

Series 60 应用程序开发

Developing Series 60 Applications

A Guide for Symbian OS C++ Developers

(英文版)

(美) Leigh Edwards 等著
Richard Barker



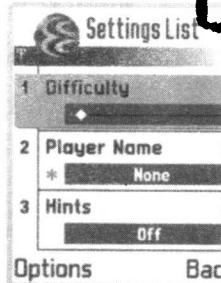
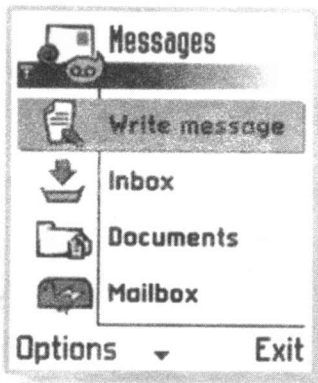
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Foreword

by Nokia

The era of mobility is upon us. Mobile phone sales are approaching a half billion units a year and climbing. The smartphone is already playing a key role in helping consumers manage their personal and professional lives.

An increasing number of mobile devices provide consumers with rich media and data services as well as voice communications. An equally impressive collection of enablers, such as built-in cameras, high-resolution color displays, streaming media and a level of memory capacity once reserved for PDAs, give developers the ability to build increasingly more sophisticated wireless applications. Mobile versions of Java and C++ provide a rich development environment for creating innovative consumer and business applications.

Programming for mobile devices has traditionally been a time and labor intensive exercise because the technology in each device is different, and device lifecycles are difficult to predict. The Series 60 Platform changes the economies of scale of mobile development by providing a standards-based development environment for a broad array of smartphones.

The Series 60 Platform provides a common screen size, a consistent user interface, a Web browser, media player, calendar, SMS, MMS and common APIs for Java MIDP and C++ programmers. It is also based on the Symbian OS, the only operating system built from the ground up for the special needs of smart mobile devices.

The Series 60 Platform was designed from the outset to be a powerful and robust platform for third-party applications. There are already 2,000 Symbian applications on the market—from 3D action games for the N-Gage mobile game deck, to photo editing software, to utilities for reading books on the go. These applications appeal to consumers and business users alike in imaginative and innovative ways.

The Series 60 Platform is smartphone software licensed by terminal manufacturers such as Matsushita (Panasonic), Nokia, Samsung, Sendo and Siemens. Combined, these players constitute 60% of the worldwide mobile handset market. The Series 60 Platform defines most of the features and functionality in Series 60 devices developed by Nokia and other Series 60 licensees, but some devices may include additional features to appeal to specific consumer segments.

This platform lets developers shine with a complete, flexible programming environment that is capable of serving the diverse needs of application programmers. The near-universal Java MIDP platform supports portable applications deployable to a wide range of devices. The native Series 60 C++ programming environment is the perfect platform for optimized applications, providing a rich programming API and large address space. And access to tools and resources could not be easier: Nokia and its licensees provide free access to the programming SDKs and documentation.

The Series 60 *Developer* Platform defines the common, relevant and visible interface to the technology enablers and APIs, and details how they are implemented in the Series 60 Platform. The Series 60 Developer Platform covers multiple devices (even if new Series 60 Platform releases with added features have been introduced), thereby resulting in a large installed base of devices with a common set of enablers and APIs.

The mobile market and its leading-edge technologies offer great opportunities for Series 60 developers, but getting started can seem daunting for developers who have spent years working with other operating systems. Forum Nokia has been assisting developers in learning about Symbian OS and Series 60 development since its inception. *Developing Series 60 Applications*, part of the Nokia Mobile Developer Series, is a further commitment by Nokia to support the Series 60 developer.

Developing Series 60 Applications is the most comprehensive reference on Series 60 Platform ever written, walking readers through their very first steps, and then building upon that knowledge to help them create more sophisticated applications. Every aspect of the Series 60 Platform is covered, from unique and powerful user interface components, through communication APIs and multimedia capabilities. The fundamentals of the Series 60 application engine are detailed, as well as best practices for testing and debugging Series 60 applications. Last but not least, over fifty complete projects, with C++ source code and installation scripts are included to help developers jump-start their own projects.

Developing Series 60 Applications draws upon the expertise of EMCC Software Ltd., a Series 60 Competence Center. Authors Leigh Edwards and Richard Barker and the staff at EMCC bring many years of experience and a wealth of expertise in working with the Series 60 Platform and the Symbian operating system.

Using this book as a guide, developers will be armed with the knowledge they need to create world-class applications for today's most exciting applications market.

Good reading and happy coding.

Pertti Korhonen
Executive Vice President,
Nokia Mobile Software

Foreword

by EMCC Software Ltd.

Symbian OS is a highly sophisticated, powerful and very reliable Operating System, written mainly in C++. Series 60 Platform, from Nokia Mobile Software, builds on the Operating System providing a carefully crafted highly optimized user interface, application framework and much more besides.

EMCC Software specializes in development for Symbian OS and the key smartphone user interface platforms such as Series 60. We have been working with the OS since before the Symbian alliance was created.

I believe strongly in the excellent technical foundations of Symbian OS and in the clear logic behind licensing of Series 60 to other handset manufacturers. A common Operating System and user interface both assist in achieving a high degree standardization and interoperability across a wide range of smartphones.

Writing this book was a major task that we undertook for a variety of reasons. The level of C++ and object orientated design employed throughout Symbian OS and Series 60 leads to a significant learning curve for developers, compared to other environments. Writing this book is an attempt to shorten the learning process. Even after five years there is still a surprising lack of good material available to engineers working with Symbian OS—especially since developing for Symbian OS is quite challenging. As an evangelist and enthusiast for Symbian OS I found this situation slightly irritating, especially since it is the leading player in the market—by far. Additional influences came from interactions with our customers, business partners and the numerous delegates who have attended our training courses. The decision to proceed was also heavily influenced by our business relationship with Nokia—in particular our role in producing much of the Series 60 documentation available via Forum Nokia.

A key objective of writing this book was to encourage developers to work with Symbian OS and in particular with Series 60—a genuine attempt to add to the total sum of what is known about Series 60 development. Hopefully, the majority of readers will be pleasantly surprised by the amount of information provided in this work. We firmly believe that helping to increase the number of Series 60 developers out there will benefit the whole ecosystem and will indirectly benefit our company.

EMCC Software works with Symbian, Nokia and a number of Series 60 Licensees on products, on advancing the OS and the platform itself. Typically we work with software and products that are one to two years away from commercial availability. However, what is provided here is necessarily focused on the current products and platform SDKs. So this detailed account of application development aims to support the production of good quality Series 60 software for devices that are currently in the market place or are about to become available very soon.

Leigh Edwards,
EMCC Software Ltd.,
January 2004

Preface

This book is for anyone who is considering or is currently involved in creating software for Series 60 using C++. For software engineers, designers and project managers, it is an in-depth practical guide to Series 60 development. Engineers from a wide range of organizations—independent software vendors, licensees, competence centers, network operators, content providers and so on—should benefit from this work. This book provides an in-depth practical guide to Series 60 software development in C++. We do not attempt to teach C++ or object-oriented design; these are essential prerequisites to getting the best from this book.

We assume at the outset that you have located and installed a suitable Series 60 SDK and a chosen development environment from Borland, Metrowerks or Microsoft. Help on acquiring these necessary materials is provided in the References section at the back of the book.

Generous amounts of documentation, information and example projects are included with the SDKs and tools, so where possible we have avoided duplicating this material. From time to time we refer to sections of the standard documentation and examples where you can find more details. Many other sources of information are available to assist engineers to acquire entry-level Symbian OS development skills, and links to such resources are provided in the References section.

Some basics of Symbian development are provided here to aid the complete beginner, but to avoid too much duplication we focus mainly on the specifics of Series 60 Platform development.

Around sixty separate buildable projects are provided, together with full source code and installation scripts. See the References section for instructions on

correct installation of the project materials. Links to the projects materials, updates and errata are available online from:

- <http://www.emccsoft.com/devzone/>
- <http://www.forum.nokia.com/books/>
- <http://www.awprofessional.com/nokia/>

Series 60 is a complete smartphone reference design, including a host of wireless applications, based on Symbian OS. It represents a rich open environment for developers to create their own innovative applications. However, it is a rapidly developing platform, and so this book covers development for versions 1.x and 2.x of Series 60 Platform.

Application developers can choose from Java™ MIDP or C++ as their development language. This book covers only C++, since it currently offers significantly greater capability in terms of performance and access to a huge set of APIs (Application Programming Interfaces).

Guide to Readers

The first part of this book provides an overview of the development process, the essentials of Symbian development and the key structural elements of a Series 60 application. Therefore, if you are new to Series 60 development, we urge you to read Chapters 1–4 completely before reading anything else. The rest of the book can be used as a reference work on Series 60 development.

A brief outline of each chapter is provided here to guide readers of varying levels of previous experience, from novice to expert, on how to proceed.

- **Chapter 1—Getting Started**

Introduces the essentials of a Series 60 project, plus building, deploying and running a simple example application.

- **Chapter 2—Development Reference**

Builds on Chapter 1 by providing a detailed description of all the essential components of two Series 60 projects, plus the use of other key development tools to build, deploy and run the example applications.

- **Chapter 3—Symbian OS Fundamentals**

The essential characteristics of Symbian OS upon which Series 60 Platform is based.

- **Chapter 4—Application Design**

Examination of the framework architecture behind every Series 60 GUI application and of key elements of application design—this is the first time the source code of a GUI application is examined.

- **Chapter 5—Application UI Components**

The basics of creating UI controls, plus the essential Series 60 UI controls such as menus, status panes, control panes and so on.

- **Chapter 6—Dialogs**

Use of Series 60 dialogs for interaction with users and displaying information or editing data.

- **Chapter 7—Lists**

User interface controls for displaying collections of items for information and user interaction.

- **Chapter 8—Editors**

Application of user interface components for entering, displaying and editing data.

- **Chapter 9—Communications Fundamentals**

Basic communication APIs for Series 60 developers.

- **Chapter 10—Advanced Communication Technologies**

Sophisticated communication APIs for Series 60 developers.

- **Chapter 11—Multimedia, Graphics and Audio**

Series 60 Graphics Architecture, drawing, fonts, bitmaps, animation and audio.

- **Chapter 12—Using Application Views, Engines and Key System APIs**

How to invoke the published standard application views, use many of the key application engines and accessing several useful system functions from within applications.

- **Chapter 13—Testing and Debugging**

Quality assurance, testing techniques and common debugging methods and techniques.

Introduction to Symbian OS and Series 60 Platform

Series 60 Platform is based on Symbian OS, a mobile Operating System from Symbian Ltd. It is an open, highly robust Operating System for data-enabled mobile phones. Symbian OS (formerly called EPOC) is a 32-bit preemptive multitasking Operating System that is central to the success of Series 60 and other user interface platforms such as Series 80 and Series 90, the communicator platforms from Nokia, and UIQ from UIQ Technology AB, a division of Symbian.

Series 60 Platform is a complete smartphone reference design, developed by Nokia Mobile Software, and is currently being licensed by several of the worlds key handset manufacturers.

Symbian OS Structure

In the real world, events often happen simultaneously and with timing that is unpredictable—usually termed asynchronous behavior. Series 60 applications are designed to behave reliably, to interact smoothly with other applications and with the numerous asynchronous services provided by both Symbian OS and Series 60 Platform. For example, a phone call may interrupt a user composing an email message, a user may switch from Messaging to a Calendar application in the middle of a telephone conversation or an incoming SMS may cause the user to access the Contacts database and forward the SMS onward. By complying with the platform architecture and software design guidelines, application designers can routinely manage such occurrences in the daily lives of smartphone users.

From the outset, Symbian OS was designed for use in small battery-powered devices with extensive communications capabilities. Its key design features include:

- **Performance**—Designed to maximize battery life through careful device-specific power management.
- **Multitasking**—Telephony, messaging and communications are fundamental components. All applications are designed to work seamlessly in parallel.
- **Standards**—The use of technologies based on industry standards is a basic principle of Symbian OS, ensuring that applications are interoperable with solutions from other platform vendors.
- **Object-oriented software and highly modular architecture.**
- **Memory management optimized for embedded software environment**—very small executable sizes and ROM-based code that executes in place.
- **Runtime memory requirements are minimized.**
- **Security mechanisms for enabling secure communications and safe data storage.**
- **Application support for an international environment, with built-in Unicode character sets and ease of localization.**

Figure I-1 shows a representation of the Symbian OS generic technology (GT) components.

The system kernel, File Server, memory management and device drivers are located in the “Base” Operating System layer. The kernel manages system resources such as memory and is responsible for time-slicing the applications and system tasks. Device drivers provide the control and interface to specific items of hardware—the keyboard, display, infrared port and so on.

The developer interface to most of the base Operating System functionality is through the `EUser` Library, via a huge range of static function calls beginning with `User::`—for example, `User::After()`, which causes the current thread of execution to be suspended until a specified time interval has expired.

The upper layers of the system provide communication and extensive computing services, such as TCP/IP, IMAP4, SMS and database management. Symbian OS components provide data management, communications, graphics, multimedia, security, personal information management (PIM) application engines, messaging engine, Bluetooth, browser engines and support for data synchronization and internationalization.

Symbian C++ APIs enable extremely efficient multitasking and memory management. Memory-intensive operations such as context switching are minimized. Symbian OS applications are primarily event-driven rather than multithreaded. Multithreading is possible and is used with the Operating System, but it is generally avoided in applications, because it potentially creates several kilobytes of overhead per thread. Conversely, a primarily event-driven

approach does not need any context switching and can have an overhead as low as a few tens of bytes. Special design attention has also been given to ensure that Symbian OS is robust and reliable.

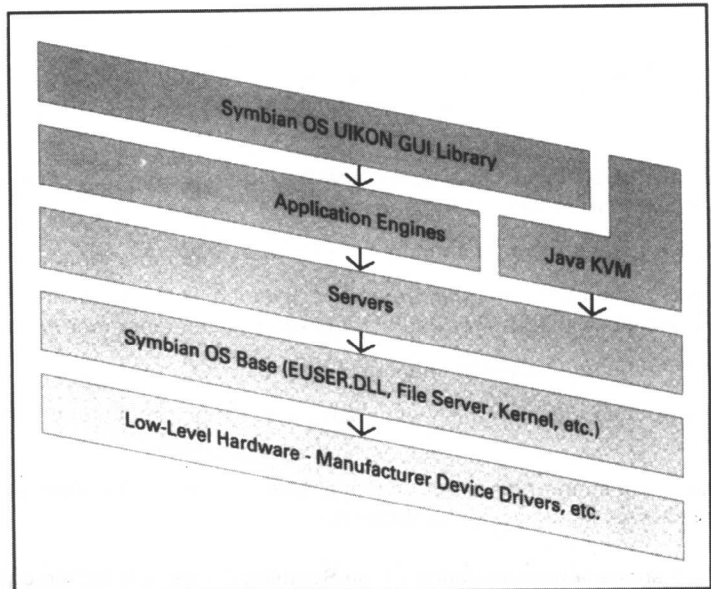


Figure I-1 Symbian OS generic technology structure.

Client/Server architecture is a key design feature of Symbian OS. User applications and system processes are clients that use the resources of a wide variety of system servers. In Symbian OS, servers can be accessed only by their clients via well-defined interfaces. Virtually all servers run with a high priority, but without system privileges, to ensure a timely response to all of their clients while controlling access to the resources of the system.

Some core application engines, written as servers, enable software developers to create their own user interfaces to the application data and databases. Examples include Contacts, Calendar, Multimedia Services (decoding and rendering of image formats) and Messaging.

Data synchronization is provided through a SyncML engine and external connectivity, such as infrared, Bluetooth and a PC Connectivity suite.

Series 60 Structure

Series 60 Platform builds on the Operating System from Symbian, complementing it with a configurable graphical user interface library and a comprehensive suite of applications plus other general-purpose engines. Series 60 is a complete smartphone reference design.

A set of robust components and APIs are provided for developers in Series 60 SDKs. The APIs provided are widely used by the suite of “standard” applications that are an integral part of Series 60 Platform. However, the extensive APIs were designed for use by third-party application developers as well.

The core of Series 60 Platform is Symbian OS GT (Generic Technology) layers—see Figure I-1. Series 60 adds the extensive Avkon UI layer, a full suite of applications based on the Avkon and Uikon libraries plus a number of key application engines—see Figure I-2. Series 60 Platform contains the majority of the user interface and framework APIs used by third-party GUI applications.

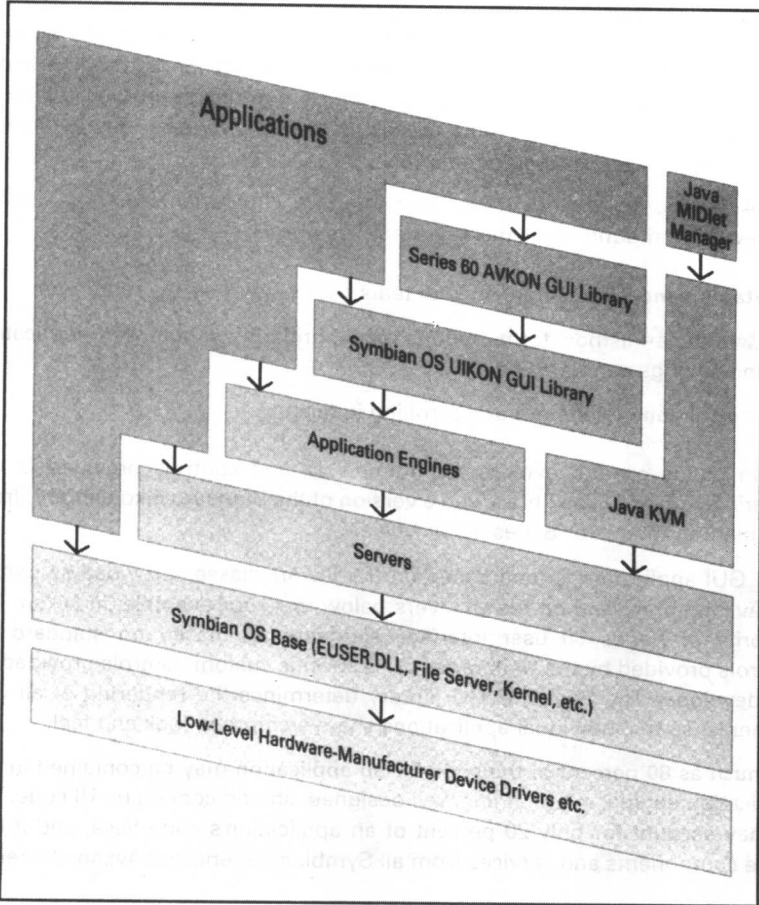


Figure I-2 Series 60 structure.

There are also a number of platform-specific dynamic link libraries, executables and device drivers—for example, to control the specific keyboard, display, real-time clock (RTC), Bluetooth, IrDA and persistent storage devices. Symbian OS

communicates with the device's core cellular software through a well-defined interface (ETel), based on a Client/Server architecture.

Porting Series 60 to a new target hardware platform will involve production of some low-level hardware-specific code such as device drivers. This can be a large specialist task and is beyond the intended scope of this book.

A number of the key Series 60 applications or system facilities provide shared access to their data or functionality by making their engines available through public APIs. Examples include Event Logging, Photo Album/Image Gallery, Browser engine and CommDB (a database containing communications and connection settings). These engines use system services from lower layers. For example, the WAP Loader uses the WAP Stack to fetch data using the Wireless Application Protocol. The WAP Stack, in turn, uses the Socket engine in the Communication layer for network access, which in turn uses the ETel engine for hardware-specific telephony data access. In general, engines may be layered upon each other.

The Avkon library defines many user interface components and application framework components. Some key examples are:

- **Status pane**—framework and contents
- **Main pane**—listbox, form, options menu, grid, query, note, soft notification and settings page
- **Control pane**—soft keys and scrolling indicator

Avkon builds on and extends the framework and controls provided in the generic Symbian Uikon library and a version of the Standard Eikon library (from Symbian) modified for Series 60 by Nokia.

Each GUI application is then based on framework classes provided as part of the Avkon library and on the UI layers below that—for example, in Uikon. The majority of Series 60 user interface elements are based on standardized controls provided by the UI libraries or as specific custom controls provided by the developer. The Series 60 GUI library determines the rendering of all GUI elements, so the individual applications share a common look and feel.

As much as 80 percent of the code for an application may be contained in the application engine, which, if it is well designed, should contain no UI code. The UI may account for only 20 percent of an application's code base, and it can share components and services from all Symbian generic and Avkon elements.

History of Series 60

Series 60 Platform is a smartphone software package developed by Nokia for use in its own smartphone products, but also to be licensed by other device manufacturers for use in their own smartphone designs. An integrated suite of

applications, built upon personal information management, multimedia, rich communication, messaging, downloading and browsing, enhances the complete software platform.

Series 60 software can be used as supplied, or, more commonly, the "look and feel" is customized to a manufacturer's required specifications. A graphical interface is used throughout the system and by the wide range of wireless applications provided.

The success of Short Messaging Service (SMS) is a good example of what happens when an easy-to-use application is widely available on terminals from different manufacturers and on several interconnected networks. Its widespread adoption has created a larger unified SMS application market that feeds its own growth.

Series 60 Platform was created for a similar unified market to ensure that a wide variety of applications, all based on a common smartphone platform, are available across multiple terminals from many different manufacturers. A potentially very large application market will result in increasing the adoption of new mobile services, enabling the creation of a new category of smartphones, boosting the market still further. As result a significant new ecosystem is now developing around Series 60, including Independent Software Vendors, Series 60 Licensees, Competence Centers, Contractors, Mobile Network Operators and others.

Developing for Series 60 Platform

Series 60 was originally designed for one-hand-operated smartphones; based around a large color screen and an intuitive user interface (UI). By using standard technologies and open standards it ensures interoperability between different terminal and infrastructure manufacturers. Besides Nokia Mobile Phones, many other major terminal manufacturers are using Series 60 Platform and Symbian OS under license to produce exciting new devices, including Siemens, Sendo, Samsung, and Panasonic (Matsushita).

Series 60 includes ready-to-run applications that hardware manufacturers can incorporate in their Series 60 devices. These applications illustrate the possibilities of the platform, but they also guide developers in designing software that complies with the user interface style. Some of the applications provide public APIs for accessing their services from other applications. For example, the Phonebook application has a service (view switching) for displaying a list of contacts; the Photo Album application has a service for finding images; and the Messages application has a service for sending emails.

Series 60 fully supports installing and running applications designed natively for Symbian OS. The installation file format used is the Symbian-specified ".sis" format. Applications can be downloaded via the browser, email, file transfer by IrDA or Bluetooth, or added via a PC connection through an IrDA or a Bluetooth connection.

The mobile phone device market is opening up for software application developers and content creators. Creating an application, downloading it to a phone, and connecting it to the world provides a new business opportunity for the software industry. Investing in a standards-based platform, which enables deployment of the same software on different types of phones and communicators, is a priority for software companies. Series 60 has been designed to ensure a safe investment in creating applications for this new mobile software market.

Developers have the freedom to create applications for a single platform available on phones from multiple manufacturers in a larger unified application market. More applications lead to greater platform adoption, which in turn leads to more devices, thus enlarging the market for everyone.

Forecasts, from several trusted industry sources, predict that during 2007, around 200 million smartphones will be shipped to customers—and by then the total number of Symbian OS based devices in use will be about 500 million. It is expected that Symbian OS will have by far the largest market share in smartphone Operating Systems.

Developing applications for a platform that originates from mobile technology and Internet standards facilitates interoperability. Freedom to create products and services for mobile phones by using, C++, Java™, multimedia messaging, and other popular technologies opens up new markets, such as entertainment and multimedia, and extends existing market opportunities into areas such as handset to corporate back-end system connectivity.

C++ Development

Each version of Series 60 Platform provides its own specific C++ SDK based on the relevant version of a Symbian OS SDK. The APIs that are provided enable third parties to develop Series 60 applications for inclusion in new Series 60 terminals or to be distributed as value-added, after-market applications.

Symbian OS is written largely in C++; the language therefore represents a strong development choice for third parties. The Series 60 SDK provides documentation, tools, and sample code to assist developers, along with a Microsoft Windows-hosted emulator (see Figure I-6). The SDK is essential for developing, testing, and debugging C++ applications.

Although C++ development is typically more complex than Java™ MIDP development, the advantages more than outweigh the additional effort required. Almost all of the device's capabilities are directly accessible to C++ developers. Creating native Series 60 applications gives the developer access to the Symbian OS APIs, to the Series 60 UI libraries, and to a number of exported application views and a variety of application engines (for example, Contacts, Calendar, PhotoAlbum). Native applications provide better performance. They can take full advantage of a multitude of functions provided