Developing a SOA-based m-commerce Android application

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Abstract. The breakthrough in wireless technology increases the number of users with cellular phones, which presents a scenario for the development of m-commerce applications. Nowadays these devices are able to manipulate more quantity of information allowing adapt technologies of communication such as Web services. Web services were available only in personal computer applications, but thanks to technological advances presented by mobile communication devices, Web services are available on mobile devices. This paper proposes a service-oriented architecture for an m-commerce application developed under the Android platform.

Keywords: Android, SOA, SOAP, Web services.

1. Introduction

The mobile commerce (m-commerce) is any electronic transaction of goods, products or services through mobile telecommunications networks. The key to distinguish between m-commerce and e-commerce is the use of a mobile device instead of using a Web browser from a personal computer.

Currently there is a growing number of cell phone users, which opening a potential market for m-commerce applications, such operations have the features that the user accesses the Internet from any location at any time from a mobile communication device to make the purchase of goods and / or services. The essence of m-commerce revolves around the idea of reaching consumers, suppliers and employees regardless of their location. M-commerce applications offer advantages not available in traditional e-commerce applications [1]: (1) **Ubiquity** is the main advantage of m-commerce. Users get any kind of information, on which they are interested at

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any time, (2) **Accessibility**, through mobile devices, business entities are able to reach consumers anywhere. (3) **Location**, applications developed in localization offer significant value to m-commerce, knowing the user's location offering new services, such as displaying user preference products just by being close to the company.

To improve this kind of applications the application development platforms play a very important role, especially adapting to **new** technologies that improve application performance, such as web services that offer full interoperability between applications through the use of open standards, this allows the data contained in e-commerce server could be displayed directly on a mobile commerce application. Based on this understanding, this paper proposes a Service Oriented Architecture (SOA) using Web services for an m-commerce application developed under the Android platform.

This paper is structured as follows: section 2 presents an introduction to the Android development platform. Section 3 describes the m-commerce Android application and the architecture to use. Section 4 presents a case study that describes the functionality of a developed m-commerce application. Section 5 discusses related work. Finally we present the conclusions of this paper.

2. Android platform

Android is a software stack for mobile devices including an operating system, middleware, user interface and applications. The Android Software Development Kit provides the tools and APIs necessary to develop applications on the platform using the Java programming language [2]. Each Android application runs in its own process, with its own instance of the Dalvik virtual machine. The platform enables the device to run multiple virtual machines efficiently and optimize files with Dalvik Executable format (. Dex) for minimum memory consumption.

Currently there are several platforms for developing of mobile applications; Table 1 presents a comparison among Android and the most popular platforms.

Table 1. Comparison of development platform for mobile phones.

	Android	J2ME	iPhone	Symbian
Developer	Google	Sun controls spec	Apple	Nokia
Programming language	Java	Java Micro Edition	Objective C	C++
Open Source Licence	Not	Not	Yes	Not
API for the use of hardware components	Yes	Yes	Yes	Not

As we can see in Table1, each platform provides different mechanisms for developing applications. For example, Apple constraints to developers releasing the contents of the SDK, J2ME provides a good abstraction for programming, but it

does not use a shortcut to the capabilities of the device. Symbian is Open Source, however it constraints the access to the hardware components of the device and does not use a standard C++ version, each company will make changes to the SDK for adapt it to the cell phone. Finally, Google and Open Handset Alliance offer Android source code under an Apache license, giving the facility to cell phones manufacturers to integrate their own changes to the device, this license allows the developer to modify the source code of the platform when the APIs included do not provide some functionality.

However, Android also has disadvantages:

1. As a newly developed platform has had little penetration and this implies that cell phones are expensive.
2. As an open platform allows examining the source code to find vulnerabilities.

3. SOA with Android

A SOA is a combination of consumers and services that work together, it is guided by principles and supports various standards [3], unlike traditional information systems which have their embedded business process. SOA separates these processes from automated functions and organized them into individual modules, listed in a dictionary of services that allow its use by the entire organization.

The key of SOA architecture is "processes abstraction", this allows the execution, management, monitoring and process changes are handled directly at business level in a versatile way, rather than being embedded [4]. But despite of the benefits mentioned previously, cell phones do not integrate technology for the use of Web services (e.g. SOAP), because many of them have limited processing capabilities and are unable to process data obtained from Web services.

The mobile devices with the Android operating system does not support SOAP processing directly to enable it, the kSOAP library is required [5] and must be included in a project. Figure 1 shows the relationship between the application and kSOAP, where Activities (main classes in Android applications) communicate directly with kSOAP to handle HTTP requests and responses to the Web services invocations.

Our m-commerce system uses a service-oriented architectural style providing the following benefits:

1. Using industry standards like XML, WSDL (Web Services Description Language) and SOAP: This ensures interoperability between different services and applications that use them.
2. The communication protocols used by Web services are independent of the operating system, platform and programming language.
3. The services to be loosely coupled enable that the applications that use them will be easily scalable because there are little dependence between these elements.

4. There is a high reuse to enable the services are used by the application of mobile commerce and other applications.

The proposed architecture has a layered-design to allow the exchange of data, in this way each layer provides its services to its adjacent layers. In Figure 2 show these components.

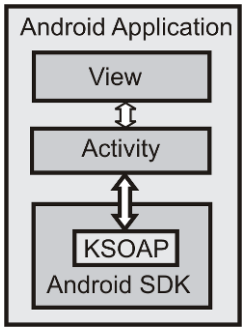


Fig. 1. kSOAP library in Android application.

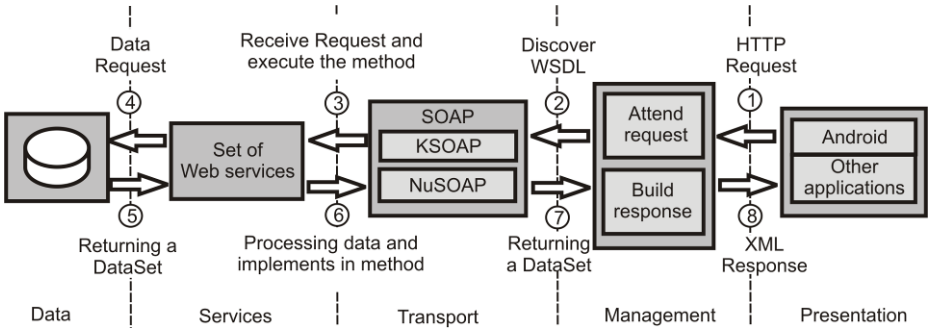


Fig. 2. Layered-design of the m-commerce application of the SOA architecture.

The layers are described below:

Presentation: This layer is responsible for managing the data flow from the user, the application consists of a light client responsible for interacting with the service provider, the application is designed with the pattern Model - View - Controller (MVC), the Model (Activities in the application) handles all requests made by the Controller and is responsible for the handling of data obtained from the functions library kSOAP, to extract each one of the ele-

ments contained in the data a SoapPrimitive class is used and then are presented through the views on the device.

Management: This layer has as fundamental purpose managing SOAP requests and providing access to WSDL documents, also classify, catalog and manage Web services so they are discovered and consumed by applications.

Transport: This layer is responsible for managing Web services using SOAP, the Web server uses a group of classes called NuSOAP to develop Web services with PHP language, the client uses kSOAP which is a function library of SOAP-based Web services for Java environments, for Android applications kSOAP use a version designed for this operating system [5].

Services: This layer is responsible to contain Web services. All business transactions are done through Web services (responsible for exposing all the functionality of the system to the pone and other applications). In order to develop each Web service, Internet standards are used: XML as the standard format for data, SOAP as a protocol for data exchanging and WSDL documents to describe the public interface of services.

Data: This layer is responsible of managing the data storage in e-commerce application and the mobile commerce.

The application functionality is explained below:

Step 1. The Android application makes an HTTP request through kSOAP, it specifies the URL of the WSDL document location.

Step 2. KSOAP discover on the Web server the WSDL document that contains the method requested by the application.

Step 3. The Web server receives the request by NuSOAP, the business logic processes the request and executes the method requested by the customer.

Step 4. The business logic communicates with the database server.

Step 5. The database server receives the request, processes it and returns the requested records.

Step 6. The result of the database server is processed and is implemented in the method by the business logic.

Step 7. NuSOAP builds the response and returns the data via web service using SOAP as an XML document to the library of functions kSOAP.

Step 8. KSOAP gets the XML document and transforms it to an object with the structure element = anyType (key0; key1 = element1; ...; Keynes-1 = elementN-1), to extract each one of the elements a special treatment is required using SoapPrimitive class, in this way the keys are obtained separately along with their elements and are used in activities.

In the next section presents a case study, which shows the functionality of the application.

4. Case study: looking for products in an application of m-commerce

The m-commerce application is based in the procedures for electronic purchasing proposed by Blommestein[6]. Figure 4 shows the whole procedure, the area dotted shows the processes that implements the m-commerce application, Delivery and invoicing and payment are relate to internal processes of the company

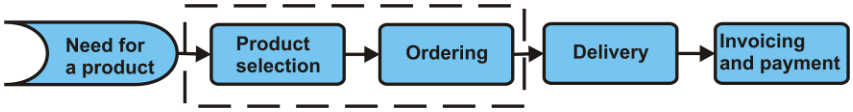


Fig. 4. Procedures for electronic purchasing proposed by Blommestein.

Figure 5 show in the area dotted the parts of the process of product selection implemented in our m-commerce application.

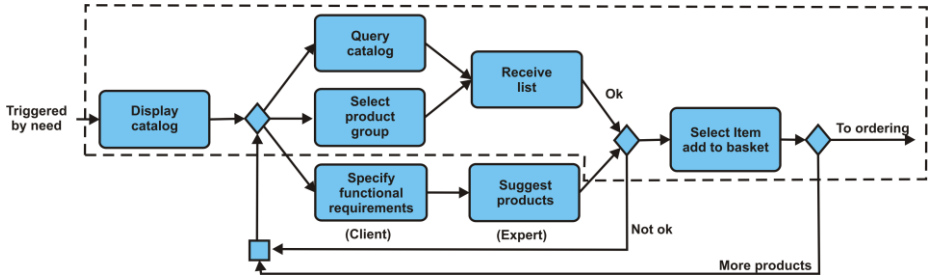


Fig. 5. The product selection process.

The processes are explained below:

1. Display Catalog: This process shows a product list offered by the enterprise. This product list can be displayed in a hierarchical way.
2. Query catalog: The client can search in the catalog using keywords, when a search query is entered the result is a product list.
3. Select product group: The products groups can be classified according to functional and technical characteristics.
4. Receive list: The product list required by the client.
5. Specify functional requirements (client) and Suggest products (Expert): The client can call on help from a product expert in the buyer or supplier organization. To do this, the client formulates a query in which he indicates the required product function. The expert concerned sends him by return a product list or groups that meet his requirements.

6. Select item, add to basket: The client selects the required product and adds the product to his shopping basket.

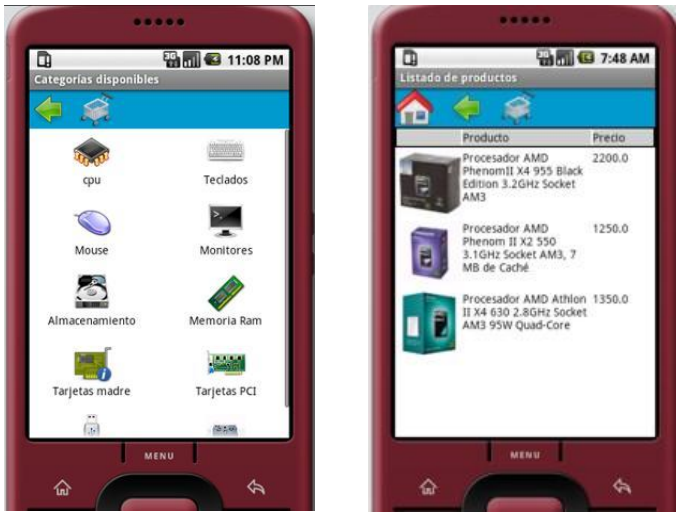
The following case study describes how the m-commerce application carries out the product selection process. Figure 6 shows the e-commerce portal which offers a catalog of products. In this case study, we covered the following premise: How does a user using a phone with Android operating system and m-commerce application retrieves products with the same features of e-commerce?

The process begins when the Android application invokes a Web service through an HTTP request, the function library kSOAP takes the URL and sends the request to the server where there are implemented the functions library NuSOAP, it communicates with the business logic and runs the appropriate method for the search of categories, to obtain records and builds the response is sent through the Web service in XML format to the library of kSOAP functions of the Android application, it extracted each one of the elements and are presented in the user view. Figure 7 (a) shows the result of this invocation.

Fig. 6. The electronic commerce portal in a Web browser

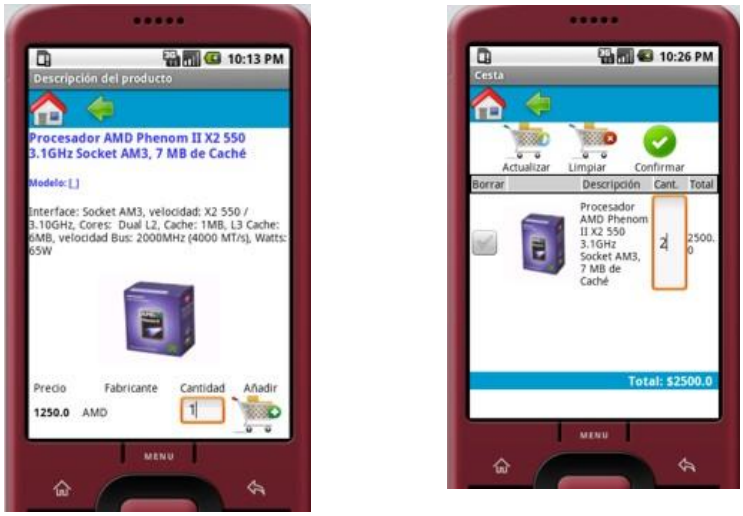
Figure 7 (b) shows the list of products available related to the category; when the client selects a product of the list, the complete description of the product is displayed, figure 8 (a) show the result of this selection. Figure 8 (b) shows the shopping cart when the user can add or delete products and clean the basket.

Once confirmed the shopping cart the client proceed to carry out the order, figure 9(a) shows the e-mail and password validation, the figure 9(b) shows the order summary.



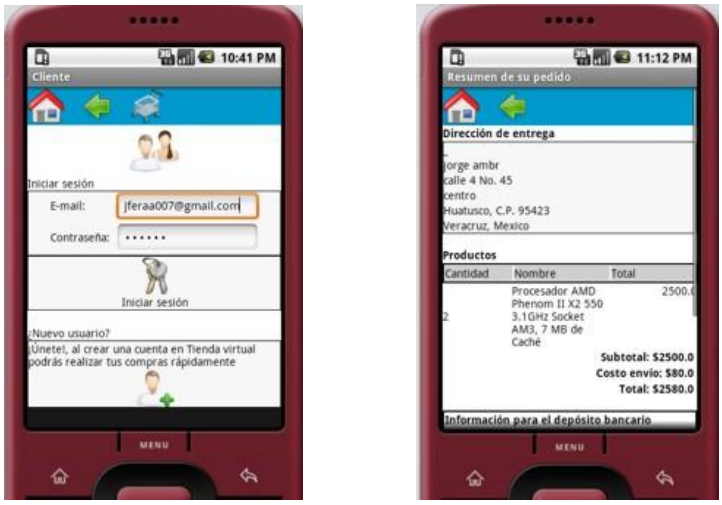
(a) (b)

Fig. 7. (a) Products categories, and (b) Products List by category of m-commerce application.



(a) (b)

Fig. 8. (a) Product description, and (b) basket.



(a) (b)

Fig. 9. (a) E-mail and password validation , and (b) order summary.

The m-commerce application is helpful to the user since provides a similar functionality of an e-commerce application. With an m-commerce application the user can performs the purchasing process of products available in stock by using an Android phone without requiring a desktop computer

Next section shows the related work using a SOA in mobile devices.

5. Related works

Currently, the amount of mobile phones are increasing daily, this allows for a new platform for business applications so that these devices need to adapt to technologies and communication protocols, below it presented works that are related with mobile applications that are developed under a SOA.

In [7] a review of kSOAP and J2ME Web services APIs (WSA or JSR 172) is presented for the use of Web services on mobile devices, also described a case study with a BlackBerry, with BlackBerry MDS Studio it creates enabled applications to communicate using a simple and compact protocol with BlackBerry Enterprise Server (BES) using Web services. In [8] a review of an application called WIPdroid is presented, the application uses Web services and real-time communication that allows to mobile computing platform support for distributed computing services, the tool gSOAP is integrated developed in C/C++, and it supports multiple platforms including embedded systems and small operating systems. In [9] a review of a framework is presented for a service-oriented using the REST technology (Representa-

tional State Transfer), in this framework, mobile applications communicate with business applications, plus inserts the execution of local and remote services, provides companies the ease to control services and data that users access through their mobile devices. In [10] a review of a SOA is presented for mobile devices through a COM implementation, for the tests using a Symbian S60 phone to demonstrate the effectiveness of the SOA for mobile applications. In [11] a review of a SOA framework is presented for mobile services, the objective is to investigate how the construction of mobile services is benefited from Service-Oriented paradigm. The framework designed by components provides services, giving the facility to be replaced by other instances or implementations. A review of an architecture for Web services consumption on mobile devices is presented in [12]. J2ME Web Services APIs are implemented on the device to provide access to Web services using SOAP. In [13] a review of a mobile Lightweight architecture SOA is presented for business applications running on devices with J2ME. It is a framework in which objects sent to the mobile device are serialized, compressed and transferred to the client as a message RDF. Communication is established using SOAP messages and all work is done through a Java midlet that exchanges data asynchronously with the server, minimizing the data transferred and stored on the device. Finally in [14] a review of a location-based mobile application is presented to enrich the experience of tourists where the application uses the principles of web service oriented architecture and data providers to support interactions among tourists.

6. Conclusions

This paper presents a service-oriented architecture for an Android application. The architecture provides a new way of communication for mobile commerce applications by invoking Web services using SOAP, the whole implementation is done only with open source functions libraries such as NuSOAP and kSOAP. This is expected that companies interested in trade Android mobile phones implement this architecture to offer customers an alternative to buying new products or services.

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