

Symbian 2007



## Untangling the Idioms: Eliminating the “Accidental Complexity” of Native Symbian C++

Jo Stichbury

Technical Editor, Symbian Press

**symbian**



## Introduction

- Technical Editor for Symbian Press.
- Previously with Nokia N-Gage™ Developer Support.
  - .... Working with games developers to create titles for the N-Gage™ Platform (and, previously, the gamedecks).
- Also Sony Ericsson, Symbian and Psion Software.





# What to expect...

- Symbian, Symbian OS and C++ on Symbian OS
  - .... Symbian OS and its dialect.
- P.I.P.S. and Open C - Erik Jacobson
  - .... What it is and what it isn't.
  - .... Examples of its use.
- Making Games Mobile
  - .... Why games are going mobile.
  - .... P.I.P.S. and Open C help games developers convert to Symbian OS.
- The N-Gage Platform
  - .... An overview.
- Conclusion and Discussion.



# Symbian OS and C++ on Symbian OS

- Some Facts
- History of Symbian and Symbian OS
- UI Platforms: FOMA, S60, UIQ
- Development on Symbian OS



## A Brief History: Before Symbian, Psion

- Established in 1980 to develop games and software for the Sinclair ZX81 and ZX Spectrum:
  - ... Flight simulator, "Horace Goes Skiing", Psion Chess, Space Raiders and other games.
  - ... Psion Chess for the ZX81 took 1K memory

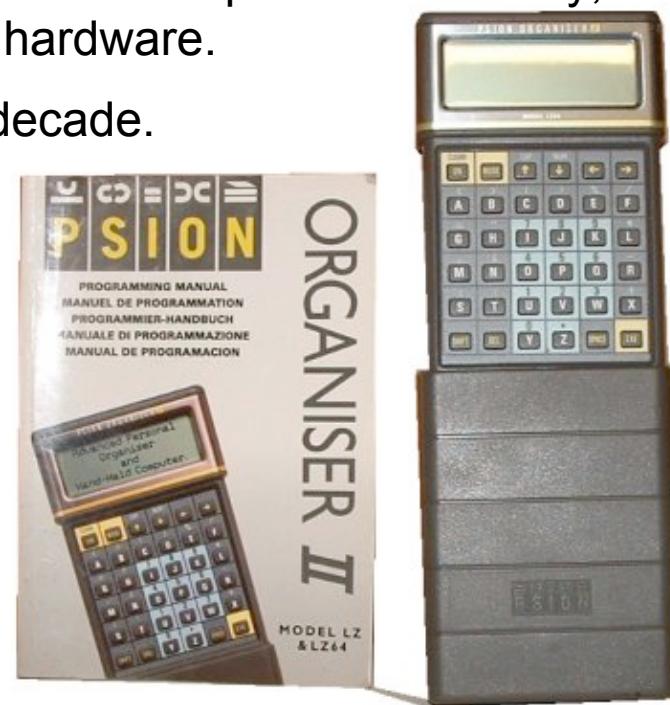


- Office suite for the Sinclair QL (1983).



## Psion: Hardware

- Mid '80s - Hardware
  - ... 8 bit Organiser (1984) - 14cm x 9cm, 2K RAM, 4K ROM, 8K datapak, 6 months battery life!
  - ... Organiser II (1986) - the world's first proper PDA.
  - ... Organiser II variants were created: up to 64K memory, 4 line screen resolution, add-on hardware.
  - ... Half a million sold over a decade.





# The Early History of Symbian OS

- 1989 - MC400 laptop
  - .... 16 bit “EPOC” Operating System - multi tasking, GUI, built-in apps.
  - .... Exceptional power management, screen technology
- 1991 - Series 3, 1993 - Series 3a, 1996 Series 3c/Siena, Series 3mx
  - .... Clam shell organisers, built in apps, OPL, up to 2MB memory.
  - .... Built on EPOC.
  - .... Over 1.5 million units sold.
- 1997 - Series 5
  - .... 32 bit OS “EPOC32” (EPOC -> EPOC16 -> SIBO).
  - .... Slide out QWERTY keyboard, touch screen, 4MB/8MB
  - .... Implemented using C++.
- Acknowledgement: “The History of Psion” - Steve Litchfield  
<http://3lib.ukonline.co.uk/historyofpsion.htm>



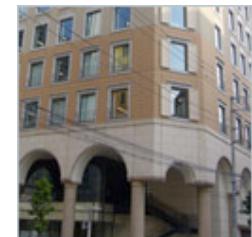


# Symbian, Symbian OS and the first Smartphones

- 1998 - Symbian formed by Psion, Nokia, Ericsson and Motorola
  - ... Matsushita joined in 1999, Sony Ericsson & Siemens in 2002, Samsung in 2003.
  - ... Motorola share in Symbian were sold back in 2003; Psion shares were sold back in 2004.
- EPOC32 was later renamed to Symbian OS, though vestiges remain.
- First Symbian OS phone was released in 2000 (Ericsson R380); Nokia 9210 Communicator released in 2001 - this was the first “open” phone.
- 2.5G phones followed in early 2002 (Nokia 7650).
- 3G phones in December 2002 (3G FOMA F2051 from Fujitsu).
- Other notable milestones
  - ... EKA2 (EPOC Kernel Architecture 2) was announced in 2004.
  - ... Secure Platform introduced in Symbian OS v9 in 2005.



# Symbian Today (April 2007)



- Approximately 1500 employees
- Shareholders:
  - ... Ericsson (15.6%)
  - ... Nokia (47.9%)
  - ... Matsushita (10.5%)
  - ... Samsung (4.5%)
  - ... Siemens (8.4%)
  - ... Sony Ericsson (13.1%)

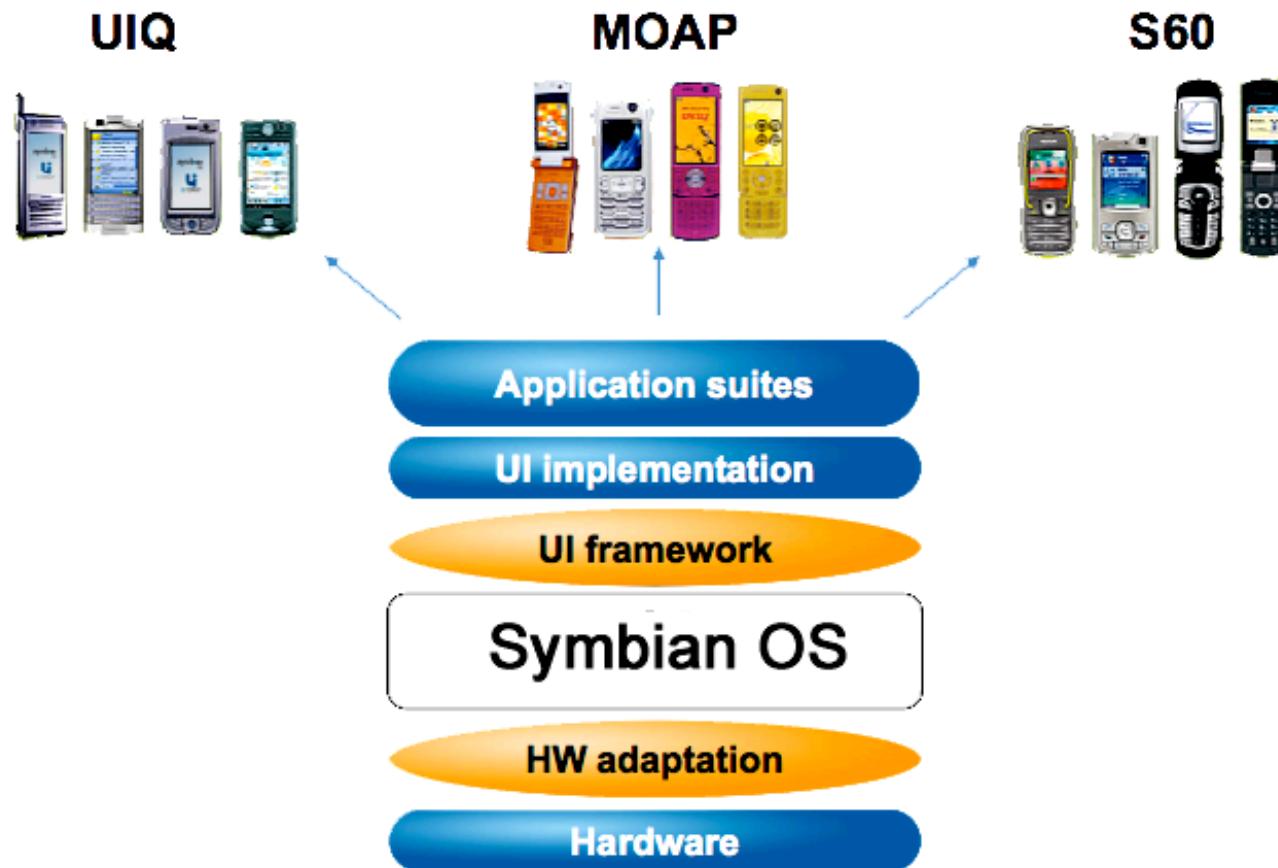


# UI Platforms

- Range of devices from different manufacturers with different requirements, form factors, capabilities...
- Various UI platforms run on top of Symbian OS:
  - ... S60 from Nokia
  - ... UIQ from UIQ Technology (now part of Sony Ericsson)
  - ... NTT DoCoMo's MOAP user interface for the FOMA™ 3G network in Japan.
- The platforms provide the GUI and extend the applications and middleware provided by Symbian.
- Each platform has a different look and feel, and is designed to support the characteristics of the handsets which use it.



# UI Platforms





## UI Platforms: S60

S60 Open to new features

- Nokia's main smartphone platform
  - ... Also licensed by Lenovo, LG, Panasonic, Samsung and Siemens.
  - ... Nokia also have the Series 40 platform (featurephones - not based on Symbian OS) and Series 80 (based on Symbian OS).
- Designed for one-handed use
  - ... Input through two soft keys, numeric keypad and 4 way controller.
  - ... No touch screen.
- Open platform (more of this shortly).
- More information at [www.S60.com](http://www.S60.com)





## UI Platforms: S60

S60 Open to new features





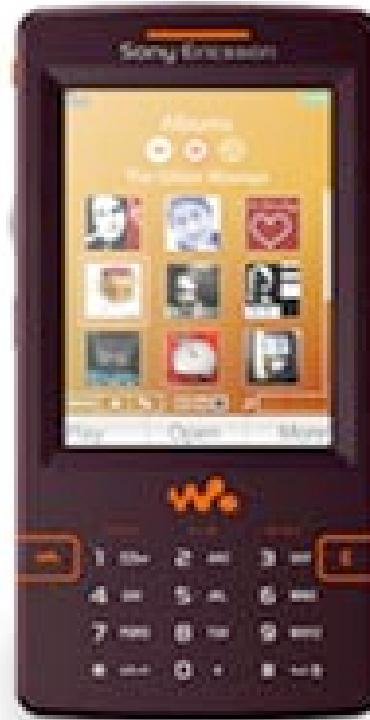
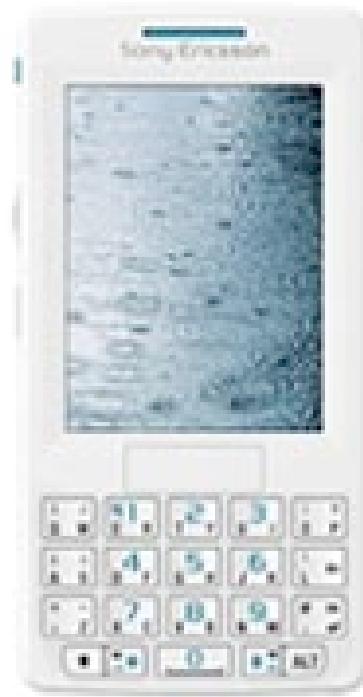
# UI Platforms: UIQ



- Acquisition by Sony Ericsson was completed in February 2007.
  - ... Previously a subsidiary of Symbian Ltd (named UIQ Technology AB in February 2002).
- The platform used for Sony Ericsson Smartphones.
- It is also licensed by Arima, BenQ and Motorola.
- Designed for two handed use
  - ... Input through soft keys, numeric keypad and 4 way controller or through touch screen (virtual keyboard, handwriting recognition and interaction with controls).
  - ... Latest version also supports one handed use as seen in Motorola RIZR.
- Open Platform.
- More information at [www.UIQ.com](http://www.UIQ.com)



# UI Platforms: UIQ





# UI Platforms: FOMA

- NTT DoCoMo is the largest operator in Japan.
  - ... FOMA™ 3G network (“Freedom of Mobile Access”).
  - ... UI is internally named MOAP (“Mobile Oriented Application Platform”)
  - ... Supported by two platforms: Symbian OS and Linux.
- Symbian OS phones first shipped in 2002.
- On Symbian OS, the FOMA manufacturers are
  - ... Fujitsu, Sharp, Mitsubishi and Sony Ericsson.
- Closed Platform (no aftermarket native C++ apps can be installed).
  - ... Allows BC breaks when necessary.
- Typically the most technologically advanced hardware (first TV phones, first GPS phones).





# UI Platforms: FOMA





## UI Platform Versions

- First S60 phone: Nokia 7650 in 2002
  - ... S60 3.2 announced Feb 2007 based on Symbian OS v9.3
- First UIQ phone: Sony Ericsson P800 in 2002
  - ... UIQ 3.1 announced Feb 2007 based on Symbian OS v9.2
- First FOMA phone announced in 2002
  - ... 3G FOMA F2051 from Fujitsu
  - ... Most recent phones use Symbian OS 8.1b (EKA2 without platform security - unnecessary in a closed phone).



# Context

1980

Games DOS Software

Hardware

1998

Mobile Operating System for Smartphones

Performance optimisation

Efficiency of Scale  
Power Management  
ReliabilityPlatformisation  
Reuse (frameworks)  
Rapid Evolution

Z80 assembler

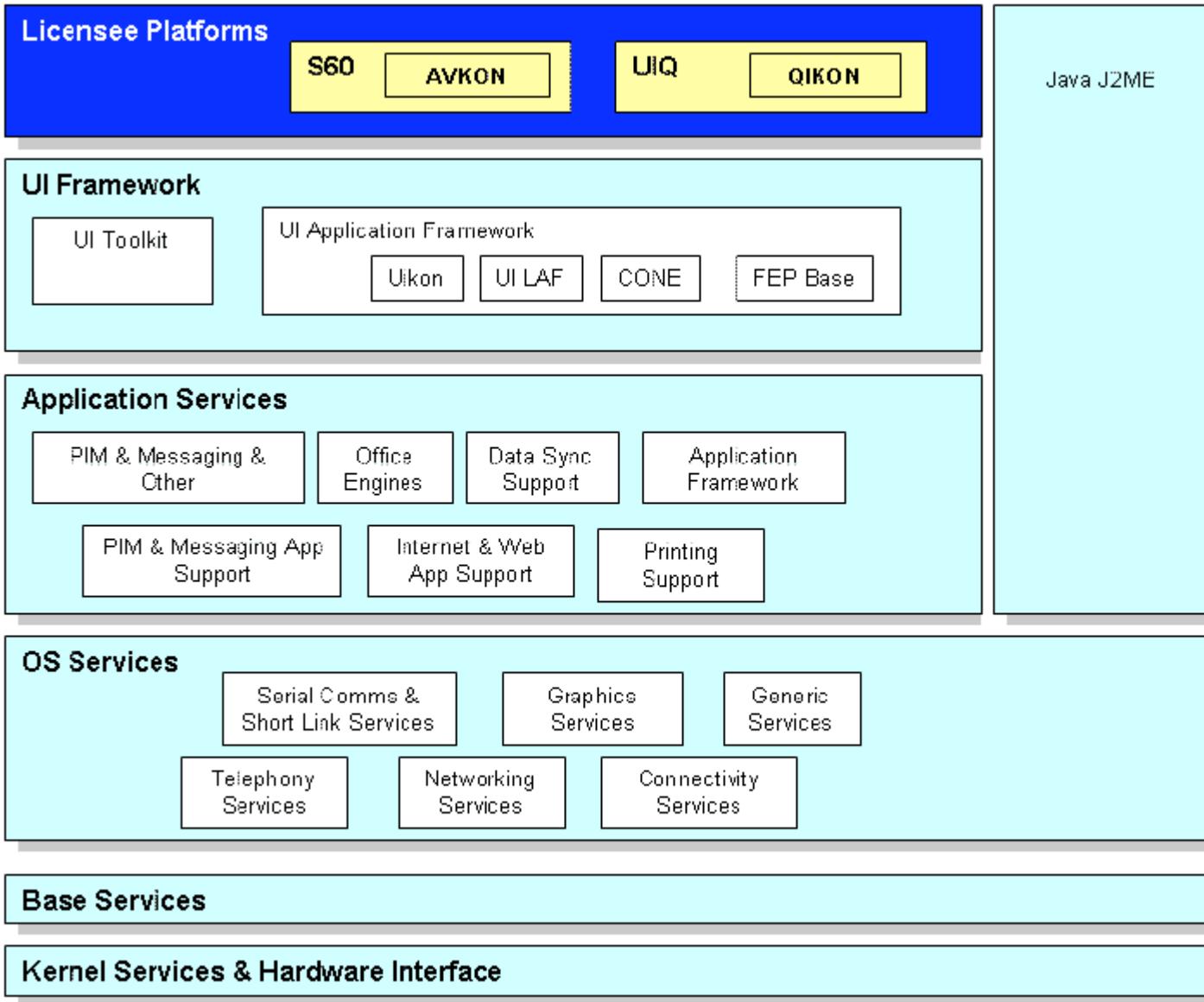
C, object-based  
design with C

C++, OOP, OOD





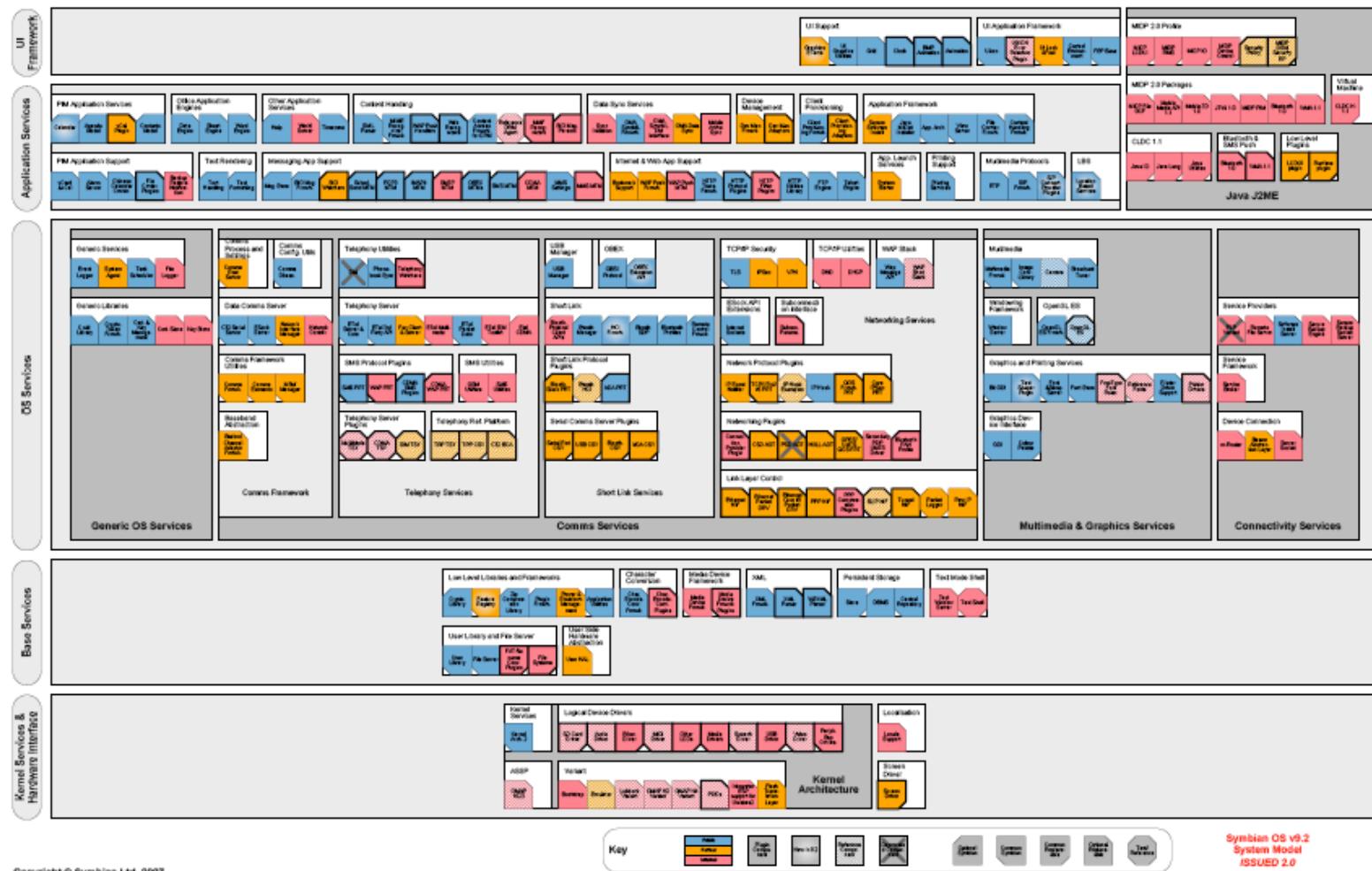
# Symbian OS Architecture





# System Model

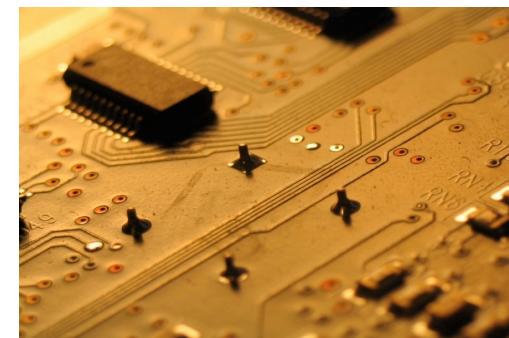
[http://developer.symbian.com/main/oslibrary/sys\\_models/index.jsp](http://developer.symbian.com/main/oslibrary/sys_models/index.jsp)





# Requirements

- Symbian OS was driven by factors such as:
  - .... Power sources (battery lifetimes)
  - .... User responsiveness
  - .... “Always on”
  - .... Limited resources (RAM, ROM)
  - .... Reuse and customisation through frameworks.
  - .... Reliable data storage
  - .... Openness





# C++ on Symbian

- C++ for Symbian OS was also influenced by the point in time at which the OS was developed:
  - .... In 1994 - C++ was still evolving; it had not yet been standardised
  - .... This affected the take-up of some of its later features:
    - .... Templates
    - .... Exceptions
    - .... Namespaces
    - .... New casts
    - .... Boolean types
  - .... Some were not supported by the toolchain or were immature.
- Idioms were invented to fix omissions: leaves, cleanup stack, descriptors.
- Certain patterns of use were not adopted because C++ was explicitly intended as a systems language; not optimised for small, low memory, low power devices: e.g. templates.





# Symbian C++ Idioms: Some Examples

- John Pagonis has already presented some of these
  - .... and the evolution of Symbian OS to present (almost) modern ISO standard C++ for some of them
- Descriptors.
- Active Objects.
- Leaves/TRAPs and the cleanup stack.
  - .... Standard C++ exception mechanisms are now available.
- No writable static data in DLLs.
  - .... Possible (if not encouraged) in EKA2.
- Functions exported from DLLs by ordinal only.
  - .... Lookup by name supported from Symbian OS v9.3.





## No Writable Static Data in EKA1 DLLs

- In EKA1, non-constant globally scoped data was not allowed in DLLs.
  - ... No separate writable data section.
- Always supported in EXEs...but prior to EKA2, applications were DLLs.
- Caused problems for code ported from other operating systems which may often contain large amounts of static data.
- Techniques to work around it
  - ... Thread Local Storage.
  - ... Moving global variables into classes.



# Writable Static Data (WSD) in EKA2 DLLs

- EKA2 makes possible, but it's not encouraged.
  - .... Expensive in terms of memory
    - .... Uses at least 4K per process (one chunk) regardless of the memory needed.
    - .... Chunks are finite (limited to 16 per process to ensure real-time behaviour).
  - .... Limited emulator support
    - .... a DLL can only be loaded into a single process
    - .... one copy for the entire emulator.
- Disabled (for hardware builds) by default.



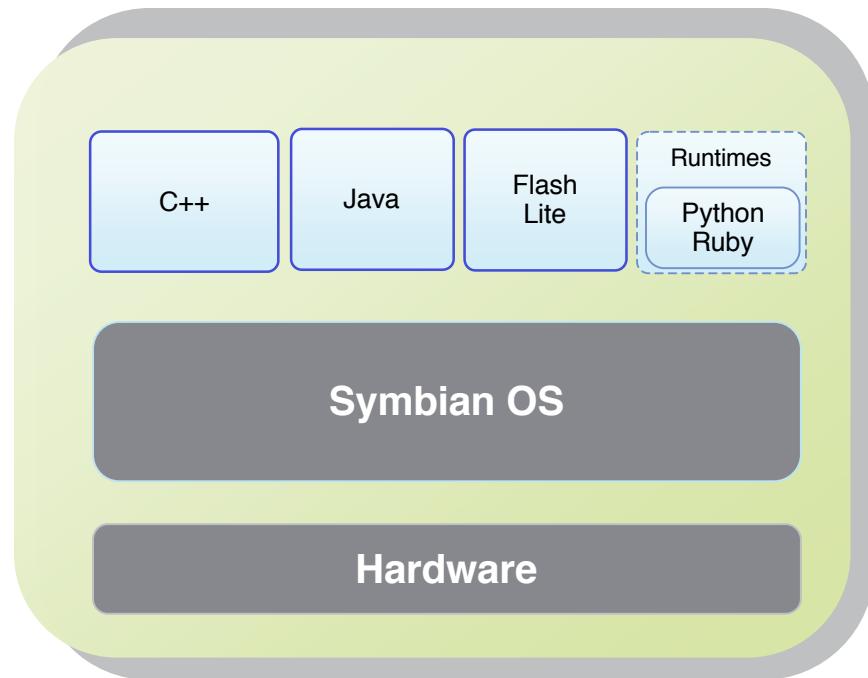
# Symbian OS: An “Open” Platform

- Software can be deployed to Symbian phones (a certification program, “Symbian Signed”, guarantees a level of quality and identifies the creator).
  - .... Unlike many traditional embedded phone operating systems, which cannot accept any aftermarket software at all (with the exception of Java applications).
  - .... Symbian OS C++ APIs are publicly documented and available to third party developers (through platform SDKs).
  - .... Symbian OS supports open standards such as those developed by the Open Mobile Alliance (OMA).
- Note that Symbian OS isn’t open inasmuch as the source code for the platform is not available to the public
  - .... Although much of it is provided to phone manufacturers and other partners in the form of “custkits”.



# Development on Symbian OS

- C++
- Java
- Flash Lite
- Runtimes such as Python, Ruby, Visual Basic
- OPL





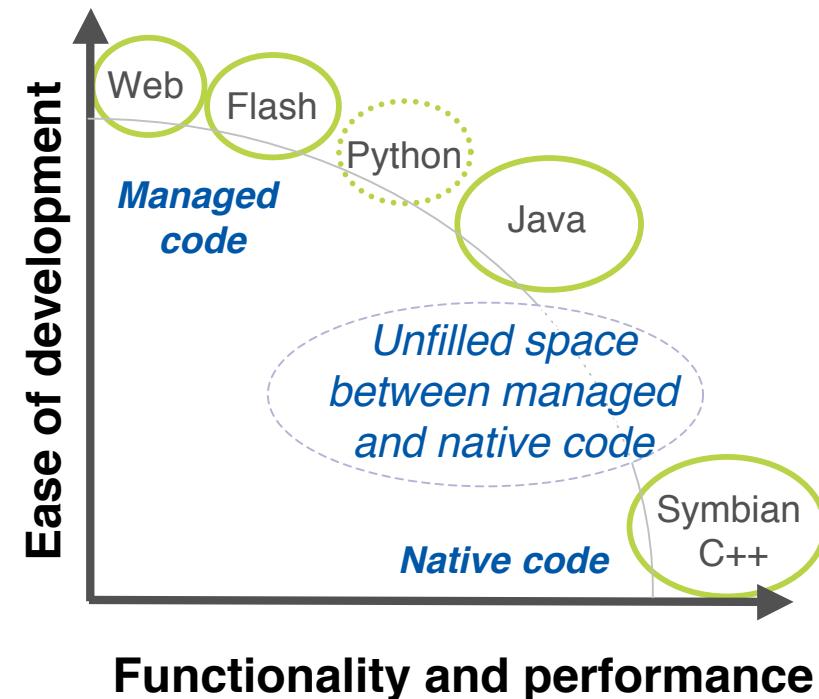
# The perception of native Symbian C++

- Symbian C++ has traditionally been seen to have a steep learning curve
- Developer productivity can be slow at first
- Experienced Symbian OS developers are hard to find and their skills are difficult to verify
  - .... Symbian Academy is now introducing Symbian C++ to universities by providing course materials for use in their courses.
  - .... The Accredited Symbian Developer scheme addresses the issue of determining a developer's proficiency and/or training needs.
- Code must often be re-architected and re-written when porting to Symbian OS
  - .... Conversion is not always straightforward.



# Easier, Faster, More...

- Symbian C++ is as it is.
- This is what has made it a success...
- Now is the time to make it easier to work on the platform
  - ... Familiarity for more C/C++ developers (those who are accustomed to a standardised language).
  - ... Ease conversion of code written for other platforms to run on Symbian OS.



# Symbian 2007



## P.I.P.S. Is POSIX on Symbian OS

Erik Jacobson

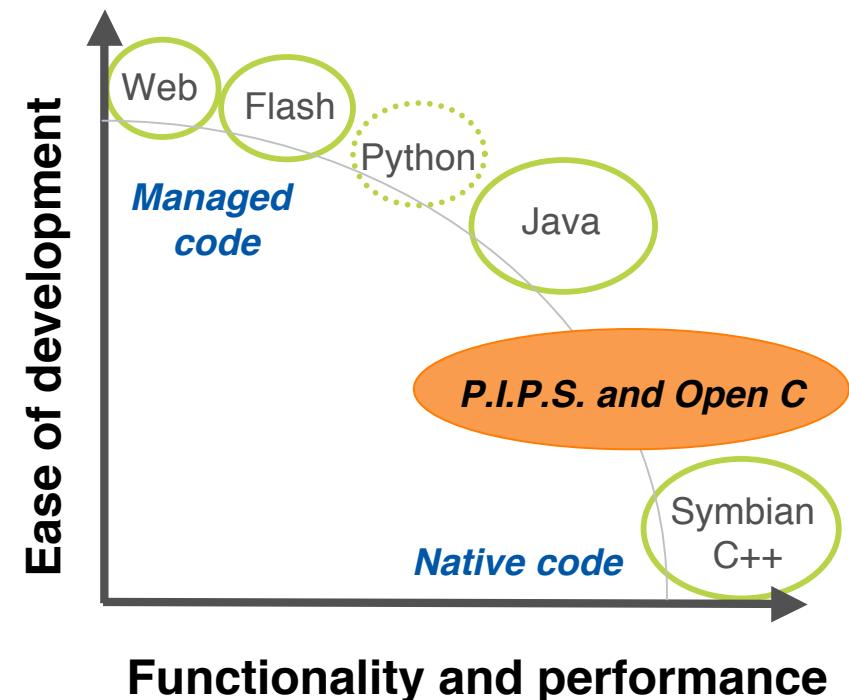
Product Manager, Symbian

**symbian**



# Easier, Faster, More...Again

- Symbian C++ is as it is.
- This is what has made it a success...
- Now is the time to make it easier to work on the platform
  - ... Familiarity for more C/C++ developers (those who are accustomed to a standardised language).
  - ... Ease conversion of code written for other platforms to run on Symbian OS.





# Games Conversions

- Games are often converted from the original target platform to others.
- A title may be published for
  - ... console (e.g. PlayStation, Xbox)
  - ... PC
  - ... handheld (e.g. PlayStation Portable, Nintendo DS)
  - ... mobile phone.
- Design and code modifications are needed for each form factor (e.g. graphics, input, differences in hardware capabilities) and recompilation is needed for each platform...
- ...but some of the codebase remains common
  - ... game engines (AI, physics).
  - ... custom 3D graphics libraries.



## P.I.P.S. is Good For Games

- Games written in C and C++ are good candidates for porting to Symbian OS using P.I.P.S. and Open C.
- Games on Symbian OS are usually UI-agnostic
  - .... Games typically require fast and frequent screen updates (20 FPS or better).
  - .... Native C++ games use a generic class from Symbian OS to draw directly to the screen.
  - .... This means little or no UI platform specific code for the game play and menu graphics.
    - .... No standard controls are used.
    - .... Look and Feel is not specific to a specific mobile UI platform.



# Games Developers and Symbian OS

- Games developers aren't necessarily Symbian experts
  - ... they're experts at writing games or games engines
- If the game is a conversion to mobile, code re-use is desirable.
- Games developers may not have time to climb the learning curve
  - ... games are written on tight deadlines - the schedule may be unslippable.
  - ... Release dates may be tied to movie release dates, football season start dates, or dictated by the publisher.
- Games developers may simply be too tired to climb the learning curve!
  - ... The games industry is notorious for demanding long hours... Sometimes 80 hour weeks at "crunch time".

# Why Convert Games to Mobile?



- The number of mobile games sold in 2006 was expected to outstrip the number of games for consoles and handheld systems combined...
  - .... and to continue to grow to double the number by 2009.
- It is estimated that 250 million smartphones will be in circulation by 2008.
  - .... This is a huge potential market compared to the number of consoles.
  - .... The industry is expected to be worth 6.1 billion USD in 2010

(Sources: IDC, Montgomery, Nokia, iSuppli)



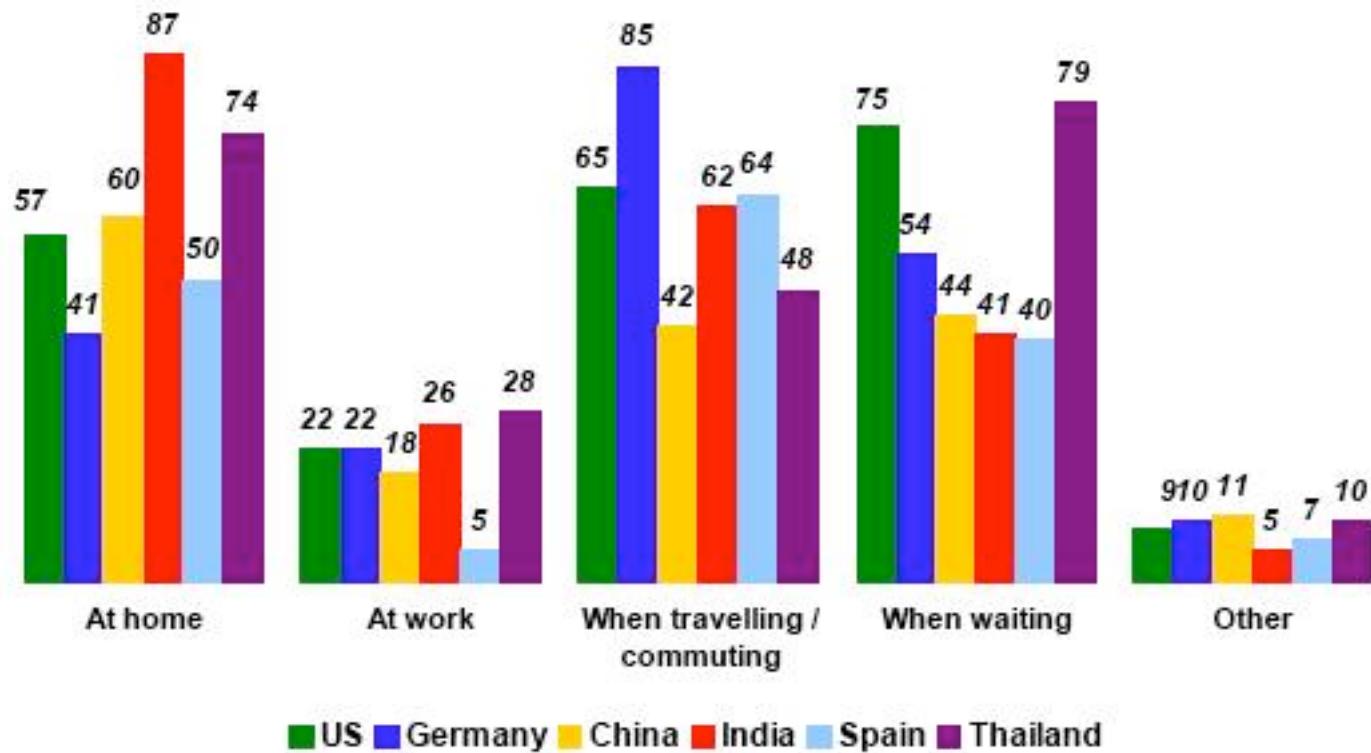
## Why Are Mobile Games Popular?

- They're mobile.
- They are necessarily more simple than a console game
  - ... Casual games - fun for frequent, short play durations.
  - ... One button games or simple controls.
  - ... Potential for different gamer profiles.
- Popular despite some obvious limitations
  - ... Physical: Screen size, input controller, graphics capabilities...
  - ... Distribution: Download size, where and how to buy them?



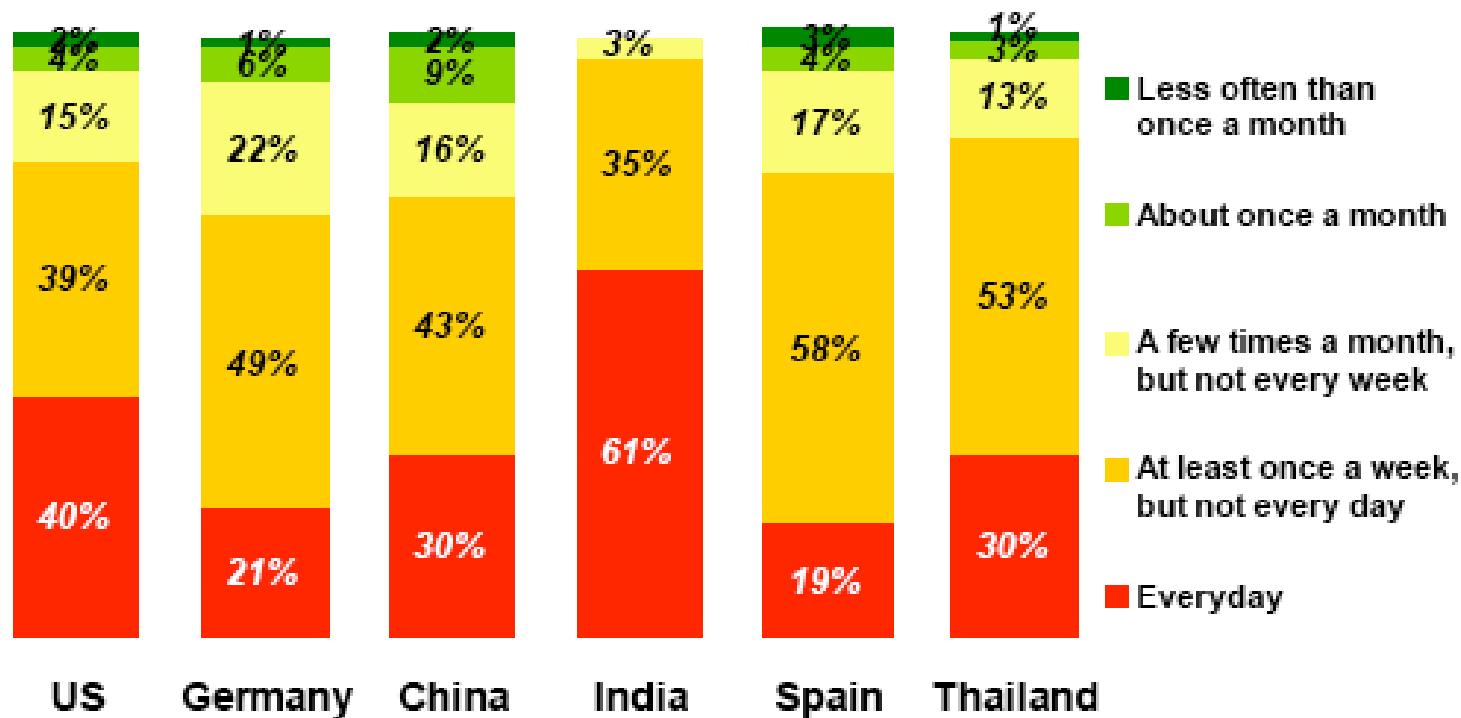
## When do you play a mobile game?

- Source: Nielsen Entertainment survey “Evolution of Mobile Gaming: Exploring worldwide mobile gaming habits”, Forum Nokia, 2006.



# How Often Do you Play a Mobile Game?

- Source: Nielsen Entertainment survey "Evolution of Mobile Gaming: Exploring worldwide mobile gaming habits", Forum Nokia, 2006.





# Why Mobile Games on Symbian OS Smartphones?

- Device Convergence makes it enjoyable. High end Symbian OS smartphones have
  - ... high resolution screens
  - ... hardware graphics acceleration
  - ... fast processors.
- Network connectivity is a relatively recent introduction for console games, but a basic feature of mobile devices.
  - ... Bluetooth and WiFi enabled for local multiplay
  - ... Remote networking over the phone network or WiFi for remote multiplay.
- Hardware support: Cameras, SMS, MMS, Location Based Services, accelerometers etc open up new possibilities.
- Why not? You can do everything else with your “Multimedia Computer”?!



## Why Mobile Games Written in C/C++?

- Why not just use J2ME?
- C/C++ enables rich, high-performance games
  - ... gives better speed for the same processing power
  - ... gives more control over the UI
  - ... gives direct access to the phone hardware



## Summary

- Games are often designed for conversion between platforms.
- Mobile games are popular worldwide.
- Mobile games need to be written in C/C++ to create the highest quality gaming experience.
- Mobile games on Symbian OS can take advantage of the platform.
- P.I.P.S. and Open C ease conversion by allowing greater code re-use for game engines.



# The N-Gage™ Platform

- The N-Gage™ Platform is Nokia's platform for Next Generation Mobile Gaming.
  - ... Successor to the N-Gage and N-Gage QD Gamedecks.
  - ... Games run across a range of Nokia S60 3rd edition devices.
- An end-to-end experience to discover, buy and play.
- Rich content games written in C/C++.
- 2D or 3D graphics.
- Social connected games
  - ... Network multiplay using the N-Gage Arena.



# N-Gage™ and N-Gage QD Gamedecks





## Historical Context

- N-Gage and N-Gage QD gamedecks were gaming-centric phones.
  - ... N-Gage shipped in October 2003.
  - ... based on S60 1st Edition (Symbian OS v6.1).
- Games were created mostly by “first party” developers, driven by internal producers and published by Nokia.
- Developers used Symbian C++ idioms.
- The development process was controlled by Nokia.
- IP was mostly owned by Nokia.
- Games were distributed shrink-wrapped on MMC.
  - ... Some games now available for internet purchase.
- 50+ games shipped between October 2003 and 2006.





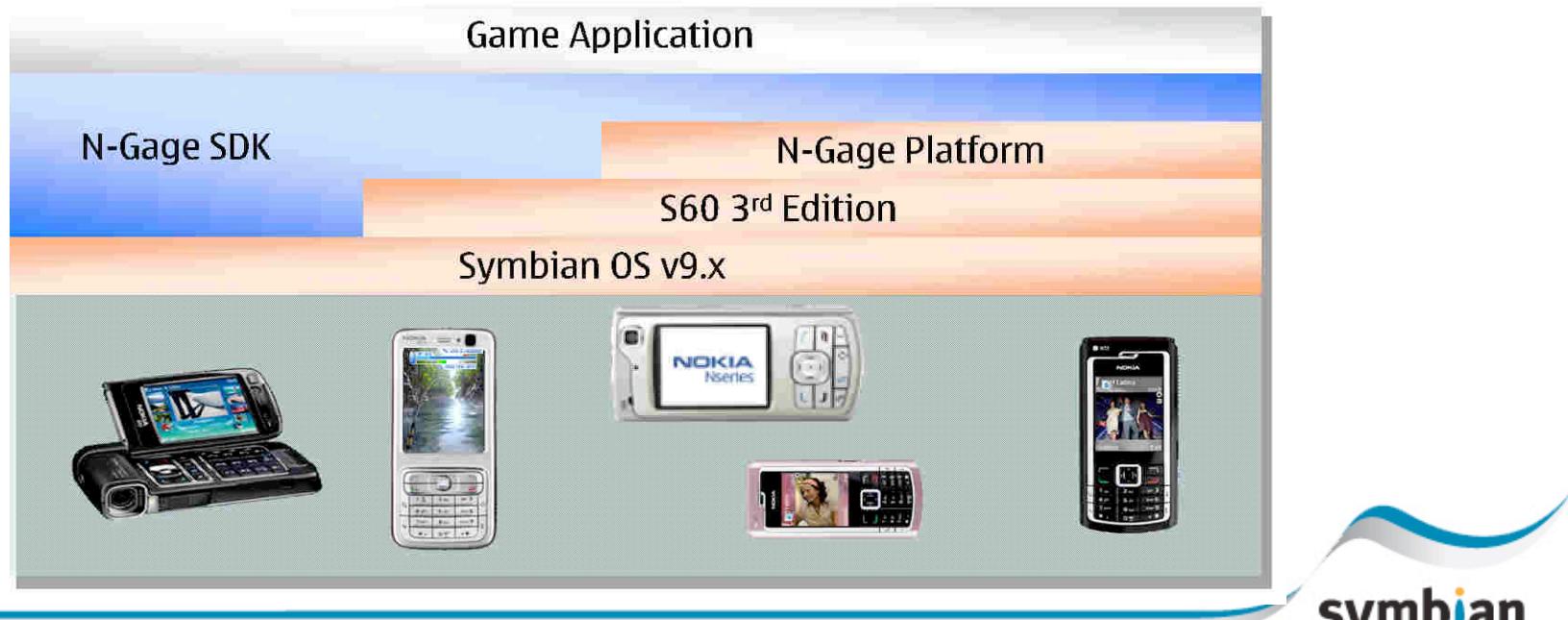
# N-Gage™ Platform

- Puts rich content games on a range of S60 smartphones.
  - .... The devices that will be “N-Gage enabled” have not yet been announced.
- Some games to be created by first party developers but emphasis is on a third party development model.
  - .... Announcements from EA, Gameloft, Glu Mobile, Indiagames and THQ Wireless.
- Familiar C/C++ APIs instead of Symbian C++.
- Games available for download OTA, OTI.
- The N-Gage Platform is expected to launch in the autumn of 2007.



# Hardware Independence

- The platform abstracts the hardware differences presented by a range of different phones.
  - .... Differences existed even between just 3 N-Gage gamedecks!
  - .... Hardware differences (e.g. screen resolutions, audio capabilities) and software differences (e.g. S60/Symbian OS versions) could potentially cause significant fragmentation issues for games.





# One SKU: Forward and Backward Compatibility

- The N-Gage Platform guarantees compatibility for N-Gage enabled devices.
  - ... One game SKU to run across a range of different phones.
  - ... Buy a game at N-Gage launch and it will run on a new N-Gage enabled phone next year.
  - ... Buy a game next year and it will run on a N-Gage enabled phone released this year.
- Devices may be split into different classes as time progresses
  - ... Technologies move on (processors, screens, graphics etc).
  - ... “Launch class” devices currently have a well-defined set of terminal requirements.



# How?

- APIs are defined as interfaces.
- Implementation is supplied in polymorphically loaded DLLs.
  - .... built-in to the phone platform or delivered by download when a game is purchased.
  - .... Allows for device-specific or bug fix patching.
- Developers work with reference devices.
- Nokia run a suite of standard tests on the SDK implementation libraries for every N-Gage enabled handset to ensure standard behaviour.



# N-Gage™ Platform Device Services





## Familiar C++

- The APIs are provided for C/C++ developers who are not familiar with C++ on Symbian OS.
  - ... Extends the initiative of P.I.P.S and Open C.
- The device services shown previously can be accessed without the need to know about
  - ... descriptors - they can use C strings.
  - ... active objects - notification through callbacks instead.
  - ... leaves - standard exception handling is used.
  - ... unfamiliar naming conventions associated with cleanup behaviour.
- Easier title conversions
  - ... Progress is faster, with fewer developer resources.
  - ... Fewer bugs.



## Additional Features

- Games available for download OTA, OTI.
  - .... Acquisition of demos, purchasing, management through an application embedded on the phones.
- Software Services libraries to enable
  - .... DRM content protection and consumption.
  - .... The N-Gage Experience - community features such as gamer profiles, multiplay, chat.
- The N-Gage Platform provides these to the developers
  - .... to ensure a consistent experience for the user.
  - .... to facilitate game creation.

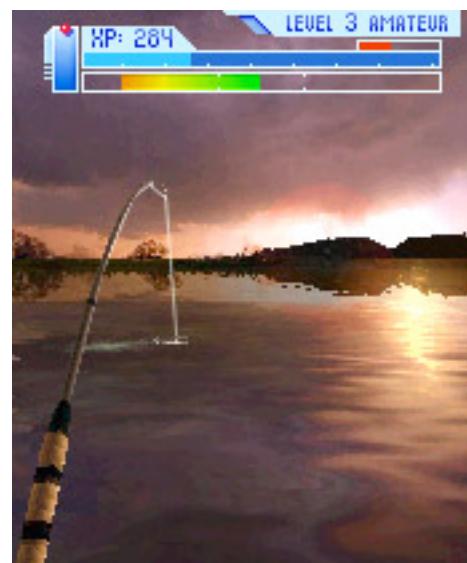
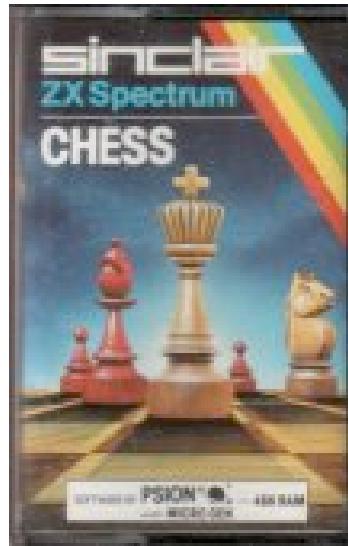


# N-Gage™ Platform Software Services





# Psion Chess → N-Gage™ Platform



# Summary

- Symbian OS and C++ on Symbian OS
  - ... Why it is as it is
- P.I.P.S. and Open C
  - ... P.I.P.S. Is POSIX on Symbian OS
- Making Games Mobile
  - ... Conversion targets
- The N-Gage Platform
  - ... Next Generation Mobile Gaming



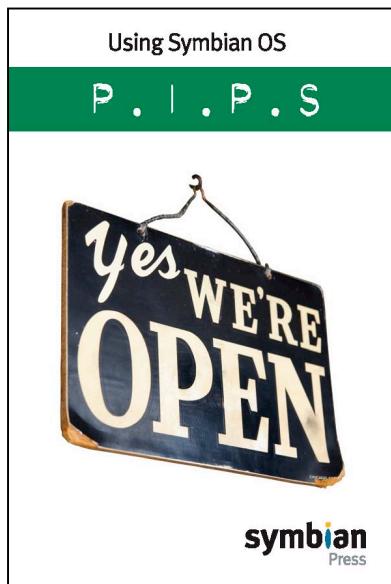


# More Information

- Symbian
  - ... <http://www.symbian.com>
  - ... <http://developer.symbian.com>
- P.I.P.S.
  - ... <http://developer.symbian.com/wiki/display/oe/P.I.P.S.+Home>
- Open C
  - ... <http://forum.nokia.com/openc> <http://www.nokia-openc.com>
- S60
  - ... <http://www.s60.com>
  - ... <http://forum.nokia.com>
- UIQ
  - ... <http://www.uiq.com>
  - ... <http://developer.uiq.com>
- N-Gage
  - ... <http://www.n-gage.com>



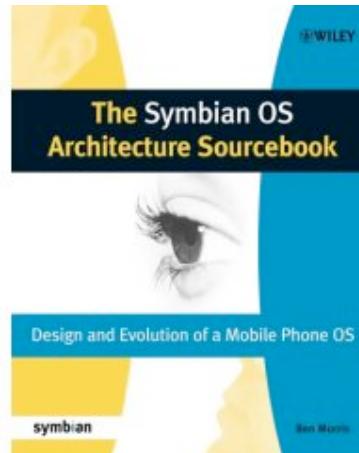
# symbian press



## P.I.P.S.

An introduction to what P.I.P.S. is and how to use it to develop software for Symbian smartphones. The booklet contains a guide to creating your first P.I.P.S. application – the ubiquitous ‘HelloWorld’

**FREE**



## The Symbian OS Architecture Sourcebook

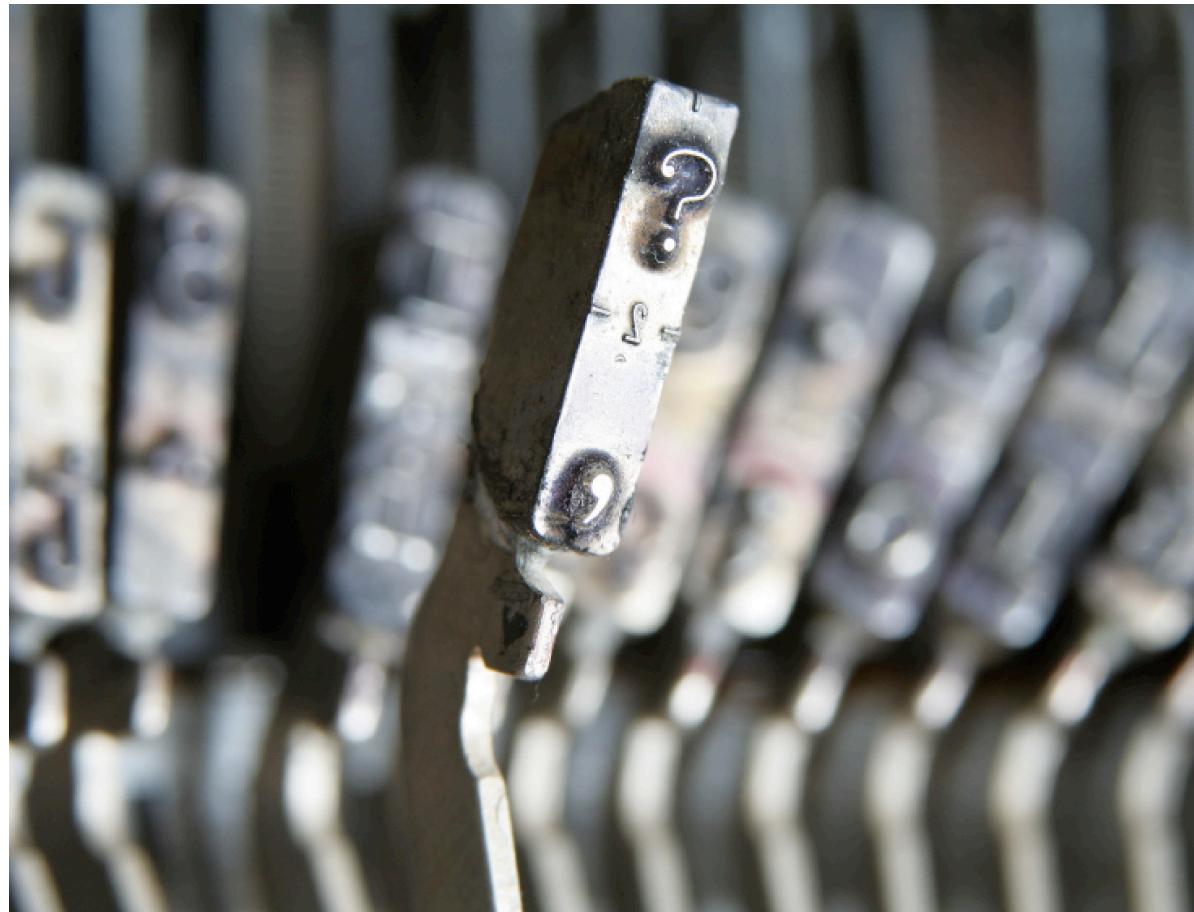
A new book, coming soon from Symbian Press, which discusses the design and evolution of Symbian OS. Packed full of insight, it provides the background to the decisions which shape Symbian OS as we know it today.



For information on other Symbian Press titles visit [www.symbian.com/developer/books](http://www.symbian.com/developer/books)



# Questions and Discussion



[jo.stichbury@meme-education.com](mailto:jo.stichbury@meme-education.com)

