

Analysis of the Effectiveness of Tariffs for Telecommunications Services with Broadband Access

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The purpose of the study was to analyze the efficiency of tariffs of companies providing telecommunications services with broadband access. The analysis was carried out with respect to both the efficiency of the tariff system in general and its individual elements. The structure of costs for services providing access to the Internet and networks of digital television has been studied. The scheme of the analysis of the product and cost parts of the tariff system of telecommunication companies is proposed. The advantages and disadvantages of pricing strategies for telecommunication services are discussed

Keywords: telecommunication services, tariff efficiency, tariff system, pricing for telecommunication services

I. INTRODUCTION

Telecommunication technologies have a significant impact on the socio-economic development of each country. They are widely used in the economy, science, education, culture, public administration, the provision of administrative services.

The most widespread now is the technology of broadband access, thanks to which subscribers can use the services of the Internet, digital television and digital communication. Usually broadband access is posed in contrast to switching access technologies using modems and public telephone networks. Broadband services are provided using fiber-optic and copper communication lines, coaxial (television) cable, satellite channels, wireless access such as Wi-Fi, WiMAX, 3G. In Ukraine, the subscriber base of broadband access services is currently 5 million consumers. Further expansion of broadband access services involves the creation of opportunities for providing broadband access services in rural areas and in hard-to-reach areas of the country, use of digital technologies in telephone networks [1-3].

Tariff system (system of tariff plans), which the company develops, establishes the number of services provided by the telecommunications company, the content and price of each of them. Tariff can be applied to one particular service or to a set of services. For example, the tariff system of a telecommunications company may contain tariffs that establish pricing for access services or only to the Internet, or only to digital television. Along with this, the tariff can also cover a comprehensive service

that simultaneously provides access to both the Internet and digital television. These integrated services can be supplemented with services of access to information bases for entertainment and cognitive purposes. Tariffs can determine the prices for the volumes of individual services or set payment for a fixed amount of services that a consumer can receive over a certain period of time, usually a month.

The tariff system is a key element of the development plan for each broadband access service provider, as it determines the ways in which the can be ensured financing of the planned development of its access network can be secured. Increasing competition among telecommunications companies makes them need to take into account the interests of their clients as much as possible when preparing proposals and providing them with their services. For possibility of adaptation of clients and employees of the company to system of tariffs, should not make significant changes to the tariff system for a sufficiently long period of time (2-4 years) [3].

Thus, for telecommunication companies, the problem of choosing a tariff system that will be attractive to existing and potential customers, as well as economically profitable for the company itself, is topical.

The features of telecommunications services lead to a strong distinction between the problem posed and traditional pricing tasks for services in other business areas. The complexity of the problem of developing a tariff system for telecommunications services is determined by the following circumstances:

a wide variety of telecommunications services and their kits that can be offered to consumers;

the dependence of the total costs of the firm and its profit not only on the prices of services, but also on the composition of the services offered;

the influence of the method of bundling services on the competitive positions of telecommunications companies

continuous changes in the conditions of competition in the telecommunications market due to its constant development.

At present, a detailed understanding of this problem and the methodology for its solution require development.

Many foreign and domestic scientists devoted their works to problems connected with the development and improvement of tariffs for telecommunication services, in particular, A. Andreeva, T. Bogdanova, R. Weinberg, A. Galyamov, U. Gilka, V. Lapta, M. Goldman, A. Lahiri, M. Moussa, S. Murphy, D. Neklyudov, M. Rayiv, S. Rao, L. Reiman, S. Rosen, A. Sundararaj, M. Freymer [2-8]. But in these works, the issues of optimizing prices for services in separate tariffs are considered mainly outside the connection with the structure of the tariff system as a whole. The emphasis is on finding prices and prices that are optimal from the point of view of the profitability of telecommunications companies, but the issue of differentiating tariff plans for accounting for client preferences turns out to be uncovered as yet.

Therefore, the purpose of the study was to analyze the effectiveness of tariff systems of companies providing telecommunications services with broadband access.

II. STRUCTURE OF COSTS FOR TELECOMMUNICATION SERVICES

The basis for the development of each tariff plan is the definition of costs for the expected volumes of services offered to subscribers.

To analyze the costs of providing Internet access services, it is worth considering the general structure of traffic exchange in this network [1-3]. The top of the Internet is several intercontinental global operators with terabytes of traffic per second (a tier-1 companies). To tier-1 are the following companies: AT & T, Global Crossing (GX), Level 3, SAVVIS, Sprint, Nextel Corporation, Telia Sonera, Tata Communications (Teleglobe). These companies exchange traffic for free. They earn money by selling channels to the bottom operators and, in some cases, to large consumers.

The next level of providers - tier-2 - is usually created by operators of the level of the country or group of countries in the region (Ukrtelecom is a typical representative of tier-2 operators in Ukraine). To communicate with other countries, they buy global connectivity in tier-1 or try to make direct free connections with a tier-2 companies in other countries.

Most of the providers work at the tier-3, where Internet services are provided to end users. Many tier-2 companies work simultaneously on tier-3. The largest Ukrainian telecommunications companies are Ukrtelecom, Volia-Cable, Kyivstar, Triolan, Vega, Datagroup, Tenet, Airbites, Frinet, Frigate.

The resources of the tier-3 provider include [1]:

- access network, which the provider manages on the basis of ownership or lease;
- information centers that implement information services of the network.

The main purpose of the access network is the concentration of information flows coming through numerous communication channels from the client equipment to a relatively small number of nodes of the backbone network. The backbone network provides the transit of information between nodes over high-speed

channels. Information centers can store information of two types:

- which is intended to interest end users irrespective of the functioning of the network (information of websites of organizations and electronic stores, news, etc.);
- which has an official nature and is intended to ensure the functioning of the network.

The main part of the cost structure of the Internet service provider to end users in Ukraine is channel payment to the highest (foreign or local) backbone provider. This payment usually includes the service of traffic transfer and related services. Data transmission is tariffed either based on the volume of transmitted traffic or as a fee for renting a channel with a certain bandwidth. The Internet provider also incurs costs to support the ability of its own telecommunications network and switching equipment, the operation of information centers, customer service, marketing, administrative and economic activities.

A similar cost price structure has digital TV. To provide services to subscribers, the telecommunications network is also used, but useful information is transmitted only towards subscribers. At the same time, the television service provider pays media groups for the right to broadcast the content of the television channels. The amount of payment is determined depending on the size of the subscriber base of the provider.

III. ANALYSIS OF PRODUCT AND COST PARTS OF TARIFFS

Each tariff consists of a part describing the service, and a part describing the conditions for the reimbursement of its value. The part describing the service determines its content (composition), and the value component establishes a pricing rule for the service depending on its volumetric characteristics, as well as the payment terms. The tariff system of the company is actually a system of tariffed services, which it offers customers at fixed prices. Thus, the tariff system reflects the commodity and price policy of the company.

For the classification of tariffed services, we will distinguish three of their varieties, which differ in complexity: simple basic services, related services, extended basic services and complex services.

A simple basic service is designed to satisfy the client's need for broadband access to certain information resources with a certain level of access quality. An example of various simple basic services are normal access to the Internet, the Internet at the maximum available speed, access to digital television with a typical set of television channels. The accompanying service is provided to customers provided they receive a certain simple basic service. For example, when customers receive some basic Internet access services, customers may be offered related services of the company information center. If customers have digital TV with typical television channels, they may be provided with related services for viewing additional television products.

An extended basic service is a collection of a simple basic service with one or more related services. For example, a simple basic digital television service with a typical set of television channels may be accompanied by

one or more services from a set of related entertainment, cognitive, sports content or intended for children. The complex service consists of several basic services, each of which can be accompanied by one or several related services.

There are many variants of pricing for telecommunication services. The most common is to assign prices for unit volume of services. The indicators that express the volume of consumption of telecommunications services during the month include: the volume of Internet traffic per month, the duration of Internet traffic at the maximum available speed, the length of viewing television channels of different directions (national, sports) and other similar indicators. If, with an increase in the volume of consumption of a service, the cost prices of its unit volume decreases, then the price that is set per unit volume of the service can also decrease according to a certain rule [3].

Tariff conditions may include either the payment of a service after its provision, or an advance payment for a certain planned amount of service and an additional payment for exceeding the actual volume of the service over the planned volume. According to many experts, if the company offers alternative options for payment of services, these options should bring an equal economic benefit to the company and, as a consequence, the same economic benefit to its customers [8].

We will estimate the quantity K of all the various services that a company can offer customers. To do this, we introduce the following notations: R - the number of basic services of the company; $m(r)$ - the number of related services that can accompany the basic service r ; $k(r)$ - the number of all possible extended basic services r , including the basic service. The following formula holds:

$$k(r) = 1 + \sum_{s=1}^{m(r)} C_{m(r)}^s = 1 + \sum_{s=1}^{m(r)} \frac{m(r)!}{s!(m(r)-s)!}$$

where $C_{m(r)}^s$ - number of combinations of $m(r)$ services on sets of s services.

If $m(r) = 4$, then $k(r) = 16$.

Suppose that $m(r) = m, k(r) = k$ ($r = 1, 2, \dots, R$), then

$$K = \sum_{s=1}^R C_R^s k^s$$

If $R = 3, m = 4, k = 16$, then $K = 832$. Thus, even with a small amount of basic and related services ($mR = 12$), the total number of services a company can offer to customers is very significant.

Two main approaches are used for the elaboration of tariffs, often combining them. The first is the direct determination of the cost parameters of the service in question. The expediency of applying this approach is obvious when rating basic services. However, its extension to extended and complex services leads to a number of negative consequences. In connection with the large total amount of the company's services, the laboriousness of calculating the cost parameters of tariffs increases sharply.

A large number of tariffs creates difficulties in the choice of services by consumers. However, this approach allows us to take into account the links between the volumes of consumption of various services that make up the complex service and determine the company's expenses with sufficient accuracy for various volumes of consumption [5,6].

The second approach involves determining the prices for all basic and related services. The tariffs for related services are established from the assumption that the corresponding basic service will be included in the customer's tariff plan. The part of tariff, describing the value, for the extended or complex service is determined in accordance with the aggregate of tariffs for services that are part of the complex service in question. This approach is simple and transparent. However, it should be noted that it allows only approximately to take into account in the established rates the real costs of providing services. Therefore, because of the need to ensure the breakeven activity of the company, these rates are often overstated.

To assess the effectiveness of the tariff system, the following average indicators of the consumption of telecommunications services over a certain period of time (usually per year or per month) are used: ARPU (Average Revenue Per User) - average revenue per user; average for the period of time the number of users; AGMPU (Average Gross Margin Per User) - average profit per user [4,5].

These same indicators can be used to assess the effectiveness of tariffs for individual services or groups of services. In particular, it is useful to assess the groups of tariffs for composite services corresponding to each basic service. It should be noted that in order to calculate the AGMPU indicators for individual services (groups services), it is necessary to develop a methodology that determines the way to allocate the company's total costs between the individual services that it provides [4].

CLV (Client Life-time Value) is used to identify the most valuable customers and their history of receiving company services. This indicator shows the profit received by the company for the entire period of consumption of its services and simultaneously characterizes the degree of customer satisfaction with the company.

IV. TELECOMMUNICATION COMPANY PRICING STRATEGIES

Telecommunication companies in the process of determining the cost components of tariffs are guided by a certain pricing policy (strategy), which is established depending on the situation on the market. From the point of view of competition, the market of telecommunications services in Ukraine is an oligopoly and has recently been characterized by relative stability. The Ukrainian market has basically already passed the stage of extensive development with high growth rates in the number of clients. Its intensive development is currently characterized by an increase in the number and quality of services provided, more and more detailed consideration of the interests of customers.

At the stage of extensive development, many companies in the process of entering the market used a strategy of dumping. For example, this strategy has been used by Volia-Cable for a long time, offering prices for its

services below market prices. This allowed it to significantly increase its subscriber base, contributed to a significant expansion of the market as a whole, and as a result positively affected its competitive position [1]. Some companies, such as Kyivstar, use a dumping strategy to increase their market share. After receiving the planned market share, the companies gradually increase their prices to the average market price.

Despite the fact that dumping helps to exclude competitors, using it by company looks unpredictable in the eyes of customers, which makes them expect in the future either a decline in the quality of services, or a significant increase in prices.

The strategy of high prices is used by companies that position themselves as a producer of high-quality services. To implement this strategy, they offer access to unique information resources, an increased level of customer service quality, for example, high speed of repair of their equipment, etc. Typically, a high-price strategy is used for narrow segments of the market.

The strategy of price differentiation is based on the segmentation of customers and the assignment of different prices for the same product to different groups of consumers. The price differentiation strategy is widespread in the field of telecommunications services and provides for the study and consideration of the characteristics of consumers. As a sign of segmentation, the geographic location of subscribers is often chosen [7].

Recently, companies providing telecommunications services are showing increasing interest in pricing based on the criterion of obtaining the maximum profit for a long period of time. Let's describe a mathematical model that can give a general idea of optimization of the tariff system on the basis of the profit maximum criterion. We introduce the following notation: M -- the set of all services that each subscriber can receive; L_i - a lot of (a set of) services, in the receipt of which the subscriber i is interested; $x_i = (x_{ik}, k \in L)$ - vector of characteristics volume of services for subscriber i ; y_i - amount of expenses of subscriber i for receiving a set of L_i services;

$z_i = (x_i, y_i)$ -- a vector of volumes and cost of services for the subscriber i ; $\varphi_i(z_i)$ - function of utility of volumes and cost of services, defined by vector z_i ; $U = U(M)$ - a lot of all tariffs set by the company; $T(L_i)$ - a lot of tariffs that establish directly the kit price of L_i services, $L_i \subseteq U$; $f_t(x_i)$ - cost of services with volumes $x_{ik} (k \in L)$, set by the tariff $t \in T(L_i)$.

In the presence of information about the utility functions of all subscribers and the company's tariffs, the following data can be determined:

$\psi_{it}(x_i)$ - the function of utility of the services in the volumes $x_{ik} (k \in L)$ in case the subscriber i uses the tariff t , $\psi_{it}(x_i) = \varphi_i(x_i, f_t(x_i))$;

$x_{it}^* = (x_{ik}^*, k \in L)$ - the vector of optimum volumes of consumption of services by the subscriber i in case he chooses a tariff t , $\psi_{it}(x_{it}^*) = \max \psi_{it}(x_{it})$;

$s(i)$ - the tariff for the consumption of services optimal for the subscriber i , $\psi_{is(i)}(x_{is(i)}^*) = \max \{ \psi_{it}(x_{it}^*), t \in T(L_i) \}$;

$x_i^0 = (x_{ik}^0, k \in L)$ - vector of optimum volumes of consumption of services by the subscriber i with the established tariff system;

$f_{s(i)}(x_i^0)$ - income received by the company from subscriber i ;

J_t - set of subscribers, for which tariff t is optimal, $s(i) = t (i \in J_t)$;

$\sum_{i \in J_t} f_{s(i)}(x_i^0)$ - the company's revenue from all subscribers who chose the tariff t ;

$F = \sum_{i \in U} \sum_{i \in J_t} f_{s(i)}(x_i^0)$ - revenue of the company from all subscribers;

$P = \sum_{i \in U} v_t \sum_{i \in J_t} f_{s(i)}(x_i^0)$ - the company's profit from all subscribers, where v_t - the share of profit, pledged by the company in the tariff t .

The tariff system of the company is determined by an aggregate of three components: $\langle M, U(M), F(w) \rangle$, where $F(w) = (f_t^h(w), t \in U(M))$ - a vector function that determines of cost of all sets of services for which tariffs are set,

$$f_t^h(w) = f_t(x_i) (t \in T(L_i)),$$

if $w_k = x_{ik} (k \in L_i), w_p = 0 (p \notin L_i)$.

$w = (w_k, k \in M)$ - vector of volumes of all services. The task of optimizing the tariff system in the framework of the proposed model consists in choosing from among all possible options such an aggregate of three components $\langle M, U(M), F(x) \rangle$, which will provide the company with the maximum profit P .

The proposed model describes the fundamentally important relationships between the tariff system established by the company, the volume of services chosen by subscribers, and the economic performance of the company. With that, competitive actions are not reflected in it. The model does not reflect the possible changes over time of the utility functions of subscribers and the cost characteristics of the services provided. The model is based on the assumption that subscribers make an unambiguous choice of tariffs and volumes of services in accordance with functions of utility.

Thus, the implementation of the approach to tariff elaboration based on the maximum profit criterion presents a significant problem even in terms of its

formulation. However, many tasks of optimizing prices for services in separate tariffs find their solution and practical application [4,5,8].

V. CONCLUSION

At the current time, it is not possible to create an algorithm that would allow to mathematically strictly optimize the parameters of the tariff system and he had at the same time all the necessary information. This is due to limited opportunities to identify customer preferences with respect to the sets of services offered and their cost characteristics, as well as the wide variety of product and price strategies that the company can guide.

The basic information about consumers, which can be used to assess efficiency and adjust tariffs, are data on the actual consumption of the company's services in the conditions of current tariffs. Tariff efficiency indicators, given above, allow to compile a complete picture of both the effectiveness of the tariff system in general, and the demand for each tariffed service, its contribution to the company's revenues and profits.

In order to create maximum attractiveness of the services provided to the clients, each company should consider the interests of each client, forming the widest variety of tariff proposals. But to ensure the profitability of the company's activities, it becomes necessary to compare the expected benefits from expanding the variety of services with expenses of diversifying them.

From the point of view of convenience of consumers, when choosing the most suitable tariff offer for complex services, an approach based on the use of a set of tariffs for component services has the advantage. However, for composite services that are in demand, it is expedient to directly determine their cost parameters. This should allow, while retaining the profit from these services, to establish lower prices for them than the prices corresponding to the tariffs for the services of components. In this case, a larger number of subscribers will have motives to increase the number of services received.

One of the ways to increase the attractiveness of the company's basic services is to expand the range of related services that may be of interest to customers. Along with this, it is necessary to optimize the composition of the proposed composite services in order to avoid excessive

number of tariffed services, at which consumer choice is difficult.

The presented materials focus on detailing the problem of optimizing tariff systems for telecommunications companies and developing a methodology for solving this problem. In addition, the study of the experience of setting up tariff systems for large telecommunications companies made it possible to offer some practical recommendations. The totality of all these results can be considered, in our opinion, as some concept of the development of tariff systems. Its use allows to create a tariffs based on "trial and error" directed character. This concept met with understanding in the marketing departments of some Ukrainian companies, in particular Volia-Cable.

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