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# Mobile Payment System – Telco 2.0 application dedicated for payments

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Abstract — **The following paper presents Mobile Payment System. The system is a prototype of an innovative method of paying for services using the mobile phone. The method is quite straight-forward, basically the user wanting to access some online service supplies his/her cellular phone number to the web form and receives a token via USSD message (Unstructured Supplementary Service Data). Then, introducing the token into the web form gives the user an access to the desired content. At this exact moment the charging is done. The due amount of money is simply added to the monthly bill, in case of postpaid phones, or subtracted from available credits, in case of prepaid mobile phones. The functionality of sending USSD messages from the system to the subscriber mobile phone was achieved by using Telco 2.0 Web Services provided by Orange Labs.**

## I. Introduction

As it is observed, nowadays in the global web there are more and more paid services. There are a numerous portals which require registration fees, an access to some scientific articles is restricted until it is paid for. There is of course possibility of buying ticket for a concert or other cultural event and a lot of other services not mentioned here. Some of the services have a great number of users and other not so many. Also as it is commonly known, everybody wants get the access in the shortest time and the easiest way possible. The need therefore arises: quick, easy mobile payment method with no scalability problems.

### A. Existing solutions

At the moment there already exist some payment methods like [11]:

- premium-rated SMS
- credit cards
- pay-pal (and alike systems)

Unfortunately each of described above system has some limitations. Premium-rated SMS requires a huge number of users per month to be cost-effective. The problem with credit cards is such that not everybody has one, another is that for some people it may seem risky to send sensitive credit card data over the internet which will discourage them from using this method. Pay-pal and pay-pal-like systems require registration and uses dedicated account which is time consuming and can act like a discouraging factor.

### B. Migration from Telco 1.0 to Telco 2.0

Telco 1.0 is about value-added services (VAS) [1] which are all services that are beyond voice calls or fax transmissions. They, as the name indicates, add value to the standard services. Historically, SMS, MMS or data access were considered VAS, however nowadays they are standard services. In that approach only the operator could create new added telecommunication services. The reason for that was the fact that such services used intelligent network platforms (telecommunication platform with centralized management), which were accessible only by the operator. Since a few years migration from Telco 1.0 to Telco 2.0 [2][2] can be observed.

In Telco 2.0, an additional layer in the Intelligent Network Platform architecture has been created. It has been added to make a creation of other VAS possible by parties other than the operator alone. In practice, the operator offers an access to the basic telecommunication functionalities (like sending and receiving USSD, SMS, MMS messages, managing phone calls, locating terminals etc.) in form of easy to use web services. The communication with those services is possible using the SOAP and REST [3][3] protocols. The conceptual difference between Telco 1.0 and Telco 2.0 approaches is

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visualized in the Fig.1. The architecture of the Telco 2.0 solution is presented in Fig. 2.

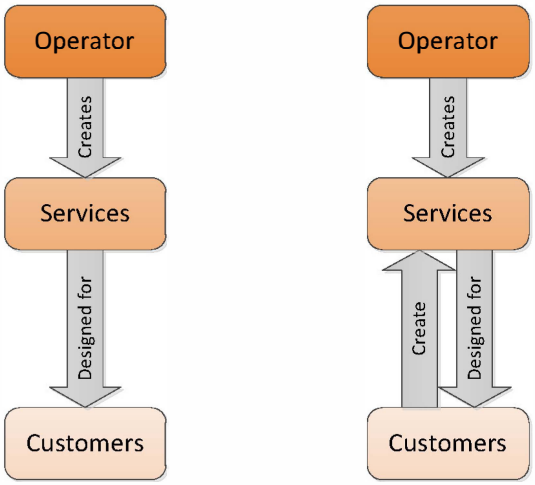


Fig 1. Telco 1.0 vs. Telco 2.0 concepts[7][7]

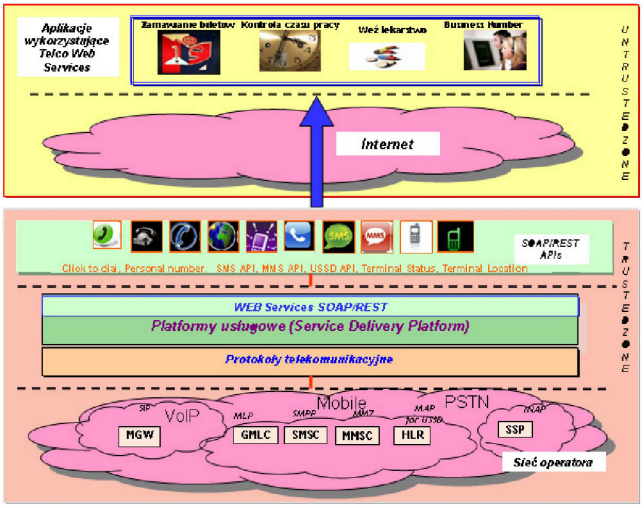


Fig 2. Telco Web Services architecture [10][10]

C. Profits of using Telco 2.0 to solve the presented problem

The great advantage of Telco 2.0 is its the range of usage. It is not restricted to the users of smartphones only but it is accessible by all mobile phone users within coverage area which is over 95% of the inhabitants of Republic of Poland. It implies that the service can be launched from any location covered by the radio access network of the native mobile telecommunication operator. During recent years there were developed a number of applications based on operators networks assets. Some examples are described in literature [6][6], [7][7], [8][8], [9][9], [10][10].

## II. THE PAYMENT SYSTEM

Mobile Payment System is a prototype of an innovative method of paying for services using the mobile phone. The system presented in this paper addresses all the arisen needs: it is fast, easy and has no scalability problems.

Implemented solution of the method is just a prototype that should be treated as a proof of concept rather than ready to deploy product. System functionalities are limited to granting access to specific URLs. Apart from that the management panels has been implemented in form of web application.


Fig 3. The schematic of service usage[7]

The method is fairly simple, the user wanting to view restricted content supplies his/her cellular phone number to the web form and receives a token via USSD message. Then, introducing the token into the web form gives the user an access to the desired content. Also at this moment the charging is done. The due amount of money is added to the monthly bill, in case of post paid phones, or subtracted from available credits, in case of pre-paid mobile phones. This is, of course, just the main idea of how the system works. The system itself is more complex. It contains also user account creation, generation and transmitting the account password to the client via SMS, storing the history of subscription, administration panel (managing of 'non-admin' users). Also, the service is protected from unauthorized use thanks to basic authentication mechanism. The functionality of sending SMS and USSD messages from the system to the subscriber mobile phone was achieved by using Telco 2.0 Web Services provided by Orange Labs. These are ready to use services that provide above mentioned functionalities. The whole system was implemented in .NET technology using C# programming language. Entity Framework was used to facilitate all necessary database operations, technology for database is MySQL. The communication with Web Services is

possible with SOAP protocol. The implementation of user interface uses ASP.NET MVC 3 Framework.

## III. SYSTEM ARCHITECTURE

### A. Functional schematic of the solution

The functionality of the solution is presented in Fig. 4.

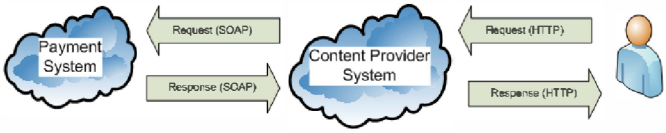


Fig. 4 Functional Schematic of the solution

The end user makes HTTP GET request to Content Provider System if the user is not authorized to view the content SOAP request is made to Payment System where the user is charged. Response is sent to the end user through Content Provider System.

### B. Used Telco 2.0 interfaces

The system is based on the functionalities offered by mobile phone networks. SMS API, USSD API and GetOperator API have been used. GetOperator API is used to check if the number provided by the user belongs to Orange operator. SMS API and USSD API provide a possibility to send a message and check the status of the message. SMS API is used in the system to send the generated password to the user. USSD API is used to send generated access token to the user's mobile phone and send notification about charging.

### C. Structural architecture of Mobile Payment System

The solution presented in this paper consists of 2 separated systems: Payment System simulating payments and Content System providing resources.

The Payment System (Telco) is responsible for exposing SOAP Web Service providing Payment API functionality. It consists of three parts based on the performed functions shown in Fig 5.

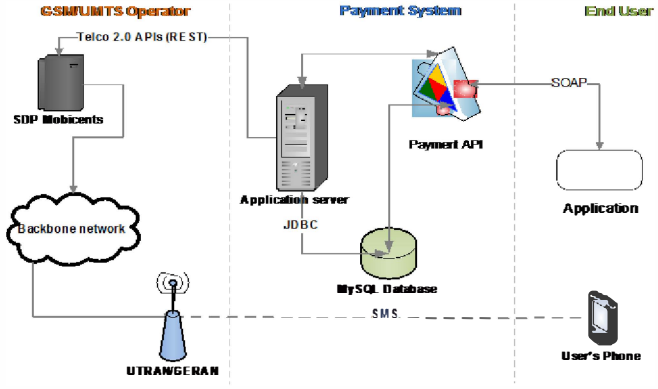


Fig 5. Structure of developed Payment System

• End User – communicates with the system via UTRAN/GERAN access network using mobile phone or SOAP web service.

• Payment System – the logic of the system consists of two applications. First one is the application implementing Web Service and the other is Web application which provides the user interface for database administration. The communication between the system and database is done using Entity Framework. The database stores information about accounts, transactions and web service users. The application uses Telco 2.0 interfaces to send passwords to the user's mobile phones.

• GSM/UMTS Operator – enables the communication with the developed system through exposed Telco 2.0 interfaces.

The second module - content system is responsible for providing paid content to the end user. It consists of three parts based on performed functions shown in Fig. 6.

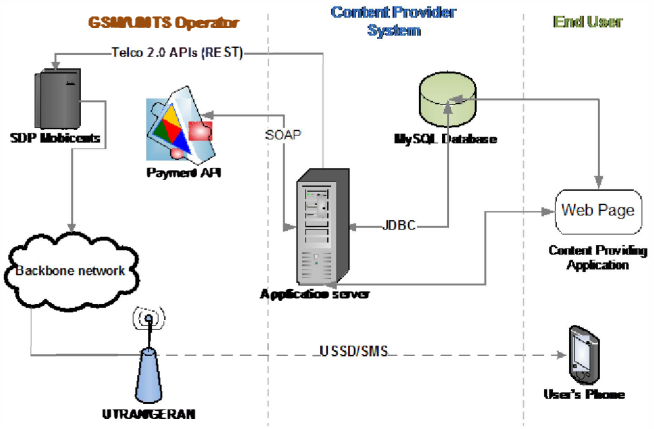


Fig 6. Structure of developed Content System

• End User – communicates with the system via UTRAN/GERAN access network using mobile phone or Web Browser.

• Content Provider System – the logic of the system is implemented as a web application, which provides the user interface for the Content Provider application. The communication between the system and database is done with use of Entity Framework. The database stores information about users, URLs and subscriptions. The application uses Telco 2.0 interfaces to send token to the user wanting to access chosen URL.

• GSM/UMTS Operator – enables communication with the developed system through exposed Telco 2.0 interfaces.

D. Class Diagrams

Presented solution was developed in Model-View Controller (MVC) style. It consists of Controller, Model, ORM and Helper classes. All interesting classes are presented below. Views are simple dynamically generated HTML. Classes in the system:

- Controller classes – responsible for handling HTTP requests. GET and POST requests are mapped to appropriate method called action from the class. Diagram is presented in Fig. 7,8
- Model classes – represents the data objects send within system. Each class consists of properties and the setter/getter methods for each.
- ORM classes – represents the database tables mapped into C# objects. Entities are generated by Entity Framework.
- Helper classes – are responsible for database operations, handling AJAX, sending response to mobile phone end user. Presented in Fig. 9, 10

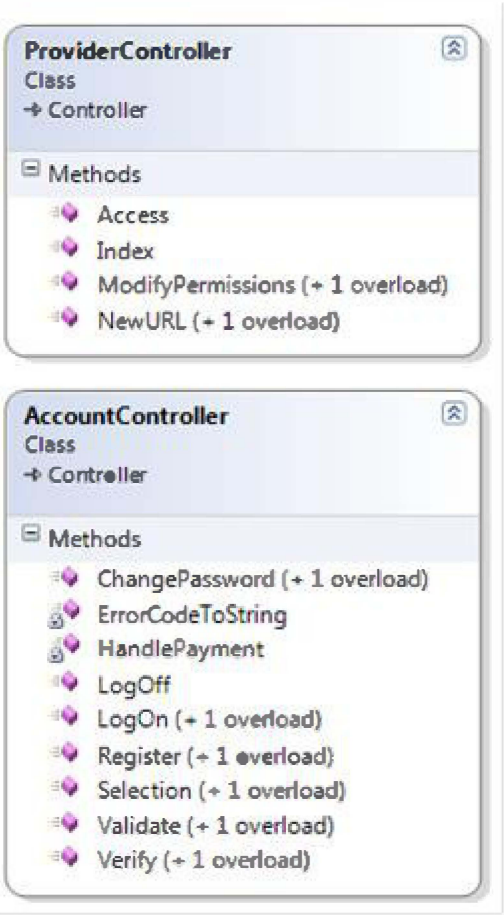


Fig 7. Controller classes

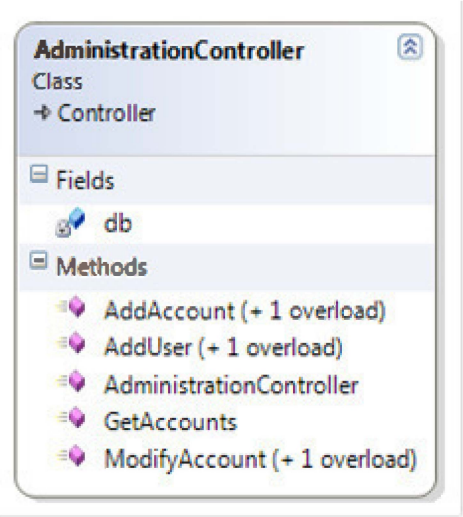


Fig 8. Controller class

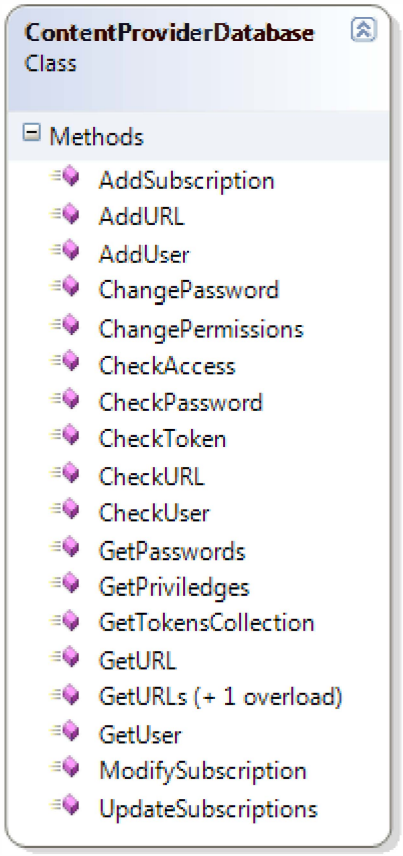


Fig 9. Helper class

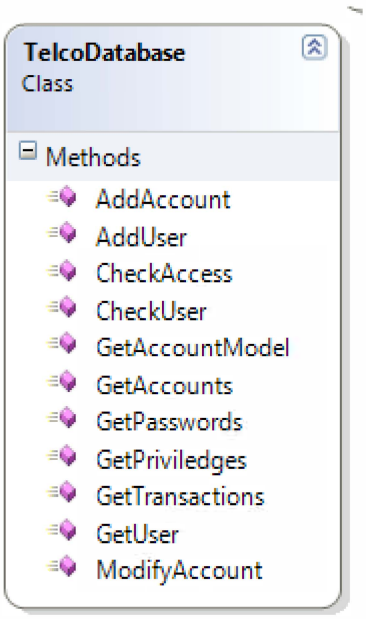


Fig 10. Helper class

## IV. USER INTERFACE

The Mobile Payment System was developed using C# programming language and ASP.NET MVC 3 framework. The system has a simple, intuitive web interface. JavaScript was used to create the user interface, Microsoft Internet Information Server was used as an application container. Some interesting views, that user may find in the system, are presented below. Implemented solution supports both types of resources: local and external.

**List of URLs**

wp.pl

onet.pl

mini.pw.edu.pl

google.pl

allegro.pl

localhost:8080/ContentProvider/Resources/house.jpg

localhost:8080/ContentProvider/Resources/koala.jpg

localhost:8080/ContentProvider/Resources/penguins.jpg

Fig 11. List of supported resources

Presented in Fig. 11 shows the list of supported resources. It can be easily extended by administrator through appropriate web form. User can check the list of his/her subscriptions Fig. 12.

**List of subscriptions**

| URL | Expiration Time |
|---|---|
| localhost:8080/ContentProvider/Resources/house.jpg | 2013-05-16 10:57:04 |
| google.pl | 2013-05-12 10:59:55 |
| en.wikipedia.org/wiki/Speech_recognition | 2013-05-12 11:06:40 |

Fig. 12 List of subscriptions

Web application allows to check the transactions made through the system. The exemplary transactions list is presented in Fig 13.

**List of user transactions**

| ID | Amount | Reference Code | State | Time |
|---|---|---|---|---|
| 1 | 2,3 | 7fa77935-882d-4792-a03f-dd8a3ec193c4 | CHARGED | 2013-01-07 13:21:59 |
| 2 | 2,3 | 6b537d50-3071-4e91-880f-28d7658bbab0 | REFUNDED | 2013-01-07 13:24:49 |
| 3 | 1 | c9e61089-8858-43f9-b9ed-afcb77f398c9 | CHARGED | 2013-01-07 14:37:39 |
| 4 | 10 | 76ef3560-5b48-4dae-9865-1aafc80a43e2 | CHARGED | 2013-01-07 15:47:30 |
| 5 | 1 | 5b40592d-b901-4d89-a419-2e6ef4f128a1 | CHARGED | 2013-01-07 15:50:04 |

Fig 13. User transactions

## V. CHALLENGES

The system that has been developed is just a prototype. The most important part of it is the Payment service. Due to the prototype version, the service provides only the basic functionality and has been secured merely with HTTP Basic Authentication without SSL. Such a solution, in fact, is not secure at all. Hence, in future, the thing of utmost importance will be upgrading the security level of the system. Since the service is responsible for financial operations it must be protected by a top-level security system. The functionalities might also be extended. The current version allows only to: charge account, refund account, check transaction status and get transactions list. The possible directions of development are to extend an existing reservation or release a reservation. Payment service is an XML Web Service supporting exclusively

SOAP protocol. Hence, another enhancement could be handling RESTful architecture style with JSON data serialization support. The advantage of REST protocol is that it is very lightweight and uses normal HTTP methods instead of heavy XML format. Both parts of the system: Telco and Content Provider have very simple user interfaces, designed just to present the system capabilities. This is however, another possibility of enhancement. At last, the mobile version of the system may be created as well.

## VI. CONCLUSION

Presented in this paper the prototype of the innovative Mobile Payment System shows the possibility of usage of telecommunication open APIs in very wide mobile payment area. The main goal of presented research was to create the payment service and simulate it using Internet. All requirements were considered when designing system's architecture. The created user interface is simplistic and should be treated rather as a proof-of-concept. Tests showed, that all functional requirements are satisfied. The End User tests and Orange Labs experts comments provoked some changes that made the system more user-friendly.

Prototype of the System service was developed under the program Open Middleware 2.0 Community [5] as a part of Piotr Trusiewicz and Maciej Witan B.Sc, thesis.

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