

Wolfgang Rankl • Wolfgang Effing

# Smart Card Handbook

Third Edition

 WILEY

**DOCKET**  
**A L A R M**

Find authenticated court documents without watermarks at [docketalarm.com](http://docketalarm.com).

First published under the title *Handbuch der Chipkarten* by Carl Hanser Verlag  
© Carl Hanser Verlag, Munich/FRG, 2002

All rights reserved.

Authorized translation from the 4th edition in the original German language  
published by Carl Hanser Verlag, Munich/FRG.

Copyright © 2003 John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester  
West Sussex, PO19 8SQ, England

National 01243 779777

International (+44) 1243 779777

Email (for orders and customer service enquiries): [cs-books@wiley.co.uk](mailto:cs-books@wiley.co.uk)

Visit our Home Page on [www.wileyurope.com](http://www.wileyurope.com) or [www.wiley.com](http://www.wiley.com)

Reprinted March 2006

All Rights Reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, mechanical, photocopying, recording, scanning or otherwise, except under the terms of the Copyright, Designs and Patents Act 1988 or under the terms of a licence issued by the Copyright Licensing Agency Ltd, 90 Tottenham Court Road, London W1T 4LP, UK, without the permission in writing of the Publisher. Requests to the Publisher should be addressed to the Permissions Department,

John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex PO19 8SQ, England, or emailed to [permreq@wiley.co.uk](mailto:permreq@wiley.co.uk), or faxed to (+44) 1243 770571.

This publication is designed to provide accurate and authoritative information in regard to the subject matter covered. It is sold on the understanding that the Publisher is not engaged in rendering professional services. If professional advice or other expert assistance is required, the services of a competent professional should be sought.

#### *Other Wiley Editorial Offices*

John Wiley & Sons Inc., 111 River Street, Hoboken, NJ 07030, USA

Jossey-Bass, 989 Market Street, San Francisco, CA 94103-1741, USA

Wiley-VCH Verlag GmbH, Boschstr. 12, D-69469 Weinheim, Germany

John Wiley & Sons Australia Ltd, 33 Park Road, Milton, Queensland 4064, Australia

John Wiley & Sons (Asia) Pte Ltd, 2 Clementi Loop #02-01, Jin Xing Distripark, Singapore 129809

John Wiley & Sons Canada Ltd, 22 Worcester Road, Etobicoke, Ontario, Canada M9W 1L1

Wiley also publishes its books in a variety of electronic formats. Some content that appears in print may not be available in electronic books.

#### *Library of Congress Cataloging-in-Publication Data*

Rankl, W. (Wolfgang)

[Handbuch der Chipkarten. English]

Smart card handbook / Wolfgang Rankl and Wolfgang Effing. -- 3rd ed.

p. cm.

Includes bibliographical references and index.

ISBN 0-470-85668-8 (alk. paper)

I. Smart cards--Handbooks, manuals, etc. I. Effing, W. (Wolfgang) II. Title.

TK7895.S62R3613 2003

006 - dc22

2003062750

#### *British Library Cataloguing in Publication Data*

A catalogue record for this book is available from the British Library

ISBN-10: 0-470-85668-8 (H/B)

ISBN-13: 978-0-470-85668-0 (H/B)

Typeset in 10/12pt Times by TechBooks, New Delhi, India

Printed and bound in Great Britain by Antony Rowe Ltd, Chippenham Wiltshire

This book is printed on acid-free paper responsibly manufactured from sustainable forestry in which at least two trees are planted for each one used for paper production.

## Preface to the Third Edition

The English version of the *Smart Card Handbook* has now reached its third edition. In comparison with the previous edition, it has been considerably expanded and thoroughly updated to represent the current state of the technology. In this book, we attempt to cover all aspects of smart card technology, with the term 'technology' intentionally being understood in a very broad sense.

As in previous editions, we have remained true to our motto, 'better one sentence too many than one word too few'. We have described this ever-expanding subject in as much detail as possible. Even more examples, drawings and photographs have been added to make it easier to understand complicated relationships. The glossary has been enlarged to include many new terms covering all essential concepts related to smart cards, and it has been enhanced with cross-references. In many cases, it can provide a quick introduction to a particular subject. Altogether, these additions, extensions and improvements have resulted in a book that is more than three times as large as the first edition.

Here we can make a small comparison. Modern smart card operating systems currently comprise 120,000 lines of source code, which roughly corresponds to two books the size of the present edition. Even if you are not familiar with programming, you can readily appreciate how sophisticated these operating systems have become.

These small, colorful plastic cards with their semiconductor chips continue to spread from their original countries, Germany and France, throughout the world. In the coming years, this technology can be expected to outstrip all others, especially since it is still in its infancy and there is no end or consolidation in sight.

Smart card technology progresses in leaps and bounds, and we attempt to keep pace by publishing a new edition of the *Smart Card Handbook* every two to three years. The *Smart Card Handbook* represents the present state of technical knowledge, and in areas that are presently undergoing rapid change, we indicate possible paths of evolution. If certain things come to be seen differently at a later date, we can only remark that no one knows what the future will bring. Despite this, or perhaps just because of this, we welcome all comments, suggestions and proposed improvements, so that this book can continue to cover the subject of smart cards as completely as possible. Here we would like to explicitly thank the many attentive and interested readers who have pointed out unclear or ambiguous passages and errors. Once again, an errata list for this edition will be made available at [www.wiley.co.uk/commstech/](http://www.wiley.co.uk/commstech/).

We would also like to thank our many friends and colleagues who have repeatedly offered valuable (and occasionally somewhat uncomfortable) suggestions for making this book better

---

and more complete. We would particularly like to thank Hermann Altschäfl, Peter van Elst, Klaus Finkenzeller, Thomas Graßl, Michael Schnellinger, Harald Vater and Dieter Weiß, as well as Kathryn Sharples at Wiley for her helpful support and Kenneth Cox for the translation.

Munich, June 2002

**Wolfgang Rankl**

[Rankl@gmx.net], [www.wiley.co.uk/commstech/]

**Wolfgang Effing**

[WEffing@gmx.net]

# 1

## Introduction

This book has been written for students, engineers and technically minded persons who want to learn more about smart cards. It attempts to cover this broad topic as completely as possible, in order to provide the reader with a general understanding of the fundamentals and the current state of the technology.

We have put great emphasis on a practical approach. The wealth of pictures, tables and references to real applications is intended to help the reader become familiar with the subject rather more quickly than would be possible with a strictly technical presentation. This book is thus intended to be useful in practice, rather than technically complete. For this reason, descriptions have been kept as concrete as possible. In places where we were faced with a choice between technical accuracy and ease of understanding, we have tried to strike a happy medium. Whenever this proved to be impossible, we have always given preference to ease of understanding.

The book has been written so that it can be read in the usual way, from front to back. We have tried to avoid forward references as much as possible. The designs of the individual chapters, in terms of structure and content, allow them to be read individually without any loss of understanding. The comprehensive index and the glossary allow this book to be used as a reference work. If you want to know more about a specific topic, the references in the text and the annotated directory of standards will help you find the relevant documents.

Unfortunately, a large number of abbreviations have become established in smart card technology, as in so many other areas of technology and everyday life. This makes it particularly difficult for newcomers to become familiar with the subject. We have tried to minimize the use of these cryptic and frequently illogical abbreviations. Nevertheless, we have often had to choose a middle way between internationally accepted smart card terminology used by specialists and common terms more easily understood by laypersons. If we have not always succeeded, the extensive list of abbreviations at the front of the book should at least help overcome any barriers to understanding, which we hope will be short-lived. An extensive glossary in the final chapter of the book explains the most important technical concepts and supplements the list of abbreviations.

An important feature of smart cards is that their properties are strongly based on international standards. This is fundamentally important with regard to the usually compulsory need for interoperability. Unfortunately, these standards are often difficult to understand, and in

# Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

## Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

## Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

## Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

## API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

## LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

## FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

## E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.