A CRM-BASED PRICING MODEL FOR M-COMMERCE SERVICES

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Abstract: Mobile network operators (MNOs) and service providers need flexible pricing mechanisms in order to fulfill next generation business models. Heavy competition in the wireless market place increases the importance of designing the most effective business models and developing long-term relationships with customers. Customer Relationship Management (CRM) is an effective tool in order to pursue long-term relationship with profitable customers. In this article, we focus on proposing a simple and robust pricing model for mobile commerce services based on CRM approach. This mechanism enables operators to satisfy the needs of their existing customers and to achieve the maximum revenue and utilization rate on their current customer portfolio as well. Our aim in this research is to come up with a unit price for each mobile service/product class by taking the issues of social welfare maximization into consideration. The CRM implementation in the proposed model further allows MNO to better understand its customers and hence to direct its marketing plans to a specific target market. Analytical and simulation results demonstrate the implementation and the effectiveness of the suggested approach.

1 INTRODUCTION

The rapid growth of wireless networks has led to vast changes in mobile devices, middleware development, standards, network implementation, and user acceptance (Deitel, 2001). Today's most popular wireless devices include cell phones, personal digital assistansts (PDAs), and laptops. Such devices allow individuals and organizations to connect to the Internet and World Wide Web at any time, from almost any place. Electronic commerce (e-commerce) was just one of the possible services performed via Internet. E-commerce still continues to grow, but so far most e-commerce applications require wired infrastructures. Mobile commerce (m-commerce) is one of the opportunities created by next generation wireless networks.

In the earlier years, e-commerce meant the facilitation of commercial transactions electronically such as sending purchase orders or invoices electronically. Later, it is defined as the purchase of goods and services over the World Wide Web via secure servers using electronic shopping carts and electronic payment services (Deitel, 2001).

Although m-commerce has a lot of common grounds with e-commerce, it is a larger set in terms of the functionality provided to the users. For example, m-commerce provides location-based services that are context-sensitive with respect to the geographic location of the user. Another functionality of m-commerce is the ability of bill integration, which refers to the several purchases combined into one bill. Customers only need to pay one bill for all of their applications (Kuo, 2006). In such an environment, the mobile network operator (MNO) plays the role of intermediator between customers and other services providers. Hence, an MNO has to apply a robust pricing mechanism so as to satisfy its customers and maximize its revenue.

In this research, we first differentiated customers of an MNO using their Customer Relationship Management (CRM) values. The purpose of this segmentation is to be able to offer different levels of quality of service (QoS) to different groups of customers. CRM is a tool which enables organizations to better understand the needs of their customers, and as a result to assure maximum utilization and revenue from their services by customer-specific strategies. In the second step, we differentiated mobile services/products according to their bandwidth requirements and their tolerances to delays. We aim to come up with a unit price for each mobile service/product class.

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The rest of this paper is organized as follows: The definition of mobile commerce and the mobile value-chain are given in Section 2. Section 3 includes the basis of a CRM tool, as well as its implementation in our approach. The unit prices of mobile services/products and a numeric application are represented in Section 4, following the proposed framework. Finally, in Section 5 we provide conclusions and we discuss the future work.

2 MOBILE COMMERCE

E-commerce continues its growth in wireless area by m-commerce (Ngai, 2006). In (Clark, 2001), it is defined as any transaction with monetary value that is conducted via a mobile network. In another study, any e-commerce transaction, processed by anyone, anywhere, through wireless devices, is considered mobile commerce (Keen, 2001).

One of the advantages of m-commerce is that it gives companies the opportunity for reaching a broad range of consumers. M-commerce has some specific dimensions which are not available for traditional e-commerce. For example it gives nomadic access to its users and it is location-centric. The services in m-commerce can be personalized and m-commerce allows service providers to treat each customer separately (Mahatanankoon, 2005). We utilized a well-known customer management tool to make MNOs recognize their groups of customers.

In the related literature, m-commerce is analyzed under five main topics: M-commerce theory and research, wireless network infrastructure, mobile middleware, wireless user infrastructure and mobile commerce applications (Ngai, 2006). The lowest level of m-commerce is the theory and research. It consists of consumer behavior, the acceptance of technology, the diffusion of m-commerce applications, m-commerce business models and strategies. Pricing models for m-commerce services, which is the main topic of our research, is a part of this level.

The new technologies, that solved the bandwidth limitation problem, allow higher transmission rates and more sophisticated mobile services. The m-commerce applications are classified into six main categories: Mobile financial applications, mobile advertising, mobile inventory management, mobile auctions, mobile entertainment services and proactive service management (Varshney, 2000). However, the number of such applications constantly increases, since existing e-commerce applications can be offered on mobile networks. Such a categorization may direct the MNO to define its product/service classes which constitutes one of the phases of our suggested mechanism. It is not always possible to use flat pricing schemes in terms of kilobytes or megabytes, as the MNOs have to manage their network traffic by analyzing the priority and the resource requirements of given services. For instance, a mobile financial application should be more privileged than a mobile advertising.

The business models and value chains established for the Internet do not exactly match to the ones for mobile networks. Therefore an m-commerce value chain needs to be formed. A value chain could be defined as the linkage and integration of a series of activities in which enterprises deliver the created and valued products or services to customers (Porter, 1985). Like any other service/product, m-commerce involves a large number of value providers in a chain that terminates with the end-user. Among the value chain actors, despite that each has its significance; mobile network operator plays the most critical role on the entire chain (Kuo, 2006; Rülke, 2003). In this article, we investigate the role of mobile network operator in the value chain, especially when charging various mobile services that are offered to different types of customers.

In Figure 1, a basic mobile value chain is shown. It mainly consists of three categories: Hardware, services and infrastructure. The hardware part of the mobile value chain includes the mobile equipment supplier, wholesaler retailer. They are responsible for producing and selling the mobile terminal to the end-user. The other part is the services part, which contains the content provider and the mobile value-added service provider. They are responsible for offering the services/products to the customers. Finally, the infrastructure part consists of software and infrastructure supplier. They provide the required software and infrastructure to the mobile network operator and to the service providers. In this mobile value chain, only the MNO has direct contact with the customer (Kuo, 2006; Questus, 2000; Barnes, 2001). Although it is possible to introduce each one of these relationships seperately into the pricing mechanism, we built a pricing model between MNO and their end-users.

3 CUSTOMER RELATIONSHIP MANAGEMENT

As competition increases, many firms use the Customer Relationship Management (CRM) systems to improve business intelligence, to make better decisions, to enhance customer relations, and to increase quality of services and product offerings. CRM could be defined as the strategies, processes, people and technologies used by companies to successfully attract and retain customers for maximum corporate growth and profit (Roh, 2005). It is a strategic process used to learn more about customer's needs and behaviors, in order to provide them with highest quality products and services. This results in customer retention and discovering and attracting new customers.

CRM is also an effective tool for customer segmentation to develop one-to-one relationships with customers. In order to truly understand customers, it is essential to have a segmentation management that divides customers into smaller

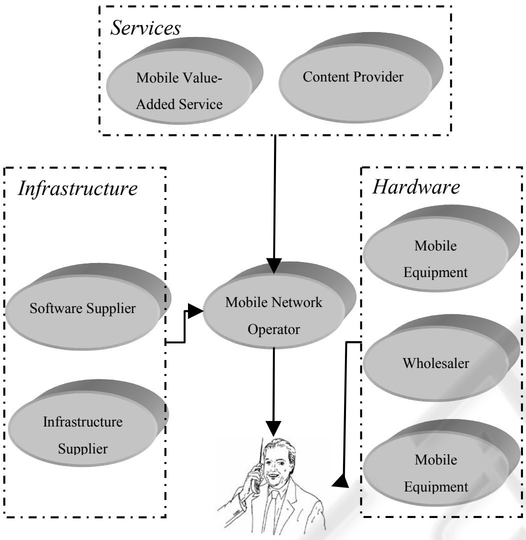

Figure 1: The mobile commerce value chain.

subgroups. Customer segmentation can be defined as the classification of customers according to their likely behavior and potential profitability. This intra-group similarity allows customers in the same subgroup to respond somewhat similarly to a given marketing strategy. Especially in telecommunication industry, the MNOs have to understand the needs of customers in specific geographical regions and demographic segments in order to be able to more successfully offer mobile services to the right people in an appropriate way. In our proposed model, we assumed that each subscriber has a CRM value defined by the MNO. In general, MNOs prefer outsourcing the CRM service to other service companies. According to SAS, one of the well-known solution companies, telecommunication providers' best hope for improving profitability is to focus on improving effectiveness in attracting and retaining customers, maximizing the value from each customer relationship, developing more efficient and dynamic business processes, evaluating success based on the right performance measures and aligning the entire organization around unified strategic directions (www.sas.com).

One of the ways of segmenting customers is using the Life Time Value (LTV) model (Kim, 2005). In previous studies, LTV is defined as the sum of the revenues gained from company's customers over the lifetime of transactions after the deduction of the total cost of attracting, selling and servicing customers, taking into account the time value of money (Dwyer, 1999; Hoekstra, 1999; Jain, 2002). These CRM values are calculated for each customer and they direct MNOs to classify their customers. In (Kim, 2005), customer segmentation methods using CRM values are categorized into three groups: 1) Segmentation by using only CRM values, 2) Segmentation by using CRM components, and 3) Segmentation by considering both CRM values and other information. In the first method, customers are sorted in a descending order according to their CRM values. The list is divided by its percentile to enable companies to offer different services and products for each percentile. The second method segments customers by using CRM components; such as the current value and the potential value of the customer, and his loyalty (Hwang, 2004). The current value is calculated by the average revenue earned from a customer's recent transactions after deducting its debts to the company. In other words, it is a measure of customer's past profitability. The potential value of costumer is the expected profits from that customer in the future.

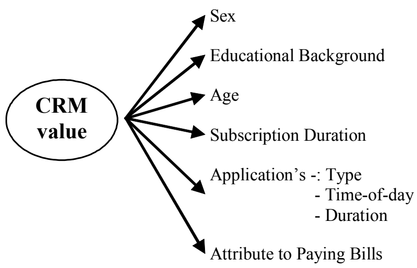

Figure 2: The components of the CRM value.

The customer loyalty is the rate that specifies the value that customer will still be the customer of that company. In the third method, customers are categorized according to both their CRM values and other managerial information; such as demographic information and transaction history.

In our research, we proposed segmenting the customers of the MNO in terms of the following categories: customer's sex, educational background, age, subscription duration, frequently used applications, average duration of his applications, time-of-day of his applications and his attribute of paying the bills (Figure 2). As each company has its own marketing strategy, the number and the variety of selected variables could be different. We proposed that each customer should have a CRM value in the range of [0-100] which is being calculated dynamically in respect to the strength of these variables.

4 PROPOSED FRAMEWORK

4.1 The Representation of the Framework Variables

Our proposed model is based on the idea of offering various quality of service levels to different customers for different types of mobile services. In this research, we performed a customer segmentation both to maximize their satisfaction and to maximize the revenue of the MNO from each customer. Although there is not a limit on the number, in this case study we divided customers into 4 different segments depending on their CRM values (Figure 3) (IBM, 2003). This segmentation was the one that IBM has used for its telecommunication customers. We defined the ranges of segments just to give an example.

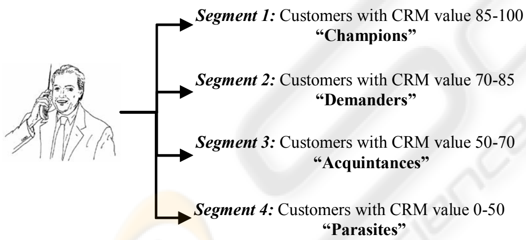

Figure 3: Customer segmentation according to their CRM values (IBM, 2003)

This classification allows the ability to develop value driven strategies. The customers with the highest CRM values, called “Champions”, are classified as Segment 1. For the company, these customers provide with high revenue and low cost. Segment 2 is constituted of customers with CRM value which is relatively lower than the “Champions”, called “Demanders”. They provide with high revenue and high cost. The customers with the medium CRM value are called “Acquaintances” and they provide with low revenue and low cost. Finally, the “Parasites”, the customers with lowest CRM value, cause low revenue and high cost for the company (IBM, 2003). Each company may have different CRM strategies; nevertheless for this case study, we supposed that our company aims primarily to satisfy its “Champions” and then, try to promote its “Demanders” and “Acquaintances” to higher-valued segment. Our company does not concentrate on “Parasites”, it just offers them the best possible quality of service level.

The service concept includes the characteristics such as throughput, jitter, delay or loss when transmitting a packet in one direction across a set of one or more paths within a network. Differentiation of services accommodates heterogeneous application requirements and customer expectations, and it permits differentiated pricing (Blake, 1998). In next generation wireless networks, different mobile services will require different amounts of bandwidth as well as different QoS requirements. In networks that handle diverse types of data stream, ranging from file transfer, to real-time traffic such as streaming audio and video, heterogeneous delay sensitivities can occur. Therefore, in our proposed model we mainly categorized the mobile services based on their tolerance levels to latency or packet losses due to the next generation of IP, IPv6 (Deering, 1998). Although there is no limit for the number of classes, as seen in Figure 4, we defined three different classes of mobile services/products to represent the various needs of customers. The services/products class 1 (Gold) with the highest priority includes the premium products, which require mostly a large amount of bandwidth and these services are very sensitive to delays. At the packet level, applications of this class are forwarded with the highest priority that the system can offer to the customers. An instance of application in this category may be the financial services. Even though they do not require large amount of bandwidth, they are very sensitive to delay and loss. The product class 2 (Silver) and the product class 3 (Bronze) have respectively lower priority than the product class 1 (Gold) and they are suitable for applications requiring less bandwidth. As seen in the Figure 4, the “Parasites”, the customers in Segment 4, are not included since they will receive the remaining best possible service level (Best Effort) after offering to the customers of the 3 upper segments.

In such an environment, both the customers of each segment and the MNO should be in social welfare. Social welfare can be taken to mean the welfare or well-being of a society. The satisfaction of a customer depends on his network access, the services being received and its quality of service level, while the satisfaction of the MNO depends on the utilization rate of its services. Therefore, we have to set the most appropriate pricing mechanism so as to encourage maximum number of customers to use mobile applications and obtain maximum revenue from these services. The network's resources are used most efficiently if they maximize the total customer satisfaction. In economic theory, *marginal cost pricing* is the concept that a customer of a system of scarce resources should be charged a price equal to the marginal cost imposed by the customer on the system, both on itself (the internal effect) and on others (the external effect) (Stidham, 2002). In other words, the marginal cost is the change in total cost associated with producing one more unit of output. The point where the optimal efficiency is achieved, usage based charges must be equal to the marginal cost of usage. Here, the marginal cost is almost solely a congestion cost; congestion costs are the performance penalties that one customer's traffic imposes on the other customers.

The social welfare is only maximized when prices are set equal to marginal cost considering all externalities (Shenker, 1996). The parameters and the variables of the model are defined as:

$u\ (x_{ij})$: Utility function value that the i^{th} customer has from j^{th} product/service class.

x_{ij} : Total number of packets of j^{th} product/service class belonging to the i^{th} customer.

γ_{ij} :Delay and retransmission cost experienced by i^{th} customer for one unit of data in the j^{th} product/service class.

$d\ (\sum x_{ij})$: Average of delays that one unit of i^{th} customer's data experiences in j^{th} product/service class.

The utility function value in the model represents the net benefits of individual customers from mobile services/ products. According to standard economic theory, the price should be set equal to the external effect of a marginal increase in flow at the resource. When this is done, the algorithm always converges to a local maximum and never to a saddle point (Stidham, 2002). In this study in order to determine the prices, external effects are taken into account. Therefore, the results that are obtained will be local maximum points but not saddle points.

$d\ (\sum x_{ij})$ expresses the relationship between the total traffic flow (the sum of i^{th} customer's packets) in j^{th} product/service class with the experienced delay in this class. We assumed that the numbers of customers in four different segments are n_1, n_2, n_3 and n_4, respectively.

4.2 The Utility-based Objective Function

A socially optimal allocation of products/services (x_{ij}^*) to the customers is defined as one that maximizes the aggregate net utility of all customers of all segments. It may be found by solving the optimization problem represented as follows;

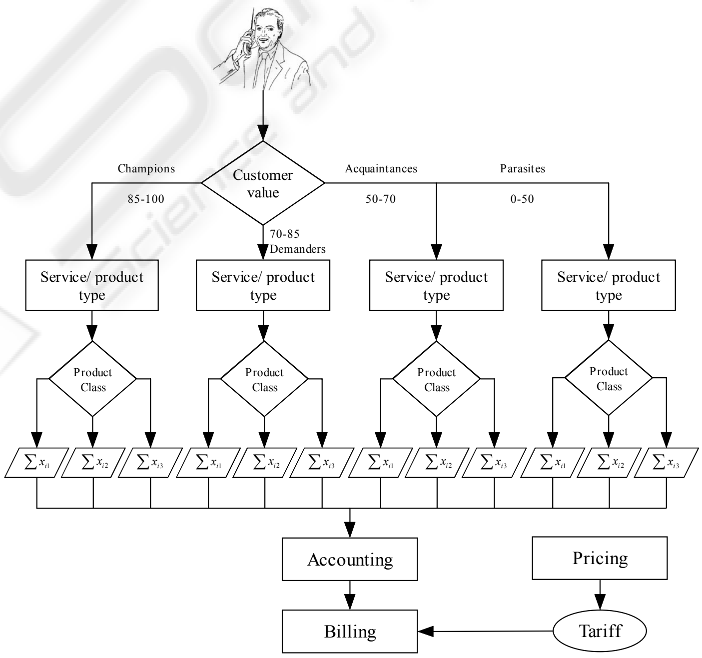

Figure 4: Pricing and billing scheme belonging to a customer.

$$\max \ U(x) := \sum_{i=1}^{n_1}\left[u(x_{i1}, x_{i2}, x_{i3})\right] + \sum_{i=1}^{n_2}\left[u(x_{i1}, x_{i2}, x_{i3})\right]$$
$$+\sum_{i=1}^{n_3}\left[u(x_{i1}, x_{i2}, x_{i3})\right] - \sum_{i=1}^{n_1}\left[\gamma_{i1}.d\left(\sum_{i=1}^{n_1} x_{i1}\right).x_{i1}\right] -$$
$$\sum_{i=1}^{n_1}\left[\gamma_{i2}.d\left(\sum_{i=1}^{n_1} x_{i1}, \sum_{i=1}^{n_1} x_{i2}\right).x_{i2}\right] - \sum_{i=1}^{n_1}\left[\gamma_{i3}.d\left(\sum_{i=1}^{n_1} x_{i1}, \sum_{i=1}^{n_1} x_{i2}, \sum_{i=1}^{n_1} x_{i3}\right).x_{i3}\right]$$
$$-\sum_{i=1}^{n_2}\left[\gamma_{i1}.d\left(\sum_{i=1}^{n_2} x_{i1}\right).x_{i1}\right] - \sum_{i=1}^{n_2}\left[\gamma_{i2}.d\left(\sum_{i=1}^{n_2} x_{i1}, \sum_{i=1}^{n_2} x_{i2}\right).x_{i2}\right] -$$
$$\sum_{i=1}^{n_2}\left[\gamma_{i3}.d\left(\sum_{i=1}^{n_2} x_{i1}, \sum_{i=1}^{n_2} x_{i2}, \sum_{i=1}^{n_2} x_{i3}\right).x_{i3}\right] - \sum_{i=1}^{n_3}\left[\gamma_{i1}.d\left(\sum_{i=1}^{n_3} x_{i1}\right).x_{i1}\right]$$
$$-\sum_{i=1}^{n_3}\left[\gamma_{i2}.d\left(\sum_{i=1}^{n_3} x_{i1}, \sum_{i=1}^{n_3} x_{i2}\right).x_{i2}\right] - \sum_{i=1}^{n_3}\left[\gamma_{i3}.d\left(\sum_{i=1}^{n_3} x_{i1}, \sum_{i=1}^{n_3} x_{i2}, \sum_{i=1}^{n_3} x_{i3}\right).x_{i3}\right]$$

In the above given objective function, the first three terms represent the sum of each customer's utility value that they obtain by using the mobile services/products. As we focus on the first three segments not on n_4 ("Parasites") in the above function, we have three expressions of the received utility by n_1 customers of the Segment 1, by n_2 customers of the Segment 2 and by n_3 customers of the Segment 3, respectively. The remaining part of the objective function consists of the experienced delay costs and retransmission costs. For instance, the fourth term expresses the total cost experienced by the "Champions" from the gold class of product/service; while the fifth term expresses the total cost experienced by the "Champions" from the silver class of product/service.

Our main assumption is that the lower product/service classes suffer from delays originating not only from their own classes but also from delays of higher classes. Therefore, these influences of the higher classes are indicated in the d $(\sum x_{ij})$ expressions. For instance in the sixth term of the objective function, we can see that the bronze products/services of the "Champions" suffer from the silver and gold products/services and also from its own class of products/services. Naturally when calculated mobile services prices, these extra costs should be added to the prices of the higher classes. Hence, the price should be computed to measure the congestion cost that the i^{th} customer's packets impose on the other customers.

In the objective function, it is assumed that the utility functions u (x_{ij}) are all increasing, concave and differentiable; likewise, the delay functions d $(\sum x_{ij})$ are all increasing, convex and differentiable, which are common assumptions in the literature (Kelly, 2000). The optimal points (x_{ij}^*) where all the customers are satisfied with the QoS of the services/products offered, can be calculated by equalizing the partial derivative of the objective function for each of the x_{ij} ($j = 1, 2, 3$, $i = n_1, n_2, n_3$) to 0.

The prices reflect the marginal costs of that the i^{th} customer's packets impose on the other customers for each product/services. Here, P_{ij} represents the price of the j^{th} service/product class of the i^{th} customer segment. Therefore, for the first three customer segments (for $j = 1,2,3$), the prices of each service/product class can be calculated by the following calculations:

$$P_{j2} = \frac{\partial d\left(\sum_{i=1}^{n_i} x_{i1}, \sum_{i=1}^{n_i} x_{i2}\right)}{\partial\left(\sum_{i=1}^{n_i} x_{i2}\right)} \sum_{i=1}^{n_i}\left(x_{i2}^*\right).\gamma_{i2} + \frac{\partial d\left(\sum_{i=1}^{n_i} x_{i1}, \sum_{i=1}^{n_i} x_{i2}, \sum_{i=1}^{n_i} x_{i3}\right)}{\partial\left(\sum_{i=1}^{n_i} x_{i3}\right)}.$$
$$\sum_{i=1}^{n_i}\left(x_{i3}^*\right).\gamma_{i3} + \frac{\partial d\left(\sum_{i=1}^{n_i} x_{i1}, \sum_{i=1}^{n_i} x_{i2}, \sum_{i=1}^{n_i} x_{i3}, \sum_{i=1}^{n_i} x_{i4}\right)}{\partial\left(\sum_{i=1}^{n_i} x_{i4}\right)} . \sum_{i=1}^{n_i}\left(x_{i4}^*\right).\gamma_{i4}$$

$$P_{j3} = \frac{\partial d\left(\sum_{i=1}^{n_i} x_{i1}, \sum_{i=1}^{n_i} x_{i2}, \sum_{i=1}^{n_i} x_{i3}\right)}{\partial\left(\sum_{i=1}^{n_i} x_{i3}\right)} . \sum_{i=1}^{n_i}\left(x_{i3}^*\right).\gamma_{i3}$$
$$+ \frac{\partial d\left(\sum_{i=1}^{n_i} x_{i1}, \sum_{i=1}^{n_i} x_{i2}, \sum_{i=1}^{n_i} x_{i3}, \sum_{i=1}^{n_i} x_{i4}\right)}{\partial\left(\sum_{i=1}^{n_i} x_{i4}\right)} . \sum_{i=1}^{n_i}\left(x_{i4}^*\right).\gamma_{i4}$$

$$P_{j4} = \frac{\partial d\left(\sum_{i=1}^{n_i} x_{i1}, \sum_{i=1}^{n_i} x_{i2}, \sum_{i=1}^{n_i} x_{i3}, \sum_{i=1}^{n_i} x_{i4}\right)}{\partial\left(\sum_{i=1}^{n_i} x_{i4}\right)} . \sum_{i=1}^{n_i}\left(x_{i4}^*\right).\gamma_{i4}$$

The tricky aspect of our proposed model is that; it does not consider the customer segment 4, the "Parasites", in the objective function. The reason is the aim of exclusion of these customers from the socially optimal allocation of products/services (x_{ij}^*). In other words, x_{i4}^* receives the remaining value, namely best effort, after the x_{ij}^* allocations for the first three:

$$x_{j4}^* = 1 - x_{j1}^* - x_{j2}^* - x_{j3}^*$$

Hence, we used the x_{i4}^* value when calculating P_{ij} values.

4.3 Numerical Example

In order to make the proposed model clearer, in this section we give an example about the implementation of the model. We chose a network with one user who utilizes four types of services in order to illustrate the model effect. The objective

$$u(x_{i1}, x_{i2}, x_{i3}) = u(x_{i1}) + u(x_{i2}) + u(x_{i3}) - (\gamma_{i1}).\, x_{i1}.\, d(x_{i1})$$
$$- (\gamma_{i2}).\, x_{i2}.\, d(x_{i1} + x_{i2}) - (\gamma_{i3}).\, x_{i3}.\, d(x_{i1} + x_{i2} + x_{i3})$$

function for this case takes the form:

with $d(X_i) = \dfrac{1}{v - X_i}$

The delay expression in the objective function is consistent with the delay expression of a resource operating as a processor-sharing single-server queue with service capacity v. Without loss of generality, we can assume that v=1 for the first stage of allocation problem (Stidham, 2002). It seems that it gives an infinite negative penalty to a 100% bandwidth allocation; however it is not exactly true. The delay function is set so as to allocate some amount of resource to each class of mobile service/product. This function enables leaving some idle portion of resource. In this manner, the total available resource is considered as 1 and the calculated x_{ij}^* values will signify the percentages of the total resource allocated to each class of mobile service/product. Then, the problem of finding the socially optimal allocation of flows then takes the form:

$$\max u(x_1) - \frac{\gamma_1 . x_1}{1 - x_1} + u(x_2) - \frac{\gamma_2 . x_2}{1 - x_1 - x_2} + u(x_3) - \frac{\gamma_3 . x_3}{1 - x_1 - x_2 - x_3}$$

$$\text{s.t.} \quad \begin{aligned} & x_1 + x_2 + x_3 < 1 \\ & x_1 \geq 0,\ x_2 \geq 0,\ x_3 \geq 0 \end{aligned}$$

Although there are different approaches for the determination of utility functions, we considered generating our simulations by use of square root utility function in the following form: $u(x_i)= a_i.x_i+b_i\sqrt{x_i}$ where $a_i \geq 0$, $b_i \geq 0$, and $i \in \{1,2,3\}$. The a_i and the b_i values symbolize the utility coefficients of the mobile service/product classes. Therefore, the utility coefficient value of the gold services/products is set greater than the one of silver services/products; because the services/products having more privilege are assumed to have more utility than the services/products having less privilege. Besides, the γ_i values in the equation describe the delay and retransmission cost coefficients. As a unit delay in the gold services/products should cost more than the one in the silver services/products, the γ_1 is set greater than the γ_2 value, and γ_2 greater than the γ_3.

Here is the net utility expression:

$$u(x_1, x_2, x_3) = 52.x_1 + 8\sqrt{x_1} - \frac{9.x_1}{1 - x_1} + 20.x_2$$
$$+ 3\sqrt{x_2} - \frac{x_2}{1 - x_1 - x_2} + 2x_3$$

The solutions are as follows: x_1^*=0.5, x_2^*=0.3 and x_3^*=0.1. The maximum objective function with these values is 29.0. These results can be interpreted as follows; when the 50% of the resources are allocated to n_1 *Champions*, 30% of the resources to n_2 *Demanders*, and 10% of the resources to n_3 *Acquintances*, both customers and MNO obtain maximum net utility value which is 29.0. From the definition, we calculated that 10% of the resources are idle and they can be allocated for the n_4 *Parasites*.

Table 1: The simulation results.

Customer segments	**Champions**			**Demanders**			**Acquintances**			**Parasites**		
Resource	0.5			0.3			0.1			0.1		
Service classes	**G**	**S**	**B**	**G**	**S**	**B**	**G**	**S**	**B**	**G**	**S**	**B**
Resource	0.44	0.05	0.008	0,28	0,9	0,09	0,097	0.001	0.001	0,097	0.001	0.001
Net utility	22.7040			15.7301			11.5482			11.5482		

Now, these allocated resources have to be distributed among three different classes of services/products. At this point, we can utilize the same objective function, or define another one; but now we should set the total capacity to 0.5 for the *Champions*, to 0.3 for the *Demanders* and 0.1 for the *Acquintances* and the *Parasites*. The obtained results are summarized in Table 1. All these x_{ij}^* values calculated by simulations are the input values of the price equations.

5 CONCLUSION

In recent years, a number of social, technological and economic trends have promoted the demand of mobile communication services. Mobile commerce is one of the subset of these services. M-commerce brought many new opportunities and also challenges to carry out one-to-one customer relationship in e-business. New actors and new value-added services enlarged the Internet value-chain and new mobile value chain is produced. The composition of the mobile commerce value chain and the relationships between the actors is extremely complicated; so in this paper we concentrated on the direct relationship between the Mobile Network Operator that plays the role of an intermediator between value chain members and end-users. For m-commerce to reach its full potential, MNOs must offer pricing strategies of the m-commerce services of maximum effectiveness to customers.

In this paper, we proposed a CRM-based framework in order to price different types of mobile services/products for customers with different profiles. In the model, customers are first segmented according to their CRM values and are offered various service levels. Furthermore for each customer segment, the services/products are also differentiated according to their resource requirements and delay tolerances. The aim is to suggest a unit price for each service/product class in each customer segment, which provides the revenue maximization for MNOs and the network resource usage optimization. We believed that in a competitive business environment, tracking the CRM values of customers and offering the service according to them is the most beneficial way to increase services quality and accordingly the revenues.

There is much work to be done in this area. First of all, it could be possible to build an architecture to dynamically track and analyze the CRM variables belonging to each customer. Since it requires a large data warehouse, some data mining mechanisms can be proposed in order to capture customer profiles and attributes. Besides, these mechanisms could be useful in measuring customer segments' utility functions.

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