APN Mobile Virtual Point of Sale Terminal

Dragomir D. Dimitrijević

Abstract — **In this article we describe the Advanced Payment Networks, Ltd. (APN), Mobile Virtual Point of Sale (MVPOS) terminal as a part of APN universal commerce (u-commerce) payment network. The MVPOS allows easy development of new mobile commerce (m-commerce) applications due separation of components which deal with handling of SMS messages and those which deal with specifics of m-commerce applications. The internal organization of MVPOS is described as well as an application for recharging pre-paid mobile phones using SMS messages.**

Keywords — **e-commerce, m-commerce, point of sale, payment gateway.**

I. Introduction

As the market leader in Serbian the area of non-cash payment and card technologies, Advanced Payment Networks Ltd. has developed a family of universal-commerce products. The adjective "universal" pertains to multiple communications means in the system (Internet, as well as wire-line and mobile telephone networks) and use of cards, which goes well beyond traditional use as a means of non-cash payment. The APN's family of U-Commerce products are Universal Payment Gateway (UPG), Virtual Point Of Sale terminal (VPOS), Mobile VPOS terminal (MVPOS), and Payment Network Management System (PayMan). The UPG and the VPOS were described in [1] and [2], while the MVPOS was developed later. More about e-commerce business models and transactions on the Internet can be found in [3].

The developed family of products is fully compliant with the ISO 8583 standard for financial transactions i.e. with the global cards processing system for Visa/MasterCard and with the national cards processing system for DinaCard.

To expedite deployment of Internet and mobile shops, APN has developed a slew of highly customizable turnkey solutions for Internet and mobile shops, which cover most of business models and needs. APN offers solutions to m-commerce merchants in the form of its Mobile Virtual POS terminal, which accepts payments with banking, proprietary cards or loyalty cards via SMS messages. APN also offers services to merchants who need online shops with more specific requirements.

In this article, we shall concentrate on description of the MVPOS. In section II we shall describe the overall APN u-commerce architecture and how the MVPOS fits in it. In Section III we shall describe internal organization of the MVPOS terminal and an m-commerce application for recharging pre-paid mobile phones using SMS messages.

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II. Payment Network Architecture

A. Overall Architecture

The u-commerce system architecture is shown in Fig. 1. The adjective "universal" pertains to all available communications means (wire-line and wireless). Also "universal" pertains not just to financial transactions in the usual sense (credit/debit card payments), but also to custom made transactions such as loyalty cards, ID access control, contactless cards, etc.

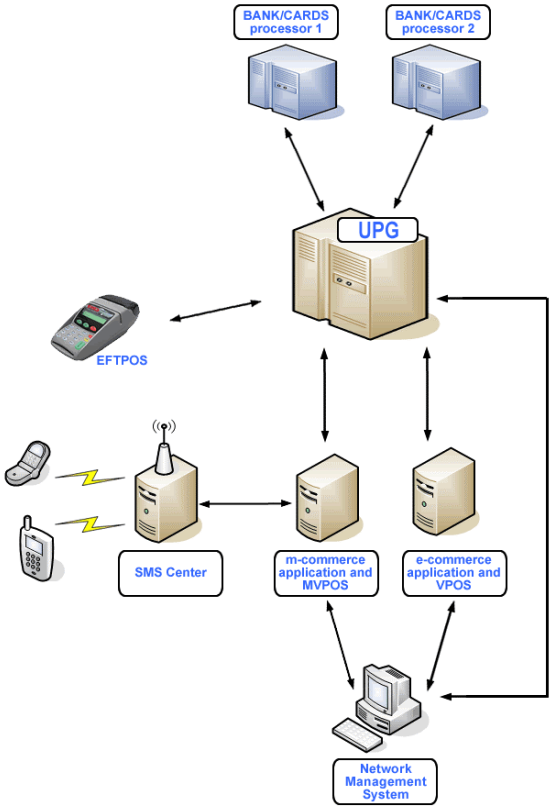

Figure 1: APN Payment Network Architecture

The centerpiece of the system is the Universal Payment

Gateway (UPG). It handles requests coming by various communications means. Requests for authorization of transactions made at various e-commerce sites are coming from the Internet using the TCP/IP protocol. Requests for transactions made face-to-face are coming from EFTPOS (Electronic Fund Transfer Point Of Sale) terminals via the public switched telephone networks. Requests may also come from cardholder's mobile phone in the form of SMS messages, from wireless EFTPOS terminals or WPOS terminals (a special WEB based Wireless EFTPOS terminals provided with a RF readers for contactless chip).

Based on their contents and types, requests are routed by the UPG toward various card processors or switch centers. In the most traditional sense, payment requests are routed based on the card's BIN (Bank Identification Number) toward the appropriate card processor or switch center. In a less traditional sense, requests may be forwarded to custom made applications that handle requests. As an example, such applications may control access to premises and accordingly keep track of timesheets, or may keep track of points awarded to customers in a loyalty scheme. Moreover, APN has its own Cards Management System designed for debit/credit (revolving), charge payments cards, loyalty and RFID cards, so every authorization request may be solved online locally. In addition, payment requests may also be handled by the UPG based on contents of reserved fields (national or private) in ISO 8583 messages. Those fields may contain information about prepaid accounts (e.g., prepaid mobile phones) that have to be topped-up in real time simultaneously with payment authorizations.

The other important part of the system architecture is the Virtual Point Of Sale (VPOS) terminal embedded in web e-commerce applications as well as in Mobile VPOS. Its role is to collect information needed for transaction authorization, format it according to the ISO 8583 standard, forward it toward the UPG, and receive the response.

The third part of the APN payment system, which is the main topic of this article, is the Mobile VPOS (MVPOS) terminal. It receives requests for payments in the form of SMS messages that come from cardholder's mobile phone via an SMS Center (SMSC). Actions performed by the MVPOS based on the content of SMS messages may be customized according to merchant's needs.

The fourth very important part is the payment network management system (PayMan). Although PayMan is neither visible nor accessible to merchants and cardholders, it allows APN staff to permanently and remotely monitor state of other elements of the system thus leading to unprecedented quality of service to customers. In addition, the PayMan allows APN staff to remotely configure the entire payment network, which minimizes the maintenance cost due minimized need for interventions at customer's premises.

B. *Software Organization*

The APN's policy is to ensure low cost products to its customers as well as high flexibility that will allow customers to enter to e/m-commerce market according to their budget. This policy implied use of open source components. All software components developed in this project are based on Java™ technology, a de facto standard for Internet applications. The latest developments in this technology are closely watched. Software had been often developed using early-access releases so it is ready when the underlying Java technology is officially released. Furthermore, Java is the underlying technology of the Visa Open Platform™ (VOP) that defines standards for the development of Smart Card applications. Due to portability of Java code, it runs on any contemporary operating system. The software has been tested on Linux and Microsoft Windows™ family of operating systems Applications are portable and have been tested with Oracle, Microsoft Access™, and the open source Postgresql databases so customers can configure their e/m-commerce applications according to their budget.

Applications that run on the APN site use Linux/Oracle combination. Web server is Tomcat. E-commerce applications are implemented using standard Java Servlet technology. All applications are highly configurable with respect to look and feel (color, graphics, fonts, etc.). All language related elements such as character-set, text strings, and error messages are also configurable. In addition, all applications generate various security and access logs that allow detection and tracking of attackers on the system.

III. MVPOS TERMINAL

A. *Internal Organization*

Internal organization of the MVPOS terminal is shown in Fig. 2. The MVPOS runs as a standalone server on the network. Mobile phones send payment requests to the MVPOS in the form of SMS messages via an SMS Center (SMSC). Content and format of payment request (content of SMS message) is defined by the merchant and the m-commerce application.

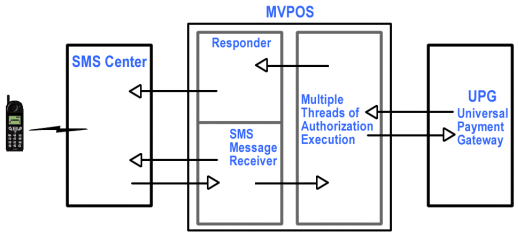

Figure 2: Mobile Virtual Point of Sale Terminal

The receiver accepts SMS messages. It immediately

replies with a message that the request is received and that the user will get a response shortly. This immediate response is made for psychological reasons. Depending on the card processing company, execution of authorization may take some 15-20 seconds. This is sufficiently long and some less patient users are tempted to re-submit the request, thus create double request. With the immediate acknowledgement of the received request, users know that they have to wait.

Upon reception of the request, the receiver creates a new thread of execution and initiates the authorization process. There may be multiple requests in different state of execution simultaneously pending in the system. Since different card processors handle requests asynchronously, they may be completed out of order, i.e., a request may be completed before one that arrived earlier. Multi-threaded execution maximizes use of system resources.

An execution thread analyzes the content of SMS message and creates a payment request. It provides all the necessary information such as card number and the amount to be paid. It generates an *authorization request* message (ISO 8583, type 200), and sends it to the UPG. The UPG converts such a message to a host-to-host message (ISO 8583, type 100) and forwards it to an appropriate card processing company or switch center. Then, it receives the *authorization response message (*ISO 8583, type 110), and converts it into message *authorization response* (ISO 8583, type 210) and returns it to the appropriate thread of execution. Based on the returned authorization response ISO 8583 message, the content of the response SMS is generated and submitted to the responder, which sends the SMS message back to the SMSC and the user.

B. *Implementational Issues*

In order to expedite the development of new m-commerce applications, the MVPOS was implemented similarly to web servers, which use Java servlets. The SMS messages are handled by the receiver and the responder in the same way regardless of actual nature of the m-commerce application and the content of the messages. The receiver and the responder act only as a transport mechanisms for messages. Actual work with details related to a specific m-commerce application is done by Java classes witch subclass the APN class MServlet (analogously to HttpServlet in the realm of web applications). The MVPOS may be configured to use different subclasses of MServlet, thus implement different m-commerce applications. The SMS Message Router does selection of an appropriate MServlet, as shown in Fig. 3.

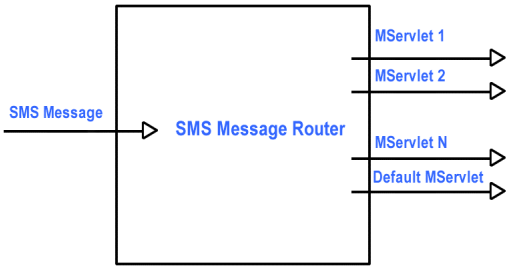

Figure 3: SMS Message Router

The implementation of the SMS Message Router is also configurable. In most of the cases, an implementation that routes messages based on the first keyword in the message will do the job. In case no appropriate MServlet can be found (e.g., invalid keyword), the default MServlet is invoked which may for example return an error message or echo the original message.

In case of a single m-commerce application configured on the MVPOS, it is possible to turn-off SMS Message Router. Then, all work is performed by the default MServlet that implements that application. Many merchants will find this solution sufficient for their needs. Others, that want to have multiple stores on the same SMS number will have to use the message router and direct messages toward different stores. As mentioned above, one way to do this, is to use the first keyword in the message.

C. *M-Commerce Applications*

On the application level, the concept of MServlet has nothing to do with commerce. The application may be submission of questions to an anchor of TV/radio show. In this section, we will concentrate on m-commerce applications, i.e., applications that involve payment using credit/debit cards. For example, the use of national Dina cards in Serbia is regulated by the Central Bank of Serbia (NBS – Narodna Banka Srbije) and, due security concerns, their approach is pretty restrictive and conservative.

One, more relaxed approach, is that the SMS message may contain all informations about the card. Most online shops on the Internet require the following data: card number, card-holder's name, expiry date, and CVV2. In such a way, any phone may use any card to make payments.

The conservative approach taken by the NBS requires that the user must register the phone and the card he/she wants to use for payments made from that phone. This approach is less vulnerable to phone eavesdropping since, there is no need to send the card information in SMS messages. Instead, the phone number is used to identify the card number that is registered with card processor (payment gateway).

APN implemented an MServlet for topping-up of pre-paid mobile phones using the national DinaCard according to operating rules written by the NBS. When operating rules for m-commerce become applicable to other merchants like for mobile operators, APN will be able to rapidly fine-tune corresponding m-commerce applications.

In order to use certain Dina Card to top-up mobile phone, the user must register the card number and tie it with the phone number. In addition, the user may add "friends and family" phone numbers that may be topped up from the users phone using the registered card. Besides the card number, the user must register the mobile PIN (Personal Identification Number). In order to top-up his/her own phone, the user sends an SMS message with the amount and the PIN. In order to top-up a "friends and family" phone, the message must also contain that phone number. The MServlet that implements NBS rules accepts the message and verifies its correctness, i.e., if the originating phone and the optional "friends and family phone" are registered, if the PIN is valid and, if the amount does not exceed the globally defined upper limit. If the message passes this pre-authorization, an ISO 8583 payment authorization request is generated using information about the registered card. In addition, the ISO message is filled with phone number so that the UPG can actually top-up the phone as described in [2]. Such a prepared ISO message is sent to UPG, which forwards it to an appropriate card processor or Dina Card Switch center. The card processor checks the card and availability of funds and returns the authorization response directly to the UPG or via DinaCard Switch center. The returned ISO response message is converted by responder of MVPOS to a human-readable SMS message and returned back to the user. In case of an approved payment, the phone number is topped-up by the UPG.

The described example was just an illustration. The approach with MServlet isolates development of other m-commerce applications to short segments of code that analyze contents of simple SMS messages and generate payment requests using information extracted from the message. Consequently, this APN technology allows rapid development of new m-commerce applications.

IV. CONCLUSION

In this article we described the APN state-of-art technology for universal commerce applications. In particular, we concentrated on mobile applications. The developed technology enables APN to rapidly develop new m-commerce applications thus allowing merchants to enter the m-commerce market at a low cost.

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