Games on Symbian OS

A Handbook for Mobile Development

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John Wiley & Sons, Ltd

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

Telephone (+44) 1243 779777

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

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, 42 McDougall Street, 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, 6045 Freemont Blvd, Mississauga, Ontario, L5R 4J3, Canada

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

British Library Cataloguing in Publication Data

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

ISBN: 978-0-470-99804-5

Typeset in 10/12pt Optima by Laserwords Private Limited, Chennai, India
Printed and bound in Great Britain by Bell & Bain, Glasgow
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.

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Foreword

Tim Closs, Chief Technology Officer, Ideaworks3D Ltd

The mobile phone is not primarily a platform for playing games, and Symbian OS is not primarily a platform for writing games. So why are you here, at the opening pages of a book devoted to the subject of mobile games on Symbian OS?

I don't have to tell you about the revolution that has happened (and is still happening) in mobile phone hardware. Phones today are unrecognizable from the cumbersome black boxes we see in 1980's video clips, proudly displayed as fashion accessories by loud-mouthed stockbrokers. One mobile phone manufacturer today describes their flagship range as 'multimedia computers' – and we can see why. High resolution, sharp and brightly-lit screens, many megabytes of memory, fast processors, and even hardware graphics acceleration, these all add up to a very powerful piece of computing hardware. Whilst it may be true that voice communication and text messaging are still the most popular services, phones are increasingly being relied upon for email, web browsing, and entertainment such as music, video, mobile TV, and games.

Network operators derive revenue by encouraging users to download content to their phone. Until recently, the primary drivers for these revenues were 'wallpapers' (images displayed on the phone's front screen) and ringtones. However, as this book will explain, over the last year many operators have seen game revenues overtake other content types. This is due partly to the increase in the quality and variety of games on offer, but also to the improved user experience offered by operators to consumers when searching for and choosing to download a game.

Symbian OS is the leading smartphone operating system in the world today, occupying over 90 % of the European market, large swathes of the

Asian markets and elsewhere. In addition, Symbian OS has evolved over many, many years and is arguably a more mature and well-understood platform than many of its competitors. As such, Symbian OS is an excellent choice for mobile games developers looking to develop expertise and deploy to a wide consumer base.

Ideaworks3D is a leading developer of advanced mobile games and enabling technologies for cross-platform mobile game development. Our BAFTA award-winning studio collaborates with the industry's leading mobile and video game publishers to mobilize their flagship game franchises, including ***Final Fantasy VII*** (Square Enix), ***Need for Speed***™ and ***The Sims 2***™ ***Mobile*** (EA Mobile). We also innovate to create original games for handheld and mobile platforms, including such games as ***System Rush***™: ***Evolution*** (Nokia). We have been developing games for Symbian OS since 2002. We were heavily involved in the launch of Nokia's N-Gage game decks (a handset designed specifically for playing mobile games, based on Symbian OS 6.1) in 2003. We are now equally involved in the next generation of N-Gage, as a platform that allows high-quality games on many of Nokia's flagship smartphones. We have also deployed games to all of the open native operating systems in the world today. As such, we believe we have some valuable insights into mobile game development on all platforms, including Symbian OS. We have passed on some of our experience within this book.

Our excitement for mobile games remains undimmed, and we believe the future for the industry is brighter than ever.

Foreword

Antony Edwards, VP Developer Product Marketing, Symbian Ltd

Game development has always been at the bleeding edge of technology. In 1984, when IBM first tried to enter the personal computer market with the IBM PCjr, they ensured Sierra On-Line's ***King's Quest*** was there for the launch. Game consoles were the first multi-processor computers to make it into most people's lives, and game developers have used the connectivity provided by the Internet to revolutionize their games more than any other software genre. We've seen ***NetHack*** on more prototype operating systems than we can remember. And, though it's not talked about, I'm sure that there was a game hidden away in the accumulators of the ENIAC somewhere. . .

Mobile devices present the next great adventure for game developers. Mobile devices are always connected, always at hand, and often include features such as location-based services and a camera, which provide a canvas for game developers to create the most engaging experiences yet.

This book is dedicated to helping game developers create and define this new genre of mobile games on Symbian smartphones. Symbian OS is the world's most popular smartphone operating system, having shipped in over 145 million devices across 120 models. Symbian licenses Symbian OS to the world's leading handset manufacturers and works closely with all leading companies across the mobile industry to help create new and compelling mobile experiences.

Symbian has been an innovator in multimedia and graphics since the beginning. Symbian OS was the first smartphone OS to support OpenGL ES for mobile 3D graphics in 2004. We recently announced a major new graphics architecture that supports OpenVG, OpenGL ES 2.0, and OpenWF Composition API. Symbian OS v9.5 is set to deliver higher performance and richer graphics. What will developers do with all our

new technology? We're not entirely sure, but we *are* sure it's going to be exciting. That's the great part of being the world's leading mobile operating system.

Symbian is also making it easier to port existing games to our smartphone platforms. The P.I.P.S. and Open C initiatives for POSIX-compliant C/C++ development, support for standards such as OpenGL ES, and our open platform for middleware solutions all make Symbian OS flexible for professional developers to migrate games to our smartphones. What better demonstration of this could there be than Olli Hinkka's open source port of ***Quake*** for S60 3rd Edition Feature Pack 1 smartphones, which uses the P.I.P.S. libraries to recreate that pre-eminent shoot 'em up in all its gory glory?

The authors bring a wealth of experience from both the game industry and Symbian OS development to this book. Whether you are new to writing mobile games, or are already an experienced game developer, you will find it invaluable. It covers Symbian OS game development using C, C++, Java ME, DoJa, and Flash Lite. We hope it will spark your imagination to create games for our next generation of smartphones.

About this Book

This book forms part of the Symbian Press Technology series. It describes the key aspects of the mobile game market, with particular emphasis on creating games for smartphones based on Symbian OS v9.x.

What Is Covered?

This book divides into four parts. The first part introduces the world of mobile games. It aims to explain what mobile games are, who plays them, who writes and sells them, how they sell them and what the major issues are in the marketplace. We'll look at some statistics for the sales of mobile games and mobile phones, and make comparisons with game consoles, handheld systems and PC games. The first chapter is not technical and is suitable for anyone interested in finding out more about the mobile games industry. However, there is an excursion into the differences between BREW, Java ME and native C++ games, a brief foray into issues of compatibility and portability, and a short introduction to some of the aspects of game development that characterize any mobile platform. So there's something for developers too: topics are introduced gradually, with signposts directing readers where to go for more information within the rest of the book – and beyond.

The second part of the book covers various technical areas associated with creating games in C++ on Symbian OS v9 smartphones (using the native APIs provided by UIQ 3 or S60 3rd Edition SDKs). Chapter 2 covers the basics of writing a game in Symbian C++, Chapter 3 delves deep into the Symbian OS graphics architecture, Chapter 4 deals with adding audio to games, and Chapter 5 discusses the issues associated with creating a multiplayer game. The final chapter in this part of the book is Chapter 6,

which discusses how to be innovative and create novel and appealing gameplay by using phone functionality, such as motion detection, the camera, the vibra or location-based services.

The third part of the book is for game developers who are interested in porting games without using just the native Symbian OS C++ APIs. Chapter 7 discusses the various standards support available on Symbian OS, such as POSIX-compliant standard C libraries, OpenKODE and OpenGL ES. Chapter 8 describes the Nokia N-Gage platform, which is Nokia's initiative to bring high quality games to S60 3rd Edition smartphones by providing a platform for professional game developers to port their game code using standard C and C++. N-Gage is more than an SDK and comprises an end-to-end solution for users to discover, play, and share games, and in Chapter 8, we'll discuss how developers work with Nokia to achieve this.

The final part of the book is for developers who want to write games for Symbian smartphones without using C or C++ at all. Chapter 9 describes the support available for Java ME on Symbian OS, and walks through an example game. The same author then explores the DoJa standards available for creating Java games for installation to Symbian smartphones in Japan, where the majority of phones are supplied by NTT DoCoMo and a different set of rules for application creation and distribution apply. The last chapter of this section, and the book, describes game creation using Flash Lite 2, which is supported on S60 3rd Edition smartphones and Symbian smartphones in Japan.

This book doesn't present a single example of a game that it builds from scratch throughout the book, because we find that this approach tends to constrain the text, and the reader, to the details of the example. Instead, we've used a number of different examples for each chapter; these have been tailored specifically to illustrate the topic in question. Where possible, we have avoided using large chunks of example code in the technical chapters of the book, and have instead put the code, in full, on the website for this book ***developer.symbian.com/gamesbook***.

If you would like to read more about the creation of a full game example in C++ on Symbian OS, we highly recommend a paper on the Symbian Developer Network by one of the authors of this book, Twm Davies. The ***Roids*** paper (***developer.symbian.com/roidsgame***) explains the design, implementation and optimization of an ***Asteroids*** clone for Symbian OS v9. The example code and installation files for both S60 3rd Edition and UIQ 3 phones can also be downloaded from the website. Recommendations for other papers and code downloads for full game examples can be found in the References and Resources section at the end of this book.

Please also take a look at the book's page on the Symbian Developer wiki (***developer.symbian.com/wiki/display/academy/Games+on+Symbian+OS***) for a set of useful links to other mobile game developer resources, and an errata page for the book. Do feel free to visit it regularly and to contribute.

Who Is this Book for?

The typical reader may be:

- a C++ or Java ME developer already creating applications or services on Symbian OS who wants to take advantage of the growth in commercial mobile games
- anyone in the game industry (e.g., a professional or hobbyist developer, game producer or designer) who wants to target games for Symbian OS
- a developer new to Symbian OS who wants to learn about the platform and is experimenting by creating a game.

But we don't like to stereotype our readers, and hope that if you don't fit into these categories, you'll still find something of interest in this book!

The technical chapters assume that you have a working knowledge of either C++ on Symbian OS or Java ME. The basic idioms of Symbian C++ and details, such as how to get a working development environment or how to create 'Hello World,' are not to be found in this book, which is instead dedicated to the specifics of mobile game creation on Symbian smartphones. However, if you need general information about developing on Symbian OS, it can be found in other titles in the Symbian Press series, and in a number of free papers available on the Symbian Developer Network website and other Symbian OS community development websites. A list of the current Symbian Press series of books can be found in the References and Resources section at the end of the book.

About the Authors

Jo Stichbury

Jo has worked within the Symbian ecosystem since 1997, in the Base, Connectivity, and Security teams of Symbian, as well as for Advansys, Sony Ericsson and Nokia. At Nokia, she worked in the N-Gage team, providing technical support to game developers worldwide, and while there, she discovered that it is possible to play games at work legitimately. There's been no going back, and she's now trying to think up an excuse for playing ***Spore*** professionally for Symbian Press, whilst eagerly awaiting the game's release.

Jo is author of *Symbian OS Explained: Effective C++ Programming for Smartphones,* which was published by Symbian Press in 2004. She co-authored *The Accredited Symbian Developer Primer: Fundamentals of Symbian OS*, with her partner, Mark Jacobs, published by Symbian Press in 2006.

Jo became an Accredited Symbian Developer in 2005 and a Forum Nokia Champion in 2006 and 2007.

Twm Davies

Twm graduated in 1999 from Cardiff University with a First Class BSc in Computer Science, where he specialized in computer graphics and artificial intelligence. After uni, he moved to London where he worked at Symbian for seven and a half years as an engineer, consultant, and product manager helping Symbian licensees get their first phones out of the door.

At present, Twm is a freelance consultant on smartphone projects (or Ronin as he prefers to call it) and a regular contributor of book chapters and technical papers to the Symbian community. Twm wrote his first game at age 12 in Amos Basic, and his favorite game is ***Chaos Engine*** by the bitmap brothers (for its steam punk stylings).

Aleks Garo Pamir

Aleks graduated from Bogazici University in Turkey with an Associate degree in Computer Programming. He also has a BA in Labor Economics from Istanbul University and an MA in Industrial Relations from Marmara University. He spent a few years in Bogazici University as a teaching assistant in the MIS department.

During his education Aleks worked as a columnist and editor for local games review magazines in Turkey including PC World/Turkey. He was also a member of the team that developed the first Turkish RPG ***Istanbul Efsaneleri - Lale Savascilari*** for PCs. He worked as a software developer in Turkey for a number of years, developing software for a diverse set of industries using multiple different languages. After the emergence of cellular networks, he decided to focus on mobile technologies, and Symbian became his first choice.

Aleks moved to Canada in 2003 and founded Capybara Games, a mobile game company. Aleks became an Accredited Symbian Developer in 2007. He lives in Vancouver with his wife Zeynep and is currently working for Intrinsyc Software International as a senior software developer.

Michael Coffey

Michael joined Symbian as a graduate in 2004 after obtaining an MEng in Electronic and Electrical Engineering from the University of Birmingham. He has since worked in the PIM team specializing in the calendar and alarm server components. In his spare time, he has worked on creating Symbian mobile games. He is an Accredited Symbian Developer.

Leon Clarke

Leon Clarke has been working in embedded and mobile computing for over 15 years. He worked at Symbian for six years in various capacities, working on web browsing technologies and system software, before moving to Ideaworks3D four years ago, where he has been the chief architect of Ideaworks3D's online gaming product, Airplay Online. Leon has been

actively involved in the Khronos Group's Open KODE standardization process, being one of the major contributors to the Open KODE core.

Paul Coulton

Paul is a senior lecturer based within the Department of Communication Systems at Lancaster University. When he first left university, Paul worked for various small games developer teams primarily on algorithm design, before utilizing his skills in the defence industry on simulators. In 1997, he completed a PhD in Mobile Systems and, although his early work was primarily associated with HDSPA, he switched to application development in 2000. The main focus of his current research surrounds innovative mobile social software with a particular emphasis on mobile entertainment, such as games. He was the first academic invited to speak at the Mobile section of the Game Developers Conference and was one of the founding Forum Nokia Champions in 2006, re-selected in 2007.

Paul has published widely (including a Symbian Press book on S60 development) and a lot of his research projects encompass novel uses of the latest technologies, such as RFID/NFC, cameras, GPS, and 3D accelerometers in mobile phones.

Because his research encompasses a great deal of HCI, Paul is a big fan of the Wii and the DS, although his favorite game is the old mega drive classic ***Toejam and Earl2***, principally because it had a soundtrack by the master of funk, George Clinton.

Fadi Chehimi

Fadi is a mobile phone software engineer at Mobica Ltd. and a final year PhD student at the Department of Communication Systems at Lancaster University, UK. During his employment, Fadi has worked intensively on Symbian OS and Windows Mobile platforms. He has had his hands on several new devices and technologies before they were released into the market and for him this is part of the joy of mobile development. During his research he worked on several projects related to 3D graphics and mobile advertising. His main focus is on utilizing mixed reality technology for business and entertainment applications on mobile phones, and for that he has developed several proof-of-concept prototypes.

Sam Mason

Sam came to computing late in life, after spending three years studying civil engineering – where he first learned to program using Pascal. Unusually, he didn't have a Commodore 64, had never heard of a Z80,

didn't write compilers at age 7, and still can't use a soldering iron! After an abortive attempt at trying to become a vet, Sam eventually graduated with a Computer Science degree from the University of New South Wales in Sydney in 1996.

He ran straight into the dot com boom as a contract programmer in eCommerce, building HR and legal extranets, as well as workflow and content management systems for a number of short-lived companies, using Java and C++. After spending about two years working on a Java-based multi-lingual video-on-demand system for Singtel and other APEC telcos, he's spent most of the last four years working with and learning about mobile phone technologies, while picking up a couple of Java certificates and completing a Masters of Information Technology in Autonomous Systems from UNSW along the way.

Having spent most of his professional career in fascinating sectors like accounting, finance, and payroll, he's become somewhat of a mobile technology and artificial intelligence evangelist these days. To that end, he started Mobile Intelligence in 2006 and became the first to sit the supervised Accredited Symbian Developer (ASD) exam in Australia, in March 2007.

Sam is happily married with three little ones who are all at pre-school, they have no cats or birds, even fewer dogs, and is currently working full-time as a mobile technology consultant based in Sydney.

Roland Geisler

Roland Geisler currently serves as Group Product Manager for Nokia and is responsible for the Nokia N-Gage product strategy and the global product management for the N-Gage application for Nokia smartphones. Roland joined Nokia in 2001, and has held various management positions in Europe and the US, including Head of Marketing and Strategy, and Technology Manager for the Nokia Mini Map Browser, project manager for a number of mobile application software projects, and Development Partner Manager for Opera Software, a Nokia software supplier. Before he joined Nokia, Roland worked as a product manager and software engineer at Gigabeat (acquired by Napster) in Silicon Valley. Prior to this, he was a research assistant at the National Center for Supercomputing Applications (NCSA). Roland earned an MS in Computer Science from the University of Illinois at Urbana-Champaign and his undergraduate degree in Computer Science and Economics from the Technische Universität München in Germany.

Peter Lykke Nielsen

Peter Lykke Nielsen started his career in the interactive entertainment industry back in early 1995, when he was part of the trio setting up and

running the independent game developer Scavenger. As well as being part of building the company, he also oversaw a number of titles in development. In the late nineties, after having relocated to England, he joined Activision as a Producer and worked with them on ***Rome: Total War*** and ***Rally Fusion: Race of Champions*** plus a number of their Disney and Star Trek branded titles. In 2004, he relocated to Canada, where he initially worked as a Producer for EA on ***Need for Speed: Most Wanted***. Subsequently, he joined Nokia to become part of the team that will launch the next generation of the N-Gage platform. In his current role as Product Manager for the N-Gage SDK, Peter Nielsen is responsible for researching, defining, and communicating the feature set required to create cutting edge N-Gage titles.

Samuel (Sam) Cartwright

Samuel graduated from Griffith University, Australia, with a BIT in 2000. Shortly thereafter, he joined an outsourcing firm in Tokyo specializing in development for the telecommunications industry. While there, he worked as a Windows application developer creating low-level protocol encoders and UML tools before a briefly working on a mobile phone MMI (man machine interface) using the Apoxi framework.

In 2005, Sam joined Gameloft K.K., where he is now a senior programmer. As a game programmer, Sam both codes original titles on MIDP and ports games from MIDP to DoJa. In his spare time he also runs the Mobile Developer Lab mobile programming site, and is completing an MBA from Charles Sturt University.

Outside of work, Sam enjoys working out at the gym and attempting to read manga in Japanese.

Nigel Hietala

Nigel Hietala is a User Interface Specialist working for Nokia on the S60 platform. He has worked for over a decade with mobile devices and always at companies using Symbian OS. He caught the programming bug while originally building UI prototypes of future designs with Flash MX and, much to the dismay of his designer colleagues, has been delving ever deeper into the world of Flash and software development.

He still loves computer games and imagines a time when his four children have grown up enough that he can play them again.

Editor's Acknowledgements

This book wouldn't have come into being without a great team to write it. We somehow managed to coordinate working in multiple time zones and countries (Australia, Canada, Finland, the UK and the US), and I'd like to thank Twm, Aleks, Michael, Leon, Paul, Fadi, Sam, Peter, Roland and Nigel for putting in countless hours on their contributions. We're all grateful to our families for their patience and understanding while we took time out to write this book.

We would all like to thank our reviewers for their efforts too, sometimes helping out at very short notice, and always providing insightful comments and showing great attention to detail. We'd particularly like to thank Sam Cartwright, not only for his review of the chapter about games in Japan, but also for volunteering to go to the 2007 Tokyo Game Show on our behalf, and writing a section about it.

We'd also like to thank our other contributors and collaborators, including David MacQueen of Screen Digest, Adam Taylor and Tim Closs of Ideaworks3D, Krystal Sammis, Jan Bonnevier, Jesus Ruiz and Carlos Hernadez-Fisher of N-Gage, and John Holloway of ZingMagic. Many other people took the time to talk to us about this project; thank you for your help – Erik, Steve, Phil, Simon, Neil, Bill and Tony at Symbian; Jonathan, Jeff, Van, Kevin and AaPee at Nokia. Thanks also to Annabel Cooke at Symbian for supplying some of the diagrams used in Chapter 1.

When the writing stops, the editing starts, and we owe a big 'thank you' to Lisa Voisin for her attention to detail and her serenity in the storm of our copy edit schedule. (Thanks must also go to Tierney at Nokia for persuading Lisa to work with us). We'd particularly like to acknowledge the hard work put in by the Symbian Press team: the ever-patient Satu McNabb and ever-calm Freddie Gjertsen. Thanks also to Mark Shackman

and Rodney DeGale for their assistance with all things related to the Symbian Developer Network website.

Many thanks to Shena Deuchars for proofreading this book and to Terry Halliday for creating the index. Finally, a big 'thank you' to our counterparts at Wiley, particularly Rosie Kemp, Drew Kennerly, Colleen Goldring, Sally Tickner and Hannah Clement, for keeping us on track. May our page count estimates always be accurate. . .

Part One

A Symbian Perspective on Mobile Games

1

Introduction

Jo Stichbury

1.1 Why Games?

Electronic games, or video games as they are sometimes known, are big business. The sales of games for PCs, consoles, portable game players and mobile phones are now competing with the film industry for consumer spending on entertainment per year. In September 2007, Microsoft's ***Halo 3*** became the fastest-selling computer game, generating global sales of $300 million worldwide in the first week it was released. The game was released for Microsoft's Xbox 360 console on September 25, and it generated global sales of more than $170 million in its first 24 hours.[1]

Let's compare the sales of games with movie tickets. In 2006, the US box office reported total sales to be $9.49 billion.[2] Over the same period, again in the US alone, the NPD Group reports game sales (portable, console and PC games) to be $7.4 billion (and sales of all games plus portable and console hardware, software and accessories, to have generated revenues of close to $13.5 billion).[3] And it's not just North America; in Japan, average monthly leisure spending was estimated to be 7300 yen on mobile phone fees, 3700 yen on an Internet connection, 2300 yen on electronic games, 2200 yen for books and other print media, 1600 yen for music, 1300 yen on karaoke and just under 1000 yen on movies.[4]

There is crossover and symbiosis between the industries. A good example comes from the animated motion picture *Cars*, made jointly by

[1] ***www.microsoft.com/presspass/press/2007/oct07/10-04Halo3FirstWeekPR.mspx***

[2] ***mpaa.org/researchStatistics.asp***

[3] ***www.npd.com***

[4] *The Business and Culture of Digital Games: Gamework and Gameplay,* Aphra Kerr, Sage Publications Ltd, 2006

Disney and Pixar (now a subsidiary of Disney). The film made sales of $244.1 million in the US, the second highest figure of any movie released in 2006. A video game based on *Cars*, published by THQ, achieved the second highest console title sales in the US in 2006, and shipped more than seven million units.

Given the size of the revenue earned, it's interesting to think that the game industry is still quite immature compared to the film industry. There are some arguments over what counts as the first computer game ever created, but it's commonly held that the first digital video game dates back to 1961. ***Spacewar*** was written by Steve Russell at Massachusetts Institute of Technology, and ran on an early DEC minicomputer, which was not really intended for playing games! The first popular home console system was the Atari 2600, released in 1977.

That the game industry has caught up with the movie industry in such a short amount of time probably reflects the growing consumer trend for interactive entertainment. It is no longer sufficient simply to consume entertainment; people want to join in too. Games are a perfect medium to do this; they provide solo and multiplayer interaction over short periods of time, or for more prolonged sessions that can be returned to, as an 'alternative reality.'

Games are everywhere. They are played for entertainment on game consoles in the living room, or on handheld systems and mobile phones on the move. Games are used in schools or in the workplace as an educational or training aid. They can be played for a short duration, to pass time, or for hours at a time, as a player developers a character and skills in a long term role-playing or adventure game. Games are fun, but the game industry is a serious billion-dollar business.

1.2 What Is Symbian? What Is Symbian OS?

Symbian is a British company, formed in 1998 as a collaboration between Nokia, Ericsson, Motorola and Psion. The company supplies Symbian OS, which is the leading open operating system found in advanced data-enabled mobile phones, known as smartphones. At the time of writing this book, Symbian OS has been used in over 120 different models of smartphone.

Symbian does not make smartphones itself, but licenses Symbian OS to the world's major handset manufacturers (in alphabetical order, Fujitsu, LG Electronics, Mitsubishi Electric, Motorola, Nokia, Samsung, Sharp and Sony Ericsson).

Symbian OS is found in the majority of smartphones available. Gartner estimated Symbian's market share as 70 % in 2006, while Canalys put it slightly higher, at 71.7 % globally for the same period and, in a separate report, at 72 % in 2007. Regional figures for the smartphone market share in China were reported at 61 % for Q2, 2007, also by Canalys, and at

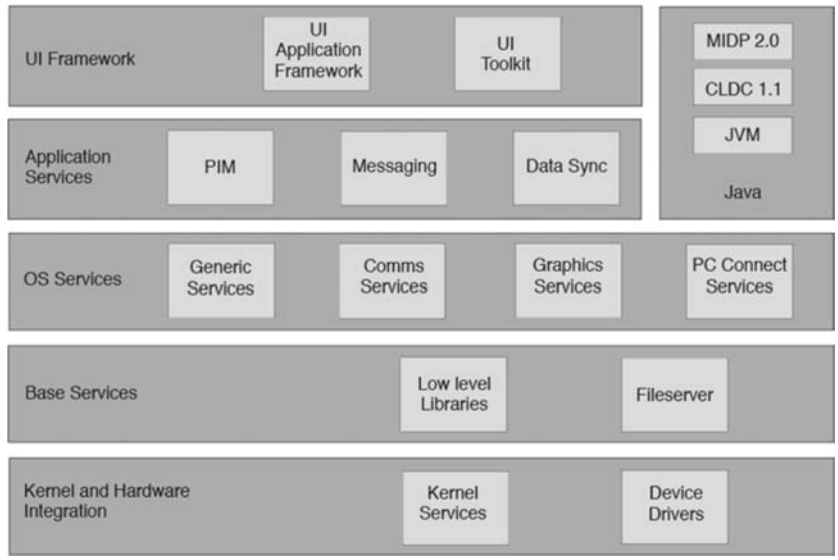

Figure 1.1 Representing Symbian OS using a layered model

72 % in Japan (where 20 million 3G Symbian smartphones have sold since 2003).[5]

Symbian OS is a modular operating system, which means that it is constructed from well-defined, discrete parts, which combine to allow for configurability across a range of target hardware. At a high level, Symbian OS can be thought of as a layered model, as shown in Figure 1.1, with hardware layers at the bottom and support for user-level applications at the top. From the bottom up, it comprises the following:

- kernel services and hardware interface layer
- base services such as file server, database and utilities libraries
- services for communication, graphics, multimedia, connectivity and standards support
- application services for personal information management (PIM), networking, messaging and application-level Internet protocols and other standards support
- user interface (UI) framework layer.

Symbian OS has a flexible architecture that allows different user interface layers to run as platforms on top of the core operating system.

[5] Figures were taken from Symbian's first and second quarter results for the year 2007, posted on their website at ***www.symbian.com/about/fastfacts/fastfacts.html***

The Symbian OS UI framework just supplies the common core that enables custom UIs to be developed on top of the operating system. Symbian OS does not include a UI *per se* – it supplies the ability for one to be customized on top of it. The generic UI framework of Symbian OS supplies the common behavior of the UI: a windowing model, common controls and support for extension by the custom UI, which defines its own look and feel.

The custom UI platforms available for Symbian OS are, in alphabetical order:

- NTT DoCoMo's MOAP user interface for the FOMA™ 3G network (see ***www.nttdocomo.com***) found in Japan
- Nokia's S60, which was formerly known as Series 60 (see ***www.s60.com***)
- UIQ, designed by UIQ Technology (see ***www.uiq.com***).

Symbian OS development environments range from the Symbian OS Customisation Kit (CustKit) which is provided by Symbian to handset manufacturers for them to create phone products, to SDKs which are provided by the UI platform vendors to application developers, and are used to create third party software for users to install. The latter can be obtained free of charge from the links found at ***developer.symbian.com/main/tools/sdks***.

1.2.1 What Is a Smartphone?

Having briefly described Symbian, the company, and Symbian OS, the heart of a smartphone, let's talk more about what a Symbian smartphone actually is. This book discusses how to write mobile games specifically to take advantage of the capabilities of Symbian smartphones – but what does that mean in practice?

Symbian defines a smartphone as:

> '*a mobile phone that uses an operating system based on industry standards, designed for the requirements of advanced mobile telephony communication on 2.5G networks or above.*'

The combination of such a powerful software platform with mobile telephony enables the introduction of advanced data services and innovation by device creators. It also allows the user to personalize the phone by installation of a wide range of applications, which in turn opens up the market for an entire industry of mobile software developers (such as game developers). A user can transform a smartphone into a unique and personal tool to suit their requirements. It may become a business productivity tool (with Push email, an office suite and even applications

written by them to be specific to their business) in one person's hands. The same phone may alternatively be a mobile entertainment device (for games, videos, mobile TV or music) or an in-car navigation system, depending on the user's lifestyle.

Nokia often refers to their Nseries S60 devices as 'Multimedia Computers' because they offer the functionality of a PC combined with those supplied by many portable single-purpose devices. For example, Nseries devices (and other Symbian smartphones) may include features such as WLAN, email, high-quality (5 megapixel) cameras, video capture and playback, mobile TV and music players with storage of up to 8 GB. Other functionality offered by Symbian smartphones may include GPS, visual radio, Bluetooth and USB local connectivity, accelerometer, Java, Web and WAP, MMS, SMS and, of course, telephony (voice and 3G data). Symbian smartphones come with a range of embedded applications such as calendar, address book, photo viewers (and editors), music players, messaging (SMS, MMS, email), web browser, converters, sound recorder and many others. Most also have at least one built-in game.

Symbian smartphones are frequently known as 'convergence devices' because the smartphone can take on the role of other single-purpose devices, rather like a Swiss army knife, and it removes the need to carry around more than one gadget. It may seem amazing, but the largest digital camera manufacturer in the world is Nokia[6] because of the number of camera phones it sells annually. Besides cameras, smartphones can now take the role of alarm clocks, calculators, pagers, game consoles, music players, portable radios, video cameras, pedometers, dictaphones, and satellite navigation units. This is, of course, in addition to being a phone, and supplying messaging, email, and web browsing!

1.2.2 Smartphones and Feature Phones

A smartphone must be contrasted with a 'feature phone' which is a term commonly used to describe a low-end or mid-range mass market mobile phone which does not have such advanced functionality as a smartphone handset. A feature phone may offer a subset of the functionality of a smartphone, but is typically far more basic, with voice and messaging being the main features of the phone. Feature phone handsets are typically smaller, and since they have fewer features, need fewer electronic components; those used are frequently less technologically advanced. As a result, feature phones are cheaper to manufacture and to sell to the consumer; they are thus sold in significantly higher volumes (as the statistics in following section reveal).

[6] In 2006, Nokia was the world's largest digital camera manufacturer with approximately 140 million cameras sold through sales of Nokia smartphones and feature phones. It also sold close to 70 million music enabled devices, making Nokia the world's largest manufacturer of music devices as well. (Source: ***www.nokia.com/A4136001?newsid=1096865***).

A feature phone does not allow for more than very basic personalization by the user through ringtones and themes or skins. Beyond these, only certain types of applications can be installed by the user, those that are sandboxed, typically written in Java ME. In consequence, the phones are said to be *closed*. Other restrictions may be in place, such as preventing access to web or WAP sites beyond those preconfigured by the vendor, or limiting the user's access to the phone's file system.

In contrast, the Symbian OS-based S60 and UIQ smartphone platforms are *open* because a user may install native applications written in C or C++, such as high-performance games, as well as applications written in Java ME.

So, besides more advanced technology found in a smartphone, one of the key differences between Symbian smartphones and feature phones is the ability to install native C++ applications. However, it's not quite as clear cut as this. One of the Symbian OS smartphone platforms, found in Japan, is also closed; it is not possible to install after-market software written in C++ on FOMA phones. For this reason, the FOMA smartphone platform will not be considered in the early chapters of this book where writing games in C++ using the native APIs and services are discussed. Those chapters are limited to S60 3rd Edition and UIQ 3. Since FOMA phones do allow games written in Java to be installed, Chapter 10 discusses writing games specifically for them using the DoJa standards, as well as discussing the Japanese game market. Chapter 9 is more general, and discusses how to write Java ME games for UIQ and S60 smartphones.

1.3 Some Statistics

1.3.1 Smartphones in Context

According to analysts at IDC, 528.3 million mobile phones shipped worldwide in the first half 2007. Of these, Canalys reports 47.9 million were smartphones. So it's clear that smartphones are only a small fraction (9 %) of all mobile phone handsets purchased. Having said that, sales of smartphones in the first half of 2007 were up by 39 %, compared to the same period in 2006. This can be contrasted with the more shallow rise of 17 % increased sales of all mobile phones over that time. (The continued momentum in mobile phone sales is driven by increased purchasing in emerging markets such as India and Africa, and purchasers in industrialized nations upgrading their current phones to the latest models).

Canalys forecasts that cumulative global shipments of smartphones will pass the one billion mark by 2012, while other analysts are less

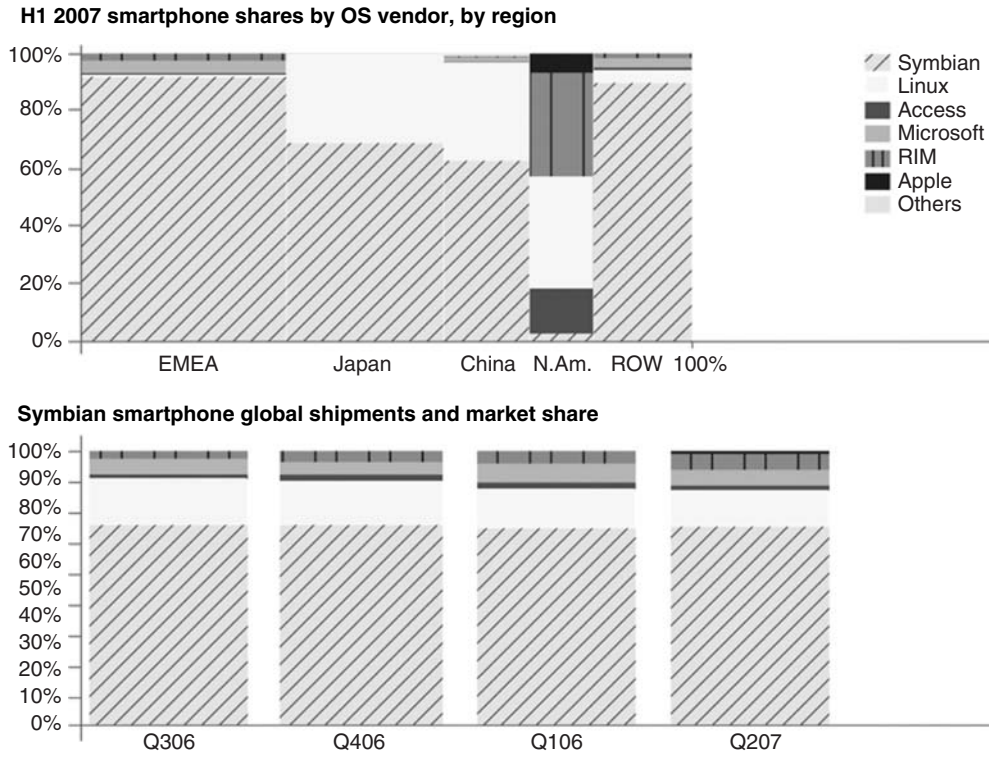

Figure 1.2 Smartphone market shares by region

cautious, and predict sales to break through one billion in 2011 (IDC) or in 2010. (Yankee Group).[7]

At the time of writing, as section 1.2 described, Symbian smartphones are reported to have a 72 % global market share. Regionally, the market share in China is reported to be 61 % (Q2, 2007 – Canalys figures) and, in Japan, the same research reports a Symbian smartphone market share of 72 %. Figure 1.2 reflects the market share, as reported by Canalys, at the time of writing (October 2007).

In February 2006, a Symbian press release announced a new pricing model for Symbian OS, designed to enable its licensees to target segments of the market for lower-cost devices, and further increase the sales volumes of Symbian OS phones. The scaleable pricing model reduces the price paid to Symbian per unit as the licensee's total volume of shipments increase. Using this model, Symbian OS royalties as low as $2.50 per unit are possible, reducing the cost of using Symbian OS in

[7] The Yankee group also predicts that smartphone sales will be 20 % of all mobile phone sales by 2010.

lower-price phones, and further accelerating the uptake of Symbian OS in the high-volume mass-market segment.

At the same time, Symbian also announced a collaboration with Freescale and Nokia to produce a 3G mobile phone reference design for S60 using a single core 3G chip. This reference design is expected to provide handset manufacturers with a cost-effective means of addressing the mid-tier 3G market segment and to reduce device development time by up to 50 percent.

Put together, the result is that Symbian OS can now be used to drive cheaper, mass-market phones as well as high-end smartphones. This effectively opens the possibility of deploying Symbian OS games to increasing numbers of consumers and leads to an interesting conclusion for mobile game developers: the addressable market for mobile games written for the Symbian platform is dramatically increasing in size.

''*Yankee believes the primary growth driver for smartphones is the economic benefit to manufacturers and operators associated with standardized, scalable software architectures...Vendors and operators will enjoy rapid time to market at low cost with services and devices that span the entirety of the market, from basic phones to ultra-high multimedia centric models*,'' said John Jackson, Vice President, Enabling Technologies Research, Yankee Group, 2007.

1.3.2 Sales of Smartphones vs. Sales of Portable Game Players

Let's take a look at some more statistics by comparing sales of Symbian smartphones with sales of comparable portable game players from Nintendo and Sony. As of 30th June 2007, Symbian reported 145 million cumulative smartphone shipments by its licensees. In the first six months of 2007 alone, 34.6 million units were shipped (a 44 % increase on the same period for the previous year and more than for the whole of 2005).

Comparatively, Nintendo has published sales figures of 1.25 million DS portable game players in the first three months of 2007 (compared to 15.9 million Symbian smartphones over the same period), and over 47 million cumulatively since the DS launched. Sales of the Nintendo Wii since its release in 2006 were said to be just over 9 million units. Sony reports cumulative sales of its PlayStation Portable (PSP) to be 25.39 million units since its launch in 2005. Sales in the first half of 2007 were approximately 4 million units.

It's clear that there are a lot more smartphones on which to play games than there are portable game units. OK, it is also true that the PSP and DS are dedicated game players, and people that buy them are likely to buy one or more games to play on them, while not everyone who buys a mobile phone also buys mobile games to play on it. But, as Dr Mark Ollila, Director of Technology, Strategy and Game Publishing at Nokia puts it, ''*With mobiles...the whole market is huge, so even if the*

percentage of those users playing games is quite small, the volumes are quite large.''[8]

Recent data suggests that smartphone buyers show particular enthusiasm for purchasing and installing software for their devices. Part of the reason for buying a smartphone, after all, is that powerful after-market software can be installed onto it. To meet this demand, over 8000 third party installable applications are commercially available at the time of writing. Furthermore, according to data from m:metrics, Symbian smartphone users perform at least 20 % more tasks that raise the average revenue per user (ARPU) for network operators than other 3G users. For example, data from October 2007[9] suggests that, in the UK, 45 % of Symbian smartphone users spend more than £35 ($70 US) per month on 3G network services (such as sending photos, videos, accessing maps and news). Feature phone owners spend less; only 20 % spend that amount or more.

1.3.3 Sales of Mobile Games

The first, and probably best known, mobile game is ***Snake***, found in most Nokia mobile phones since the Nokia 6100 phone was released in 1997. Since then, the mobile game industry has grown swiftly and is accepted as an important, and growing, sector of the game industry. We've looked at the statistics for sales of mobile phones in general, and smartphones in particular, so let's move on now to examine the market for mobile games in more detail. It's important to point out that this market data doesn't differentiate between games for smartphones and games for feature phone handsets.

Mobile games are a major revenue generator for network operators, game publishers and developers alike. For example, the market for mobile games took off in 2002, with the number of game services launched by network operators in Western Europe growing more than seven fold between mid-2002 and mid-2003, according to Screen Digest.

Various figures have been quoted for the value of the mobile game market to date, and for the years to come. iSuppli predicts that revenue is likely to increase rapidly, driven by heavy adoption of mobile handsets in China and India. Forecasts are for expansion to $6.1 billion by the year 2010.[10] A different report, from Informa Media & Telecoms, values the market at $3.3 billion for 2007 growing to $7.2 billion by 2011.[11]

However, it would be irresponsible not to sound a note of caution at this point. In 2003, the major market research firms predicted sales of mobile

[8] ***www.mobileindustry.biz/article.php?article_id=2689***
[9] ***www.mmetrics.com***
[10] ***www.isuppli.com/news/default.asp?id=7242&m=1&y=2007***
[11] Informa Telecoms & Media: *2006 2007 Mobile Entertainment Industry Outlook*

games by 2006 to range from $3.6 billion (Informa) to $18.5 billion (Datamonitor); some were predicting sales of mobile games to be bigger than sales for dedicated game consoles and PCs combined. Although strong sales were reported in 2006, the market didn't take off as rapidly as expected, and Informa revised their estimate to $2.5 billion, which is generally taken to be accurate for mobile game sales that year. Later in this chapter, I'll discuss some of the reasons why the market wasn't as strong as predicted, and what is changing to address it.

1.4 Games Platforms Compared

Most people typically think of a game system as a dedicated game console such as Sony's PlayStation 3, the Nintendo Wii or the Microsoft Xbox 360. A console is most definitely not mobile! It does not have a display unit and is plugged into a separate television, and optionally a separate audio system.

The PC is another very popular game machine, particularly for games involving keyboard input, for example, to communicate with other players or characters in a game. Again, a PC is hardly mobile. If you play a PC game on a laptop, your play time is limited to the lifetime of a typical laptop battery, which is fairly short (shorter than the battery lifetime of a typical mobile phone). Furthermore, most PC games are not tailored for limited input from a laptop touchpad, but assume a mouse or joystick, as well as a full QWERTY keyboard.

Moving on to game machines that are more obviously portable, the most familiar at the time of writing are the Sony PlayStation Portable, the Nintendo DS and the Nintendo Game Boy series. While each of these have some level of connectivity (see Table 1.1), none have the facility to make voice calls from anywhere[12] or all the other characteristics of a mobile phone. This is one factor that differentiates a *portable* platform from a *mobile* platform. An additional difference between mobile and portable game platforms is that the mobile phone is ubiquitous; as we've seen from the sales figures, a wide cross-section of the population owns one and most carry them with them at all times. Relatively speaking, the market for portable game players is much smaller.

A portable game machine has fewer functions than a mobile phone, but does have the advantage that it is designed specifically to have controls and form factor that are optimized for game playing. Most mobile phones are phones primarily – game controls are a secondary consideration

[12] In early 2007, it was announced that PlayStation Portable owners in the UK would be able to make voice and video calls when using software developed by BT, through one of their BT WiFi hotspots. Nintendo DS users can use VoIP to chat during game sessions in some countries, but there is no commercial application to allow widespread use of the DS to make voice calls.

Table 1.1 Comparison of handheld game players and Symbian smartphones

	Sony PlayStation Portable	Nintendo DS	Nintendo Game Boy Advance	Symbian Smartphone (September 2007)
Graphics	High end 3D (approx 200,000 polygons per second)	High end 3D	2D	2D low end 3D (approx 25,000 polygons per second or lower)
Convergence	Camera and GPS attachment, Digital TV receiver attachment (available in some regions), Web browser	Web browser, MP3 player	MP3 player, e-reader bar code scanner	As described earlier in this chapter, Symbian smartphones are highly convergent
Connectivity	WiFi, IrDA, USB	WiFi, USB	WiFi, cable connection to Nintendo GameCube	WiFi, 2.5G/3G data and voice, SMS Bluetooth, USB, IrDA
Ergonomics	Dedicated game controller keys	Dedicated game controller keys, one touch screen	Dedicated game controller keys	No dedicated game controller keys (except in legacy devices such as the N-Gage and N-Gage QD game decks) • Standard phone keypad • 4-way directional controller (can be simulated 8-way in some smartphones) • Touch screen (some smartphones)

(*continued overleaf*)

Table 1.1 (*continued*)

	Sony PlayStation Portable	Nintendo DS	Nintendo Game Boy Advance	Symbian Smartphone (September 2007)
Support for independent games developers	Closed platform (there is some 'homebrew' development which exploits missing security functionality in early models)	Not officially supported, but it is possible to develop games independently	Not officially supported, but it is possible to develop games independently	Open platform, SDKs available from the UI platform creators (e.g., Nokia and UIQ)

(although the Nokia N-Gage game decks, discussed in Chapter 8, are a notable exception to this general rule). Another aspect for game designers to consider is that, because a mobile phone is a multiple-function device, the game may be interrupted at any time because one of the other services becomes active (e.g., the player receives a phone call or SMS, or a calendar alarm alerts them of their next meeting).

Not all mobile games use all the features that differentiate a mobile phone from a portable game player, but increasing numbers of games do use the connectivity offered by the phone network or WiFi. Some also take advantage of other features that are standard in mobile phones, particularly Symbian smartphones, but that are less well established in portable game players. These include features such as access to APIs to control the camera, microphone and location-based services. Chapter 6 discusses this further when describing some innovative mobile games created for Symbian OS smartphones.

Of course, while mobile phones offer a new set of opportunities for game design, there are also some trade-offs which lead to challenges when creating a mobile game. The mobile phone demands a very different style of game to those found on consoles. Games are played for a few minutes at a time; they need to be quick to grasp and deliver fun in short bursts.

A mobile device needs to be small and have a long battery lifetime, and is built with hardware limitations such as memory, screen size, and input controls to maximize portability and minimize price. Other, less obvious, limitations include how games are purchased and acquired. For mobile games, this tends to be different to the distribution of games for portable players, which are traditionally acquired as cartridges or on memory cards. We'll discuss some of the challenges of creating and distributing games for mobile phones in this chapter, and return to them throughout the book, since it's a general theme affecting mobile game design and implementation.

1.5 Types of Mobile Games

Mobile games have a broader, more diverse, audience than games for dedicated game consoles. Owners of consoles such as Sony's PlayStation 3 or the Microsoft Xbox 360 are keen gamers; they have purchased a machine specifically to play games, which are often expensive (when compared to typical mobile games), and they dedicate time regularly to playing games at home. In contrast, most mobile phone owners bought their phones for communication with others. The ability to play games is mostly a secondary benefit.

Most people who have a phone have at some point tried a game on it, if for no reason other than because it was already on the phone and they had time to kill.[13] A number will play games regularly – we'll look at the statistics shortly – but others will be more occasional users. Mobile games are cheaper than console games, and many will make impulse purchases of games, particularly if recommended by a friend.

In general, because the demographic of mobile phone owners is so diverse, the reasons for purchasing and playing games is variable, which means that the range of games available varies widely too. Mobile games are all somewhat limited by the form factor and resource limitations of the phones, but the range of games available is limited only by the imagination! Mobile games typically fall into two broad categories: casual games and hardcore games, with multiplatform games providing a bridge between mobile games and play on other platforms.

1.5.1 Casual Games

It's fair to say that simple games (often known as 'casual games') form a large part of the mainstream mobile game market. In fact, it is probably true for all games, not just on mobile platforms. It's been said that the biggest games in the world aren't ***Halo*** or ***Zelda*** or ***Final Fantasy***, but the ***Solitaire*** game that comes with Microsoft Windows[14] and ***Snake***, found on an estimated 350 million Nokia mobile phones.

Casual mobile games are targeted at a wide audience, and thus are designed to be accessible and easy to learn. Besides having simple rules, they only require the use of basic input controls (they are sometimes known as one-button games) and do not require long play times, so can be played briefly during a lunch break, on public transport, or covertly in a meeting. They are low maintenance. This kind of game is perfect for a mobile device. Most people always have their phones with them, so can use them to play when they have a few minutes to spare.

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[13] Nokia's own research suggests that 68 % of Nokia phone owners have played the ***Snake*** game at least once, and given the number of ***Snake***-enabled phones that the Finnish company have sold, this makes the game the most played in the world!

[14] *Edge Magazine*, May 2007