

MOBILE SOFTWARE ARCHITECTURE

Introduction
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CONTENT

- Architecture
- Roots of mobile software
- Mobile specific considerations
- Mobile Software Stack
- Platform differences
- Mobile application development

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MOBILE SOFTWARE ARCHITECTURE

1. Structure and organisation of responsibilities between independent components
2. Communication between independent components
3. (Structure and communication of objects or subcomponent inside a larger component)

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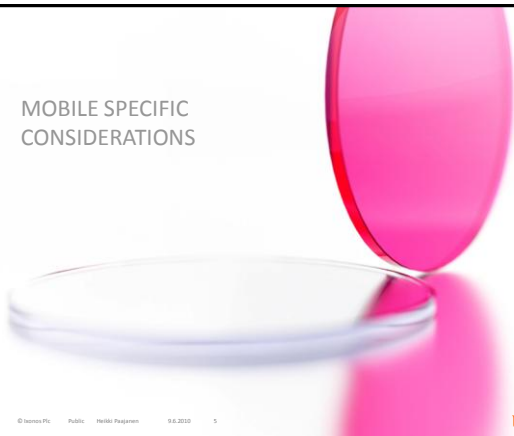
ROOTS OF MOBILE SOFTWARE

- First specialized Real Time Operating Systems for a long time (and they are far from gone yet)
 - For example: Nokia S40 which is probably running in more phones than any other OS
- As more features were needed (and processing power and memory) also more capabilities required from OS
 - Symbian is a little closer to modern multitasking and pre-emptive systems that power our desktops
- Finally full modern operating systems are a real option => Unix and Linux invade mobile space
 - Linux based phones, like Android
 - iPhone

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MOBILE SPECIFIC CONSIDERATIONS

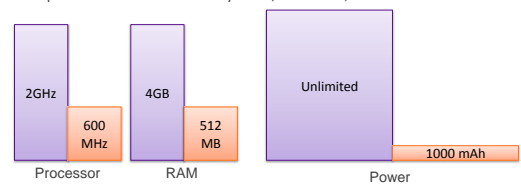


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CONSIDERATIONS - PHYSICAL

- Limited CPU, memory and power resources compared to desktop
 - CPU: 4 core 2GHz vs 1 core 600MHz - 1GHz
 - RAM: 4GB vs 256 - 512 MB
 - Power: off-the-wall vs battery
- UI: screen size
- Input methods: no full size keyboard, no mouse, touch screen



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CONSIDERATIONS - MOBILITY

- Usage control: offline, silent, normal modes
- Wireless communication
 - IP connections always started from device. Operator policies block incoming connections.
 - Network connections might change (wlan => 3G) or break (devices moves out of network reach)
- Single task oriented UI with high priority events interrupting usage flow
 - Incoming phone call interrupts current application.

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CONSIDERATIONS – SECURITY AND LEGAL

- SIM authentication
- Device lock
- Legal requirements
 - Regulatory & type approval: Emergency calls
 - Product safety: Over-heating, Too loud sounds
 - Liability: Protection against unintended service costs (e.g. Some malicious application calling to expensive service numbers silently)

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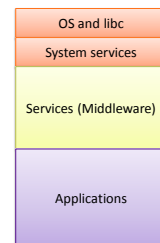
MOBILE SOFTWARE STACK

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OVERVIEW OF TYPICAL MOBILE STACK (LINUX)

- OS kernel (Linux)
- Standard C library (GNU libc, BSD libc)
- System services
 - Bluetooth (Bluez)
 - USB
 - Network
 - Input
 - Access to peripherals
 - Graphical services (framebuffer, X server)
- Services (Middleware)
- Applications



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SERVICES (MIDDLEWARE)

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SERVICE – 1

- Core
 - High level messaging (IPC) service
 - Power management
 - Connectivity management: WLAN, BT, Mobile data, USB
 - Security: Access to some APIs are restricted to selected applications (e.g. usually third party applications cannot make phone calls or start mobile data connections without users explicit acceptance)
 - Related to legal requirements
- Cellular
 - Phone calls
 - Text messages
 - Mobile data (3G/GPRS/etc)

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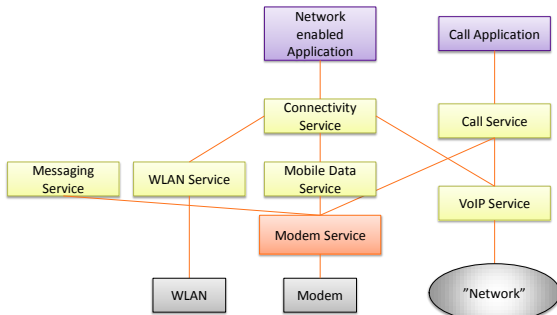
SERVICE - 2

- Messaging: text and multimedia messages, instant messages, email
- VoIP (Voice over IP)
- PIM: contacts, calendar
- Content management
- Camera
- Locationing: GPS
- Sensors: motion detection (accelerometers), ambient light sensors
- Media: media player, media streaming + connectivity, hardware accelerated decoding/encoding, DRM
- Web: Influence of Ajax, SOA, flash and cloud computing to future mobile devices. Growing number of web enabled mobile devices also have influence to web sites and services: m.facebook.com, etc.

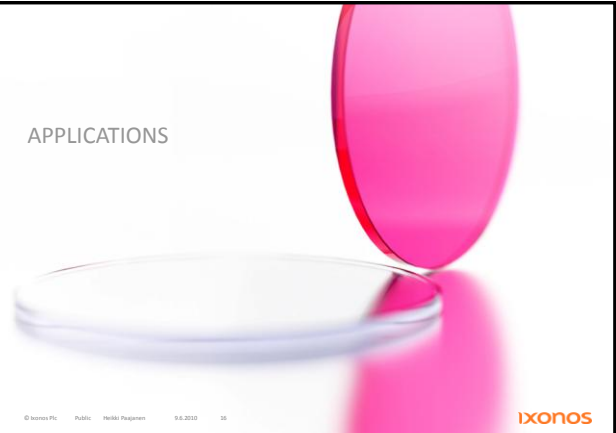
SERVICE - 3

- Data synchronization and full user content backup
- Internet service account management
- UI Application framework
- Input: Softkeys, limited hw keyboard, virtual keyboard, special buttons
- Task/process/application life-cycle management system

SMALL PART OF A FICTIONAL SYSTEM



APPLICATIONS



APPLICATIONS - MOBILE SPECIFIC

- Cellular UI: phone calls, text/MMS message app
- OTA (Over-The-Air) data sync, full device backup app
- Games
- Radio and mobile TV

APPLICATIONS - TAILORED FOR MOBILE

- Camera UI
- Messaging apps: email, IM
- Maps and navigation
- Gallery
- Media player
- Office applications

APPLICATIONS - SIMILAR AS IN DESKTOP

- File manager
- Phonebook
- Calendar

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PLATFORM DIFFERENCES



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MAEMO 5, ANDROID, IPHONE AND S40

- Some examples of platform differences
 - Power Management
 - Development languages support
 - Integrated UI Toolkits
 - Task/process/application life-cycle management
 - API access for 3rd party applications
 - Messaging (IPC) mechanisms
 - Platform openness

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POWER MANAGEMENT

- Different strategies
 - Maemo 5
 - IP heart beat + device state information
 - Android
 - wakelocks (aka suspend blockers)
 - iPhone
 - Limited amount of concurrent applications
 - S40
 - System in full control of running J2ME applications
- **And most important of all**
 - **Event based programming: Do Not Use Polling!**

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DEVELOPMENT LANGUAGE SUPPORT

- Maemo 5
 - At least C/C++, Python
- Android
 - Dalvik VM (Java)
- iPhone
 - C/C++ and Objective-C/C++
- S40
 - J2ME, Flash lite

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INTEGRATED UI TOOLKITS

- Maemo 5
 - QT, GTK+, Clutter
- Android
 - Android UI
- iPhone
 - Cocoa touch
- S40
 - J2ME UI

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TASK/PROCESS/APPLICATION LIFE-CYCLE MANAGEMENT SYSTEM

- Maemo 5
 - Normal linux processes
 - Multitasking with task switcher
- Android
 - Components: Activities, Services, Broadcast receivers and Content providers
 - Running in various combinations of different threads, processes and VM instances
 - System can request components to stop anytime
 - Activities need to be able to save transient state
- iPhone
 - Normal unix processes
 - Only one 3rd party application running
- S40
 - J2ME

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API ACCESS FOR 3RD PARTY APPLICATIONS

- Maemo 5
 - Full access for published APIs
 - Maemo 6 will include more elegant security framework
- Android
 - Operations that "would adversely impact other applications, the operating system, or the user " are protected
 - Permission for requested operations is granted by user when installing new application
- iPhone
 - Full access for published APIs
- S40
 - Full access for published APIs
 - Private APIs that are available by agreement with Nokia

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Messaging (IPC) mechanisms

- Maemo 5
 - Dbus
 - Also standard POSIX and unix/linux IPC mechanisms available
- Android
 - Intents and built-in RPC (Remote Procedure Call) support
- iPhone
 - Not public.
 - Standard POSIX and unix IPC mechanisms available
- S40
 - Some of the private APIs are available through custom IPC mechanism

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PLATFORM OPENESS

- From open to closed: Desktop -> Maemo 5 and Android -> S40 -> iPhone
- Desktop
 - You have full administrator rights => no restrictions
- Maemo 5
 - No root rights (without rd-mode)
 - Can only run as normal user
- Android
 - Development on top of Dalvik and provided APIs
- S40
 - J2ME + some extensions
 - Some APIs available only for certified application
- iPhone
 - Only certified applications can be installed

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MOBILE DEVELOPMENT



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MOBILE DEVELOPMENT - 1

- Most of coding and design principles work well
 - Modern multi-tasking operating systems just like your desktop (except S40)
 - Although: Be aware of the differences between different platforms! Understanding them is often the key in both good design and troubleshooting
- Only few things require more consideration
 - Power management
 - Limited CPU and RAM
 - User interaction: small (touch) screen and input systems
 - Mobility
- Quite straightforward platforms with lots of integration opportunities available
 - More integrated applications => more effort on integration testing

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MOBILE DEVELOPMENT - 2

- Platform may limit the available "sensible" architecture options or at least provides good examples (i.e. existing platform services) for creating architectures that follow platform style or patterns
- Interactive applications and services can be thought as system and input event driven state machines – it often makes sense to explicitly model them as such
- Emulators and possibly cross compilation
 - **Host development and on-device development phases**

ANY QUESTIONS?

Feel free to contact me
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