ALGORITHMS OF MANAGEMENT REQUIREMENT PACKAGES FOR SWITCHING CENTERS

[1]Nigmatov Kh., [2]Tursunbaev T.
Ministry of Investment, Industry and Trade of the Republic of Uzbekistan
https://doi.org/10.5281/zenodo.7965863

Abstract. *The article proposes a methodology and algorithm for optimal scheduling of packages of requirements coming from various objects of the telecommunications network to automated switching centers with different types of communication channels and changing structure.*

Keywords: *information, network, problem, indicator of objects, wireless communication channel, communication technology, economic indicator, main task, telecommunication network.*

At present, the processes of development of global information and communication technologies are very dynamic, and their opportunities for society and the economy are beginning developed and used on a large scale. A few years ago, the Internet was considered mainly as a giant library, and its main task was to help in finding the proper information and providing access to it. Although at present computer networks use various means of communication through wired and wireless communication channels. At the present "communication" stage of its development, the main task of a telecommunications network with various types of communication channels as a whole is the early and error-free delivery of any type of information to its owner. The results of recent studies have shown that early receipt of actual and reliable information allows in many cases to reduce the overall costs, damage and material losses generally. This means that the use of information and communication technologies in the transmission and reception of various types of messages including prompt receipt of any information upon request requires correct data packages flow distribution in the switching networks.

Many researchers involved to solve the problem of optimal usage of telecommunications networks while evaluating the effectiveness of certain methods guiding their work do not take into account the influence of operational mode on techno-economic indicators of objects of information recipients. In this regard, the main attention in this article is aimed on the issues of optimal control of the transmission of packets that are set with the arrival time at the switching nodes of the network through wired and wireless communication channels. As a criterion of efficiency of the network while evaluating as it is suggested in [3] operate with the total rate of loss of objects from by the reason of delays and errors in information. The use of such an estimation will make it possible to take into account the techno-economic indicators of objects that are being managed while their operation in accordance with their purpose of usage.

This arises the problem of constructing the optimal sequence of package transmission process between switching nodes in a distributed telecommunication network. With the increase of quantity of objects between which the information should be delivered the problem of the rational usage of existing communication lines is occurred. This problem encounters a number of difficulties associated with the complexity of the networks themselves and with the variety of parameters that determine the quality of service for information consumers.

The effectiveness of message flow management depends not only on the rational use of the existing telecommunications network, but also on the influence of its operation mode on the

quality of functioning of the served consumers (service objects, subscribers). The main requirement for a communication system is to ensure the quality of transfer of these packets to consumers (in terms of delivery time and reliability) and minimal costs [1,3].

The algorithm for distributing data flows from subscribers to the telecommunications network occurs at switching nodes and depends on the location of controlled objects. For stationary processes, this arrangement could be given as a matrix of distances between each pair of nodes $\alpha = \|l_{ij}\|$ (ij = 1, 2, 3, ..., N). The structure (configuration) of the network is determined by the presence of branches (main lines) between individual nodes and their power $P = \|p_{ij}\|$ or graph P. The elements p_{ij} of the power matrix could be either the number of channels going from the control center i to the object j, or the total number of channels between these objects $p'_{ij}=p_{ji}=p_{ij}=p_{ji}$. The graph corresponding to the matrix, oriented under directed channels, has weighted edges. To characteristics of the network also are also related cost parameter of branches and nodes, which are included in the given capital expenditure and operating costs. The reduced costs can be described by the matrix $\tilde{N} = \|\tilde{n}_{ij}\|$, where c_{ij} are the costs of the branch between the control center i and j, and $c_{ii} = c_i$ are the costs of object i.

Load characteristics of system define the structure and volume of information traffic for each direction of exchange. Usually, they contain general characteristics of the information to be transferred between the objects of the system, and particular characteristics of information in each direction of exchange when it is transmitted from center i to object j, regardless of which path the transmission takes in a real communication network. The total average number of packets passing the network per unit of time from external sources that can be determined by the expression $A = \sum_{ij} \lambda_{ij}$, where λ_{ij} is the resulting flow density (means a packet of all priority ranks). The collection λ_{ij}, represented as a matrix $\| \lambda_{ij} \|$ characterizes the load of the information system as a whole.

The request service process in switching centers can be described by specifying a set $s = \{s_1(t), s_2(t), ..., s_M(t)\}$ of piecewise constant left-continuous functions $s_L = s_L(t)$ ($L = \overline{1, M}$), each of which is defined on the interval $0 \le t < \infty$ and takes the values 0, 1, ..., n. If $s_L(t') = i \neq 0$, then at the time t' the device L serves the requirement i. If $s_L(t') = 0$ then at the moment of time t' the device L idles.

Since each requirement cannot be simultaneously served by two or more devices, then from the condition $s_L(t') = i \neq 0$ it follows that $s_H(t') \neq i$ for all $1 \le H \ne L \le M$. Since requirement i enters in queue at time of service d_i then $s_L(t) \neq i$ ($L = \overline{1, I}$) while $t \le d_i$ ($i = \overline{1, n}$).

If t_{iL} is the total length of time intervals on which the function $s_L(t)$ takes on value i, then the relations $\sum_{L=1}^{M} (t'_{iL} / t_{iL}) = 1 (i = \overline{1, n})$ is carried out. Particularly, if the devices are identical then the total length of all time intervals on which the functions $s_L(t)$ ($L = \overline{1, I}$) take the value i must be equal to t_i.

The set of function s that has properties shown above is called the schedule for servicing packets of requirements of set N by a system containing M parallel devices.

The most common way to evaluate the effectiveness of schedule of requirement service in one-stage systems is as follows. To each schedule *s* corresponds vector of moments of completion of servicing requirements while this scheduling $\bar{t}(s) = (\bar{t}_1(s),...,\bar{t}_n(s))$. Here $\bar{t}_i(s)$ is the largest value of *t* for which there is an $L \in \{1,2,...,M\}$ such that $s_L(t)=i$. Real non-decreasing function by all its arguments for *n* variables $F(x) = F(x_1, x_2, ..., x_n)$ is being set. The quality of timetables *s* is characterized by the value of this function at x = $\bar{t}(s)$. From two timetables the best is that considered to be the one that has least value of *F(x)*. The timetable that corresponds to least value *F(x)* (among all allowed timetables) called as *optimal* timetable.

The proposed algorithm of optimal servicing on packet requirements in the switching nodes of the monitoring center is based on minimization of summary value of losses from information delay and provides for:

- comparison of different options of servicing by values of loss;
- restriction by data packets disposition with taking in account that transmission of any message cannot be started before it's receiving;
- preference for serving packets of requirements with greater value of information and transmission of packets with lower value of information by later time;

The use of the temporal criteria of optimization of timing data and its value for each package requirements lets to take in account the technical and economic indicators of each individual object of a telecommunications network with wired and wireless communication channels that is to say in combination with a wired telephone network with mobile cellular communication. These characteristics could be set in advance by both senders of information from the object and recipients in the monitoring center.

REFERENCES

1. H. Nigmatov, Umarov U.A. «Analytical simulation methods determining the basic characteristics of a telecommunication network with different communication channels and a changing structure». Bulletin of TUIT: Management and Communication Technologies Volume 4 2021-third number Article 3.
2. Nigmatov Kh. «Computer networks and systems in IP telephony». Study guide. Kazakhstan. Shymkent. 2015. Ed. "ZHEBE". 240 p.
3. Nigmatov Kh. «Information flows management in automated control systems in data transmission networks». Tashkent. Ed. "FAN", 1984 96 pages.