, which were held at a convention center near campus, were respectively chaired by UCI computer science professors Aditi Majumder and Gopi Meenakshisundaram. On the second night of the session, shuttle buses brought several hundred attendees in shifts to see demonstrations in Calit2 labs. "It was a fantastic way for us to showcase the relevant work we are doing at UCI," said Majumder, who manages the building's Visualization Lab. "We got so much positive feedback and, hopefully, generated some proposal collaborations down the road." Among the projects demonstrated was a projector-based display system Majumder's research group is developing that incorporates gesture-based interactivity (see page 5).

photo: Adam More, UCI undergraduate

Up for Review

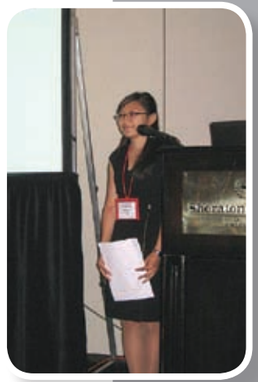
Calit2 directors and administrative staff spent a good deal of time last year documenting the 10 years of progress made since the institute's December 2000 creation and the path it will take going forward. The UC Office of the President requested a formal review of the institute, which included preparing a 300-plus page report documenting Calit2's successes in developing unique research opportunities, fostering collaborations and seeding innovation. The report not only qualitatively highlighted examples but quantified the institute's impact on California's economy, workforce development and technology transfer. In October, a six-member panel comprised of outside reviewers visited the Irvine and San Diego divisions. They spoke with campus senior administration, industry partners, and Calit2-affiliated faculty and students, who also provided lab demonstrations. In the end, the review team provided an assessment that included a list of findings and suggestions to better guide the future investment by UCOP and the two campuses.

A Powerful Advocate

Calit2's leadership in energy-efficiency innovation grabbed the attention of U.S. Sen. Dianne Feinstein when she visited Orange County in January. Director G.P. Li was among a campus delegation of researchers that participated in the OC Business Council Forum featuring the senior lawmaker from California. A member of the Senate Appropriations Committee, Feinstein chairs the subcommittee on energy and water. She learned more about UCI's efforts in these areas, particularly the institute's latest work on plug-load devices such as set-top boxes (see page 14). That topic is of considerable interest to Feinstein, who sent a letter last September to the CEOs of the country's largest cable and satellite providers calling for the phase-out of energy inefficient set-top boxes and digital video recorders. "These 'always on' boxes do not have meaningful standby or sleep modes and operate at near full power 24 hours a day, 365 days a year," Feinstein wrote.

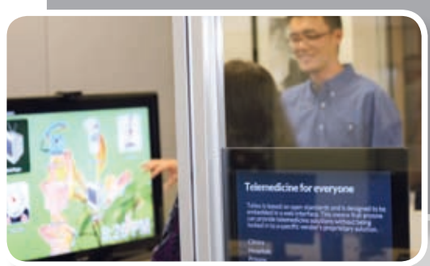
All Conference Honors

Seven students from Calit2's SHAPe lab in the eHealth Collaboratory presented their research at the International Association for Dance Medicine and Science annual conference last fall in Washington, D.C. The group was the largest U.S. student contingent to be invited to share their work. Among those participating were undergraduate biological sciences major Alison Ozaki, who delivered a talk about the pressure- and accelerometry-insole system for tap shoes she is developing, while graduate student Kumiyo Kai displayed her work in dance biomechanics, earning the Best of Session prize in the Educational Poster Category. The students are under the mentorship of Jeff Russell, assistant professor of dance science. "The real validation of the work my students have done is the large number of compliments I received from many IADMS attendees, including the organization's senior leaders. They were amazed by the level of research and academic professionalism."



Living Beyond Limits

Members of UCI's Chief Executive Roundtable were inspired by a guest speaker and impressed with innovative prototypes at Calit2. In February, the institute hosted the group's annual winter forum, which highlighted technology breakthroughs that impact healthcare delivery and improve patient outcomes. The evening started with a talk by Amy Purdy, a double amputee, competitive snowboarder and advocate for Freedom Innovations, an Irvine-based prosthetic manufacturer. A panel discussion with several campus medical research leaders followed, and then participants were invited to explore the building's third-floor eHealth Collaboratory, where more than a dozen projects were on display. "This was the first time for many of our members to visit Calit2," said Goran Matijasevic, director of the CEO Roundtable. "They were enthused by what they saw and some even expressed interest in bringing back a team from their company to explore further collaborative opportunities."



Enhanced Instrumentation

The first-floor Microscopy Center in the Calit2 Building continues to upgrade and expand its capabilities. Funded by the UCI Office of Research, the FEI Magellan 400 was installed in February. It is equipped with a magnetic immersion lens, and the latest backscatter and scanning transmission electron microscopy (STEM) detectors, as well as state-of-the-art spectroscopy and electron-beam lithography systems. "The Magellan is very powerful. It will enable users in physical sciences, engineering and biology to see, probe, and even make nanometer-scale features with unprecedented clarity and ease," explained Matt Law, the faculty lead for the center. Three new state-of-the-art tools, and a refurbished microscope from another campus location, have been added to the facility over the course of 16 months. The equipment is available to on- and off-campus researchers on a recharge basis. Visit *lexi.eng.uci.edu* for details.

Grabbing the Spotlight

Calit2 graduate researcher Nizan Friedman and his MusicGlove project were showcased on a new radio special that highlights science and technology. Spectrum radio *(http://spectrum.ieee.org/radio)* came to campus in January to learn more about the sensor-laden prototype being used by stroke patients to recover fine motor skills. Friedman has been using the MusicGlove in a clinical study that involved 12 patients over three months working with therapists at UCI's Gross Hall. As part of the radio feature, he introduced the reporter to an 18-year-old stroke patient participating in the study and his dad. "It really helped the reporter understand the real-life impact the glove is having on patients," explained Friedman. "In the beginning, this young man could hardly move his hand, but by the end of two weeks he had good thumb movement and some digit dexterity." The segment on the MusicGlove is part of an hour-long documentary on technology innovations impacting healthcare.

The Internet of Things

With Calit2 as a primary sponsor and venue, the IEEE International Conference on Service Oriented Computing & Applications (SOCA 2011) had a successful three-day run at UC Irvine. The conference provided an international forum for researchers from multiple disciplines to exchange and share their experiences, ideas and latest research results on all aspects of service-oriented computing. This year's program, which was chaired by UCI engineering professor Kwei-Jay Lin, included a dedicated industry track, as well as invited talks, technical paper presentations, tutorials, workshops and panel discussions. Each day's session began with a plenary talk featuring a distinguished speaker on topics related to cyber-physical systems and Internet of Things. "It was a productive conference with 140 papers presented during the week," said Lin. "The participant feedback has been very positive with strong technical presentations, friendly discussion and a great venue."

Putting Theory into Practice

The fifth in a series of startups has moved into Calit2's second-floor technology business incubator. Joining the TechPortal in January is Praxis Biosciences, which has several early-stage medical devices in the works, all of which are geared toward ear, nose and throat healthcare providers. The prototypes, based on research by several UCI clinicians, could put low-cost but highly-effective technology tools in the hands of practitioners and their patients. As the company's CTO, Joon Yu, who earned his Ph.D. in biomedical engineering from UCI, is refining the prototypes with SBIR funding before entering the proof-of-concept stage. One of the products – a simple sinus-screening tool for primary care use – will undergo clinical trials later this spring. "If you focus on the right market with the right product you can make it successful, you just have to be realistic about the returns," Yu added. "At the end of the day, you have to understand why you are doing this, why it should go to market … it's to really help the patients."

Collaborative Design

The second year of the Multidisciplinary Design Program (MDP) kicked off in March with 90 UCI undergraduates chosen to participate. The design program teams groups of students from different majors with faculty co-mentors from multiple departments, giving them an opportunity to see how multidisciplinary collaboration can lead to innovative results. "We want these students to leave their majors at the door and learn how to value every team member's skills and contributions," said Said Shokair, director of the Undergraduate Research Opportunities Program, which co-sponsors MDP. In the initial meeting, the participants took a tour of the MDP customized lab space on Calit2's second floor, which offers workspaces and technology-based tools for robust collaboration and interactions. The teams, spread over 23 projects, will present their progress in mid-May and again in June. Some projects will continue through the summer, while a new round of proposals will be selected next fall.

Calit2@UCI is a multidisciplinary research institute that develops information technology-based innovations. By integrating academic research with industry experience, the institute seeks to benefit society, incubate new technology companies and ignite economic development. Calit2 focuses on the digital transformation of healthcare, energy, the environment and culture.

University of California, Irvine
California Institute for Telecommunications and Information Technology
4100 Calit2 Building
Irvine, CA 92697-2800

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The data products at UCI's Center for Hydrometeorology and Remote Sensing (CHRS) are probably more striking than most. With support from the U.S. Army, NASA and UCI's Office of Research, the center recently purchased its own nine-panel Hiperwall to display visualizations of hydrologic information, including processed satellite precipitation in ultra-high resolution.

The CHRS team is developing new rainfall and hydrologic prediction tools, and director Soroosh Sorooshian (pictured, from left, with Kuolin Hsu and Jing Jing Li) says the Hiperwall enables more effective and precise examination of information, and faster experimentation with the huge data sets.

"As technology moves forward and earth science relies more on satellite data representing higher-resolution information at global scale, it's useful to be able to zoom in and see close-up the impacts on areas experiencing extreme events, such as floods, hurricanes and typhoons. As more data become available, the Hiperwall will allow us to better display it."

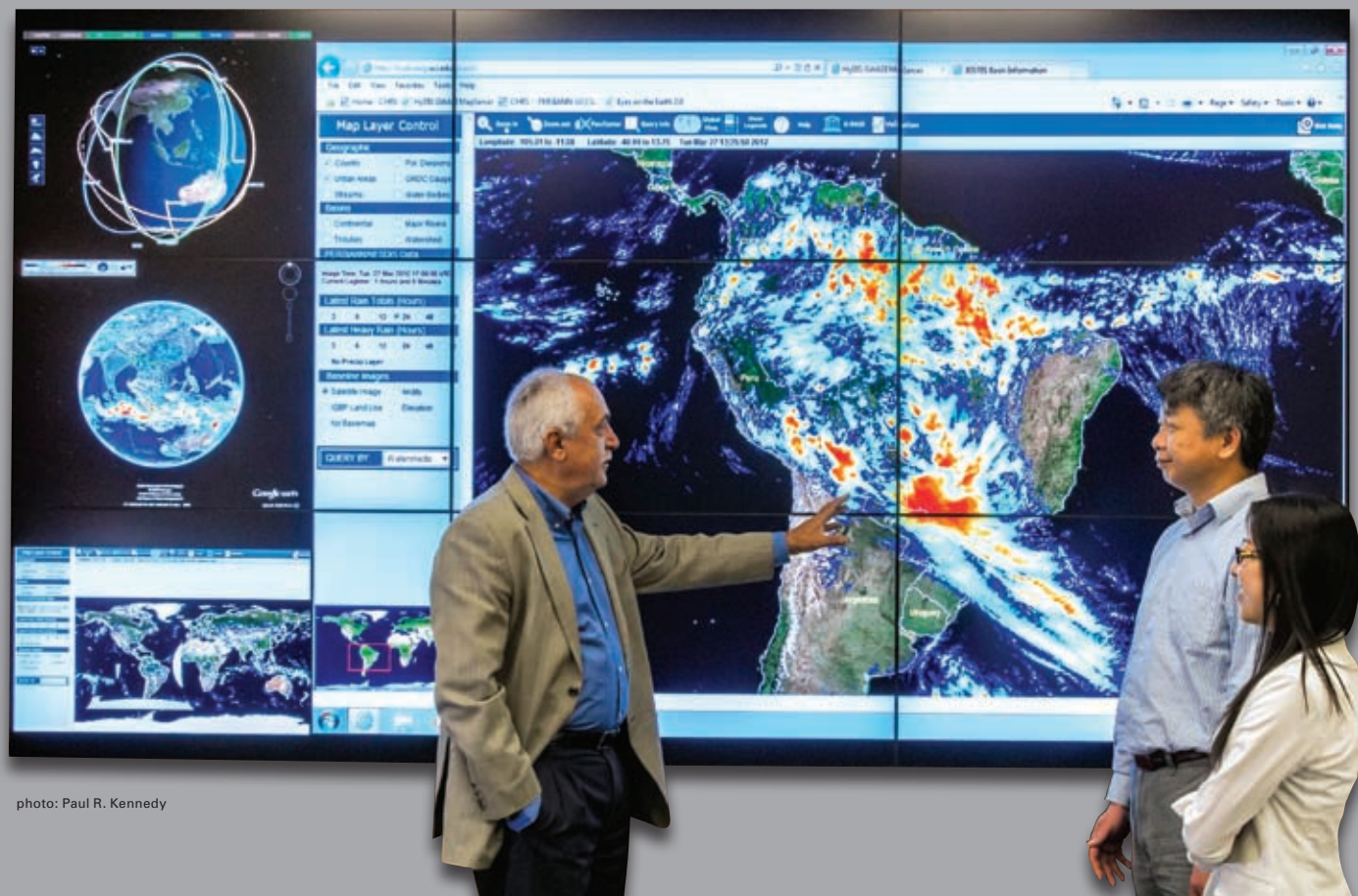

photo: Paul R. Kennedy