Beskorovainyi V.[1], Russkin V.[2]
[1]*Kharkiv National University of Radio Electronics*
[2]*Kharkiv Humanitarian and Pedagogical Academy*

FORMALIZATION OF OPTIMIZATION TASK IN CORPORATE COMPUTER NETWORK REENGINEERING PROJECTS

The formalization of the multi criteria task of reengineering of a corporate computer network is carried out, which assumes its structural, topological, parametric and technological optimization according to the complex indicator "effect-costs". The proposed detailing of indicators in the form of particular criteria of costs, efficiency, reliability and survivability allows us to reduce it to a traditional optimization problem with a scalar criterion.

The efficiency of corporate computer networks (CCN) is largely determined by the way they are structured. Variants of network structures can be implemented on different sets of elements, different architectures and channels for organizing connections between elements and nodes [1]. Changes in the requirements for the functional characteristics of the existing CCN, the improvement of technologies and information processing facilities at a certain stage lead to the need for their modernization. Fundamental changes in the structure, topology, parameters and technology of networks functioning are implemented in the process of their reengineering [2]. At the same time, the structural, cost and functional characteristics of networks are largely determined by the topology of their nodes and connections, and the optimization of the options for their construction is carried out on the basis of forecast data, taking into account a variety of functional and cost indicators by solving a variety of combinatorial problems. The close connection between the input and output data tasks gives rise to methodological and computational problems [3].

The task of choosing a reengineering option is formalized in terms of "condition-goal". In this case, the conditions determine the initial data and constraints of the problem, and the goal is the best option for constructing a network from a set of admissible $s^o \in S$, according to a set of particular efficiency criteria $K(s)=\{k_1(s), k_2(s),..., k_m(s)\}$ [4]. In the general case, the functional effect of using CCN is a non-decreasing function of the resources (cost) $\overline{Q}(s)=F[\overline{C}(s)]$ spent on its achievement (where $\overline{Q}(s)$ and $\overline{C}(s)$ are generalized scalar estimates of the effect and cost of a network option; F is an operator displaying the strategy of using resources).

Under the conditions of the given constraints on the effect indicators $\overline{Q}(s) \geq \overline{Q}*$ and (or) cost $\overline{C}(s) \leq \overline{C}*$, the network reengineering problem can be represented as:

$$s^o = arg\, \max_{s \in S} [\overline{Q}(s) / \overline{C}(s) : \overline{Q}(s) \geq \overline{Q}*, \overline{C}(s) \leq \overline{C}*] , \quad (1)$$

where $\overline{Q}*$, $\overline{C}*$ are limit levels of the generalized estimates of the effect and costs of CCN reengineering.

Particular cases of the task (1) are the tasks of choosing an option that maximizes the reduced effect under the conditions of given constraints on resources $\overline{C}(s) \leq \overline{C}*$ or an option that minimizes the reduced costs to obtain a given level of effect $\overline{Q}(s) \geq \overline{Q}*$.

The most essential and general requirements for CCN are efficiency, reliability, economy and survivability.

The CCN reengineering task is considered in the following setting. The existing version of the network construction $s' \in S$, as well as the set of users $I = \{ i \}$, $i = \overline{1, n_O}$, and their characteristics (territorial location, the need to perform information and computational work); typical nodes $\Omega_U = \{ \omega \}$ and links $\Omega_C = \{ \omega \}$, on the basis of which the network is synthesized; places of possible placement of its nodes $G = \{ g \}$; acceptable technologies for its functioning $\Gamma = \{ \gamma \}$.

It is necessary to determine: the number of network nodes n_U; their types $X = \{ x_i^{\omega} \}$, $i = \overline{1, n_U}$, $\omega \in \Omega_U$; location of nodes $Y = \{ y_i^g \}$, $i = \overline{1, n_U}$, $g \in G$; set and types of links between elements and nodes $R = \{ r_{ij}^{\omega} \}$, $i, j = \overline{1, n_o}$, $\omega \in \Omega_C$; subsets of users associated with each of the nodes and the technology of their functioning $Z = \{ z_i^{\gamma} \}$, $i = \overline{1, n_U}$, $\gamma \in \Gamma$. At the same time, the desired goal is to extremize a set of particular criteria of efficiency:

– costs

$$k_1 = C(n_U, X, Y, R, Z) \to \min_{n_U, X, Y, R, Z} ; \quad (2)$$

– efficiency (access time)

$$k_2 = \tau(n_U, X, Y, R, Z) \to \min_{n_U, X, Y, R, Z} ; \quad (3)$$

– reliability

$$k_3 = \psi(n_U , X , Y , R , Z) \to \max_{n_U , X , Y , R , Z} ; \qquad (4)$$

– survivability

$$k_4 = \mu(n_U , X , Y , R , Z) \to \max_{n_U , X , Y , R , Z} . \qquad (5)$$

Reengineering costs (2) include the costs of creating new nodes and connections between users and nodes. The access time to network resources (3) includes the time spent at all stages of the process, including the waiting times, processing and transmission of requests and responses between elements and nodes. To assess it, it is proposed to use its average, weighted average or maximum value for all network users. As an estimate of the reliability (4), it is proposed to use the probability of the network being in a working state. For the indicator (5), it is proposed to use the estimates of the structural and functional survivability of the network, obtained on the basis of the analysis of its topological structure, as well as the reliability of its elements and connections.

The proposed specification of indicators in the form of particular criteria (2) - (5) allows to reduce the multicriteria CCN reengineering task to a traditional optimization task with a scalar criterion.

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