

EECS 294-12 (3 units)
Fall 2003
AN INFORMATION AND COMMUNICATIONS TECHNOLOGY (ICT)
FRAMEWORK FOR DEVELOPING REGIONS

Description:

There are only 100 million people on this planet who have a purchasing power in excess of US\$20,000 per annum, while there are 4 billion people who earn US\$2,000 or less. How can we use information and communication technology most effectively to create opportunities for these people to improve the quality of their lives? How can we do this in a sustainable way, not simply as a charity? What are the technologies, architectures, and business models that can make this possible? And what applications must this infrastructure enable?

In this course we explore the key research and deployment issues for novel information and communication technologies (ICT) for developing regions of the world. The class will be co-taught at Berkeley, CMU and the University of Washington via Internet teleconferencing, and will include several guest lecturers from a wide variety of backgrounds. The class will require a final paper or a project but will not have a final exam and, while listed as an EECS course, is open to any Berkeley graduate or undergraduate students. We would especially like to include students from business, sociology, and the humanities who have an interest in the subject.

The course will address three principal questions, as follows:

- ❖ *Context:* What are the major economic and social challenges faced by developing countries?
- ❖ *Application:* What role could an effective ICT infrastructure play in addressing these challenges?
- ❖ *Technology:* What are the technologies, architectures, basic services and associated research needed to make such an ICT infrastructure affordable, useful, and economically viable?

Format

One meeting per week, with typical format of 1hr presentation and 1hr discussion in one of these three areas each week. Presentations will be made by participants and invited guests on selected topics in each area. Final grade will be determined by quality of class participation, selected homework assignments, and final project or research assignment. Reading assignments will be provided and participants will be expected to come to class prepared for discussion.

Instructors

Berkeley:

Professor Eric Brewer, Department of Electrical Engineering and Computer Sciences
Tom Kalil, Special Assistant to the Chancellor for Science and Technology, Berkeley
Professor Richard Newton, Dean of the College of Engineering

CMU:

Rahul Tongia, Institute For Software Research International
M. Bernardine Dias, Robotics Institute
Prof. Raj Reddy, Robotics Institute/Computer Science

Logistics

Meeting locations: Wednesday, 11am-1pm, 290 Hearst Mining Building
For more information contact Eric Brewer (brewer@cs.berkeley.edu) or see
<http://courseweb.berkeley.edu/courseweb/pub/courses/2003/FL/COMPSCI/294/012>

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Expanded Description

CONTEXT

We will consider two levels of context in this course—the macroscopic or global context for this issue, and the contextual issues related to a specific ICT deployment.

Global Context

What are the economic, political and social challenges faced by developing countries? A major goal in this aspect of the course is to familiarize course participants with the range of challenges and the key sociological factors involved in undertaking such research. Speakers will also familiarize participants with methodologies for understanding the diffusion and adoption of technology in a broader economic and social context. What are the range of economic and social conditions prevalent in developing conditions? What is it like to live on \$1-2/day? What are the different ways in which concepts like “development” and “sustainable development” have been defined? Why have some developing countries grown faster than others in the post-war period? We will also discuss the potential impact of ICT on the developing world and possible implications of such work—positive and negative! In fact, why are some observers skeptical about ICT for development?

Deployment Context

What are the elements of a successful national strategy to reap the benefits of ICT?

- ❖ Legal/policy regulatory framework
- ❖ Infrastructure
- ❖ Enterprise/private sector
- ❖ Human resources

What are different players (e.g. G-8, multilateral and bilateral development assistance agencies, developing country governments, NGOs) currently doing to take advantage of the promise of information technology?

APPLICATION

How could an affordable ICT infrastructure address these problems? What are the range of needs in such an infrastructure to be effective? What are key applications and their associated benefits and over what timeframes might they have measurable impact? What business models might “serve the poor profitably” in an ICT context? What strategies are being pursued by NGOs, social enterprises, and multinationals such as HP? How is ICT being used to address specific developing country challenges, or how might it be used in the future?

- ❖ ICT for economic growth, productivity, job creation, commerce, and income generation for the poor
- ❖ Knowledge and development
- ❖ E-health
- ❖ E-learning
- ❖ E-government, transition from authoritarian to more democratic society

What can the research community do to maximize the contribution that ICT can make to development? We will build a taxonomy of applications of interest and their characteristics and potential benefits, along with existing projects and their status in each area.

TECHNOLOGY

What are the appropriate technologies, system architectures, deployment and support strategies needed to implement effective solutions to the above (e.g. role of wireless, optical fiber, satellite, etc.) How can one build, deploy, and support such a system so that it can be a self-sustaining, profitable business? What new technologies (hardware, software, basic services) are needed to make such an enterprise viable? Which existing technologies are so cheap (as a result of economies of scale and learning economies) that they can be usefully adopted in a developing country context?

- ❖ Continuously versus occasionally connected network
- ❖ Where and how to maintain state in the system and its implications
- ❖ Implementation of a robust, 'fail safe' architecture under continuous challenges—from the elements (e.g. sand, unreliable power, monsoons, etc.) as well as a shortage of technically skilled workers.
- ❖ Delivery of voice versus data (versus both!)—what are the tradeoffs and most resilient approaches?
- ❖ Interaction of technology with business models (e.g. 'all at once' versus incremental deployment and its impact on approaches to financing).
- ❖ Role of ultra-low-cost hardware: displays, power supplies, other input/output options
- ❖ Importance of ultra-low-power technologies.
- ❖ Green approaches to ICT—what does that mean in this context?
- ❖ User interface for populations with low levels of literacy and multiple languages/dialects.
- ❖ Possible system-level impact of co-design of network infrastructure and client
- ❖ 'Ultra-privacy,' role of security, open source, and other deployment strategies
- ❖ User-driven innovation on the framework—to what extent can this be enabled in the architecture?

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APPROXIMATE SYLLABUS

Week 1: Introduction

- Objectives for the course.
- Economic and social conditions in developing countries – range between and within developing countries.
- Different definitions of “development”
- Overview of the challenges and opportunities
- Discussion of Millennium Development Goals

Week 2: The role of ICT in development

- Previous instances of developing and introducing new technologies (e.g. Green Revolution)
- What is it like to live on \$1-2/day?
- Why the growing interest in ICT for development?
- Current state of the debate. How important is IT?

Week 3: ICT for development – current activities

- An overview of “ICT for development” activities by different actors:
 - Int’l organizations (G-8, UN, World Bank)
 - Companies (e.g. HP)
 - NGOs and social enterprises (e.g. GrameenBank)
 - National governments
- National frameworks for “e-readiness” being adopted by developing countries to accelerate the adoption of ICT:
 - Infrastructure
 - Development of workforce with ICT-specific skills
 - Legal, regulatory and policy environment
 - Role of private sector
 - Applications
- Is it possible to “serve the poor profitably”? (Prahalad). Possible business models – shared access, micro-franchise, etc.

Week 4: Trends in information and communications technologies

Overview of price and performance in ICT “building blocks.”

- Semiconductors (memory and logic)
- Storage
- Development of low-cost single-chip platforms for the developing world.

- Wired and wireless networks (satellite, cellular, 802.11, 802.16)
- Displays

Possible unique requirements for developing country users:

- Low-cost
- Low-power
- Intermittent connectivity
- User interfaces for populations with multiple languages and low levels of literacy
- Shared access as a possibly dominant use mode
- Limited skilled workforce for maintenance

Week 5: Economic benefits of ICT:

- Income generation
- Job creation (e.g. outsourcing)
- Better functioning of markets, lowered costs of domestic and international economic transactions
- Economy-wide increases in productivity
- E-commerce
- Benefits for the poor?

Week 6: E-health, e-learning

- Public health applications
- Health information
- Tele-health

Week 7: E-government, E-democracy

- Can government work better and cost less?
- Reducing corruption and increasing transparency
- Use of ICT by civil society
- Government efforts in censorship and surveillance

Week 8: Energy and environment

Week 9: Technology-specific issues – networking/infrastructure

- Alternative network architectures
- Co-design of infrastructure and device – advantages for cost and functionality
- Intermittent connectivity
- Use of 802.11 in developing world – leapfrog opportunities?

Week 10: Technology-specific issues - devices

- Current approaches such as Simputer
- Low-cost single-chip platforms
- Novel, low-cost, low-power devices – how low can we go?

- Novel, low-cost displays

Week 11: Technology-specific issues – user interfaces

- Support for multiple languages
- Speech as interface
- Support for users with low-levels of literacy
- User interaction with sensor networks

Week 12: Cross-cutting issues

- Intellectual property
- Privacy
- Role of open source in developing countries
- Developing countries as producers as opposed to merely consumers of innovation

Week 13: Beyond ICT – other technology needs for developing countries:

- Water purification
- Affordable energy
- Low-cost diagnosis of infectious diseases
- Cook stoves

Week 14-15: Student presentations