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DETERMINATION OF TARIFFS FOR TELECOMMUNICATION SERVICES ON THE BASIS OF COST SIMULATION MODELLING

Abstract
The proposed approach to determination of tariffs for telecommunication services allows taking into account nature and specific characteristics of each services and conditions of providing, in contrast to existing. The core of the proposed approach is the model of services providing process (conceptual model) that takes into account only elements of the existing network, involved in realization of provided services, and simulation model which determines operational costs through modeling work of a similar scale hypothetical subsystem using the original data corresponding to the current state of the market and the current legislation, and taking into account particular qualities of the operator (provider).
It becomes possible to refuse of using the separate accounting system, as well as to eliminate the disadvantages of the «historical» costs method and Long-Run Average Cost method, which can significantly reduce the complexity of the tariffs determination procedure and increase their validity. Its usage gives the greatest effect in the case of tariffs determination for telecommunication services, in conditions when the operator provides a wide range of services, as well as in calculation of tariffs for new services. The proposed approach of determination of tariffs for telecommunication services is successfully implemented in practice activities of some telecommunications operators.

Keywords: Telecommunication Services; Tariffs; Costs; Method; Simulation Modeling.
JEL Classification: L96; C53; M21

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ВИЗНАЧЕННЯ ТАРИФІВ НА ТЕЛЕКОМУНІКАЦІЙНІ ПОСЛУГИ НА ОСНОВІ ІМІТАЦІЙНОГО МОДЕЛЮВАННЯ ВИТРАТ НА ЇХ НАДАННЯ

Анотація
Запропоновано метод визначення тарифів на телекомунікаційні послуги, ядром якого є модель процесу надання послуг (еталонна модель), що враховує тільки ті елементи існуючої мережі, які беруть участь у реалізації надаваних послуг. Цей метод також базується на імітаційній моделі визначення обсягів експлуатаційних витрат шляхом моделювання роботи, аналогічної за масштабами гіпотетичній підсистемі, із використанням вихідних даних, що відповідають сучасному стану ринку та чинному законодавству і враховують особливості функціонування мережі.
Застосування запропонованого методу дозволяє відмовитися від використання методу роздільного обліку витрат, а також усунути недоліки методу «історичних витрат», що істотно зменшує трудомісткість процедури визначення тарифів і підвищує їх обґрунтованість.

Ключові слова: телекомунікаційні послуги; тарифи; витрати; метод; імітаційне моделювання.

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ОПРЕДЕЛЕНИЕ ТАРИФОВ НА ТЕЛЕКОММУНИКАЦИОННЫЕ УСЛУГИ НА ОСНОВЕ ИМИТАЦИОННОГО МОДЕЛИРОВАНИЯ ЗАТРАТ НА ИХ ПРЕДОСТАВЛЕНИЕ

Аннотация. Предложен метод определения тарифов на телекоммуникационные услуги, ядром которого является модель процесса предоставления услуг (эталонная модель), учитывающая только участвующие в реализации предоставляемых услуг элементы сети. Этот метод базируется также на имитационной модели определения объемов эксплуатационных затрат, предполагающей моделирование работы, аналогичной по масштабам гипотетической подсистеме, с использованием исходных данных, которые соответствуют современному состоянию рынка и действующему законодательству и учитывают особенности функционирования сети.
Применение предложенного авторами метода позволяет отказаться от раздельного учета затрат, устранить недостатки методов «исторических» затрат и долгосрочных дополнительных затрат, что существенно уменьшает трудоемкость процедуры определения тарифов и повышает их обоснованность.
Ключевые слова: телекоммуникационные услуги; тарифы; затраты; метод; имитационное моделирование.

1. Introduction

Impetuous, even unprecedented, development of techniques and technologies, principles of telecommunication networks building and, as a consequence, innovations in the field of offered services packages, leads to the appearance of new participants, creates new business processes. In these conditions, application of effective methods of tariffs determination is becoming increasingly important. This application is ensuring maximum satisfaction of consumer demand for telecommunication services, creating favorable conditions for attracting investments, maximization of operators and providers revenue and profit, implementation of effective long-term policy of state regulation in telecommunication sector. At the same time, as practice shows, occurring changes give rise to certain scientific and methodical difficulties in development and implementation of economically feasible methods for determination of tariffs for telecommunication services, require special researches to solve appearing problems.

2. Brief Literature Review

Analysis of researches and publications on the problem of tariffs determination for telecommunication services and methods of its formation, including works of V. N. Orlov, S. S. Novitskaya, and K. A. Kuprianova (2014) [1], E. E. Ibrahimov (2008) [2], O. O. Mostovenko (2006) [3], allows concluding that current theoretical and methodological approaches in most cases are general and do not take into account the nature and characteristics of the specific services and conditions of providing. A similar characteristic is inherent in the works of foreign authors: H. Intven (2000) [4], J. Lusvere, N. Hubavenska, and A. Sniepis (2012) [5]. This circumstance leads to the reduction of the validity of tariffs and efficiency of their usage in practice. It is known that costs of providing for every particular service are significantly differ among different operators, and they depend on the range of services provided by the operator and the quantities of each service, and the specific conditions of providing – nature and state of technical means, indicators of usage, organization of technological process and so on.

It should be noted that in the contribution of O. S. Popov ONAT to the International Telecommunication Union «Determination of tariff to provide Internet access services based on ROI accounting method» (Document 957, Question – 12-3/1, Study Period 2010-2014) the method, that takes into account the nature and specific characteristics of access to the Internet services, was proposed by us. At the same time, as practice has shown, the area of effective usage of this method is a particular case, when the operator (provider) provides only Internet access service, or, along with it, a narrow range of services. In the general case, when the operator provides a wide range of services, features of providing and consumption lead to appearance of difficulties in process of tariffs determination for telecommunication services, the solution of which requires the

development and application of special methods. First of all, we are talking about the methodical difficulties connected with the necessity to use the separate accounting system, since, as known, indirect costs are overwhelming in the cost price structure of telecommunication services.

3. Purpose

To present the proposed method of determination of tariffs for telecommunication services, for the general case, when the operator (provider) provides a wide range of services and taking into account the particular conditions of providing and consumption.

4. Result

The solution of this problem can be proposed approach to determination of tariffs for telecommunication services based on the simulation modeling of providing costs. Building of the simulation model and determination of tariffs for providing of services are based on the current (operational) costs, which are determined in accordance with planned amount of services and economically justified planned providing costs, taking into account investment costs for development of networks and/or services for the planning period and profit. Justification of the choice of the tariffs determination method taking into account profitability of the investment is given by us in [7].

In our opinion, for understanding the essence of the approach, offered in this article, it is necessary to consider some assumptions and preconditions that were used during solving problems and reflect characteristics of telecommunication services, the conditions of providing and consumption.

First of all, we are talking about the key factors that it is necessity to consider before constructing a tariff for a particular service, and the division of each service on two key components: component of traffic transportation and component of direct services implementation.

The key factors that affect the magnitude of the tariff should include:
- distance between the point of the subscriber connection and the communication node or the distance between two points of subscribers connections;
- bandwidth, which is necessary and sufficient for providing of services;
- type of communication channels (lines) and terminal equipment, which are used to provide services;
- range of services, the nature of the terrain (urban, rural and so on);
- tariffication mode (time-based or depending on volume of services).

Under the component of the traffic transportation here and will continue to understand the process of communication traffic through a set of transmission systems, communication lines or whole network segments which are used to enable providing of services.

In its turn, as a component of direct services implementation we will understand the process of providing a particular service between two end devices or between the end device and the device that performs the functions of the «central node»for this service.

For a better understanding of this division we will give an example for classical telephone communication. In this case, the component of implementation is provided in sections «Telephone Subscriber 1 – Subscriber Line – Private Branch Exchange (PBX)» and «PBX – Subscriber Line – Telephone Subscriber 2». Component of transportation is provided in the area of «PBX-PBX» in the transmission of voice traffic over the transport network. Thus one and the same transport network can be used for transmission of traffic generated by different services. Obviously, if the service does not involve the transmission of traffic over the transport network, the component of transportation traffic of such services is missing.

Thus, the formula for calculation of tariffs (T) for telecommunication services has the following view:

$$T = T^{tr} + T^i, \tag{1}$$

where T^{tr} – component of transportation of the traffic over the transport network of definite type, in the amount which is sufficient to provide the service with the specified level of quality;

T^i – component of direct services implementation (excluding transportation of the traffic).

Component of transportation of the traffic over the transport network of definite type can be defined using the formula:

$$T^{tr} = C^{cons.tr.} \ Z^{cons.tr.}, \tag{2}$$

where $C^{cons.tr.}$ – minimum number of consumption units of telecommunications traffic in the range of the transport network, sufficient to ensure providing of services with a given level of quality;

$Z^{cons.tr.}$ – reduced costs (including investments required for development of the transport network for the period of tariff determination) on providing of minimum telecommunication traffic consumption unit in the transport network, «monetary units per time unit».

A typical example of the telecommunication traffic consumption unit can be a virtual connection, characterized by a definite nominal speed of information transmission (in bits/s). Thus, the most striking example of minimum consumption unit can be channel tone frequency (TF) or digital channel bandwidth of 64 Kbit/s.

In the context of the proposed approach, the minimal telecommunication traffic consumption unit is the costs driver of the transport network.

Thus, all services which are involving the usage of the transport network can be divided into two groups: services of unshared and shared resource consumption of the transport network.

The first group (services of unshared consumption) includes services that do not involve the possibility of simultaneous usage of the same consumption unit by two or more subscribers. A striking example of this service of this group may be providing for usage (rent) of a digital communication channel, which provides for a fixed reservation bandwidth of a transport network in all sections from one destination to another.

The second group (services of shared consumption) includes services, which provide the ability of simultaneous usage of the same consumption unit by more than one subscriber (while maintaining an appropriate level of service quality). A striking example of services of this group may be a telephone communication service, the providing of which does not provides for permanent reservation for each subscriber of a connection line in all sections passing voice traffic.

Thus, the number of required connection lines on each stage of the passing traffic is determined based on the given quality and the average intensity of the traffic per one subscriber.

Component of the tariff for implementation of services can be defined using the formula:

$$T^i = \sum_{k=1}^{N} C_k^{dr} Z_k^{dr}, \tag{3}$$

where N – number of types of costs drivers that determine the providing of services;

C^{dr}_k – number of costs drivers of the k-th type, providing of services implementation;

Z^{dr}_k – reduced costs for one driver of the k-th type (taking into account the investment required for development of an appropriate subsystem for the tariff determination period) for the tariff calculation period, «monetary units per time unit».

As it can be seen from formulas (2) and (3) the initial data for calculation of both tariff components are information about involved cost drivers for providing services as well as the data about reduced costs on each of drivers, taking into account the investment required for development of an appropriate subsystem (for example, transport network). Thus, one driver costs can be defined by the formula:

$$Z = \frac{E + I}{D}, \tag{4}$$

where E – modeled amount of operational costs for the tariff calculation period, necessary to ensure the uninterrupted functioning of all elements of the network infrastructure, providing for transportation traffic or implementation of services respectively, «monetary units per time unit»;

I – setting of norms of amount of investment costs required for development of the transport network or corresponding subsystem, for the tariff calculation period, «monetary units per time unit»;

D – total amount of driver costs that determine capabilities of the transport network or telecommunication subsystem.

It should be noted that the setting of norms of total investment costs is used to determine the allowable limited value and can be determined as a proportion of operational costs, the average rate of profit or the weighted average cost of operator's (provider's) capital.

In the process of tariffs determination for telecommunication services should also take into account the fact that for various circumstances, part of elements of the existing operator's network is not involved in implementation of the planned range and amount of providing services for the expected tariffs validity period. The reasons of this may be the evolution of the network as a result of modernization of equipment, variation in the range and structure of services and so on.

The core of the proposed approach is the model of services providing process (conceptual model) that takes into account only elements of the existing network, involved in implementation of provided services. In the process of its construction the scheme of connection and traffic transmission between two subscribers or end devices (in the context of each specific service) is formed.

In general, the telecommunication network is a set of connection schemes and traffic transmission between two end devices in the context of each specific service. Each such scheme reflects the model of organization of communication, consisting of transmission equipment (seals) and connecting lines. The characteristic that defines its ability to provide services, are the distance between two end devices and bandwidth (for example, number of communication channels) that it provides. The unit of measurement 1 channel-kilometer is used to quantify this possibility. Thus, the total capacity of this scheme of communication channels organization is calculated as the product of distances by the number of channels that it provides. The total capacity of the telecommunication network to provide specific services is measured as the sum of capacities of all involved schemes of the organization which provides it.

In conditions of large number of various schemes of the specific service providing that vary in length and number of

channels, for building the model of the process of the specific service providing and further determining costs of providing it, it is enough to use basic elements of the network, which will reflect average the amount of involved resources. Examples of such elements in telecommunications can be «PBX port», «conditional subscriber line», «conditional connecting line», «conditional trunk connecting line» and so on. Thus, for example, conditional connecting line represents one channel, which provides a scheme for providing of services.

For situation when a connecting line passes through several transmission systems (seals) for providing connection, it can be denoted as a trunk connecting line.

In the modeling process is also determined by the average length of a conditional trunk connecting line. Standard telecommunication parameter «average distance between network nodes» is used to determine this length.

The end result of this stage is the allotment of base elements of the network for each service and determination of the numerical equivalent of the each element consumption in the context of each service.

For example, one one of base elements is the numerical value of connecting line per subscriber for telephone connection services. This value is defined as the ratio of the number of connection lines needed to provide all subscribers of the telephone connection to total number of subscribers. In its turn, the required number of connection lines is determined based on standard quality indicators and traffic per subscriber line per busy hour.

The generalized algorithm of tariffs determination for telecommunication services using the proposed approach is shown in Figure.

The structure of the algorithm consists of two independent blocks of operations, which are divided into five levels. The first block (the left part of the algorithm) is a sequence of steps for determining of the component of the traffic transportation. The second block (the right part of the algorithm) is devoted to determine the component of direct services implementation.

In the second stage of the algorithm carried out the development of corresponding conceptual models of the transport network (for the first block) and implementation of services (for the second block). The main purpose of indicated models is the allotment of separate cost drivers that characterize the work of the transport network or a separate subsystem, which provides implementation of certain services, as well as determining total number of costs drivers.

In the third stage of the algorithm carried out the building of the simulation model of operational costs amount determination for the maintenance of the transport network (for the first block) or each of services implementation subsystems (for the second block). The elaboration of simulation models have to determine total costs for the tariff calculation period the necessary to provide continuous functioning of segments of all network infrastructure elements that provide the traffic transportation or the implementation of the corresponding subsystem. Thus, the key characteristic of these models is that costs are not defined for an existing subsystem, and by means of modeling work of a
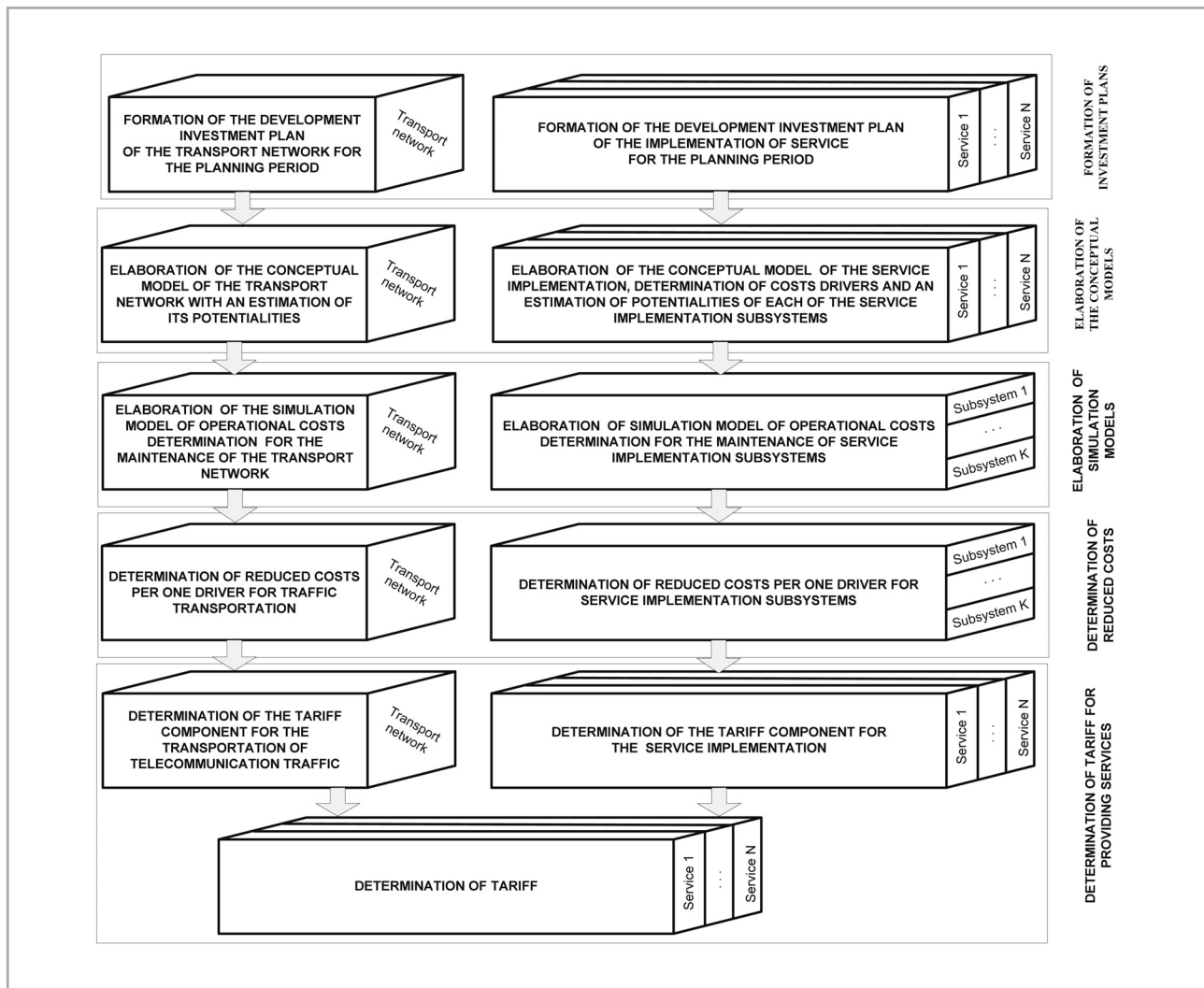

Figure: **The generalized algorithm of tariffs determination for telecommunication services**
Source: Own research

similar scale hypothetical subsystem using the original data corresponding to the current state of the market and the current legislation, and taking into account particular qualities of the operator (provider). So, for example, for determination of total amount of costs to operate subscriber lines subsystem carried out an estimation of the number of staff which is required for the operation of this subsystem in amount which is similar to the current (or forecasted for new or developing systems), number of required materials and so on. The indicated values are the basis for modeling the corresponding components of total costs by usage such indicators as average salary of the staff, current (forecasted) market costs of materials and so on.

In the last stage of the algorithm two basic components of the tariff (for the traffic transportation and implementation of corresponding services) are determined. Determination of the tariff for each service is carried out according to the results of addition of the two basic components of the tariff.

5. Conclusions

The proposed approach to the tariffs determination for telecommunication services allows taking into account the nature and specific characteristics of each specific services and conditions of providing, in contrast to presently existing. It allows to refuse of using the separate accounting system, as well as to eliminate the disadvantages of the «historical» costs method and Long-Run Average Cost method, which can significantly reduce the complexity of the tariffs determination procedure and increase their validity. Its usage gives the greatest effect in the case of tariffs determination for telecommunication services, in conditions when the operator provides a wide range of services, as well as in calculation of tariffs for new services. The proposed method of tariffs determination for telecommunication services are successfully implemented in practice activities of some telecommunications operators. The proposed approach can also be used for the determination of prices and tariffs for products and services in other industries, if indirect costs constitute a significant proportion in the cost structure.

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