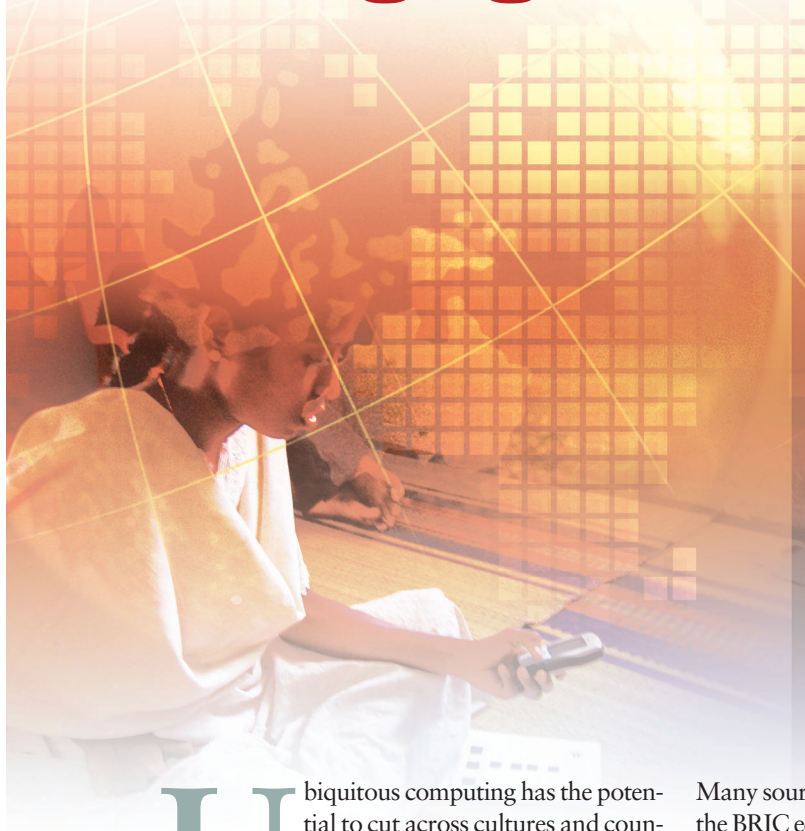


# Pervasive Computing for Emerging Economies



**U**biquitous computing has the potential to cut across cultures and countries, to be both locally valuable and globally pervasive. For our field to reach this potential, it's important for researchers to recognize the challenges, rewards, goals, and methods of developing these technologies—not just in wealthy IT-saturated environments, but in developing economies and regions as well.

For this reason, *IEEE Pervasive Computing's* editorial board was excited to issue a call for papers on pervasive computing technologies in emerging economies.

## Why now?

It seems the time has never been better to approach this topic. As I write this introduction, the front pages of *Newsweek* (6 Mar. 2006) and *The Economist* (25 Feb.–3 Mar. 2006) are about India's vigorous economic growth and its increasing cultural importance outside its own borders.

Many sources (including Goldman Sachs<sup>1</sup>) predict the BRIC economies (those of Brazil, Russia, India, and China) will surpass those of the G6 (economies with GDPs over US\$1 trillion—the US, Japan, the UK, Germany, France, and Italy) in the next 40 years. In just the next 10 years, China's gross domestic product is expected to surpass those of the UK, Germany, and Japan. While such predictions are always risky, nobody can doubt these countries' amazing economic growth. Over 125 Fortune 500 firms now have R&D sites in India,<sup>2</sup> indicating the growing global importance of the Indian economy.

The IT sector is no exception to this growth. For instance, Indian IT-related revenues increased 28 percent over the last year and could top US\$36 billion this year.<sup>2</sup> If Western researchers and developers don't learn about technology deployment in these emerging economies, they run the risk of their work being unusable by most people in the world.

## In this issue

Although the other guest editors—Tim Kind-

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berg, James Landay, Eric Brewer, and Anthony Joseph—and I knew this topic was important, we had no idea what to expect in response to our call for papers because this topic isn't the usual focus of most technology publications. So, we were gratified to receive some excellent submissions. We also received critical reviewing help from researchers working day-to-day on technologies for developing economies. This issue wouldn't have been possible without their efforts. I would also like to thank the other guest editors for their valuable help.

## Articles

After our extensive reviewing process, we bring you three articles. Ajay Gupta, Parthasarathy Ranganathan, Prashant Sarin, and Mehul Shah—researchers collaborating across Hewlett-Packard Labs in the US and India—wrote “IT Infrastructure in Emerging Markets: Arguing for an End-to-End Perspective.” This article describes the need to concentrate on infrastructure for developing regions and not just on the technology for end users, the frequent focus of ubiquitous computing research. Differences in the delivery fabric (for example, cable and wireless phone networks reach a far larger population in India than the Internet) and the need to support an enterprise backbone that can handle a potentially huge customer base require special concentration on infrastructure. One sidebar briefly describes the focus of some of the big research labs in India: IBM, Cisco, HP, Microsoft, and Motorola. Another describes the reverse migration of technologies designed for emerging economies back to developed economies.

“Understanding and Designing for Intermediated Information Tasks in India,” by Tapan S. Parikh from the University of Washington and Kaushik Ghosh of Human Factors International, discusses the importance of considering indirect technology use in developing

regions. Poor people with limited education and literacy in these regions often don't access computing devices directly. They're more likely to access information resources via a “proxy”—a user with the required access rights and skills. These multiuser interaction scenarios are more common in India than in the West and require different kinds of support than direct end-user scenarios.

In “The Challenges of Technology Research for Developing Regions,” University of California, Berkeley, researchers Eric Brewer, Michael Demmer, Melissa Ho, R.J. Honicky, Joyojeet Pal, Madelaine Plauché, and Sonesh Surana describe the lessons they learned in the course of field work in India, Ghana, and Cambodia. Researchers with no experience working in developing regions are likely to find these lessons important if they hope to extend their efforts to those locations.

## Interviews

I also had the great pleasure of interviewing two very different experts in this area: Raj Reddy of Carnegie Mellon University and Genevieve Bell of Intel. Reddy has had an illustrious career in computer science. He's an ACM Turing Award winner, was founding director of CMU's Robotics Institute, and was dean of CMU's School of Computer Science for eight years. When he returned to teaching, he decided he wanted to work on things that had an “impact on people.”<sup>3</sup> One of his many projects is the PCtvt, an information appliance that combines a personal computer, television, videophone, and telephone. Affordability is a major goal of the project, and the hope is to provide the device, content, and required infrastructure at a price acceptable to rural villages and families in developing regions. In his interview, he discusses proposed models for achieving affordable infrastructure and content, as well as the need to adapt

interfaces so they don't require literacy.

Bell is an ethnographer and director of User Experience in Intel's Digital Home Group who studies the use of technology by different groups of people. Her team consists of both social scientists and developers. She has spent several years doing field studies in many parts of the world, and her keynote address at MobiSys 2003 on mobile phones' different uses in parts of Asia caused a lot of excitement. In this interview, Bell describes how development teams can avoid making cultural mistakes with inventions and deployments. She also touches on different views of privacy in the world, the opportunities to create technology for emerging economies that are culturally or religiously based rather than region based, and the often-overlooked existence of emerging economies within the industrialized world.

Following this theme, this issue also includes a news brief by Benjamin Alfonsi, “Defining the Digital Divide,” that focuses on whether technology designed for developing regions can also be useful for economically disadvantaged regions within nations traditionally considered to have mature economies.

**T**his issue of *IEEE Pervasive Computing* manages only to scratch the surface of this exciting area—many topics are left unexplored and many questions left unanswered. For example, how do we identify the potential broader applications of technologies designed for specific regions or cultures? Will developed economies learn to make use of the innovations coming from new technology centers around the world? How can we attract more ethnographers to our cause? How well can we evaluate technology in the field to assess its level of harm or benefit? In five years, if we revisit the PCtvt and other current

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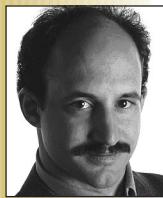
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efforts, what will we find? How well will the proposed infrastructure cost models work in developing economies?

Tremendous opportunities exist for pervasive computing technology all around the globe within many emerging economies and cultures. We hope this issue brings our field closer to meeting more of these opportunities. We look forward to a future where most development teams include not just technological expertise, but also cultural expertise, where designing technology for challenging environments is as well rewarded as design for expensive machine room environments, and where improving lives in globally and locally meaningful ways is a first-order goal for technologists. ■

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