

# Mobile Service-Management System

Józsefné Kovács  
Árpád Laczkovszki  
Óbuda University/Kovax '95, Ltd., Székesfehérvár, Hungary  
laczkovszkia@kovax.hu

**Abstract** -Providing online services has become a critical factor in the life of every enterprise in the world, regardless of their fields of work.

In order to maintain competitiveness - especially in the case of small businesses - it is essential to be able to provide services promptly, cost-effectively and on the highest level possible, while also bearing the security questions in mind.

The main subject of our research, is to examine the realization of a software setup, which is possible to provide a general purpose service-management system available to mobile devices.

The research essay contains the description of the currently available mobile devices (PDAs and smartphones), an introduction to mobile operating systems, development technologies and programming languages, and also the analysis of wireless communication techniques, network solutions and security aspects.

## I. INTRODUCTION

As a consequence of expanding and more sophisticated device functions, and the appearance of advanced communication techniques, handheld computers, smartphones and personal digital assistants have become very popular in the last years.

People living in the present's digital world tend to become more and more attached to their mobile devices, because these handheld machines offer on-the-go services and solutions for the daily tasks, so instead of sitting in front of a desktop computer, people can solve their problems on the move.

In the meantime, demand for using these services in a corporate environment for tasks such as data manipulation and information sharing, got higher.

The main goal of this research essay is to introduce these devices, platforms, software development technologies and programming languages, while concentrating on the features that provide a solid base for a mobile service-management system.

## II. PDAS AND SMARTHPONES

### A. PDAs

A PDA (Personal Digital Assistant) is a mobile device, which utilizes advanced multimedia and communications techniques to provide the functions of a personal organizer, the ability to play media files, and the access to networks and to the internet.

Current PDAs often come with a stylus-controlled touchscreen and virtual keyboard, and utilize a small amount of actual physical controllers. A PDA is able to transfer data using both wired and wireless solutions, which in most cases are USB and Bluetooth or IrDA connections, completed with Wi-Fi capabilities.

Generally these devices store their data using the built-in memory, but nowadays' advanced PDAs can use memory cards too.

Users' ability to be able to synchronize data, notes and documents stored on the device is also an essential requirement and integration to another software system (such as Microsoft Outlook) also, which is available through using the wired and wireless connection method.

In order to make organizational and communicational tasks simpler and easier to do, such a device meets the software requirements, when it is capable of realizing functions for contact information-, task list- and calendar data management.

### B. Categorization of PDA devices

The past years' PDAs could be divided into two well separated groups: devices equipped with phone functions, and devices without these features, thus they were easily distinguishable from smartphones. However, given the very low market share rate of these so-called „stand-alone” PDAs, (which comes from the complete lack of phone capabilities), and the current tendencies that indicate the integration of PDAs' and smartphones' features, it is safe to say that most of the current PDA devices are actually smartphones.

### C. Smartphones

There is no industry-standard definition of what makes a phone “smart”, and existing definitions are also different on many levels.

Some say that a smartphone is in fact a mobile phone which is capable of completing more complex tasks with its enriched feature set, for example communicating on the internet, providing better multimedia experience, and a sophisticated document-management system. Others state however, that the refined operating systems, the high-end hardware components and the widened multimedia capabilities are in fact resulting in a pocket computer system, which is also capable of using phone services.

Due to the increasing speed and decreasing size and power consumption of hardware elements, and the growing demand for mobile services, these devices became much more popular than ever.

The ever-growing feature set of mobile communication services and the current capabilities of data transmission technologies made accessing the internet from almost anywhere possible, and gave the users the ability to utilize the functions of advanced connection services such as WAP, GPRS, EDGE, UMTS, HSDPA or Wi-Fi on the move.

Current smartphones come with specific operating systems, exquisite e-mail and www capabilities, a personal assistant with name- and contact list, and also state of the art hardware functions, such as built-in high-

resolution cameras, navigational modules, touchscreens, and also advanced media playback- and document management services.

To summarize, these devices exceed their companions in both hardware- and task management-wise, and based on this, it is safe to say, that smartphones are mobile devices with expanded functionality, enhanced communication technologies and advanced hardware, often give access to desktop-level functionality while providing standard mobile phone and other mobile services, common to the GSM networks.

D. Categorization of smartphones

Categorization of smartphones is the most obvious by the utilized operating systems. The use of hardware elements, software technologies and operating systems tend to differ per manufacturer, yet it is the OS that is the most important part, if it comes to effective operation, and the best use of the given resources.

The OS, together with the development environment results in a tool, capable of providing means to the programmer to harness the potential of the given platform, and deliver innovative applications using the available functions.

Today’s smartphone operating system market consists of five different competitors, namely Symbian, developed by the Symbian Foundation and used by Nokia, Research In Motion’s BlackBerry OS, Apple’s own platform, the iOS, Microsoft’s Windows Phone 7 (formerly known as Windows Mobile) and Google Android.

In addition, there are devices equipped with Palm OS/Garnet OS, Palm webOS, open source Linux based systems (such as LiMo and Moblin), Nokia and Intel’s MeeGo, Nokia’s own Maemo, and Samsung’s bada.

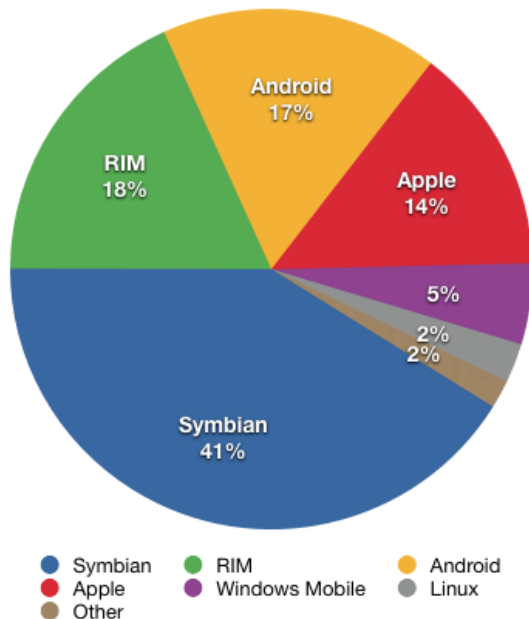


Figure 1. Smartphone sales by operating systems for 2010 Q2[1]

Current mobile operating systems market leader is Symbian, who keeps a close business relationship with

Benq, LG, Motorola, Samsung, Sony Ericsson and since the introduction of the 9210 communicator, Nokia too.

Nokia even developed an own software platform for Symbian, called S60, and it is used by Lenovo, LG Electronics, Panasonic and Samsung.

Second place holder Canadian RIM (Research In Motion) has been on the market since 1998, and has an 18% share.

Sales of Windows Mobile devices have been constantly decreasing in the last years, however the recent release of Windows Phone 7 seems to be able to change the tendency, with a whole new approach to mobile devices’ operating systems.

Android took over the small Linux based solutions, and other competitors in terms of sales numbers, which is mainly because of the growing interest about Taiwanese mobile phone manufacturer HTC’s high-quality products. Although the newest HTC smartphones use the new Windows Phone 7, recent models like Desire or Aria come with Android.

Apple recently fell back to the fourth place on the list, which is mainly because of the introduction of Windows Phone 7, and the advancement of Android. However, having a 14% share of the operating system market also means a 14% market share in global mobile phone sales, because only Apple iPhone smartphones can use this operating system. Other iOS devices such as the iPad or the iPod are excluded from this calculation.

III. MOBILE OPERATING SYSTEMS

Mobile operating systems have been developed in order to operate the device running it, just like desktop operating systems. Although they were designed with the same idea in mind, they tend to do different jobs, and they are also quite different in terms of structure and operating methods.

The main task is to use the device’s resources effectively, while maintaining connection between the user and the device, so a mobile operating system’s main job is to make use of the different input methods, network protocols and connections, and also the management of different media formats. Beside these, the operating system provides the software environment to run additional programs.

Hardware device management is a crucial point in terms of effectiveness, because in contrast to desktop workstations using the electrical network, a handheld device does not have an “infinite” power supply to operate the hardware. Because of this, the used parts, consume less power, but also tend to have less performance, which affects the device’s overall performance as well, resulting in a limited number of options for operation.

With battery operated devices, it is imperative to optimize the usage of memory, processor and different peripherals (touchscreens, physical controls, speakers, microphones, proximity- and brightness sensors, accelerometers, memory cards) in order to use the given amount of energy effectively, and for as long as possible.

A. Symbian

The Symbian platform is an open source operating system and software platform designed for smartphones. It is the successor to Symbian OS, and it is developed and

maintained by Nokia. Actually it is a combination of the Symbian OS, developed by Symbian Ltd. and later acquired by Nokia, and Nokia's own S60.

It runs on ARM processors, and contains the libraries developed by Symbian Ltd. It uses object-oriented programming, preemptive multitasking and memory protection.

The system makes use of the MVC (Model-View-Controller) architectural pattern, as shown on Figure 2.

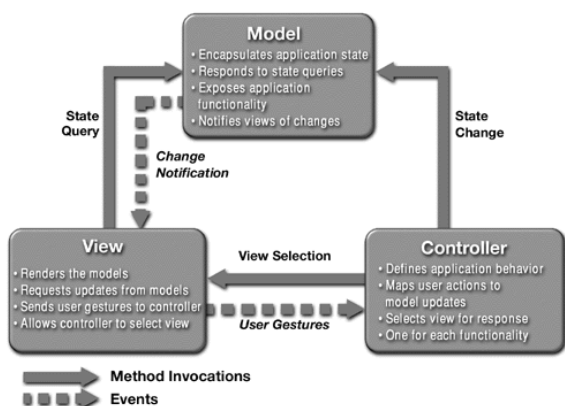


Figure 2. The MVC pattern[2]

In the MVC architecture, Model represents the collection of data to be processed and controlled by the application. Whenever the status of the Model changes, it notifies the corresponding View, which is able to refresh its own state based on the changes.

The View is responsible for polling the Model's status, and convert it to a format, that is manageable by the user, which is typically a user interface widget. A Model can have multiple Views, assigned to different tasks.

The Controller gets the actual inputs, and acts accordingly, by calling the Model objects.

This pattern is very useful, when designing smartphone graphical user interfaces, because it makes the control of different views, functions and interactions much easier.

The Symbian operating system model comprises of the following layers:

- user interface framework
- application services
  - Java Micro Edition
- operating system services
  - basic services
  - communications ser
- core services
- kernel services and HW interface

Beside these layers, there is an important part of the system that manages storage devices, in most cases flash memory cards.

Another subsystem deals with the graphical user interface, which is capable of utilizing touchscreens, in order to provide a rich user experience using third party software platforms, such as the S60.

### B. BlackBerry OS

BlackBerry OS is RIM's own multitasking operating system, used solely in BlackBerry devices. Selling since 2002, smartphones in the BlackBerry product line tend to have similar functionalities with differing hardware setups. There are touchscreen, trackball, track pad, QWERTY keyboard and even scroll wheel equipped devices. These smartphones make use of the ARM architecture, and also Intel's XScale processors.

The most popular feature of BlackBerrys, beside the standard phone functions, and the internet browsing capability, is the push email.

By using push services, the messages are automatically transferred from the MDA (Mail Delivery Agent) to the MUA (Mail User Agent). The function is achieved with the BlackBerry Enterprise Server, or BES, which connects to a regular e-mail server, and monitors the traffic. When a BlackBerry user receives a message, the BES authenticates the user with the BlackBerry PIN, a unique device identifier, and forwards the message to RIM's Network Operations Centre (NOC), where it gets transferred to the device via the mobile service provider's network. Using push, users can send e-mail messages, as if they were using SMS services.

This is one of the functions that made BlackBerry so popular. The mailbox refreshes automatically, so it is guaranteed that it is always up to date, showing the current state, new messages can be accessed as well, without delay, and the device and the BES maintains an AES encrypted connection, so it is secure too.

The BlackBerry platform supports Java MIDP for applications, which makes the devices capable of running Java MIDlets, and it can be synchronized with collaborative software systems like IBM Lotus Notes and Novell Groupwise, and it also contains all the functions of a personal information manager.

### C. Windows Phone 7

Microsoft's Windows Phone 7 is the successor to the Windows Mobile platform. Launched in October 21, 2010, it is the newest possible future successor in the mobile operating system market.

Learning from their earlier mistakes with Windows Mobile, Microsoft created a whole new user interface, using the company's own Metro Design Language, which is able to produce typography-based, enhanced graphical user interfaces. Microsoft also integrates the operating system with desktop Windows versions, and created a strict guideline for hardware specifications.

Minimum Windows Phone 7 requirements include among other things a capacitive touchscreen, a 1GHZ ARM processor, at least 256 MB of RAM and 8GB of flash memory, creating a solid base for a rich user experience.

Windows Phone 7 supports multi-touch technology, and because of the hardware specifications that emphasizes the use of touchscreens, it also utilizes a virtual keyboard, and invokes a small amount of physical controls.

The system has a built in web browser, called Internet Explorer Mobile, and also has the means to integrate with social networks, and other web based services, like e-mail, Windows Live, Microsoft's Bing search engine or the Windows Phone Marketplace, which is for the distribution of third party applications.

The reception of the system was quite well, critics were enthralled by the new UI, and the system as a whole, and the fact, that the operating system will be used in the future products of companies like Dell, HP, LG, and Toshiba, and the first Windows Phone 7 equipped smartphones are already on the market, distributed by HTC and Samsung, is showing a bright future for the new Windows Phone 7 platform.

#### D. Android

Android was introduced in 2007, by Android, Inc., which was later purchased by Google and the Open Handset Alliance, that consists of almost fifty companies, like T-Mobile, Vodafone, eBay, Intel, nVidia, Samsung Electronics, Motorola, and of course Google.

Android is a free and open source software, its source code was made publicly available by Google under the Apache License in 2008.

The current version (v2.2) has similar features to other mobile operating systems, and amongst other things, it uses the Google Chrome web browser's JavaScript engine, supports HTML 5, Microsoft Exchange, and Adobe's Flash version 10.1.

The system, similarly to other mobile OSs uses ARM, MIPS and x86 architecture processors, but it can utilize the Power Architecture family CPUs too.

The operating system itself comprises of four main components, forming four layers:

- Applications
  - Contacts, phone, browser
- Application framework
  - Window-, view-, phone functions-, package-, and resource- management modules
- Libraries and the Android environment
  - Additional libraries (Media framework, SQLite, 2D/3D graphics, SSL)
- Linux Kernel
  - Display-, camera-, flash memory-, keyboard-, Wi-Fi-, and audio drivers, resource management

Android uses the Dalvik virtual machine to run the applications written using the Java syntax. However, it is not a Java compatible VM, which means that software using the Java ME cannot be used directly. This makes the porting of existing applications difficult, but in case of newly developed software, Android has all the utilities to aid the programmers, and provide a friendly development environment. The software development kit has a comprehensive set of tools, including libraries, debuggers, a hardware emulator, the app designer, and ways to integrate with development environments like Eclipse IDE.

The operating system supports EDGE, UMTS, Bluetooth and Wi-Fi connections, single- and multi-touch touchscreens with high resolutions, cameras, accelerometers, magnetic and proximity sensors, thus devices running Android are capable of using navigation services, compass information, or running 3-dimensional games, which require fast processing capabilities.

Mainly because of its open source nature, and the widely available smartphones that use the operating system, Android is gaining more and more from the market shares, and recently toppled Apple's iOS from the third place in mobile OS market shares.

#### E. iOS

Apple's iOS (formerly known as iPhone OS) was introduced in 2007 with the launch of the original iPhone.

The most recent iPhone model, called iPhone 4 became available in June, 2010, and it also brought the new iOS 4 with itself.

The iPhone 4 uses Apple's multitouch "Retina Display", with a 960x640 resolution, a 5 megapixel back camera with an LED flash, capable of recording 720p HD video at 30 frames per second, a quad-band antenna, an integrated GPS module, a proximity sensor and a 3-axis accelerometer.

The processor is an Apple A4, composed of Cortex-A8 CPU and a PowerVR SGX 535 GPU (graphical processing unit). The iPhone 4 uses 512 MB of eDRAM, which supports multi-tasking and increased performance.

Every bit of data is stored in flash memory (16 or 32 GB, based on actual model version).

The most recent edition of the system, version 4.1, became available in September, 2010, and beside the iPhone, it is available for all other Apple mobile devices, such as the iPod, and the iPad. The base of the software is the Darwin operating system, that is also the foundation of the Mac OS X, Apple's desktop operating system.

Darwin is a NeXTSTEP and BSD (Unix-like systems) based POSIX (Portable Operating System Interface for Unix) and SUS (Single Unix Specification) compatible operating system, and it uses the XNU hybrid kernel. The kernel uses the best features of both monolithic-, and microkernels in a way, that less critical system services like file servers are running in the user space of the virtual memory, and the kernel keeps other services in the kernel space, like messaging between processes. It provides a fast, yet stable basis for the operating system.

The implementation of iOS's technologies is represented with a four-layer model, as seen on Figure 3.

Higher level frameworks provide object-oriented interfaces to low-level complex functions, beside the existing direct access to these low-level features. This gives programmers a simple, yet effective tool, because it is no longer necessary to know the lower level functions through and through, for the simplified abstractions contain a way to access them in a simplified way.

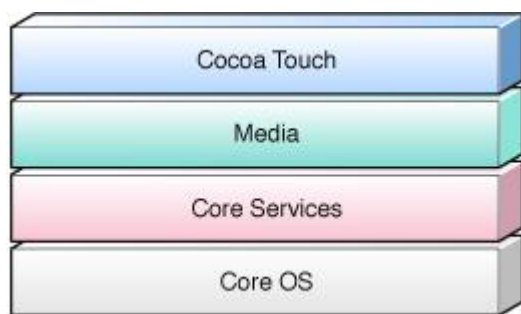


Figure 3. Layers of iOS[3]

Cocoa Touch has all the important frameworks to program applications for the operating system. With Cocoa interfaces, the development becomes similar to Mac OS application development, so all application automatically inherits all the touch-based functions, optimized for mobile use.

Cocoa is implemented in Objective-C, and uses a dynamic runtime, which automatically deals with application events.

The Cocoa API and Cocoa Touch uses the MVC pattern, which enables graphical editing of user interfaces in the Xcode development environment, without writing a single line of code, underlying controller code can be also connected with the view by Interface Builder's GUI. Programmers no longer need to write the code for connecting the view and the controller.



Figure 4. Cocoa MVC[4]

The media layer provides the frameworks for rendering iOS's graphical elements, and also for the management of picture-, audio-, and video-services and data.

Core Services has all the basic system services available for all applications, like basic networking and data manipulation functions.

Core OS means the kernel, the device drivers and the corresponding interface together. It manages threads, security, virtual memory, inter-process communication, network protocols and the file system.

The graphical user interface provides an almost unmatched media-rich user experience, with a unique approach to interfaces.

Preinstalled applications include messaging, calendar, photo viewer, YouTube, stocks, weather, Google Maps, calculator, voice recording, notes, compass, mail, Safari browser, iPod media player and of course a phone application. There is also an application for accessing the

App Store, where users can download applications from, and also iTunes for music and video downloads.

The system's other features include multitasking, FaceTime video telephone system, voice control, copy-paste actions, internet tethering through USB and Bluetooth, and also accessibility features.

Apple's iPhone platform gained 14% of the whole market shares since its 2007 launch, and recent upgrades, constant development of the iOS, and the unification of Apple's mobile platform shows a possibly bright future for this line of devices.

The robust architecture of the system, which makes it more than capable of handling business-related operations, caught the eye of the world's biggest companies too, and the likes of eBay and Netflix have already provided iOS applications for using their services.

#### IV. MOBILE DEVELOPMENT TECHNOLOGIES, AND PROGRAMMING LANGUAGES

The previously introduced operating systems all have a development kit, which provides debuggers and emulators to successfully program and test the applications, yet they use quite different technologies to achieve the same results.

##### A. Java, Java ME

Android and Blackberry platforms both use the object-oriented Java base, thus the applications are written in Java. Symbian can also run Java applications, so it is the most common way to develop an application for a mobile system. Java is a simple, object-oriented, secure, portable, architecture-independent, high-performance, dynamic programming language, which makes it perfect for mobile use, with different architectures and operating systems.

##### B. C#, .NET

C# was developed by Microsoft for CLI (Common Language Interface) in order to support the .NET framework.

The CLI describes the .NET framework's runtime, providing the means for using multiple programming languages in different computer systems. Applications run in a platform-specific virtual runtime environment (CLR – Common Language Runtime), which interprets the CIL (Common Intermediate Language) code, to hardware specific binary.

##### C. Objective-C

Objective-C is a superset of the C programming language, used mainly in Mac OS and iOS applications.

Since the language is a superset of C, the Objective-C compiler can compile standard C as well, so programmers can mix the Objective-C code with the old C code.

The syntax is similar to C's, with an additional Smalltalk-style messaging system for object-oriented services, which results in messaging instead of calling methods. Because of messaging, the addressed objects are chosen during runtime, and they also evaluate the messages during runtime as well.

An Objective-C program's code is divided into two files, one with a .h extension, which is a header file containing the interface, and an .m file containing the actual program code.

There are quite a lot of web technologies as well, (like JSP and ASP.NET), but since the main objective is to examine the realization of a native application, it is not necessary to include their description in this current publication.



## V. CONCLUSION

Through applied research we explored the mobile devices (PDAs and smartphones) that can be used in the project and their opportunities and potential security problems.

We analyzed in detail the security problems of wireless communications and their solutions, but these results will be covered in a next publication.

We have set up the requirements for the mobile service management system, prepared the functional specification, designed and implemented the prototype of the system, and we managed to prove that such a system using these devices would be an excellent choice for small service-providing businesses. They can upgrade, enhance and fasten their existing services and operations, while also cutting the costs on some levels with a service-

management system, that provides instant mobile information access.

We have done the fine tuning of the system according the starting experience. The result is a prototype of a service-management system that can be used simultaneously but independently by multiple small businesses.

The system supports the work of the customer, the helpdesk agent, the dispatcher, the administrator and the field worker equipped with a mobile device.

The system is a resilient, customizable application matching the ITILv3 recommendation that is able to handle the different data, workflow, device and availability needs of the distinct companies.

For example the system sends the todo items (name, address, task, registry of affected devices) to the field worker, shows the way to the workplace using a map and route planner, the worker can request material from the central document management system or the history of the case, can take picture using the mobile device and attach it to the service ticket, can describe the work done, can request another professional, etc.

## REFERENCES

- [1] Gartner, Inc. Official Press Release  
<http://www.gartner.com/it/page.jsp?id=1421013>  
Image source: Wikipedia
- [2] Image source: Sun Microsystems, Inc.
- [3] Apple iOS Dev Center
- [4] Apple Developer Connection