Symbian OS as a Research Platform

Present and Future

Lawrence Simpson
Research Department
Symbian

Symbian Platform

Symbian OS is a separate platform, specifically designed for mobile & convergent devices.

Not an adaptation of Unix or Windows or ....

Symbian OS has facilities to support

- Small (memory) footprint

- Low power consumption

- High reliability

- "Always on", but must deal with unplanned shutdown

- Diverse range of hardware

- Diverse manufacturers – multiple UIs and multiple brands

Different UIs on the same underlying system

Series 60 (S60)

- Provided by Nokia.

- Used by Nokia & S60 licensees.

- Originally a keypad-based UI ... now supporting touch-screen variants.
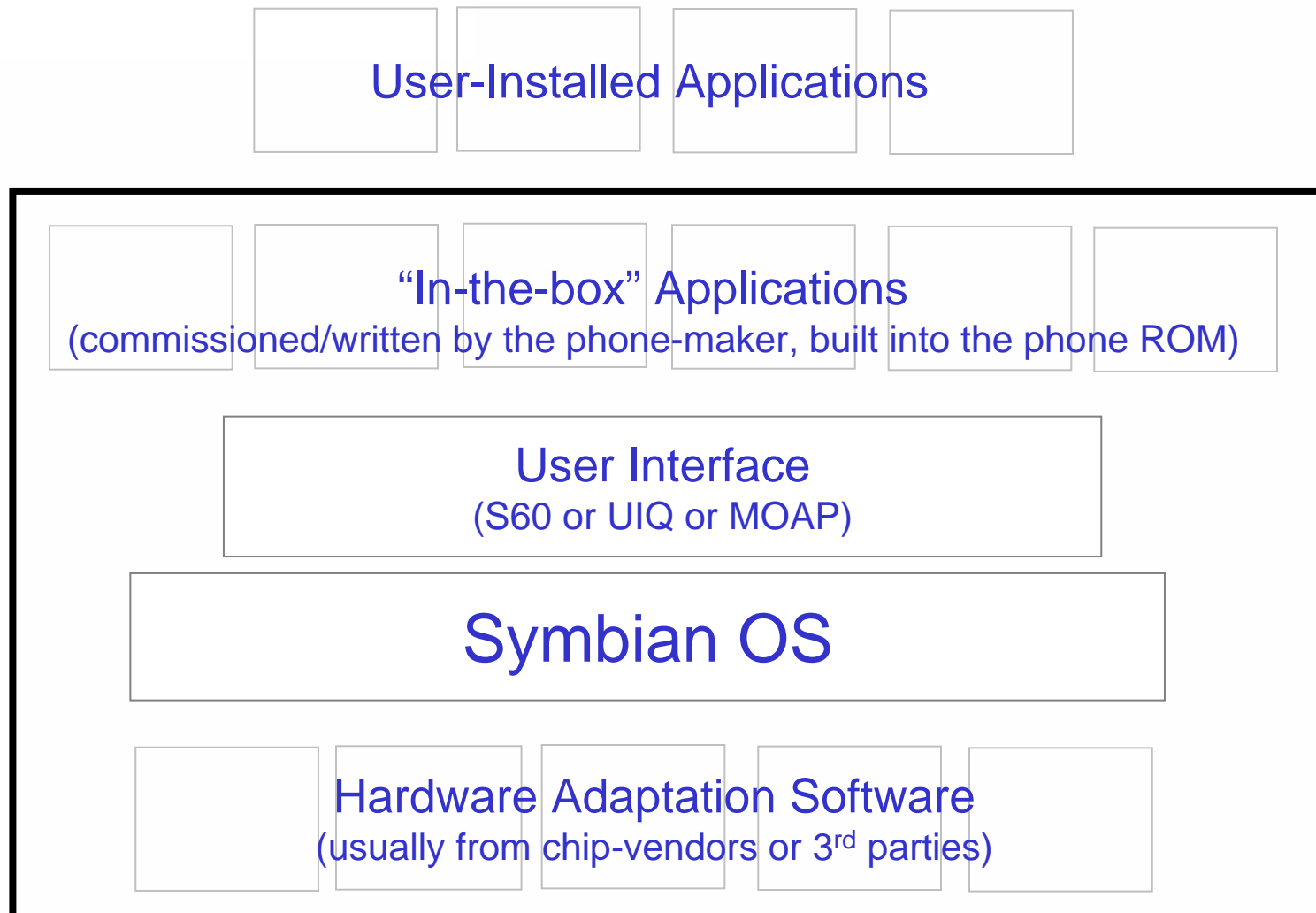
UIQ

- Provided by UIQ – company has sometimes been owned by Symbian, sometimes by Sony Ericsson/Motorola.

- Used by Sony Ericsson & Motorola.

- Originally mainly a touch-screen UI ... now supporting keypad-only variants.

MOAP(S)

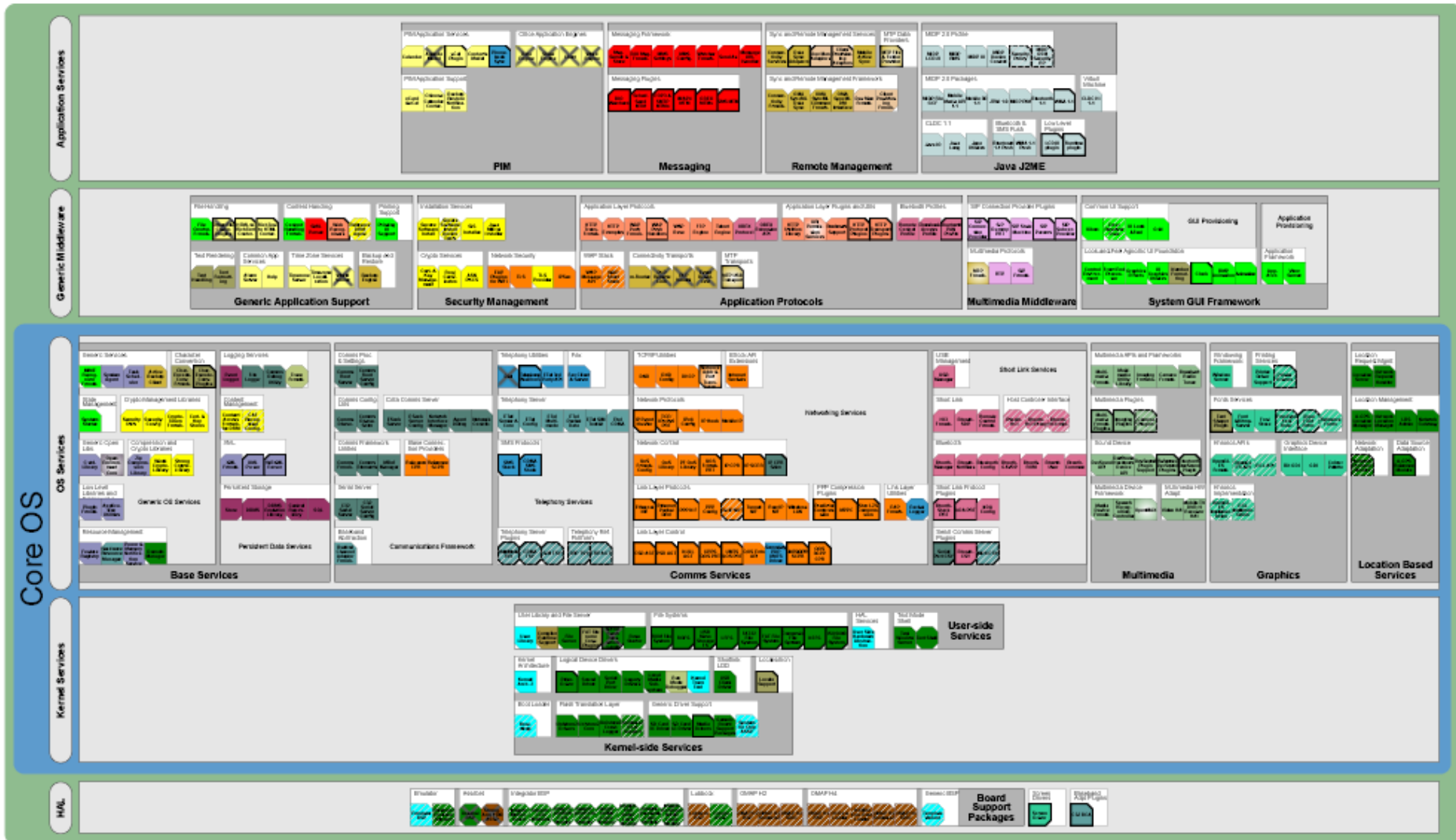- Provided through NTT DOCOMO.

- Used by several Symbian licensees in Japan.

Software in a Symbian Phone – "Habitats of the Symbian Eco-System"

User-Installed Applications

"In-the-box" Applications
(commissioned/written by the phone-maker, built into the phone ROM)

User Interface
(S60 or UIQ or MOAP)

Symbian OS

Hardware Adaptation Software
(usually from chip-vendors or 3rd parties)

Symbian OS component level view

developer.symbian.com/main/documentation/technologies/system_models

OS designed for Smartphones & Media Phones

Core OS Technologies

- Telephony Services

- Shortlink (BT, USB) Services

- Networking (IP) Services

- Multimedia (audio & video)

- Graphics

- Location-Based Services (LBS)

- Base Services: (Database Utilities, Localisation, etc.)

- Kernel

Other Smartphone Technologies

- PIM (calendars, agenda, etc.)

- Messaging

- Remote Management

- Java / J2ME

- Security Management

- Multimedia Middleware

- Application Protocols

- GUI Framework

Symbian programming paradigms

- Several paradigms to support mobility, reliability, security, including...

  - "Descriptors" – Classes for bounded strings, avoids buffer-overflow problems etc.

  - Leave() – Deep bail-out and cleanup.
    - Early exception structure. Now incorporates C++ standard exceptions.

  - Active Objects – Utility to support low-overhead FSMs (e.g. for server processes) based on cooperative multi-tasking ("run to completion").

  - Platform Security – Lightweight system-wide control for privileged operations ("Capabilities") and data-caging.

- POSIX APIs to support easier porting.

  - Easier porting for POSIX code. Reduces the initial learning curve.

  - Loses some of the mobility, reliability, security advantages ... once the port is working, you may want to use some of the Symbian-specific facilities to improve these attributes.

Oversimplifications – effectively untrue

- ~~"Symbian is commercially closed – not practical for academic work."~~
- ~~"Symbian development is just too hard – the learning curve is vertical."~~
- ~~"Linux-based system <insert name here> offers all the mobility support that Symbian offers."~~
- ~~"Symbian has 100% POSIX support – porting is no longer a problem at all."~~
- ~~"Symbian is the best operating system ever."~~
- ~~"<insert name of system here> is the best operating system ever."~~

Simple untruths

- ~~"Symbian isn't serious about open source – it's just a gimmick."~~
- ~~"Symbian access licenses make a claim on the IP from your research."~~
- ~~"Series 60 & other UI systems won't be part of the Symbian open source."~~

Should we use Symbian as a research platform?
Choice of a platform is always a balance of trade-offs.

Pro

- Very widely deployed – over 250m devices from multiple vendors

- Paradigms and facilities to support mobile devices

- Exposure of students & researchers to different OS models

- Support organisation & structure

- Non-native programming environments (scripting languages etc.) becoming available

- Becoming open
  - … Symbian Foundation will open-source Symbian, Series 60, UIQ, MOAP(S).
  - … New Academic License structure to cope with not-yet-open components.
  - … New support for University Research (access & technical assistance)

Con

- Less "market visibility" than some systems with much smaller numbers

- Steeper initial learning curve*

- Non-standard, unfamiliar*

- Fewer mutual support networks*

- Native C++ programs can be large – especially awkward for small applications and for beginners or students.

- Not open yet*
  - … Academic License still has non-commercial & non-disclosure clauses.*
  - … It may take a long time to open some components.*
  - … No open reference device.*

* Current, recent, or planned work to reduce or eliminate this disadvantage.

Non-native (non-C++) programming on Symbian

Scripting languages or other non-C++ programming environments can allow much quicker software development – especially for simple or prototype applications.

Ruby 1.9 – new implementation from the Symbian Research Department

- Downloads, example scripts & source available - see link from http://symbian.com/universities.

- Example: 21-line script takes a photo and uploads it to Flikr

- UI-independent structure – though this new system is currently tested only on Series 60 devices.

- Feedback wanted. Contributions wanted.

Interested? Experiences or scripts to share? Questions or problems? Other feedback? Use the **Runtime Environments & Programming Languages forum** on the Symbian Developer Network (http://developer.symbian.com).

Other non-native programming environments are also available:

... Java
... Python for Series 60

Background Slide:
Likely steps/phases in the move to Symbian Foundation

- This is a history-making large-scale move to open source. See symbianfoundation.org and many other sources.

- This is still in planning, but it seems likely that the sequence will be something like this...

Stage 0 (now):

... Government approval to proceed with the plan (multiple governments)

... Analysis, detailed planning, preparation.

Stage 1 (late 2008 or early 2009):

... Nokia buys all Symbian shares from other owners.

... All Symbian employees & premises become Nokia employees & premises.

... Symbian Foundation is created.

Stage 2 (2009 and onwards):

... Nokia donates Symbian OS & DP and Series 60 software to Symbian Foundation. UIQ and MOAP(S) will also be donated to the Foundation.

... Some Nokia staff transfer (back) to the Foundation – especially platform-related functions.

... Most Symbian developers remain working for Nokia – working on software that will be donated to the Foundation.

... Symbian software will be "decontaminated" of 3rd party IP component-by-component before it is made available as open source (Eclipse Public License). **It seems likely that this process will continue over a year or more.**

... Other technological evolution and developments needed to support the new combined platform.

Symbian University Engagement – three facets

www.symbian.com/universities

Symbian Academy
www.developer.symbian.com/academy

Primary goals: Increasing the innovation and popularity of mobile software development.
Grow the number of Symbian skilled graduates available to the Symbian ecosystem.

…   Provides teaching support; course material and other teaching resources, and support through SDN.

…   Symbian Academy jobs board ties students with employers in the Symbian ecosystem

…   Growth in specific regions based on Symbian ecosystem needs

University Research Relations (URR)
research@symbian.com

Primary goals: Promote awareness and use of Symbian as a platform among academic researchers.
Increase Symbian presence in research on ubiquitous computing & converged devices.

…   Engages with universities' research programmes.

…   Supports research on Symbian-related topics or other research that uses Symbian as a platform.

…   Also promotes Symbian presence and presentations at academic conferences & journals.

…   A new role in the Symbian Research dept, created June 2008.

Graduate Recruitment
www.symbian.com/graduates/

Primary goals: Recruit excellent graduates from universities for positions in Symbian.
Provide structures for training, networking, and career development of the new grads.

…   Engages UK universities in a series of recruitment events.

…   Manages the graduate recruitment process and Bootcamp training programme.

…   Works with universities to provide student placement & internship in Symbian.

- These programmes are designed for *complementary overlap.*
- Symbian Academy provides a base for most other University Engagement.

Symbian Academy
Universities

Symbian
University
Research
Relations

Symbian
Graduate
Recruitment
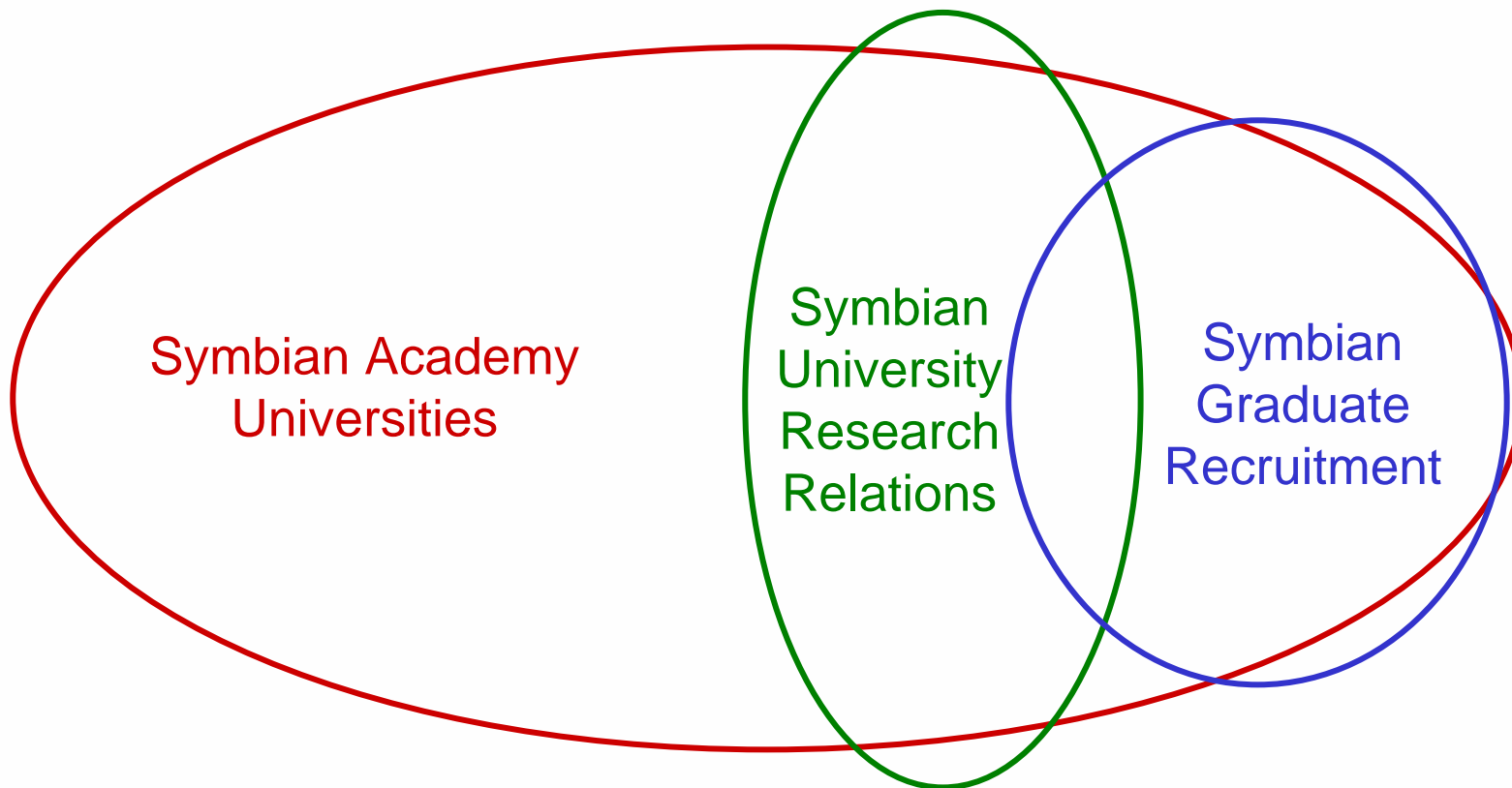
Symbian Academy support & services

- Software (SDKs and example software)
- SDN Technical support
- Course materials (complete courses or case studies & examples)
- Instructor training
- Teaching notes
- Books & documentation
- Exercise material
- Promotional material and services
- Students can gain Accredited Symbian Developer qualification

- Updates & news
- Community support & involvement with other Symbian Academy institutions
- Guest lectures & workshops with Symbian subject-matter experts
- Internship opportunities for students
- Networking opportunities for academic staff
- Research opportunities & contacts

University Research Relations

Goal:

Promote & support academic research

- on the Symbian platform (e.g. systems-oriented research)

- or using Symbian devices (e.g. as a mobile platform for other research)

Symbian University Research Relations

- Provides Access

- Provides Technical Support

- Encourages Cross-Fertilisation of Ideas – seminars, etc.

- Some Research Funding Available

University Research Relations

Provides Access

- Minimise and solve problems university researchers face with access arrangements

- Access free of charge and with minimal overhead

- Academic License for the BAK (Binary Access Kit) ... full Symbian APIs

- Academic License for component source, where needed.

- Advice and contact point for phone-maker's APIs

University Research Relations

Provides Technical Support for Researchers

- First level of support is Symbian Academy / SDN

- Direct access to subject-matter experts and additional documentation for Symbian technologies

- Advice & assistance with system-level build & test techniques

- "Find a solution" service to ease researchers' problems

University Research Relations

Cross-Fertilisation of Ideas

- Programme for academic/industrial discussions and exchange of ideas

- Symbian Seminar presentations of topics of specific interest to research groups

- Opportunities to present research topics to Symbian audiences and discuss with Symbian engineers and audiences

- Exploring and encouraging possible mobile applications of research innovations

University Research Relations

Research Funding

- New program to provide funding for research of specific interest to Symbian

- Full or part funding PhD studentships and other projects

- Focus on areas relating to Symbian technologies or platform and on the future of mobile computing

- Continuation arrangements to reduce uncertainty during transition to Symbian Foundation

So, what access can Symbian give academic researchers in this new programme?

- Anything:
  - … Needed APIs, source, binaries, documentation, technical support.
  - … The research does not always need to be specific to Symbian's research agenda, but needs to be "of general interest" to Symbian (a very broad range of research).
  - … For Symbian items that are not yet available openly:
    - "Anything" is not "everything" – need to show that the particular items are relevant to the research.
    - Non-disclosure terms and non-commercial terms still apply – once the item becomes open-access, these restrictions disappear.

## What's the catch? What do you expect from the academic researchers?

- Patience – the academic access programme is new, so we can expect some delays & glitches.
- Assistance in developing the package for academic access – again because it is a new programme, many areas lack needed documentation, adaptation structures for academic usage etc.
- Assistance from academic-access "pioneers" to other academic users who arrive later – we need to create a self-supporting academic structure to expand without creating an increasing burden that Symbian cannot support.
- No other expectations – the goal is to encourage wider use of the Symbian platform, and increased university access is one of the most effective ways to do this.

Symbian criteria for closer Research relationships

- Demonstrated excellence in fields important to Symbian
  - … Mobile or ubiquitous computing, comms, multimedia, innovative user interfaces, converged devices.

- The university is largely self-sufficient
  - … Will make great use of the support provided

- Potential for long-term relationship via short-term projects
  - … Platform approach – programme not just project
  - … Deliver some value quickly

- Established Symbian Academy tuition programme in Symbian OS
  - … (Not mandatory – but highly desired)

- Good links with Symbian's customers and partners
  - … (Not mandatory – but highly desired)

Research at Symbian
is responsible for
understanding
pervasive disruptive trends
in technology, business, and society
and guiding Symbian's responses to them

Insight and Innovation

partners

customers

Symbian

universities

Insight and Innovation
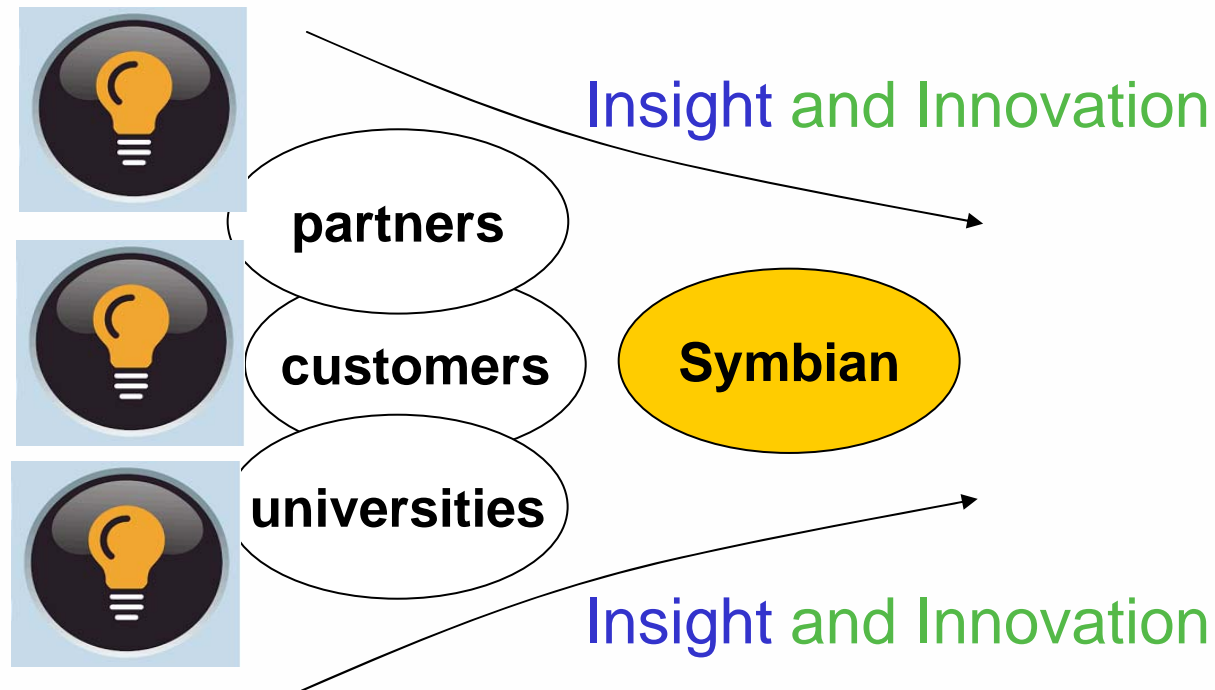
Challenges for Mobile Systems – Research Focus Areas

- Power Management & Battery Life

- Performance (and trade-off with power management)

- Screen Size & Usability

- Cost of manufacture

- Ease of creation for new/variant devices

- Platform Security

- Data Sharing & Data Privacy

- Ever-increasing comms rates

- Increasing multimedia performance expectations

- New Location-Based Services ... evolution toward a full model of mobile "context"

- Converged device interaction, ubiquitous computing, "smart spaces", etc.

Thought experiment...

Imagine the fully-converged mobile device and the possibilities for truly ubiquitous computing ...

- ... linked to servers, databases, and "smart spaces" ...

- ... with "senses" of the environment (location, Bluetooth, camera, microphone) and a concept of "mobile context" ...

- ... with a display, but also the ability to connect and display with cooperating devices nearby ...

- ... In a physical environment that supports mobile ubiquitous computing (labels on surrounding objects & places, cooperating networked devices near & far, etc.) ...

What could a system like that do for us?

What research can take us toward this?

Reminder:
Symbian Essay Contest 2009

- Following the success of the 2008 Symbian Essay Contest the 2009 contest is now open

- Open to all university students around the world

- Two rounds of entries and prizes – first round closes 31 January 2009

- Up to ten £1000 prizes in 2009

- See symbian.com/universities for details

Reminder:
University Engagement with Symbian – step by step

1	For background documentation & support, sign up with SDN – the Symbian Developer Network.	developer.symbian.com
2	For overall university engagement & support, and/or course materials contact Symbian Academy.	developer.symbian.com/academy
3a	Interested in Symbian-related research projects? Send enquiries or proposals by email.	research@symbian.com
3b	Enquiries about Graduate Recruitment – internship and permanent positions.	www.symbian.com/graduates/

- If your interest is commercial / non-academic, see symbian.com/partner

- For non-graduate career opportunities, see careers.symbian.com

Additional thoughts on research agenda...

Symbian Research Challenges & Themes

The next wave of smartphone innovation
Issues and opportunities with smartphone technologies

Challenge areas

A. Device evolution / revolution through 2012-2015

B. Improved development and delivery methodologies

C. Success factors for mobile applications and mobile operating systems

D. Possible breakthrough applications and markets

E. Possible breakthrough technology improvements

(A) Device evolution / revolution through 2012-2015

1984	1996	2008	2015…
PDA	**Smartphone**	**Converged mobile devices**	

PDA

- Electronic organiser
- Interactive manipulation of local data
- Battery life
- Memory constrained
- Instant-on
- Fast task-switching
- Graphical screen (overlapping windows)
- RAM persisted application state
- PC Connectivity

Smartphone

- Phone as the most important application
- Smartphone as "Phone Plus…"
- Smartphone as "simply great phone"
- Device start-up
- Cellular baseband abstraction
- Flash persisted state
- IP connectivity and networking

Converged mobile devices

- All-IP wireless broadband and multiple bearer management
- Real-time networking
- Multimedia (creation, consumption, communication)
- Graphics and multimedia hardware acceleration
- Broadcasting and positioning
- Large fast persistent storage
- Content protection/rights management
- Energy & thermal constraints
- Disruptive new technologies

(A) Device evolution / revolution through 2012-2015

- What are the key changes in smartphones that are needed for market success in 2012-2015?

- What new hardware architectures will need to be taken into account for the 2012-2015 timescale?

- What peripherals and sensor mechanisms will need to be taken into account for the 2012-2015 timescale?

- Market impact of Web 2.0 and Web 3.0 (semantic web)

- New device category between feature phones & smartphones?

- What are the limits to the notion of "device convergence"?

  … in which a single device takes on functionality from a larger number of previously distinct items of consumer economics?

Symbian Research Challenges & Themes

The next wave of smartphone innovation
Issues and opportunities with smartphone technologies

Challenge areas

A. Device evolution / revolution through 2012-2015

B. Improved development and delivery methodologies

C. Success factors for mobile applications and mobile operating systems

D. Possible breakthrough applications and markets
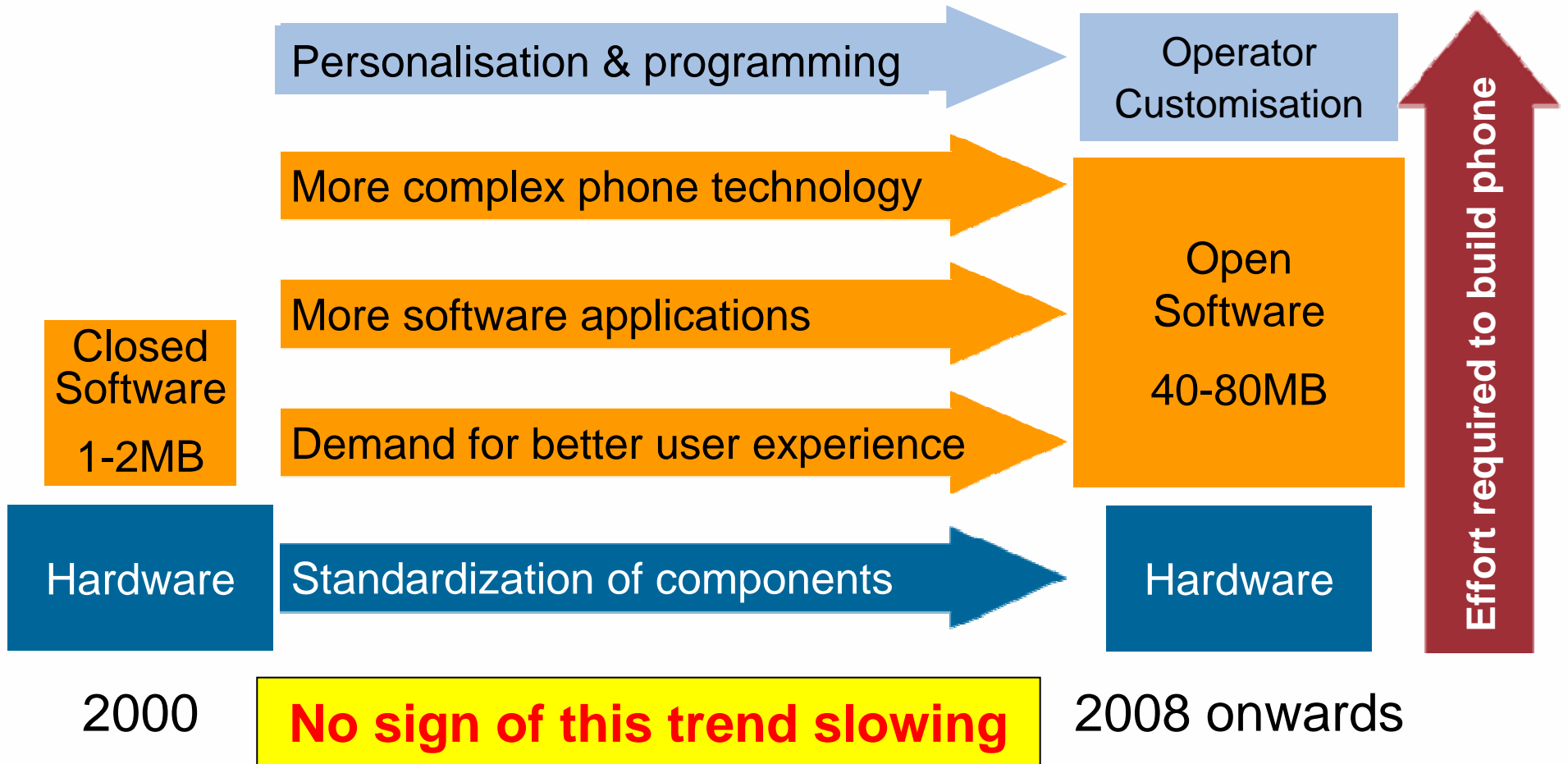
E. Possible breakthrough technology improvements

symbian

B Improved development and delivery methodologies

value   complexity   pain

The increasing scale of mobile software

| Personalisation & programming → | Operator Customisation |

More complex phone technology →	
More software applications →	Open Software
	40-80MB
Closed Software 1-2MB	Demand for better user experience →	

| Hardware | Standardization of components → | Hardware |

Effort required to build phone

2000   **No sign of this trend slowing**   2008 onwards

Difficulties in creating smartphones

Integrating c. 10 M lines of code – fast; 1000+ different devices

All-IP wireless broadband and multiple bearer management

Supporting multiple configurations and extensions – without fragmenting the platform

Real-time services: Networking, storage, display, multimedia

Providing all this power, on limited hardware, without bamboozling users

Without jitter – even though there are multiple apps running at the same time

Providing all this power – fast – without draining batteries too quickly

Internet-speed rich end-user programmability (Mobile Web 2.0)

Balancing openness (convenient access to underlying APIs) and security

Ⓑ Improved development and delivery methodologies

- What are the factors that cause some smartphone projects to deliver quickly, with good quality, whereas others deliver slowly, or have bad quality?

- Can the complexity of the mobile value chain be reduced?

- Evaluating new development methods for smartphones

  … Agile; Lean; Open Source; Web; Product Line Engineering…

- What are the sustainable business models for companies in the smartphone space?

- What are the factors governing the successful adoption of different development languages on smartphones?

  … Scripting / Native; Standard / Proprietary; etc

Symbian Research Challenges & Themes

The next wave of smartphone innovation
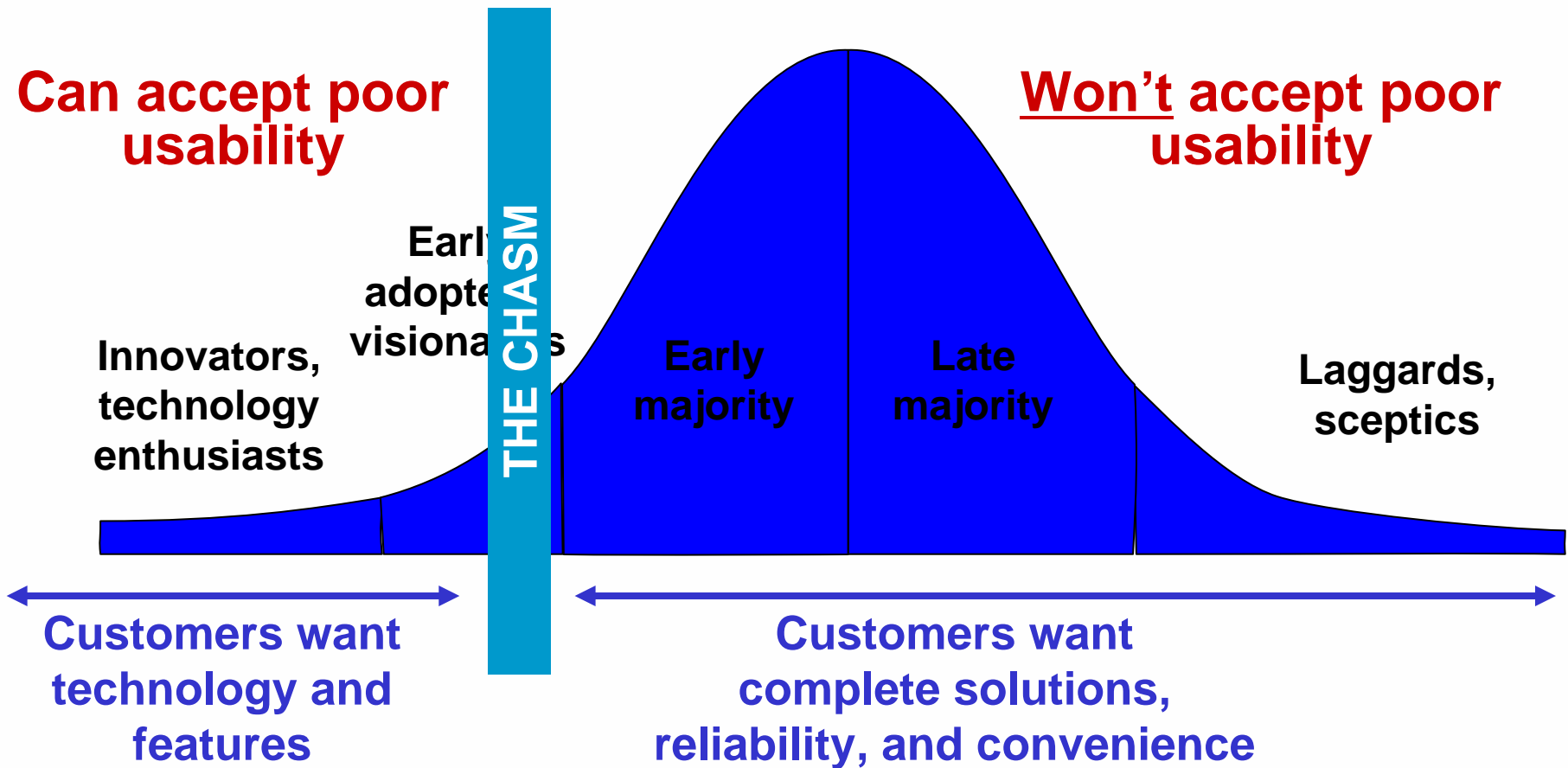Issues and opportunities with smartphone technologies

Challenge areas

A. Device evolution / revolution through 2012-2015

B. Improved development and delivery methodologies

C. Success factors for mobile applications and mobile operating systems

D. Possible breakthrough applications and markets

E. Possible breakthrough technology improvements

© Success factors for mobile applications and mobile operating systems

Technology adoption life-cycle

Can accept poor usability

Won't accept poor usability

THE CHASM

Innovators, technology enthusiasts

Early adopters, visionaries

Early majority

Late majority

Laggards, sceptics

Customers want technology and features

Customers want complete solutions, reliability, and convenience

(source: Geoffrey Moore)

© Success factors for mobile applications and mobile operating systems

– Factors significantly impacting adoption

- Usability

- Performance

- Security

- Quality

- Discoverability

- Auto-adaptability (mobile intelligence)

- Others?

- Sustainable advantages of various mobile operating systems

- Open OS vs. Closed OS

- Modular development

- Pros and cons of multi-platform software

- API design

- Others?

Symbian Research Challenges & Themes

The next wave of smartphone innovation
Issues and opportunities with smartphone technologies

Challenge areas

A. Device evolution / revolution through 2012-2015

B. Improved development and delivery methodologies

C. Success factors for mobile applications and mobile operating systems

D. Possible breakthrough applications and markets

E. Possible breakthrough technology improvements

Possible breakthrough applications and markets

Health monitor

Games console

Newspapers

To-do list

Diary

Alarm clock

Tickets

Keys

Camera

Vouchers

Camcorder

Wallet

PDA

Radio

Dictionary

Map

TV

Books

BlackBerry

Watch

Calculator

Web tablet

Music player

Symbian Research Challenges & Themes

The next wave of smartphone innovation
Issues and opportunities with smartphone technologies

Challenge areas

A. Device evolution / revolution through 2012-2015

B. Improved development and delivery methodologies

C. Success factors for mobile applications and mobile operating systems

D. Possible breakthrough applications and markets

E. Possible breakthrough technology improvements
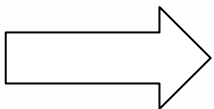
Ⓓ Possible breakthrough applications and markets

- Are there substantial new smartphone application markets waiting to be unlocked by new features at the operating system level?

  - … *How to enable* an order-of-magnitude increase in mobile applications in huge sectors like **Health**, **Education**, **Enterprise**, and **e-Government**?

- Smartphones as mobile wallet replacements?

- Smartphones in home automation? ("Remote control to life"?)

- Mobile social networking? Other new uses of the Mobile Internet?

- Improved mobile search?   Language translation?

- Augmented reality? Next generation mobile games?

- Smartphones and emerging economies?

- Smartphones and environmental issues?

Ⓔ Possible breakthrough technology improvements

Possible breakthrough technology improvements

- Power Management (battery life)

- Kernel enhancements

- Large data management

- Security and privacy

- Mobile networking

- Mobile location-based services

- Graphics and rendering

- Multimedia

- System management