

Preface

*"...a billion people interacting with a million e-businesses
with a trillion intelligent devices interconnected ..."
(Lou Gerstner, IBM Chairman and CEO)*

Information is the nucleus of today's interconnected economy. We need to be able to exchange and retrieve our personal information quickly, efficiently, and securely, at any time and regardless of our current physical location. Electronic storage, transmission, and access of information are common tasks we rely and trust on.

*Information
everywhere*

Convenient applications for helping users manage information in daily life and business environments will be an essential growth factor in tomorrow's IT industry. Such applications will integrate software, hardware, infrastructure, and especially services and will focus on the needs and convenience of their potential users. Those who provide these applications will be able to offer added value, allowing them to differentiate themselves from their competitors. Traditional off-the-shelf software and even hardware will serve only as enabling components for these integrated solutions. These components will be standardized and exchangeable.

"Everywhere at anytime" ...

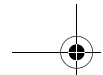
*Pervasive
Computing*

This common slogan expresses in a nutshell the goal of *Pervasive* or *Ubiquitous Computing*. Both terms describe the visible and mobile front-end for the next generation of integrated IT applications. Pervasive Computing includes flexible and mobile devices like personal digital assistants, mobile phones, pagers, hand-held organizers, and home entertainment systems, which will access or provide a rich diversity of applications. As part of our daily life, these intelligent devices will offer an emerging number of private and professional transactions. They connect to worldwide networks without boundaries and provide quick and secure access to a wealth of information and services.

The early pilot applications of Pervasive Computing seem to originate from the pages of a science-fiction novel:

*A new era of
applications*

A supermarket chain equips its customers with free mobile devices accompanied by an application for placing online orders. A salesman for agriculture seeds accesses, from a remote farm, his company's order systems via a wireless network. Theatergoers pay for their ticket using a mobile WAP phone. In a networked home equipped with intelligent appliances, the microwave and the air-condition are controlled through the Internet using a common browser.



*Integration
behind the
scenes*

Nevertheless, Pervasive Computing is far more than just plugging in new incredible devices for multiple purposes. Behind the scenes, an increasing number of these new devices must be integrated into the IT organization. Device management as well as application management are two issues back-end systems have to deal with. Gateways, application servers, and communication networks are just some of the components used for building Pervasive Computing solutions. Small footprint clients for common systems, like databases or web servers, have to be supplied for numerous platforms.

Services

Besides making the systems ready for Pervasive Computing, the service infrastructure has to be extended. Internet Service Providers must be prepared to react to a rapidly growing demand for network access by everyone. GSM has turned out to be the dominant wireless network for communicating anywhere, making it the first choice for accessing Pervasive Computing applications from any point. Upcoming Internet portals will act as an “anytime available” intermediary between users and providers offering payment facilities, shopping opportunities, or information access. Nevertheless, even more complex services, like a public key infrastructure adding enhanced security and privacy to transactions, are beginning to be established.

*Common
standards*

To make all these things work together seamlessly, the industry is currently agreeing upon the required standards. SyncML is one promising approach for ensuring the possibility to synchronize all kind of data on different devices. XML is definitely the basis for standardized data exchange.

About This Book

Technology

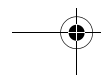
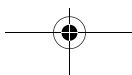
This book explains the fascinating variety of front-end devices for ubiquitous information access and their operating systems. It also covers the powerful back-end systems, which integrate the Pervasive Computing components into a seamless IT world. Fundamental topics include such commonly used terms as XML, WAP, transcoding, cryptography, and Java, just to mention a few. Another focus is set on the evolving industry standards, like SyncML, WAP, on which these new technologies are based.

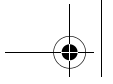
Development

The book presents an overview of the different development strategies and tools for different Pervasive Computing platforms. In order to ease the planning and development of new solutions, concepts and considerations are explained specific to a variety of different target environments, such as handheld computers, home networks, smart phones, and others.

Business

Finally, this book has a strong emphasis on the business aspects, such as the new generation of services, delivering added value to a growing number of customers. E-Business, private home, finance, or travel will not be the only industries which will change their face entirely due to a new class of mobile computing devices, making the customer omnipresent.





We try to give an impression of what Pervasive Computing is about and how it differs from conventional computing. We avoid losing ourselves in details, but provide a way through the jungle of terms, concepts, standards, and solutions instead. The major goal of this book is to put the various facets of Pervasive Computing together to a consistent and comprehensive view.

*A red line through
the jungle*

The Audience of This Book

Giving a comprehensive and profound overview of Pervasive Computing makes this book very valuable for a wide audience of readers. Following the main thread of this book, they will find an easy and quick entry to the related topics.

Business managers will learn what impact Pervasive Computing has on economy and society. The knowledge about Pervasive Computing paradigms, new business models, and a new generation of applications will affect their work as well as their decisions. They will see where Pervasive Computing can help businesses to offer new services and new products or how to improve existing businesses to reach a new range of customers. This book gives an overview about the broad range of possible as well as already existing solutions in the field of Pervasive Computing.

*Business
Managers*

Those software architects and project managers who extend their e-business activities to a new front-end will read about which components pervasive solutions are made of and how these building blocks are related with each other. This book gives an overview of state-of-the-art pervasive technology and shows which components are available as well as how they fit together to build a complete solution.

*Software
Architects and
Project
Managers*

Application developers getting involved with a particular segment of Pervasive Computing will find a high-level but profound introduction leveraging the start before digging into mazes of programmer guides. They will learn how to rapidly enable applications for the use of pervasive devices. They will also learn some typical patterns of Pervasive Computing and how to trade off various desirable properties in making design decisions. Typical development processes and tools are described.

*Application
developers*

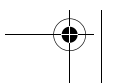
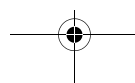
No Need to Read the Whole Book

Most of us no longer have the time to read a book cover to cover. Therefore, we have broken this book into chunks that may be read in almost any sequence:

- “Introduction”,
- “Part I, Devices”,
- “Part II, Software”,
- “Part III, Connecting the World”,

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- “Part IV, Back-end Server Infrastructure”,
- “Part V, New Services”, and
- “Part VI, Appendices”

At the end of each chapter, you will find a list of interesting links and suggestions for further reading.

Introduction

We set the stage by providing an overview of Pervasive Computing in general.

Chapter 1 **What Pervasive Computing is all about**

We describe the evolution from conventional computing via e-business to Pervasive Computing. We explain the paradigms and principles of Pervasive Computing, like decentralization, diversification, connectivity, and simplicity.

Part I **Devices**

In this part, we cover the most commonly used pervasive devices, like handheld computers, smart phones, telematics, smart cards, and many more. We describe their characteristics from a user’s perspective, explain the areas of usage, their basic applications, their look-and-feel and everything else you need to know to get a good understanding of these devices. This part groups the vast mass of devices into four categories, which are described in more detail within the different chapters.

Chapter 2 **Information Access Devices**

The first category covers handheld computers and smart phones, which are primarily used to access and communicate information. They are currently the most important group of Internet connected devices beside the traditional PC.

Chapter 3 **Smart Identification**

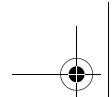
The second category comprises tiny labels and smart cards, which offer a huge possibility for identifying objects electronically in pervasive applications.

Chapter 4 **Embedded Controls**

This category shows how everyday devices, such as controls, refrigerators, or vending machines can provide additional services and applications while connected to a network. Another section describes the automobile as a versatile pervasive device.

Chapter 5 **Entertainment Systems**

Finally, the fourth category covers devices, which provide manifold sort of entertainment, such as game consoles and interactive television. For these devices analysts predict a promising future.



Software

In this part, we cover the most commonly used software components needed to build pervasive applications, like, Java, operating systems, middleware, and security building blocks. We also show which components are necessary to develop applications for these operating systems and how to start doing this.

Part II

Java

Chapter 6

Java is used in almost every area of Pervasive Computing, in some of the devices as well as in the server back-end infrastructure. The different flavors of Java, especially the ones for Pervasive Computing, are covered and explained here.

Operating Systems

Chapter 7

There is a wide variety of different operating systems used in the field of Pervasive Computing. In this chapter, we cover the most-widely used ones in handheld devices: Palm OS and Windows CE, as well as EPOC, which is used within phones and smart card operating systems like Java Card. We describe the architecture and list the necessary tools to start developing for the respective platforms. This chapter also contains small sample programs for most of these operating systems.

Middleware Components

Chapter 8

Basic plumbing or middleware is necessary to leverage application programming for the devices themselves. Developing on top of common components helps to achieve independence from a particular Pervasive Computing device used by the customer. Middleware components are used to integrate the clients to their backend servers. We describe an exemplary selection of widely used components, like DB2 Everyplace, WebSphere MQ Everywhere, the JavaTV and JavaPhone APIs, as well as OpenCard Framework and PC/SC.

Security

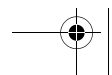
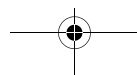
Chapter 9

Security is an extremely important part of every mobile e-commerce solution. We explain the background of security and the cryptographic techniques used to secure Pervasive Computing and give an overview of the different standards, algorithms, and protocols used.

Connecting the World

Part III

Pervasive Computing and the different devices get really powerful if they are integrated with each other and the back-end infrastructure to form powerful solutions. This Part covers the important industry standards and technologies that provide connectivity and enable communication.



Chapter 10 Internet Protocols and Formats

As Pervasive Computing is somehow an extension of the Internet, most of the protocols and formats you might already know from the Internet are also used here. This chapter introduces HTTP, HTML, XML, XSL, XHTML, and XForms for those of you who are not yet familiar with these standards.

Chapter 11 Mobile Internet

The Wireless Application Protocol (WAP) and i-mode are today's standards for enabling wireless information devices and especially mobile phones to send and receive information and HTML-like pages in an efficient and performant way. We introduce you to the secrets of WAP as well as i-mode and describe to you the most important facts that you need to know.

Chapter 12 Voice

Ease of use is a very important factor in making pervasive computing application a success and voice is the natural way to communicate. In this chapter we introduce what is currently possible and what is underway.

Chapter 13 Web Services

An enormous amount of information is available on the Internet and web services provide a uniform and easy way to access this information for an application. In this chapter we introduce web services to you, show the benefits as well as the limit, and look into one specific example: a web service for remote portals.

Chapter 14 Connectivity

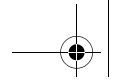
We cover the different protocols used to connect traditional and Pervasive Computing devices. We explain the background of wired networks, infrared communications, Bluetooth, Wireless LAN as well as cellular and short-range radio wireless connections.

Chapter 15 Service Discovery

With a set of distributed Pervasive Computing devices offering different services to each other, a mechanism for service lookup and discovery is needed for an easy and automatic configuration of this complex environment. We explain the three mechanisms Jini, uPnP, and Salutation.

Part IV Back-end Server Infrastructure

Behind the scenes, the server systems need to be prepared for Pervasive Computing and its requirements, which differ significantly from the needs of today's PC-focused networks. We discuss the applied technologies and concepts.



Gateways

Chapter 16

Gateways are intelligent interceptors between servers and specific classes of devices. We show how they can be used to prepare data and to establish own sub-nets, for example the wireless network of a particular service provider.

Application Servers

Chapter 17

In most cases, Pervasive Computing devices are used to interact with data residing on back-end servers. This chapter describes the different additional jobs a back-end server has to do for Pervasive Computing front-ends. Load balancing, servlets, and Enterprise Java Beans are among the captions of this chapter.

Portals

Chapter 18

Portals are the central points of access to services in a connected world. A portal must be very attractive, interactive, complete, and easy to use to make the customer come back. In this chapter we describe functionality that is common to most portals and explain some exciting examples.

Device Management

Chapter 19

This chapter deals with managing the incredible amount of devices and applications that are deployed in the field. Examined aspects include customer profiles, accounting, and billing. Another topic is the management of device capabilities and life cycles. And of course, the distribution and maintenance of applications are an important issue covered within this chapter.

Synchronization

Chapter 20

Keeping data consistent on the server and on various mobile devices requires intelligent synchronization mechanisms. Aspects of synchronization are detailed within this chapter.

New Services

Part V

Pervasive Computing offers a vast amount of new possibilities to create services, streamline processes and to start new businesses. The following chapters provide an overview on these areas, which are the most likely ones to boom first. They describe some of the most known Pervasive Computing solutions, which are in use by the customers today already.

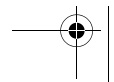
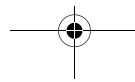
Home Services

Chapter 21

Today a Personal Computer is the only computer that a user directly interacts with at home. We explain how Pervasive Computing offers a huge potential for new and additional services at home, like intelligent appliances, home automation, remote home health care, energy services, new communication services, and many more.

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Chapter 22 **Travel & Business Services**

A person who is traveling is mobile per se. Offering to a traveler the services he normally uses from his office and additional ones that ease his travel, like checking-in from a mobile phone at an airport, are some examples. Pervasive Computing can also make the daily life in the office easier. This chapter describes the new service opportunities that service provides in these areas face.

Chapter 23 **Consumer Services**

This chapter describes the new services that businesses will offer to consumers, like offering the possibility to shop using mobile devices, or ordering stocks and checking the balance of a checking account from the road. In this chapter, we will explain what is available today and what will come in the near future.

About the Authors

Uwe Hansmann is currently release manager for WebSphere Portal – Express. He was the Secretary of the Open Services Gateway Initiative and a Board member of the OpenCard Consortium. Uwe received a Master of Science from the University of Applied Studies of Stuttgart in 1993 and an MBA from the University of Hagen in 1998. He joined IBM in 1993 as software developer and led the technical marketing support team for IBM Digital Library before joining IBM's Pervasive Computing Division in 1998. Since then he has managed various pervasive computing development projects for IBM.

Uwe is also the co-author of Smart Card Application Development Using Java, as well as SyncML – Synchronizing and Managing Your Mobile Data.

Scott Nicklous currently manages the WebSphere Portal and Pervasive Computing Solutions department at the IBM development laboratory in Böblingen, Germany. He joined IBM in 1984 as software development engineer at the IBM Böblingen lab. While at IBM, Scott has been involved as developer and team leader in numerous projects, mainly in the financial sector, including banking machine and image processing system development. He joined IBM Smart Card Solutions in 1997 to lead the OpenCard Framework development team. Later, he worked as development manager for the IBM WebSphere Portal product. He has been responsible for bridging the gap between development and customer organizations for Pervasive Computing technology products since 2002.

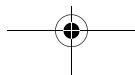
Lothar Merk is working for the IBM Data Management Division as team leader of a Data Management Infrastructure team. He joined IBM in 1995. While at IBM, Lothar has been involved in numerous service and development projects, mainly in the system integration area. Before joining IBM, Lothar worked in a Medical Imaging and System Integration Project for the European Union.

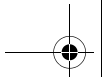


Lothar holds a Master's degree in Computing Science and Theoretical Medicine from the University of Heidelberg/Germany, a Master's degree of Artificial Intelligence from the University of Chambéry/France, and a PhD in Computing Science from the University of Tuebingen/Germany.

Thomas Stober received a masters degree from the University of Karlsruhe and a Ph.D. from the University of Stuttgart, Germany. After 5 years of research at the Fraunhofer-Institute IPA, where he focused on mobile computing, and information logistics, he joined IBM's Pervasive Computing Division in 1998. As a technical leader and architect, Thomas developed smart card technology, data synchronization solutions, and was a member of several related standardization activities. In the past 2 years he worked for the Lotus development team in Westford, Massachusetts. As software architect he pursued the extension of Lotus Notes and Domino to mobile devices. He was a key player in the development of the Websphere Everyplace Access Server. Thomas filed several patents and wrote numerous publications.

The authors can be reached at pvcbook@web.de .



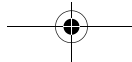
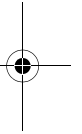
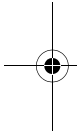


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The Mobile World

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