Symbian OS C++ for Mobile Phones

Richard Harrison

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Published by John Wiley & Sons Ltd,
The Atrium, Southern Gate, Chichester,
West Sussex PO19 8SQ, England

National 01243 779777
International (+44) 1243 779777

e-mail (for orders and customer service enquiries): cs-books@wiley.co.uk
Visit our Home Page on http://www.wileyeurope.com or http://www.wiley.com

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Library of Congress Cataloging-in-Publication Data

(to follow)

British Library Cataloguing in Publication Data

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

ISBN 0-470-85611-4

Typeset in 10/12pt Optima by Laserwords Private Limited, Chennai, India
Printed and bound in Great Britain by Biddles Ltd, Guildford and King's Lynn
This book is printed on acid-free paper responsibly manufactured from sustainable forestry, for which at least two trees are planted for each one used for paper production.

CONTENTS

About this book

Symbian OS C++ for Mobile Phones draws on the experience of Symbian's own engineers to provide a thorough grounding in writing C++ applications for Symbian OS phones. It won't teach you *everything* you need to know about developing Symbian OS applications – no single book could do that. However, it will take you a long way along the road to being an effective Symbian OS developer and give you a deep understanding of the fundamental principles upon which Symbian OS is based. The text is complemented by a specially developed suite of examples.

The book is organized into four sections, each of which starts with a chapter that describes a working example application, followed by chapters that expand on some of the issues raised by the example. The advantage of this approach is that, at all times, you can see where you are going and have a working example to refer to.

– **Section one** (Chapters 1 to 3) provides a general introduction to Symbian OS. In addition to explaining the main development tools, it introduces you to the overall system structure and the way that Symbian OS uses object orientation and C++.

– **Section two** (Chapters 4 to 8) explains the basic classes, resources, APIs, and programming idioms that you need to create a simple GUI (graphical user interface) application.

– **Section three** (Chapters 9 to 15) is about writing non-trivial standalone applications. It starts by taking a deep look at the effective use of the graphics and file APIs before moving on to the extremely practical topics of packaging applications for delivery to the end user and ensuring that your application code is as device-independent as possible.

– **Section four** (Chapters 16 to 20) treats the related topics of system programming, communications and event-handling that, together, allow you to develop sophisticated and responsive applications for Symbian OS phones.

Symbian OS is used in a variety of phones with widely differing screen sizes. Some have full alphanumeric keyboards, some have touch-sensitive screens, and some have neither. In order to enable this kind of variation, a range of user interface designs is required. As far as possible, the material in this book is independent of any particular user interface. However, real applications run on real phones so, where necessary, we have chosen to take the user interface known as UIQ and the Sony Ericsson P800 phone as concrete examples. Where we need to refer to a specific compilation tool, we use the Metrowerks C++ compiler and the Metrowerks CodeWarrior IDE.

Symbian OS C++ for Mobile Phones complements Symbian OS software development kits. When you've put this book down, the UIQ SDK will be your first resource for reference information on the central Symbian OS APIs that we cover here. For more specialized and up-to-date information relating to a specific mobile phone, you will probably need to refer to a phone-specific SDK, available from the relevant manufacturer.

The SDKs contain valuable guide material, examples, and source code, which together add up to an essential developer resource. We've pointed to these where they tie in with the book content. But as a general rule, look in the SDK anyway: you'll usually find additional information that explains things further than we could in this one book.

Who Is This Book For?

If you've programmed, at any level, in C++, it's for you. As a real and comprehensive system written in C++ from the ground up and targeted at the high-growth area where computers and mobile communications converge, Symbian OS gives you unparalleled opportunities in mass-market, enterprise, and system programming.

Besides C++ programmers, this book is interesting to other audiences:

- any other programmer or manager looking to exploit the potential of mobile solutions with Symbian OS technology
- consultants, trainers, and authors who think of basing their activity on Symbian OS technology
- anyone with an interest in system design, since Symbian OS is a full and interesting example in its own right

Conventions

To help you get the most from the text and keep track of what's happening, we've used a number of conventions throughout the book.

These boxes hold important, not-to-be forgotten information that is directly relevant to the surrounding text.

This style is used for asides to the current discussion.

We use several different fonts in the text of this book:

When we refer to words you use in your code, such as variables, classes and functions, or refer to the name of a file, we use this style: `iEikonEnv`, `ConstructL()`, or `e32base.h`

URLs are written like this: ***www.symbian.com/developer***

And when we list code, or the contents of files, we use the following convention:

```
Lines that show concepts directly related to the surrounding
text are shown on a gray background
```

But lines that do not introduce anything new, or that we have seen before, are shown on a white background.

We show commands typed at the command line like this:

```
abld build winscw udeb
```

Foreword

David Wood, Executive Vice President, Partnering, Symbian

It has been my pleasure to have personally coached several hundreds of developers over the years in the art of Symbian OS C++. From this experience, I know that learning Symbian OS C++ can be something of a roller-coaster ride.

Symbian OS is a deep and subtle software system. Its designers have kept several demanding principles carefully in mind over many operating system iterations: the software should be long-lived, flexible, customizable, robust, high-performance, efficient, communications-centric, and future-proof. These goals have been admirably fulfilled. Witness the ever-increasing number of state-of-the-art mobile phones that take advantage of the rich benefits of Symbian OS. Witness also the rush of innovative applications, tools, and services that independent companies are bringing to the market, adding to the appeal of the Symbian OS phones that run them.

C++ is the native programming language for Symbian OS. It exposes the full power of the operating system to software developers. Unsurprisingly, this degree of depth and subtlety poses challenges to first-time Symbian OS developers, who often need to unlearn various programming idioms from other software contexts. The Symbian OS architecture is sophisticated and makes broad use of advanced features of C++ and object-oriented design. There's lots to savor and lots to ponder.

The book you now hold in your hand is packed with practical guidance to ease software developers up the Symbian OS learning curve. It contains insights and advice from many seasoned in-house Symbian engineers. Like Symbian OS itself, it's the outcome of a very substantial collaborative effort. Also like Symbian OS, it builds productively on the work of previous versions – specifically, the book *Professional Symbian Programming* published in February 2000. The benefits that readers can gain from *Symbian OS C++ for Mobile Phones* have their roots in the intense hard work of that pioneering writing team.

Simply better phones

The nature of the mobile phone market has changed. Sales are being driven by innovative new features combining voice, data, imaging and new wireless communication technologies such as wireless packet data and Bluetooth. Symbian OS provides both the technologies needed for this new market phase and the flexibility that enables mobile phone manufacturers to sustain innovation in their phone designs, which meet the needs of their many and varied customers.

Symbian OS C++ for Mobile Phones will help you understand the fundamental concepts behind programming in C++ for Symbian OS phones. Mobile phone manufacturers licensing Symbian OS have the advantage of being able to customize their products while maintaining interoperability between their own designs and those of their competitors, growing the entire wireless economy. Understanding the technologies that are common to Symbian OS phones will allow you to target phones from different manufacturers, regardless of the version of the operating system or the form factor of the phone. This introduction gives you a brief overview of the Symbian OS economy and explains how this book will benefit you.

Symbian, which formed in June 1998, is the result of an unprecedented level of collaboration in the wireless industry. It is owned by the industry, for the industry, and counts among its shareholders Ericsson, Nokia, Matsushita (Panasonic), Motorola, Psion, Siemens, and Sony Ericsson. All major mobile phone manufacturers now license Symbian OS for smartphone development.

Symbian develops Symbian OS – the open, industry standard operating system for mobile phones. This advanced operating system is the foundation of a generation of mobile phones that are evolving new ways to communicate, play, and work while on the move. With tightly integrated personal information management and rich communications capabilities, Symbian OS is an opportunity for software developers to deliver feature-rich applications and services to mobile phone users that number in the millions.

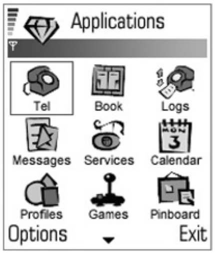
Symbian OS phones

Symbian OS C++ for Mobile Phones focuses on C++ programming and, specifically, on the core C++ APIs and programming patterns used on all Symbian OS phone designs and in Symbian OS itself. Its purpose is to equip you for programming in any Symbian OS environment – whatever the tool product and whatever the user interface, even in contexts such as developing low-level technology components, where there is no user interface at all. You can use what you learn here for application programming, although you'll also want to consult other works on user interface design and the specifics of the user interface you're targeting. You can practise what you learn here with whichever tool product you use, though you'll want to consult the tool's documentation for features unique to that product.

At the time of publication, Symbian OS phones on the market are based on three user interfaces open to C++ programmers – Nokia Series 80 Platform (Nokia 9200 Series Communicator), Nokia Series 60 Platform (Nokia 7650, Nokia 3650, N-Gage and Siemens SX-1), and UIQ (Sony Ericsson P800). All these designs and also Symbian OS phones from Japanese manufacturers are open to Java programming. Tooling available to C++ programmers includes CodeWarrior for Symbian OS from Metrowerks, C++Builder Mobile Set from Borland, and, on a legacy basis, Visual Studio from Microsoft. Borland and Metrowerks are adding unique value in terms of integrated development environments, ease-of-use, debugging, and support of Symbian OS features.

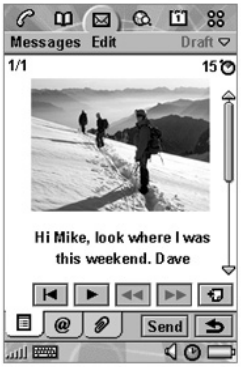
Mobile phones with a numeric keypad:

These phones are designed for one-handed use and require a flexible UI that is simple to navigate with a joystick, softkeys, jogdial, or any combination of these. The best current example of this form factor is the Series 60 Platform, which is the basis of the Nokia 7650, Nokia 3650, and Nokia N-Gage. Series 60 is also licensed to Panasonic, Samsung, Sendo, and Siemens.



Mobile phones with touch screens:

These mobile phones tend to have larger screens than the first category of phone and can dispense with a numeric keypad altogether. A larger screen is ideal for viewing content, working on the move and pen-based interaction and gives new opportunities to users and developers. The best current example of this form factor is UIQ, which is the platform for the Sony Ericsson P800. The P800 actually combines elements of full-screen access and more traditional mobile phone use by including a detachable numeric keypad.

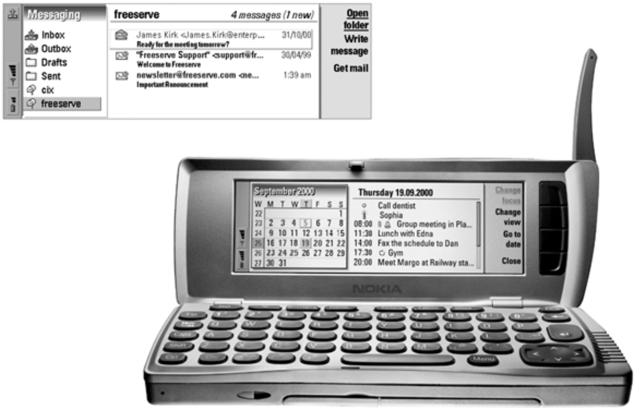


Hi Mike, look where I was this weekend. Dave

Mobile phones with a full keyboard:

These mobile phones have the largest screens of all Symbian OS phones and can have a full keyboard and could also include a touch screen. With this type of mobile phone, developers may find enterprise applications particularly attractive. A current example of this form factor is the Series 80 Platform from Nokia. This UI is the basis of the Nokia 9200 Series, which has been used in the Nokia 9210 and Nokia 9210i.

To make this book as practical to use as possible, we've chosen to demonstrate the core Symbian OS APIs and programming patterns through a consistent development environment throughout the book. We chose the UIQ user interface, the Sony Ericsson P800 phone, and



freeserve 4 messages (1 new)

James Kirk <James.Kirk@enterp... 31/10/00
Ready for the meeting tomorrow?
"Freeserve Support" <support@fr... 30/04/99
Welcome to Freeserve
newsletter@freeserve.com <ne... 1:39 am
Important Renouncement

Thursday 19.09.2000
Call dentist
Sophia
08:00 Group meeting in Pla...
11:30 Lunch with Edna
14:00 Fax the schedule to Dan
17:30 Gym
20:00 Meet Margo at Railway sta...

Metrowerks CodeWarrior for Symbian OS tools. However, Symbian is equally committed to all its customers and all its tools partners, and this is not an application-programming book. So, on the one hand, we don't cover real-world UIQ application programming, we don't go into too many specifics of the CodeWarrior tooling, and if you don't have a P800 phone, you can still build and test almost all examples on the UIQ emulator. On the other hand, we mention specifics of Nokia Series 80 or Series 60, where these would motivate the use of core Symbian OS APIs or programming patterns that are less relevant for UIQ, and we cover all available tools in the appendix.

When you're ready to use the Symbian OS programming skills that you've learned in this book, you'll want an up-to-the-minute picture of available phones, user interfaces, and tools. For the latest information, access ***www.symbian.com/developer***, which gives to pointers to partner websites. If you're developing technology that could be used on any Symbian OS phone, you can find more information about partnering with Symbian at ***www.symbian.com/community***.

We wish you an enjoyable experience programming with Symbian OS and lots of commercial success.

This book includes a 30-day Evaluation Edition of Codewarrior Development Studio for Symbian OS Personal Edition, v2, featuring:

- **UIQ SDK for Symbian OS v7.0 Sony Ericsson P800 smartphone**
- **Windows x86 emulation debugging support**
- **Symbian descriptor presentation in debugger**
- **Updated Symbian OS build components, including AIF, resource compiler, bitmap compiler, and .sis file compiler.**

About the Authors

Richard Harrison, Lead Author

Richard has spent the majority of his time at Symbian in system integration, building up and leading the SI team. He joined Psion in 1983 after several years, teaching maths, physics and computer science. During that time he wrote a Forth language implementation for Acorn Computers and accompanying user manuals for the Acorn Atom and BBC Micro.

During his career he has produced user software documentation for the Sinclair QL and Psion's PC application software. Other assignments include coauthoring of the Organiser II spreadsheet, being the principal designer and author of the Psion Series 3 and 3a word processors, and the lead author of the Psion Sibo SDK team. He has also written system software for the Psion Organiser I, and developed the source code translator for the original version of OPL.

Educated at Balliol College, Oxford with an MA in Natural Science (Physics), Richard also gained an MSc in Astronomy from Sussex University, and spent a further two years of postgraduate research in the Astronomy Group at Imperial College.

Alan Robinson

Alan Robinson joined Symbian shortly after its formation in 1998 and has mostly worked on documentation and examples in messaging and communications. A key contributor to this book, Alan is an accomplished author, and has previously contributed to *Wireless Java for Symbian Devices* (Wiley, 2001).

A graduate of Cambridge University with a BA in literature and philosophy, he became interested in applying logical theory and took a Computing MSc at Middlesex University. He has worked on developer kits for a start-up company's messaging middleware platform, and for IBM's MQSeries.

Arwel Hughes

Arwel joined Psion in 1993, working on documentation for the Series 3a and also some software development. Since the formation of Symbian, he has contributed documentation and examples for Symbian OS. This is rather like painting the famous Forth Bridge: just when you think you can see the end...

Arwel previously worked on IBM mainframes in roles including programmer and systems programmer for a number of companies including GKN, Prudential Assurance, Shell and Chase Manhattan Bank (now renamed to J P Morgan Chase). He has a BSc in Applied Mathematics from Sheffield University.

Carol Holmes

Carol first joined Psion as a graduate software engineer in 1987 with a BSc in Maths. She was part of the original development team for the Series 3 product family, joining the company as it pioneered the use of object-oriented software development. She spent several years working for a management consultancy on large development projects, before happily returning to Psion, to work on the email software for the Series 3a.

Carol went on to lead the team that developed the messaging software for the Psion Series 5. Since then, Carol has led other large development groups in Symbian, but now works from home doing analysis and research on Symbian's development processes and their improvement. She has a reputation for being very organized, enjoys making things (from cards to quilts), and her favorite color is purple.

Colin Anthony

Since joining Symbian, Colin has worked with the systems integration team on various releases of connectivity software and most recently as a developer consultant assisting Symbian partners.

Colin began his career as an apprentice electronics engineer with an international medical company. He worked with the production engineering team (amongst others) on new production systems for medical equipment. During this time he became involved in the deployment of a new IT infrastructure in the company. This gave him new direction in software engineering and the idea of going back into education, where he graduated from Southampton University with a BSc in Computer Science.

Outside of work there's nothing he enjoys more than getting away from the distractions of London by doing a spot of rock climbing, scuba diving and snowboarding.

Dan Daly

In his time in developer relations at Symbian, Dan Daly has provided technical consultancy to the third party community on all areas of

Symbian OS. Recently, Dan joined the Partner Projects Group, which provides support and bespoke development to partners and advice and support for technical issues.

Dan worked for several years for GEC Marconi Defence Systems Division, now known as BAE Systems, developing Aircraft Flight analysis and replay software, before joining Symbian in July 2000. He has a BSc (Hons) degree in Software Engineering from the University of Westminster.

Dr David Cunado

David joined Symbian's browsing team in 1999. After working on the web browser he moved on to the WAP browser, both of which were released on the Nokia 9210. Since then he has been working on the Symbian OS transport framework. This includes enabling it to support WSP, receive HTTP requests and send pipelined HTTP requests.

David previously took part in biometrics research at Southampton University, investigating person recognition by gait, using a new feature extraction technique called the Velocity Hough Transform. The work produced several publications, including collaboration in the book Biometrics: *Personal identification in networked society* by A Jain. R Bolle and S Pankanti.

Dominic Pinkman

Dominic joined Psion in October 1995 as a technical author, remaining with the company as it evolved into Psion Software and then Symbian. He has worked on writing and maintaining the documentation for APIs throughout Symbian OS, in particular those in the application engines, base, application frameworks and graphics subsystems.

He has an MSc Computer Science from the University of Kent and a BA Modern Language studies from Leicester University. His interests include indoor hockey and playing the mandolin.

Elisabeth Måwe

Elisabeth joined the system documentation team in 2000 and has since been involved in designing and writing the Symbian Developer Library, specializing in operating system customization, kits and build tools.

Elisabeth has a BA (Hons) in Technical Communication/Information Design from Mälardalens Högskola and Coventry University, as well as an MA in Contemporary English Language and Linguistics from Reading University. After graduating in 1996 she worked as a technical author, information designer and web editor for various IT companies in the UK, producing documentation for both network management and market research software.

Ian Bunning

Ian joined Symbian after graduating from the University of Cambridge in 2001. He is now an engineer on the Personal Area Networking team, dealing primarily with infrared and OBEX, but also with USB and Bluetooth development.

While at University, Ian held the post of Director of Production at *The Cambridge Student*- the Student Union's weekly newspaper. He assisted two editorial teams by ensuring that their articles had pictures and reached the printers. He also acted as an interview photographer – his subjects included John Madden, Gail Porter and Big Brother's 'Nasty' Nick Bateman. Outside of Symbian, Ian is a keen photographer and occasional jeweler.

Ian McDowall

Ian joined Symbian in 2000 and is currently a technology architect responsible for connectivity. He has filled roles ranging from developer, through project manager to technical manager by way of quality manager and process consultant (including presentations at international conferences).

He has an MA in Computer Sciences from Cambridge University and an MBA from Warwick University. As a software engineer for over twenty years he has been with a number of software companies and has worked on more than fifteen operating systems, developing software ranging from enterprise systems to embedded software. He is married to Lorraine and they have two children, Ross and Kelly, and a number of pets.

John Crickett

John is an experienced independent software developer, specializing in object-oriented software engineering. He is a member of the British Standards Institute C++ Language Panel, and regularly writes articles on software development with C++ and Java for the Association of C and C++ Users magazines. He can be contacted through his website ***www.crickett.co.uk***.

John Davis

John has worked for Symbian for six months. He has written many in-house guides for leading edge C++-based applications and has eight years industrial experience, where he began as a C programmer writing communications packages.

Educated in Dublin and Aberystwyth, he enjoys travel and has published many travel articles on the web. You can find his archives at ***www.heldencrow.com***.

John McAleely

John works in the partner projects group at Symbian, providing technical support to key partners as they prepare products for Symbian OS. Recent partner development projects include audio engine development, ports of Symbian OS to new hardware platforms and delivering technical training material to developers around the world.

John has worked for Symbian since 2000, and previously worked on DVD software for PCs while writing programs for Psion computers in his spare time. He has a Master's degree in Software Engineering from Imperial College.

John Pagonis

John joined Symbian in 1998, where he worked on the development of the Ericsson R380 smartphone before joining the personal area networking team, which implemented Bluetooth for Symbian OS.

These days, John works in the emerging technologies and telephony group. John is also on an academic quest as part-time PhD student, focusing on the issue of information overload. Other interests include computer and wireless personal area networks, software agents, software engineering, organizational process patterns, object technology, wearable and wireless information devices, resource-constrained systems and user interfaces.

John graduated from the University of Essex with a BEng in Computers and Networks and an MSc in Computers and Information Networks. A part-time martial artist, open source and freeware advocate, John believes it is better that certain things are kept unread.

Laura McLeod

Laura joined Symbian in 2001 as a technical author. She has written a range of reference documentation for the Symbian Developer Library, including for Versit (an application engine) and the file system. Before joining Symbian, she was a technical author in C++ software development, and also worked in customization of financial middleware software.

Malcolm Box

Malcolm joined the Symbian base team in 1998. After working on the kernel for the Ericsson R380 smartphone, he moved over into the personal area networks team. He was the technical architect and lead for the Symbian OS Bluetooth stack, which shipped in the Nokia 7650 and Sony Ericsson P800. Recently he has been working in Japan, leading a system architecture group. Now in the UK, Malcolm is involved with product development with Symbian's Japanese licensees. Malcolm has a MEng degree in Microelectronics and Software Engineering from Newcastle University. He started his career at Nortel, where he designed VLSI circuits for ATM and exchange equipment.

Outside work, Malcolm maintains the LXR code cross-referencer project and contributes to other freeware. An adventure sports enthusiast, Malcolm is learning to white-water kayak, which involves a lot of time swimming in cold rivers. Thanks are due to David Amos and Tim Ocock for their help in reviewing and Andrew Thoelke for the server startup code. He also thanks his family for putting up with him spending weekends writing rather than with them.

Nao Kagabu

Nao joined the research group at Symbian Japan in December 2000. After working on several research projects, he was transferred to Symbian UK. Since then he has been providing technical support to key partners, integrating their technologies into Symbian OS. Recently, he joined to the Partner Projects Group.

Nao previously worked on GPS car navigation for six years and has a Master's degree in Software Engineering from Toyohashi University of Technology, Japan.

Acknowledgements

Eagle-eyed readers will observe that *Symbian OS C++ for Mobile Phones* resembles one of its predecessors, *Professional Symbian Programming*, published in February 2000. Symbian OS has evolved a great deal since *Professional Symbian Programming* was written, but the previous publication served as an excellent framework for the new book. Therefore, the current authors owe a debt of gratitude to the original writers – lead author Martin Tasker and his team. Thanks also to the Laughing Gravy for providing vital fuel to us all. Cover design by Jonathan Tastard.