E-Banking platform for mobile users

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Abstract In this paper we present an e-banking platform for mobile users. The data communication is performed on the support of 3G/4G or wireless networks, which ensures high speed information traffic on the client side. The platform is designed in a client - server architecture, which ensures the distribution of IT resources in an integrated environment, organized on principles of information access and processing efficiency. Due to the advantage of mobility, such services have a great success on the market. Installed on mobile devices, with various operation systems, the software client applications are consuming the e-banking service. The e-banking tools are provided to mobile users through a Web Service. A Web Service is more efficient, from the data traffic volume and cost point of view, when comparing to an access solution based on Web Browsing.

Keywords: e-banking, client - server architecture, Web Services, mobile communications.

1. Introduction

Client server architectures for mobile clients, using mobile networks for data transmission represent a very good solution for a variety of economic agents, to promote and deliver their products and services to customers, in order to commercialize them faster. We consider that, in this way, a wide range of economic activities will be stimulated. The mobile terminals of last generation are equipped with operating systems and remarkable computing and information resources, which allows them to run complex software applications. The platform which is presented in this

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paper can be integrated with various e-business services, which can be delivered within the mobile or wireless channels to a large number of clients.

The citizens are using increasingly more the mobile and wireless networks as they become potential consumers of products, goods or services, provided by economical agents. Such services are accessed by the consumer through mobile applications installed on smartphones and tablets having various operating systems like: Android, iOS, Windows Mobile [1],[2] BlackBerry OS, etc., anytime and from anywhere.

The e-banking platform service is overlaid upon the telecomm layers. In this way, added value is provided to the telecomm services offered by the network operators, representing an attractive business development model for them and also for the economic agents. The platform exposes its functionality through a Web Service over XML / HTTP.

Even if high-end browsers are embedded in the 3G/4G smartphones, there is a lack of efficiency to display HTML based Web sites which contains large amounts of information. The viewing of large web pages is possible only using scroll up and scroll down functions. This can be cumbersome for the user, because the amount of information that can be accessed is directly proportional with the mobile terminal display dimensions. That is why, the platform provides specific client applications which offer to the mobile user a direct, efficient, improved and secured access to the e-banking facilities. This represents an important advantage for mobile users because the amount and cost of the data traffic involved is significantly reduced. Mobile client applications consume the Web service's methods, which are installed on the e-banking server. The architecture of the e-banking platform for mobile users is presented in Fig. 1
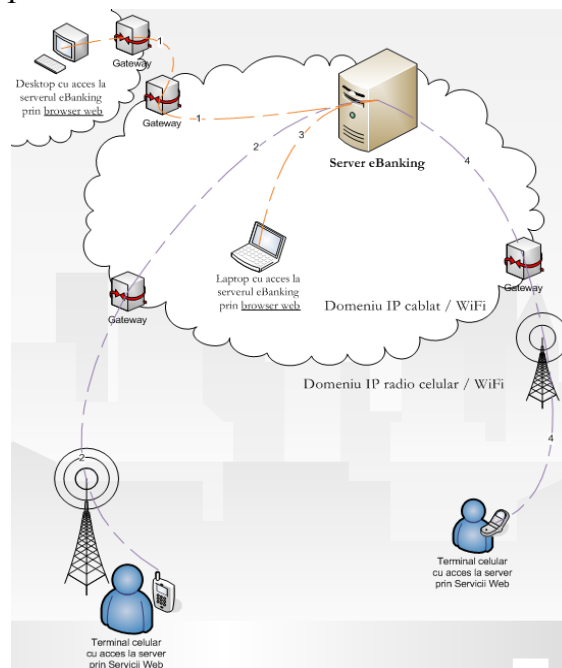

Fig. 1 The e-banking platform for mobile users architecture.

2. E-banking platform architecture

2.1. Hardware architecture
The e-banking platform has a client-server architecture, suitable for informational traffic on mobile or wireless channels, containing:
- a server with adequate technical characteristics for data storage, business logic and applications interfaces;
- mobile devices like Android Smartphones / tablets, compatible with the 4.4. (KitKat), 5 (Lollipop), 4.2.2. (JellyBean) platforms, ex: Samsung Galaxy Alpha, Samsung - Galaxy Tab 4 - 8" - 16GB - Wi-Fi + 4G LTE, etc.
- 3G / HSPA, HTC Touch Cruise, with Windows Mobile 6.0 OS [3] with Wi-Fi 802.11 b/g.
The devices presented above were selected to demonstrate that the software client applications of the platform can be used for a variety of mobile operation systems and terminals. Symbian OS [4] was also used, in order to ensure an increased number of target users of the platform.

2.2. Software Architecture
2.2.1. The server software architecture and functions
In order to accomplish the specific facilities of the e-banking service, the server side has been comprised of the following main modules:
- a database for storing and managing the destined user online information: accounts, beneficiaries list, bank transfers, payments etc.
- an admin panel which allows the administrator to access the platform's database, managing accounts, create new banking products, modify the rates, export reports, etc.;
- a Web Service layer interfacing between client applications and the database;
- an appropriate operating system (e.g. Windows, Linux, Unix, etc.); Windows OS was used for development;
- an appropiate Web Server able to run PHP scripts (eg. Apache, IIS, Tomcat, etc.); IIS 5.1 was used for development;
- a MySQL 5.0 database server [5]; we consider that switching to the version 5.1 or above is not recommended, due to the Php versions bugs in the operation;
- a Php interpreter module, version 5.2.6 or newer [6].
The server architecture of the e-banking platform is presented in Fig. 2 above. The core data exchange and browser clients data exchange takes place within a cabled network, with an outer 3G/4G mobile communication network layer enabling service to the mobile clients.
The database stores informational content which is delivered to the customers through the platform. All the e-banking service components have direct access to the database as follows:
- the web application publishes database informational content over the Internet, facilitating to browser clients essential functionality such as issuing orders, making payments, etc.;
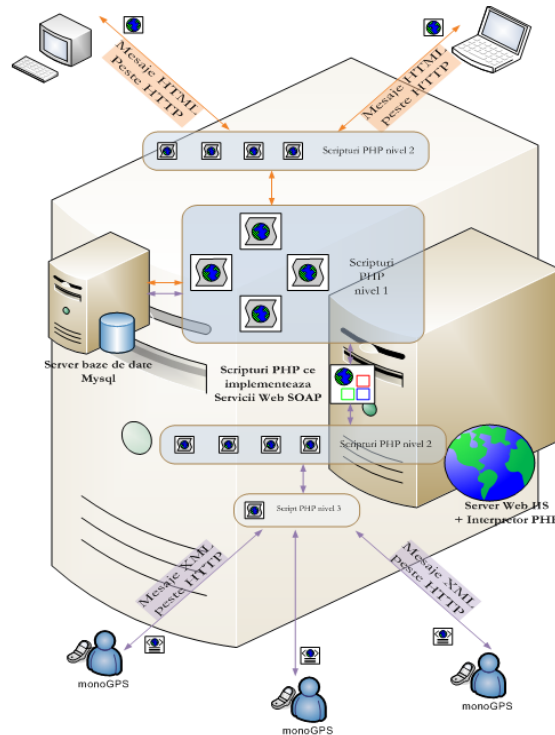
Fig. 2 The e-banking platform server.

- the admin panel allows the administrator to operate on whole platform, enabling functionality such as database modifications, creating new Web Services, issuing new facilities, etc.

The Web Service represents the interface between the client applications and the database, allowing the informational content access on the move [7], [8].

2.2.2. The Mobile Client Software Functions

The e-banking platform services are accessed from mobile terminals via the Web Service endpoints. Client software applications of the e-banking platform do not necessarily involve a browser; they are specifically designed for direct accessing the server through HTTP socket data transmission [9]. The software applications are designed for a variety of 3G terminals, like Smartphones and tablets equipped with different mobile operating systems: Android OS, Windows Mobile OS, Symbian OS, [10] etc. The installation kits are available to be downloaded from the server side of the platform, in order to be installed on mobile terminals. The client application instalation kits can be downloaded from the platform's site. After downloading, the client application is installed on the corresponding Smartphone or tablet. After instalation, the mobile user has access at the e-banking software tools published on the platform's server side. Customers will be able to open new accounts, order payments, and money transfers, etc. while on the go.

The data traffic within the platform takes place via the TCP/IP protocol. Although the 3G / 4G mobile terminals include advanced browsers, they are difficult to use for displaying web pages of the sites containing a large amount of information [11].

3. Developing methods and tools

Implementation of the e-banking mobile applications and publishing the service's functionality over the Internet was achieved with the following tools:
- for Android 4.4 v OS applications development: Eclipse Java IDE version 3.6., Helios, Android Studio, Android ADT Plugin for Eclipse, 10.0.1, Android SDK Tools, Rel. 10, Sun Java SE JDK 7;
- Netbeans IDE with J2ME, CLDC, MIDP [12];
- HTTP application server IIS 5.1 and HTML language;
- MS Visual Studio 2008, ASP.NET, VISUAL C#;
- Net Framework 3.5, Adobe Dreamweaver CS3, Active Sync 4.0.

4. The E-Banking platform service
4.1. Web service

Part of the client-server architecture lies in the Web Services way of exposing themselves through a service provider interface [7]. Different applications, written in different programming languages are allowed to communicate with each other. Since the communication is based upon XML, Web Services are not tied to a particular operating system or programming language.

Basically the term "Web Service" refers to a standardized method for Web applications integration, using standards and protocols such as XML, WDSL, SOAP and UDDI. XML is used for data serialization, SOAP is used for data transfer, WDSL is used to describe the available services and UDDI for discovery of available services. Mainly used in B2B (Business To Business) applications, Web Services allow organizations to transfer data without an intimate knowledge of their IT systems, behind firewalls.

Within the e-banking platform, the Web Service enables the client-server structure interoperability within the mobile or wireless communication network.

Web Services do not provide the user with a GUI (Graphical User Interface). The application interfaces are placed at the base of client-server data transfer. Programmers can then add GUIs as they need (e.g. a web page, a mobile client application) to provide specific functionality to the users.

The Web Service is the platform part which allows users access to the e-banking service through mobile terminals. From the mobile devices point of view, the e-banking platform tools are invoked as a Web Service and functions are somehow similar with those available through browsers, but more efficiently. The Web service architecture offers functionality which the web server is providing to a browser. The major difference, with respect to browsers lies within the access interface, because our Web Services are using SOAP (Simple Object Access Protocol). Although it is

more complex and implies a more voluminous data traffic than the REST (Representational State Transfer) protocol, SOAP is still a protocol with clear specifications. The REST protocol is just a way of implementing Web Services. The security model adopted for the e-banking application is HTTPS. Because no other intermediary entities come in between our mobile client and our web server the WS-Security specification has not been integrated.

Among PHP libraries which implement the SOAP protocol, the NuSoap library was chosen because of its popularity and ease of use for Java client libraries. The Web Service type interface access - between server and mobile users - presentation follows.

PHP Script of Level 3 represents the entry point of the platform's SOAP clients comprised of a single this script that can be found at the path: /ebanking/WSEP.php. It has an important role in the session maintaining, because Java mobile clients associates a web session with a URL (Uniform Resource Locator). If the script path is modified, the default URL and the session is lost.

PHP scripts of Level 2 are the Web services interfaces themselves, for example:
-/Webservice/log.php defines loginService and logoutService services;
-/Webservice/new.php defines common feature service for new records to be added to the database.

Although this level is the entry point used by mobile clients to access the e-banking functionality, it is also accessed from browsers to inspect the WDSL specifications. Other such level 2 services: newExchangeService, newTransferService, newBeneficiaryService; newAccountAliasService, existentOperService; existentBenefService, existentAccService.

PHP scripts of Level 1 represents the core of the e-banking platform and are placed in the /include/operatiuni.inc.php. The script contains the functions that are called directly by mobile applications and by browsers. The functions return the error/success messages defined in /include/defines.php script, or records from the database, as appropriate. Any operation firstly checks if the current session is not expired, otherwise a forced logout is performed. An expired session means that the last operation took place an certain amount of time ago, longer than the maximum delay allowed. This maximum delay is defined by the SESSION_EXPIRATION_TIME constant in the file /include/defines.php along with other configurable constants. The date and time of any operation updates the database 'sessions' table. For example, the function logoutFunc () is called by the "logoutService", to log the users out of their accounts and returns "DB_ERROR, OPER_SUCCESS, or OPER_FAILED, according to the results.

The client software GUI classes for mobile devices can be divided into several categories, which are summarized in the following.

The control classes are responsible for user's navigation between screens, depending on the selected menu and the information received after Web Service invoking.

The WsoapModel class is responsible for calling the proper Web Service endpoint on the server. The classes, by means of which the Graphical User Interfaces are displayed, enable the customer to use and interact with the mobile applications.

5. E-banking access experimental results

5.1. E-banking Web Service access through a browser
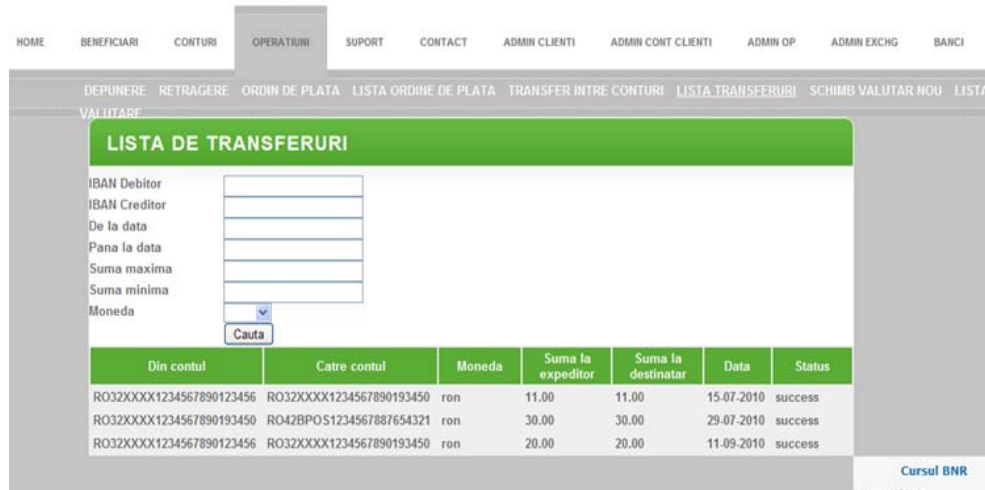

Fig. 3 The Web service's Transfers List method, displayed in browser.

It is useful to test the Web Service's functionality before consuming it on mobile channels. This allows us to establish if the Web service works properly and can be used on wireless channels. Fig. 3 and Fig. 4, respectively, illustrate the 'Transfer List' and 'New Account' functionalities invoked through the Web Services layer from a browser [15].
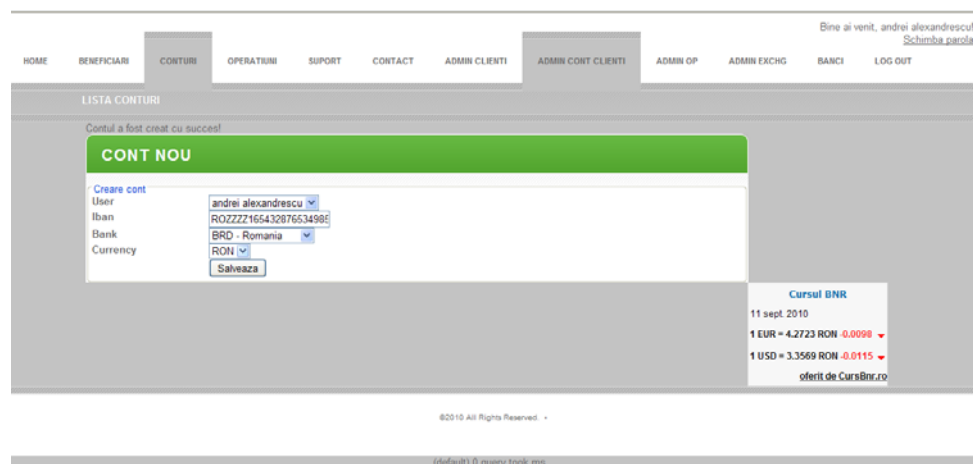

Fig. 4 The Web service's New Account method, displayed in browser.

5.2. Mobile client applications for smartphone
5.2.1. Banking procedure and terms

A banking client, in terms of customer contract holder, can be an individual or a legal entity (company, organization), that has a contract with a bank. The bank may associate to this client several types of accounts, in different currencies.

Our users are banking clients allowed to perform banking transactions within the customer account ex. (payments to beneficiaries within the customer accounts, previously set by the client).

User's beneficiaries are legal entities or individuals that are created within the e-banking platform and with which the user has established various contracts (telephone services, public utilities companies, businesses) etc.

5.2.2. Banking operations

The allowed banking operations are of 2 types: wire banking transfers and payment orders, further detailed below.

Transfers between the users own accounts (CK - CK) or from one account (source) to another account (destination) of the same user.

Transfers from a user account to a beneficiary account. The payment orders are issued by selecting the source account, the defined beneficiary and specifying the payment amount. Banking operations are allowed only if the accounts are issued in the same currency.

Banking operations are transfers and payment orders, ordered within the account which is involved in the operation. In the banking operation table, two operations will appear for a transfer operation:

a - which registers the source account and the debited input balance - output balance amount;

b - which registers the destination account, the credited payment input balance - output balance amount.

For the two operations, the same operation reference number will be used, which is either id_transfer or id_order, depending of the operation type.

The mobile client software components of the e-banking platform are developed for 3G / 4G mobile terminals, Smartphones and tablets, with Android OS [13], Windows Mobile OS, and Symbian v.9.1 OS [14].

Users can browse in order to access the e-banking platform, where they can download mobile client applications deployment kits for their mobile devices. Every submenu of the mobile client application corresponds to a Web Service endpoint on the platform. Some of these submenu GUI's are shown in Fig. 5 – Fig. 8; the snapshots were captured from mobile device emulators.

Users can select the desired tool via the Welcome GUI Form, as is presented in Fig. 6 and can realize on-line payments using the Exchange Form GUI, as is presented in the Fig. 7. The Retrieved Operation list performed by the client and the Operations Details are presented in the Fig. 8.
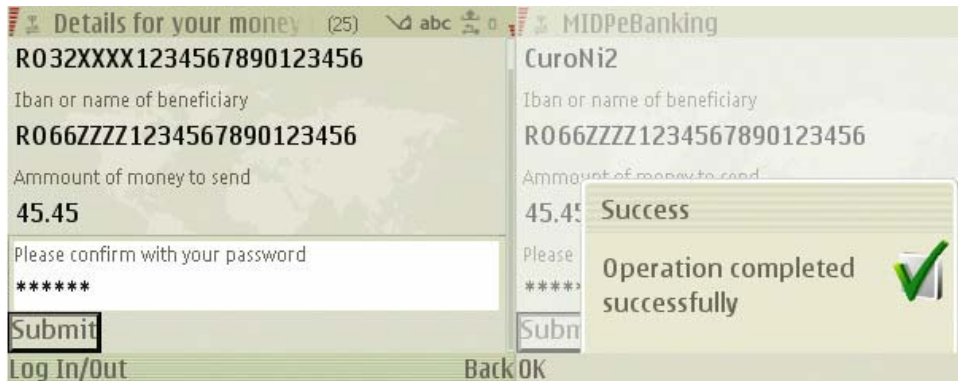
Fig. 5. The Symbian mobile application GUI snapshots

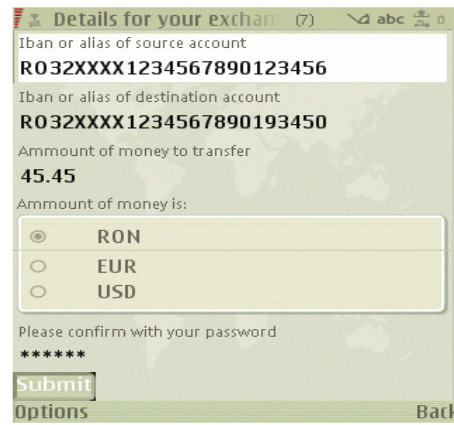Fig. 6 The Welcome Form instance interface and GUI

Fig. 7 The Exchange Form interface and GUI, for payments

a) lista rezultatelor   b) detalii rezultate

Fig. 8 The retrieved operation list and the operations details.

The results of the client operations are presented through Operations List screen, that displays the list of operations details.

5.2.3. Issuing a new payment order
The steps necessary to perform this operation are presented in the following.
Menu selection for placing a new payment order:
- In the application's main menu, the user operates the "Place Order Money" sub-menu;
- the GUI Money Order form is displayed, for issuing appropriate orders.
Selecting the IBAN payer account (Money source)
- in the "Money Order Form" GUI, the user enters in the text box "Iban or name of your source account", the payer IBAN account or alias.
Beneficiary IBAN account selection
- the user enters in the text box "Iban or name of beneficiary", the IBAN of the beneficiary's account, where the money will be transferred.
Entering the amount required for payment
 - the user enters the amount required to make the payment;
Entering the password for user identification
-the user enters her/his password, to confirm her/his identity, in the "Please confirm your password" text box;
Effective payment achievement and receipt of the confirmation message
- the user activates the "Submit button" to realize an effective payment operation;
Payment confirmation
- in the "MoneyOrderForm" GUI, the message "Success" is displayed;
- Operation completed successfully" message is displayed, confirming that the effective payment was realized,, or that this task was assumed by the bank.

6. Conclusions

An e-banking platform for mobile users was implemented using wireless networks for data transmission. The client software applications are designed for 3G /4G Smartphones and tablets, with various operating systems like Android OS v. 4.4., Windows Mobile v. 6.0 OS, Symbian V 9.1. OS. The client software applications are available on the platform site and can be downloaded in order to be installed in the user's mobile terminals.
An important module of the e-banking platform is the Web Service layer, whose contents are consumed by the client applications, but which can be also accessed by browsing. Invoking a Web Service endpoint using browsers is useful for testing purposes, while invoking the same from a mobile client offers the advantage of a decreased data traffic volume and cost, all in the context of security and mobility.
The menu and GUI of the mobile applications offer the possibility of basic e-banking operations. The e-banking platform can be integrated in a cloud computing environment and, from this point of view, the e-banking platform brings some remarkable elements of originality, such as:

- a value added service providing, overlaid on the telecomm services supplied by the network operators, which is a vision that correspond to a "win - win", efficient business model;

- the possibility to integrate location based services within the e-banking platform, to make the proposed e-business model adapted to the geographical context of the user and of the economical agents current location;

- the platform's Web Service methods can be used by third parties to develop their own software applications, according to their marketing targets [14];

- integration of the different client software applications, designated for different types of mobile

terminals and operating systems, which will use the same server resources.

Future research aims to develop a complex e-business platform which integrates various e-services, applications and modules into a complex framework.

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