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OPTIMAL ALLOCATION OF NETWORK PARAMETERS THAT DETERMINE THE QUALITY OF SERVICE

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Abstract: This article describes quality of service indicators for data flow over a telecommunication network and analysis of different types of data flow over a network with several types.

Key words: Telecommunications, network, public service, quality indicators, Network resources, network topology.

One of the main factors of maintaining the quality of data service transmitted through telecommunication networks at a constant level is the time-probability characteristics of the network, i.e. the average data retention time in the nodes, the throughput capacity of the nodes and the speed of data transmission. Instead, the data retention times at the nodes are directly related to the throughput of the nodes. Each section of the telecommunications network is represented and interpreted through public service delivery (PSD) models. It should also be noted that quality of service depends on network resources, that is, on network throughput. According to the network theory, we express the queues at the nodes through the M/M/1 model of the ISS. The telecommunication network implements different types of priorities during data transmission through nodes. That is, each data stream is assigned a priority value of a certain level and is transmitted through the nodes with this priority. Now we express the waiting time of the data flow in the nodes with a certain waiting time and relative priority. Different categories of user subscribers are served with different priority values to receive data. In this case, in the example of the quality indicator, the data service time waiting parameter is considered, that is:

$$W_i = \frac{\lambda \quad M(t_S^2)}{2(1 - R_{i-1})(1 - R_i)}$$

here: $R_k = \sum_{i=1}^{k} A_i \quad A_k = \frac{\lambda_k}{\mu_k} \quad \lambda = \sum_{i=1}^{K} \lambda_i$

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$M(t_S^2)$ - the second calculation of service time according to function distribution;

$\lambda_i - i$ - data intensity of subscribers of the category;

$\mu_k - i$ - service intensity of subscriber data of the category

For the sake of simplification, we assume that the data flow is exponentially distributed, and the service time is exponentially distributed, and the following expression $M(t_S^2) = \bar{t}^{\,2}$:

$$W_i = \frac{y\ \bar{t}}{(1-R_{i-1})(1-R_i)}$$

here: $y = \lambda\ \bar{t}$ upload $0 \quad y < 1$;

$\bar{t}$ - mathematical representation of service time expectation.

If the service intensity does not depend on the above time value, then:

$$\mu_1 = \mu_2 = \cdots = \mu_K = \mu; \quad A_k = \frac{\lambda_k}{\mu}; \quad R_k = \frac{1}{\mu}\sum_{i=1}^{k} \lambda_i$$

Allocation of network resources in telecommunication networks begins when a high load is generated, that is, an increase in the load falling on the nodes and $y \to 1$ thus, the data can be queuing in the nodes and cause a sudden overload, in which case we can write the above formula as follows:

$$\widetilde{W}_i = \frac{\bar{t}}{\left(1-\frac{1}{\mu}\sum_{j=1}^{i-1}\lambda_j\right)\left(1-\frac{1}{\mu}\sum_{j=1}^{i}\lambda_j\right)}$$

To determine the amount of useful work, the efficiency of the operator depends on the increase in data intensity and the decrease in efficiency depends on the increase in the time of the data flow in the nodes. In that case, we can write the function of the amount of useful work in the following form:

$$\varphi_i(\lambda_i) = \frac{\lambda_i}{n_i \lambda_i^{(0)}} ARPU_i - \frac{\widetilde{W}_i}{W_i^{(0)}} p_i$$

here: $\lambda_i^{(0)} - i$ data intensity of subscribers in a category when there are sufficient network resources;

$W_i^{(0)} - i$ data retention cost for category subscribers.

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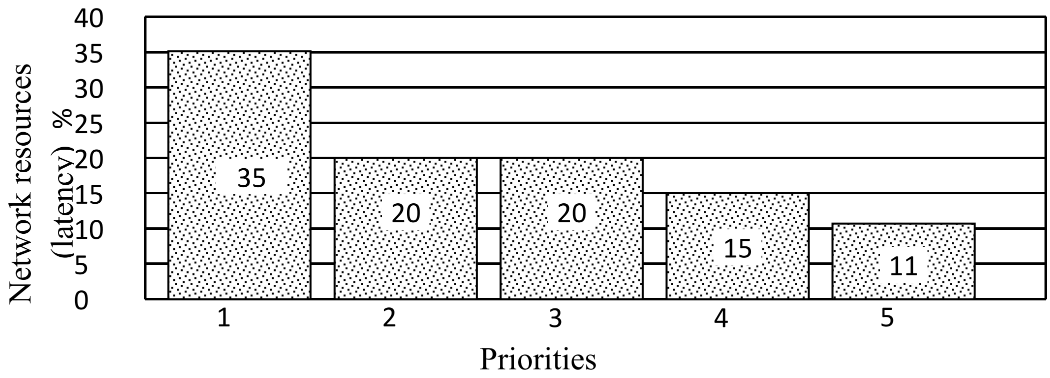

A model of optimal distribution of network resources.

Data intensity using the above formulas and special software tools $\lambda_i = \{\lambda_1, \lambda_2, \ldots, \lambda_K\}$ an optimal distribution among nodes will be possible. The model of optimal distribution of network resources was obtained using the formulas mentioned above and is represented in the graph shown in the figure below.

Conclusions:

In order to maintain quality indicators in telecommunication networks, it depends not only on data transmission, efficient use of network resources, but also on choosing the least expensive paths and sending data at high speeds, on the network topology, that is, on the network structure. . Therefore, it is important to choose the network structure and to determine and find the optimal structure in order to provide quality service indicators to the data flow transmitted through the network.

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