Formation of optimal communication service portfolio for corporate clients

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Abstract – The article presents the development of information technology for developing an optimal portfolio of communication services for corporate clients. To solve the problem, an optimization model is developed, which formalizes the selection of the most accurate composition of communication services for a corporate client. The problem is solved using the method of genetic algorithms.

Keywords – communication services portfolio, corporate clients, optimal composition, genetic algorithms, customer needs.

I. INTRODUCTION

The market of communication services is one of the most dynamically developing segments of the high-tech market both in Russia and around the world. For each communication company, one of the main tasks is to attract and retain customers. Among the entire mass of clients, the main profits of the company are corporate clients – legal entities, individual entrepreneurs, individuals in the corporate business development (B2B) segment, who currently have at least one valid contract for communication services. At the same time, the most convenient way to provide communication services is the portfolio of communication services provided to the client.

The purpose of a commercial client is to work with a company to provide cellular or fixed-line services to grow their business: making profits, increasing competitiveness, increasing their customer base, simplifying customer service technology, etc. Due to this variety of effects (about ten) and a wide range communication services (more than 10 categories and more than 100 services proper) an urgent task is to form an optimal portfolio of communication services according to the integral criterion of optimality.

Since the optimization parameters are of a different nature, it is appropriate to use multi-parameter optimization to find the optimal solution. At different times, such domestic scientists as Mikhailovich V.S., Volkovich V.L., Sergienko I.V., Tanayev V.S., Ovezgeldyev A.O., Diligensky N.V., Dymova L. G., Sevastyanov P.V., Zak Yu.A., Demidova L.A. V. Kureichik, Yu.A. Skobtsov, E.E. Ivanov, A.N. Pylkin; Abroad R. Shtoyer, M. Ehrgott, A. Mustafa, M. Mitchell, M. Goh, D. Whitley, and others. Most of them are in agreement that such a complex socio-economic system, in a complex way integrated into adjacent areas and branches of the economy, can be effectively organized only with the use of non-trivial means of mathematics and computer science. From this point of view, such progressive information technology of evolutionary search as genetic algorithms (GA), which are well recommended for solving such NP-complex tasks like scheduling or finding a route as a combination of components, is of interest.

II. SEGMENTATION OF CORPORATE CLIENT

Commercial customers can be divided into segments:

- ME (Medium Enterprises) – a segment of corporate clients "medium business";
- SE (Small Enterprises) – a segment of corporate clients "small business";
- SoHo (Small office / Home office) – a segment of corporate clients "low-income Clients";
- KA (Key Account) – a segment of corporate Clients "key Clients";
- LA (Large Account) – a segment of corporate Clients "large Clients".

Client segmentation identifies certain target groups of clients, taking into account the scale of their business, profitability, and the requirements that customers can make to the telecom operator, and allows them to develop clear sales strategies that take into account the specifics of doing business for different categories of clients [1]. A customer segment is determined by its potential monthly revenue. Criteria for customer segmentation are presented in tab. I. Potential revenue, in thousand rubles per month for each segment is indicated.

The need of a corporate client directly depends on which segment this client belongs to. In tab. I presents the requirements for the corresponding segment of QC. However, we should not forget about the assessment of trends in changing needs. To do this, it is necessary to conduct a consumer analysis, study the services and the demand for them, also study the competitors and analyze the indicators of their activities.

III. CLASSIFICATION OF COMMUNICATION SERVICES

Large enterprises need high-quality communication without interference and interruptions. Optimal today communication channels, designed specifically for corporate clients, are the following: high-speed Internet for the office (dedicated line and Wi-Fi, operating without interruption at speeds up to 10 Gbit / s), 4G Internet; the presence of a virtual PBX, which serves as a convenient alternative to analogue; telephony working with the VATS; virtual servers that ensure data integrity and uninterrupted operation, multichannel number, IP or SIP telephony. The number of lines when a company uses a virtual PBX can be almost unlimited.

TABLE I. SEGMENTATION CRITERIA

Segment	Potential revenue	Segment features	Basic needs
KA	> 3300	– major Russian corporations and companies, strategic partners; – annual turnover in excess of 15 billion rubles; – tender procedures, a large number of parties involved; – customized solutions integrated with internal systems.	corporate mobile contract (4G +); Internet (mostly 4G or Wi-Fi) and telephony in the office; number 8-800; virtual ATC; data transfer; SMS distribution
LA	100-3300	– annual turnover up to 15 billion rubles; – platform solutions customized to customer requirements; – more than 100 employees; – distributed federal structure; entry into the top industry list; – confirmed revenue for communication services.	high-speed Internet, networking for internal use; access to financial systems; telephone organization; advantageous mobile communication for different categories of employees; VPN-secure communication channels; virtual ATC; corporate mobile contract (4G+); number 8-800; Internet and telephony in the office
ME	25-100	– annual turnover of up to 1.5 billion rubles; – 50-100 employees.	corporate mobile contract (3+ SIM); cloud ATC; unlimited internet (4G); mailing to customers; number 8-800; high speed internet anywhere; mobile telephony for the whole family; digital TV
SE	6-25	– annual turnover up to 250 million rubles; – decisions are made by the owner; 10-50 employees.	Internet anywhere; mobile telephony for the whole family; digital TV; unlimited internet (4G); corporate mobile contract (1 SIM); mailing to customers; cloud ATC
SoHo	< 6	– annual turnover up to 100 million rubles.	fixed telephony; mobile phone with cheap rate; cloud ATC; Internet anywhere; digital TV; mobile telephony for the whole family

Classification of communication services for corporate clients is carried out according to 3 types: the first need, the second need, and the third need [2] (tab. II).

TABLE II. CLASSIFICATION OF COMMUNICATION SERVICES FOR CORPORATE CLIENTS

Category of necessity	Communication services
First	– affordable tariff plans – high speed internet – virtual servers – ensuring data integrity and uninterrupted operation – telephony
Second	– digital telephony with a choice of "beautiful" numbers (including number 8-800) – connection of virtual numbers and installation of virtual ATC – digital television – Wi-Fi network for employees customers or guests – remote surveillance
Third	– SMS Target – electronic document management – video conferencing – mobile information – frame control – M2M monitoring

IV. FORMATION OF COMMUNICATION SERVICES PORTFOLIO

A communication services portfolio is a set of services provided to a client and aimed at satisfying its needs, bringing profit to the company and another positive effect. This effect is manifested in solving the tasks that the company sets itself, namely: making profit, increasing competitiveness, increasing the customer base, simplifying customer service technology [1]. Therefore, a portfolio of communication services is proposed as a new solution. There are different types of portfolios of communication services that can be classified for the following reasons [3]:

– the composition of the services included in this portfolio;
– providing a portfolio to groups of clients;
– portfolio formation option;
– subject of use of this portfolio;
– the term for this portfolio.

The procedure for building a portfolio of communication services is a complex process and consists in its phased compilation [3]:

1) determining the segment of clients for which the portfolio will be formed;
2) study the needs of this group of clients;
3) exploring the capabilities of a communications company to provide services that meet these needs;
4) study of the possibilities of the communication company to reduce the basic tariffs for services;
5) the formation of the portfolio;
6) adjustment of the communication services portfolio for a specific customer of the industry.

An important step is to study the needs of the selected customer segment. With an individual approach to the formation of the portfolio, it is necessary to take into account the industry, the size of the enterprise, the stage of development of the enterprise, its position in the market, competitiveness, etc. Further, an adjustment of the portfolio is necessary, taking into account the specific activities of a particular client.

V. OPTIMIZATION MODELING OF COMMUNICATION SERVICES PORTFOLIO

Consider the information model of the task of building a portfolio of communication services. The portfolio includes such entities as: communication services, the client segment, the client proper and his needs. The ER model is shown in fig. 1. Information is entered into the database after each formed portfolio. Also, as necessary, updated operational data.

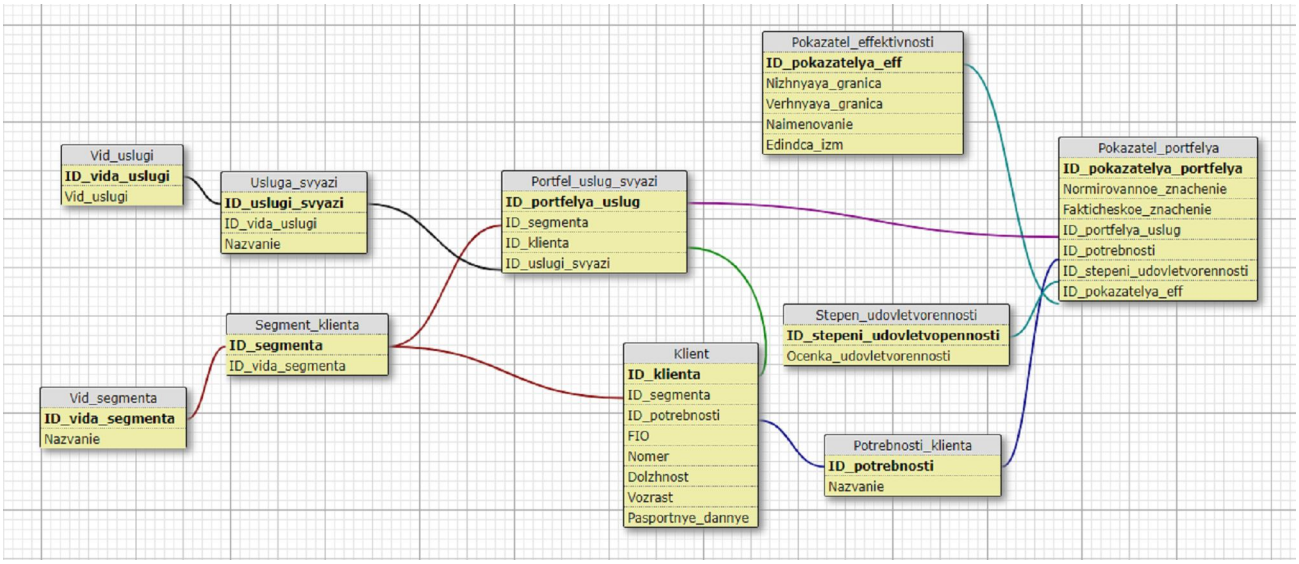

Fig. 1. Database chart

The optimization component of the model is based on a classical genetic algorithm that encodes a communication services portfolio on the chromosome. The most convenient way to encode a portfolio is the binary method that encodes a portfolio in the form of a binary vector of dimension N, where N is the total number of services that can be added to the portfolio. A fragment of the empty chromosome is presented in tab. III. Here 1 is recorded in the free cells if the service is included in the portfolio, 0 otherwise.

TABLE III. FRAGMENT OF AN EMPTY CHROMOSOMAL MATRIX

Locuses	1	2	3	4	...	N
Alleles						

The general polynomial representation of the fitness-function of portfolio optimization is as follows:

$$F = \{F1, F2, F3, F4, F5, F6\}, \quad (1)$$

where F1-F6 – factors of optimality of the communications services portfolio, characteristics of which are presented in tab. IV. Fitness-function is the sum of the normalized squared differences, which is supposed to go to zero, reaching a quality solution:

$$F^* = \sqrt{\sum_N K_E (x_{trg.} - x_{fact.})^2} \to 0, \quad (2)$$

where $x_{trg.}$ – the specified value; $x_{fact.}$ – the actual value, K_E – coefficient determined by the accuracy of the genetic coding of the parameter, is determined as the value inversely proportional to the number of coded bits [4]; N – number of quality parameters used. In this case, the value of F1 is advisable to rush to the minimum value. Its optimal value is determined by reference experts at the level of 10 thousand rubles. The remaining parameters F2 – F6 rush to the unit. The valid area parameters and their best values are given in tab. IV.

Classic GA is implemented with the following standard parameters [5]:

– pseudo-random generation of the initial population with given restrictions;
– natural selection by means of a tournament draw with a high dimensionality of a tournament group (Nt = 4) and a reduction coefficient KR = 0.7;
– pairing crossover operator;
– the use of outbreeding for parenting;
– recombination and variability with different types of chromosome breaks;
– repair of damaged chromosomes (not corresponding to the specified parameters) by means of directional mutations;
– the formation of a new generation of elite selection method.

The initial population is formed with the following parameters:

1) a set of communication services associated with this client according to the segmentation presented in tab. I
2) category of communication services according to tab. II;
3) the interval of permissible power (the number of units in the vector);
4) the interval of permissible financial costs in accordance with the valid area of factor F1 (tab. IV);
5) parameters of the GA (number of generations, population size, etc.).

At the same time, parameters 1-4 represent a failure of the limitations imposed on the components of the target GA function.

TABLE IV. INDICATORS OF THE EFFICIENCY OF THE COMMUNICATION SERVICES PORTFOLIO FOR THE PARAMETERS OF THE FITNESS-FUNCTION GA

F_i	**Optimization factor (performance indicator)**	**Valid area**	**Best value**
1	Budget (matching client's budget)	(0; ∞]	min
2	Demand factor for communication services	[0;1]	1
3	Service need factor	[0;1]	1
4	Factor diversification of the structure of services	[0;1]	1
5	Contracting factor	[0;1]	1
6	Factor of assortment limitation (possibilities and priorities of the company's development, legislation)	[0;1]	1

VI. Information Technology of Forming the Optimal Communication Services Portfolio for Corporate Clients

Based on an optimization model, an information technology has been developed that provides a portfolio of communication services for corporate clients. The program has the following modules:

- the list of corporate clients – includes information about clients: name, age, phone number, passport details, position;
- segments of corporate clients – contains all the identified segments;
- needs of client groups – contains a directory of needs;
- classification of communication services – implements the classification according to the levels of need (according to tab. II);
- list of communication services – contains a directory of communication services; initiates the formation of an optimal portfolio, which includes information on communication services for each client, for this purpose the button “Create an optimal portfolio”;
- settings and restrictions – allows you to set the genetic algorithm settings, such as population size, number of iterations, crossing-over and variability probabilities, as well as limitations in the form of settings for optimization factors from tab. IV.

The compilation of the optimal portfolio has been tested on different data sets and with different settings. The population size used was 50, the number of iterations was 1000, the probability of crossing-over was 0.55, the probability of mutation was 0.15. The procedure of portfolio compilation can be repeated; for this, the “Repeat portfolio compilation operation” button is provided. Performance evaluation is calculated by the formula (2) and for the given settings of the optimization parameters presented in tab. IV is 68.9. Testing was also conducted on another data set and with the following GA parameters: population size 100, number of iterations 10,000, crossing-over probability 0.55, mutation probability 0.15, target values of F1 factors – 7000 p., Target values of F2 – F6 factors – 0.8. An optimal portfolio was obtained, in which the efficiency score is 36.7. The content of the resulting portfolio is displayed in a table (fig. 2). At the top of the window in fig. 2 displays the value of the portfolio efficiency, calculated by the formula (2). Below there are buttons (from left to right) to display a detailed report, to restart portfolio optimization and return to the main menu.

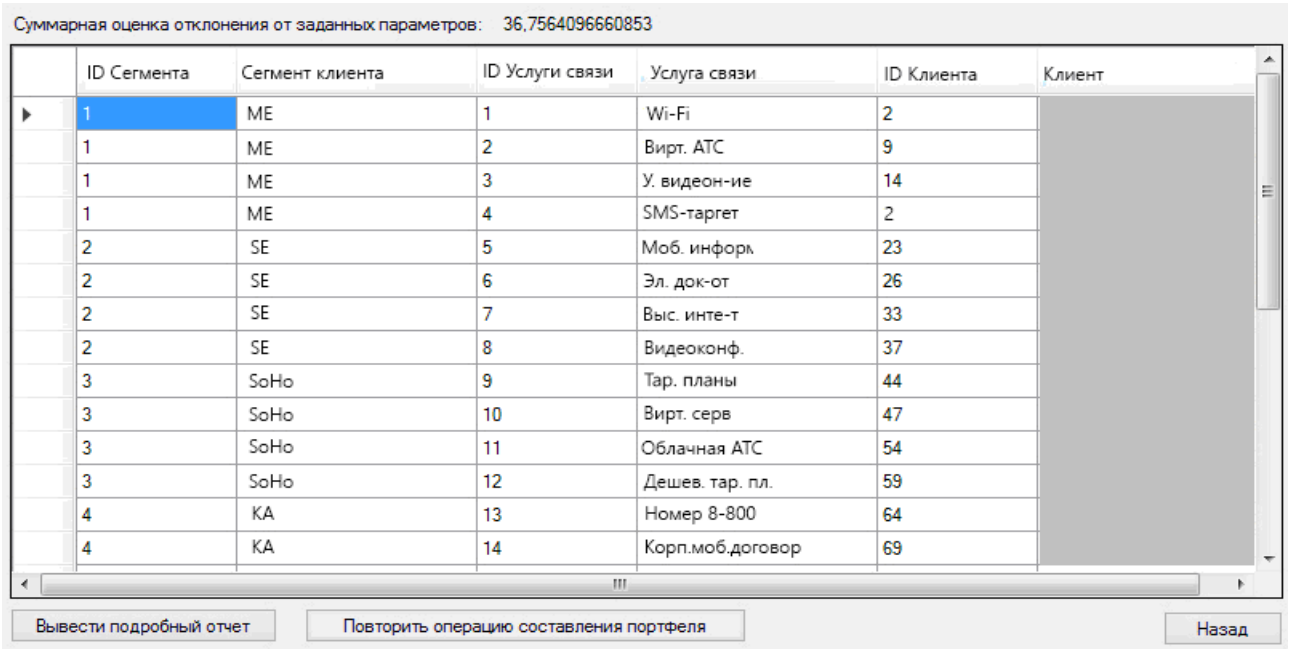

Fig. 2. Optimal communication services portfolio

VII. Afterword

According to the results of the work done, the main goal was achieved. An information technology has been developed to form an optimal communication services portfolio for corporate clients, which is universal in its application and can be used in any communication company. The system generates the optimal portfolio automatically and evaluates its effectiveness. To do this, we studied the needs of customers in the field of communication services and identified customer segments. The scientific material has also been thoroughly investigated, allowing to apply the theory of genetic analysis to the solution of the problem of forming an optimal communication services portfolio for corporate clients. Made methodological developments on the application of genetic analysis to this problem. The practical significance lies in the use of the results obtained for the creation and further use of a stable information-analytical system in a communication company.

For sustainable operation, the database must be supplemented, as human needs change. For a more flexible presentation of data on the proposed option, you can provide greater interactivity of the interface. The resulting mathematical model can be used for further research and improvement of information technology in the field of communication services.

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