



# Programming Smart Cards

## Part 2:

PC/SC Specifications

Open Card Framework

Java Smart Card I/O API

Sample codes in:

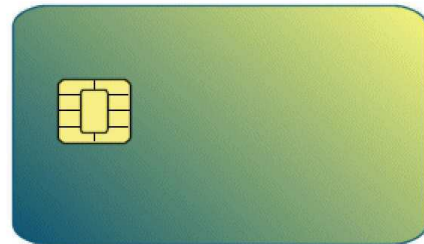
C/C++

C#

VB.NET

VB 6

Java



Ugo Chirico

Ugo Chirico

# Programming Smart Cards

## Part 2

**PC/SC Specifications**

**Open Card Framework**

**Java Smart Card I/O API**

**Programming Smart Cards is:**

- **C/C++**
- **VB 6**
- **C#**
- **VB.NET**
- **Java**

Copyright © 2003-2009 by Ugo Chirico – <http://www.ugosweb.com> – All rights reserved

No part of the contents of this book may be reproduced or transmitted in any form without the written permission of the author.

All product and company names mentioned herein may be the trademarks of their respective owners.

### **The Author**



Ugo Chirico is graduate with a Master Degree in Physics and Cybernetics at University of Naples "Federico II" and currently is the Director of Mobile Development of KeyVision (<http://www.key-vision.com>) and is the owner of Cryptware (<http://www.cryptware.it>).

He wrote numerous articles on several technical magazines such as "Computer Programming" and "Dev" and he is an expert in software designing and development in C/C++, C#, VB, Java, Prolog e LISP on .NET platform, Win32, Linux, Symbian, Windows Mobile, iPhone and BlackBerry and embedded systems. It is also passionate in Artificial

Intelligence. His personal web site is: <http://www.ugochirico.com>

Introduction	4
1 PC/SC Specifications	5
1.1 Integrated Circuit Card	5
1.2 The InterFace Device	6
1.3 The InterFace Device Handler	6
1.4 The Resource Manager	6
1.5 The Service Provider	6
2 The Resource Manager service	7
2.1 Windows	7
2.2 Linux/Unix	7
3 The Resource Manager API	8
3.1 Importing API functions	9
3.2 Connecting to Resource Manager	9
3.3 List of Known Smart Card Readers	9
3.4 Connecting to the smart card	10
3.5 APDU Submission	10
3.6 Reading a PIN-protected File	12
3.7 Tips	15
3.8 Exercises using the emulator	15
4 The Service Provider	16
4.1 Reading an Elementary File	16
4.2 Connecting to the smart card	17
4.3 Verifying the PIN	17
4.4 Reading an Elementary File	18
4.5 Writing on an Elementary File	18
4.6 Closing the connection	19
4.7 Error handling	19
4.8 The SCardAuth Object	20
5 .NET Smart Card API	21
5.1 Sending an APDU to the Smart Card	22
5.1.1 C#	22
5.1.2 VB.NET	23
5.2 Using .NET Smart Card API with virtual smart card emulator	24
6 OpenCard Framework	25
6.1 OpenCard Framework Architecture	25
6.1.1 CardTerminal	26
6.1.2 CardService	27
6.1.3 CardTerminal Events	27
6.2 Programming in Java	27
6.2.1 Installing and configuring OCF	28
6.2.2 Sending Command APDU Sample Application	28
7 Java Smart Card I/O API	35
7.1 Sending Command APDU Sample Application	36
Appendix A: ISO 7816 error codes	38
Bibliography	39
Web References	39

## Introduction

ISO 7816 specifications define the way to communicate with the smart card specifying in a formal and strict way all commands involved in interfacing a smart card. The proposed programming interface, which deals with hexadecimal commands, is however placed at a very low-level of abstraction. Also, ISO 7816 specifications don't provide any indications on interoperability between different vendors smart card readers, while all commands have to be sent to the smart card through a specific driver provided with the reader (on which applications rely on, evidently). To solve interoperability issue three programming models and APIs has been defined: PC/SC, Open Card Framework and, more recently, Java Smart Card I/O API.

A group of vendors such as Microsoft, Siemens, Hewlett Packard and a few other, proposed PC/SC specifications, nowadays became a *de-facto* standard, defining hardware and software architecture of a computing system resolving all issues related to interoperability amongst different model of readers and offering a highly abstracted programming interface.

PC/SC specifications hide the operating logic of particular smart card and smart card reader offering a unique consistent programming *framework*.

PC/SC specifications defines a set of API that allows to communicate with smart cards. Such API has been implemented in Windows Operation System and on Linux/Unix based Operating Systems and can be used for programming smart cards in C/C++, Visual Basic 6, C# and VB.NET.

In parallel to PC/SC specifications, *OpenCard Framework* (OCF) was developed as a joint initiative by IBM, Netscape, Sun and NCI which later also joined Siemens, Gemplus, Schlumberger, Bull, Visa and some other firms and proposed a generic object model, aimed to develop smart card-based applications.

OCF proposes a model that hides the complex operational logic of smart cards and reader terminals, offering a unified Java programming framework mapping low-level smart card's and reader terminal's native functionalities into a set of high-level abstracted Java classes.

Unlike PC/SC standard, specifically designed for Windows and Linux/Unix platforms, OCF has been designed to operate also with ATM, POS, embedded and handheld devices.

More recently, starting from the version 6.0 of JDK a new package has been introduced in the JDK to manage smart cards using Java programming language: Java Smart Card I/O API.

In this chapter we will describe the main features of PC/SC specifications highlighting specifically some architectural components such as the *Resource Manager* and the *Service Provider* showing how to send command to a smart card via PC/SC API in C/C++, VB6, C# and VB.NET, we will introduce all peculiar features of OCF and Java Smart Card I/O API showing how to program smart cards using Java..