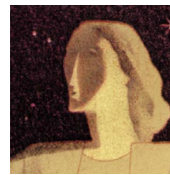


# MOBILE COMPUTING: Technologies for a Disconnected Society

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Three broad challenges  
face mobile computing  
today:  
reliable wireless  
communications,  
support for  
disconnected operation,  
and mobile applications  
development.



The term *mobile computing* is used to describe an array of technologies supporting personal mobility for computer users. Such mobility can take the form of users moving between fixed terminals anywhere in the world or users taking mobile devices with them wherever they move. In both cases, the user should have a consistent working environment with access to their usual files, email, and so on. Mobility should therefore support the seamless movement of people, data, and/or applications between different locations.

The technologies required are a combination of various communications media, data servers, and (possibly portable) computers. Fundamentally, mobile computing aims to provide a totally ubiquitous computing environment where people can work and play anywhere, and at anytime. The term “ubiquitous computing” is usually first attributed to Mark Weiser, a chief technologist at Xerox PARC. Weiser defined the term well in a description of the future and potential of mobile computing:

The technology of literacy when first invented, and for thousands of years afterwards, was expensive, tightly controlled, precious. Today it effortlessly, unobtrusively surrounds us. Look around now: how many objects and surfaces do you see with words on them? Computers in the workplace can be as effortless, and ubiquitous, as that. Long-term the PC and worksta-

tion will wither because computing access will be everywhere: in the walls, on wrists, and in “scrap computers” (like scrap paper) lying about to be grabbed as needed.

Although this vision of ubiquitous computing is not yet here, the requirements for mobility are. The most obvious case is the business user. Business requirements for up-to-date information are continuous, and workers on the road in particular are more and more demanding communications such as email and fax at all times. One conservative estimate of potential business users suggests that 20–40 million workers will require mobile computer access within five years.

A more compelling example of the motivation for using mobile devices is exemplified by the MediPad project at Purdue University. Providing medical staff with instant access to patient records, up to date medical information, and specialist medical staff irrespective of location could potentially save lives—surely a very strong motivation for mobility.

Medipad is a prototype telemedicine system implemented on a platform consisting of mobile hosts and a high-speed network facility connecting seven rural counties, Indiana University Medical Center, and Purdue. It is being tested in the context of the medical needs of these counties.

### TECHNICAL CHALLENGES

The challenges for mobile computing lie in three broad areas:

- providing reliable wireless communications services,
- building applications that deal with the arbitrary disconnected nature of mobility, and
- building applications that are not tied to fixed locations.

The articles in this issue have been collected to provide a snapshot of mobile computing technology today with respect to these challenges.

#### “Toward Ubiquitous Environments for Mobile Users”

Alan Dearle sets the scene for mobile computing by revisiting the notion of ubiquitous computing. Dearle characterizes mobility for users, views, and platforms, and examines strategies for overcoming the technical problems associated with environment and channel mobility, code and state migration, and locating views. This discussion is then given some context through the description of a set existing systems that provide some of the functionality described.

#### “Virtual Network Computing”

Tristan Richardson et al. look at how a software version of a network computer can be used to facilitate personal mobility. VNC provides access to a home computing environment from fixed and networked terminals anywhere in the world. The system provides a secure and transparent interface to

desktop computers, irrespective of whether they use Unix or MS-Windows, from workstations or Web browsers located anywhere in the building, company, or world.

#### “Dynamic Adaptation of Network Connections in Mobile Environments”

Jørgan S. Hansen et al. take a look at applications in general and describe how the possibility of disconnected operation affects their design and operation. They argue, quite correctly, that physical devices have progressed to the point where portable computing is practical, while applications lag behind. Support for mobile computing is poorly integrated in operating systems and network software. The authors describe the AMIGOS project, which addresses these issues, providing an environment where TCP/IP applications can be used unchanged in both connected and disconnected environments.

#### “UMTS: Fusion of Fixed and Mobile Computing”

Donal O’Mahony reports on a European standards effort to develop cellular systems that transmit both data and voice on a global basis—an important infrastructure requirement for disconnected mobile computing. The Universal Mobile Telecommunications Systems aims to integrate versions of today’s second generation digital cellular systems together with new terrestrial and satellite components. The article discusses the feature set of UMTS and its relationship to other standards activities such as GSM and IMT-2000.

#### “Mobile Networking Through Mobile IP”

Mobile IP is a standard proposed by the IETF (Internet Engineering Task Force) and designed to support mobile users via TCP/IP. Charles Perkins, editor of RFC-2002 on support for mobility in IP, presents a tutorial on Mobile IP, introducing one of the key technologies that will enable current machines to physically migrate between locations.

### TO CONNECT OR NOT

Collecting the articles for this issue has been a fascinating task. The wealth of activity and the technology challenges make the topic of mobile computing excellent and exciting reading. The promise of ubiquitous computing is not far from becoming reality, as the articles in this issue demonstrate.

So now we need to ask ourselves, do we really want a *connected* or do we want a *disconnected* society? ■

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**URLs for the Guest Editors' Intro**

- AMIGOS** • [www.econ.cbs.dk/people/birger/AMIGOS/](http://www.econ.cbs.dk/people/birger/AMIGOS/)
- IETF** • [www.ietf.org/](http://www.ietf.org/)
- MediPad** • [www.cs.purdue.edu/research/cse/mobile/medipad.html](http://www.cs.purdue.edu/research/cse/mobile/medipad.html)
- Mobile IP RFC 2002** • <ftp://ds.internic.net/rfc/rfc2002.txt>
- UMTS** • [www.umts-forum.org/](http://www.umts-forum.org/)
- VNC** • [www.orl.co.uk/vnc/](http://www.orl.co.uk/vnc/)
- Mark Weiser** • [www.ubiq.com/hypertext/weiser/UbiCompHotTopics.html](http://www.ubiq.com/hypertext/weiser/UbiCompHotTopics.html)

**Other sites of interest**

- Dataman Mobile Computing Laboratory, Rutgers University** • [www.cs.rutgers.edu/~badri/dataman](http://www.cs.rutgers.edu/~badri/dataman)
- Mobile Computing Laboratory, Columbia University** • [www.cs.columbia.edu/mcl/](http://www.cs.columbia.edu/mcl/)
- Sun's Solaris Mobile IP page** • [playground.sun.com/pub/mobile-ip/](http://playground.sun.com/pub/mobile-ip/)

**Also see the sidebar**

"Other Links on Mobile Computing," in *IC's Elsewhere* department, p. 16.

**COMING NEXT MONTH**

**The Evolving Architecture of the Internet**

**March / April 1998**

**Guest Editor:**  
**Miro Benda, The Boeing Company**

**CALLS FOR PAPERS**

**Software Engineering over the Internet**

**September / October 1998**

**Guest Editors:**

**Frank Maurer, University of Calgary**  
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Projects like the Apache server illustrate the potential for software engineering over the Internet. What are the requirements, tools, and techniques for the successful development and maintenance of software on the Internet? Topics of interest include:

- Web-based software process modeling environments
- distributed process enactment
- replication support for software documents
- knowledge management for SE projects

**Submission deadline: 12 March 1998**

**All submissions are peer reviewed.**  
**For complete instructions, see**  
<http://computer.org/internet/edguide.htm/>

**Internet Security in the Age of Mobile Code**

**November / December 1998**

**Guest Editors:**

**Gary McGraw, Reliable Software Technologies**  
[gem@rstcorp.com](mailto:gem@rstcorp.com)  
**Edward W. Felten, Princeton University**  
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The very concept of executable content involves fetching and running data from untrusted sites. This issue will be devoted to security implications of mobile code. We are particularly interested in discussing topics like:

- Code signing technologies, including models for permissions, capabilities, and principals
- Proof-carrying code and security policy resolution
- Implications of existing protocols
- Design of secure interfaces

**Submission deadline: 12 May 1998**

