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EVALUATION OF TELECOMMUNICATION NETWORK

Solved the problem of the choice of parameters control the telecommunications network. The mathematical model that is suitable for the analysis of networks of different sizes. As the study parameters selected number of nodes switching characterizes the network size and the degree of connectivity of its nodes. We analyze the simplest case of the minimum connection that matches the architecture of the ring, which is a chain of linked nodes switching.

Keywords: *telecommunications network switching nodes, multi-agent system.*

Introduction

Management system allocates resources telecommunications network between subscribers with regard to quality of service. Dynamic control for each user thread the distinguished em certain set of network resources. The resources include network capacity of communication channels, highlight emoe time for packet transmission and capacity of buffer-storage device. Effectiveness of the system of the dynamic control is also dependent on the amount of information transmitted over the telecommunications network and the state of yaniya its facilities. It is also important the handling characteristics of the object, the time of reaction and the other, the dynamic performance [1].

Dynamic management should decay so thinned network resources to the packet rate was the highest.

$$V_п = \max . \qquad (1)$$

Assessment of performance of the dynamic control and finding the optimal Rasp-determination of network resources is a task of optimization with constraints. These restrictions, described Q a matrix are related to the topology of the telecommunications network, its dimensions, the number of transmission routes, the capacity of channels:

$$Qr \le d , \qquad (2)$$

where r – a subset of the distribution of resources; d – subset restrictions.

In addition, there are limitations associated algorithms functioning telecommunications network. Assumes no packet loss, and other confounding factors, these restrictions can be written as follows:

$$x(n+1) = f[x(n), r(n), \xi(n)] , \qquad (3)$$

where $x(n)$, $x(n+1)$ – subsets of states telecommunications network n and $n+1$ steps of the algorithm; $r(n)$ – subset allocation telecommunications network n-th step; $\xi(n)$ – function describing the influence of random factors.

Network resources on k-th step control are allocated $r(k)$ directly to the delivery of packets of users $r_{ТКС}(k)$ and the needs of dynamic control $r_{СДУ}(k)$ to the following limitations:

$$r_{ТКС}(k) + r_{СДУ}(k) \le r(k) . \qquad (4)$$

Typically, the amount of resources available for dynamic control, not more than 15% of the total resource [2]

$$r_{СДУ}(k) \le 0{,}15 r(k) . \qquad (5)$$

With regard to (1) – (5) the problem of optimal allocation of resources telecommunications network can be represented as follows:

$$\max_r V_п =$$
$$= F[r_{ТКС}(0), x(1), r_{ТКС}(1), x(2), ..., r_{ТКС}(K-1), x(K)];$$
$$x(n+1) = f[x(n), r(n), \xi(n)] ;$$
$$Qr = d ; \quad r(k) \ge 0 ;$$
$$r_{ТКС}(k) + r_{СДУ}(k) \le r(k) ;$$
$$r_{СДУ}(k) \le 0{,}15 r(k) ,$$

where K – number of time steps.

As a result of a need to find followers lnost telecommunications network of distributed resources $r_{ТКС}(0)$, $r_{ТКС}(1)$ ..., $r_{ТКС}(k)$ ..., $r_{ТКС}(K)$ that the rate of transfer of information was maxim-flax.

The choice of the efficiency of the system dynamic control

In this problem the telecommunications network acts as a controlled subsystem some Torah-transport network, control of which is a set of management and control. To describe the structural model of the transport network will dem-use graph schemes which have the simplicity and clarity. Structural model of the transport network can be represented as a weighted graph G, until-zannogo in Fig. 1. Often to describe the structural mo-Delhi telecommunications network with duplex communication channels used directed weighted graph $G(V, D)$, where the vertex set corresponds V to a set of nodes, and the set of arcs denoted D many transmission paths connecting the nodes of telecommunications network. Let the total number of nodes in the telecommunications network as well n .

In the framework of developing the model we assume that the basic characteristic of network nodes $V_i \in V$ ($i = 1, 2, .., n$) is the amount of buffer resources and the basic parameters of transmission paths $D_{ij} \in D$ ($i = 1, 2, .., n$, $j = 1, 2, .., n$, $i \neq j$), connecting nodes V_i and V_j is throughput c_{ij}. Vertices V are many control centers (servers, routers), and the set D is a collection of official communication channels, which are used to provide information on the telecommunications network and management.

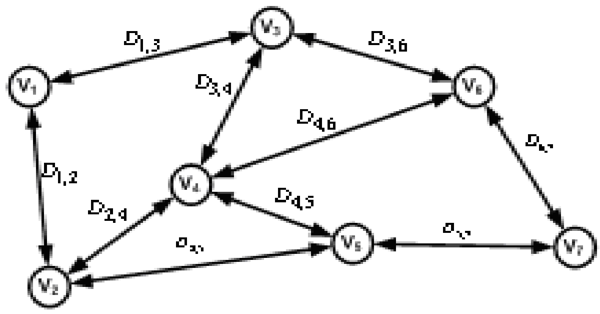

Fig. 1. Graph representations
of the telecommunications network

Conducted the following analysis is valid for networks of different sizes. As a parameter characterizing the size of the network, we use the number of switching nodes. As shown in Fig. 1. One example, the number of nodes switching tion $n = 7$. You have to properly allocate network resources between these nodes of telecommunications network. The successful solution of this problem is likely the correct distribution of the dynamic network $P_{пр}$ resource management system. The value of this probability-minute depends on the completeness through $P_{пол}$ all the possible solutions of alternatives, completeness $P_{инф}$, and the probability of timely resolution of the problem of distribution of network gas resources $P_{вр}$

$$P_{пр} = f(P_{пол}, P_{инф}, P_{вр}) . \qquad (6)$$

When choosing a functional $f(P_{пол}, P_{инф}, P_{вр})$ consider that the probability of correct decision is in the range from 0 to 1. If too much non-existent, then the probability is equal $P_{пр}$ to the probability distribution of resources in the previous step P_{k-1} . If the information is out of date, when $P_{инф} = 0$, and (or) the decision was made out of time ($P_{вр} = 0$), then the probability of correct allocation of resources $P_{пр}$ will also be equal P_{k-1} . If $P_{пол} = 1$, $P_{инф} = 1$ and $P_{вр} = 1$, then the probability of correct allocation of resources will also be equal $P_{пр} = 1$.

Consequently, the functional (6) can be written as follows:

$$P_{прK} = 1 - (1 - P_{K-1}) \exp[-P_a / (1 - P_a)] ;$$

$$P_a = P_{пол} P_{инф} P_{вр} .$$

Consider the definition of each parameter of the expression. Completeness of the selection of alternatives for the management of information flow p between i and the first type and m-th $P_{ij}^{(p)}{}_{пол}$ switching nodes is defined as the ratio of the studied alternatives to control $L_{ij}^{(p)}$ the total number of possible alternatives $N_{ij}^{(p)}$. Then complete selection can be expressed as

$$P_{ij}^{(p)}{}_{пол} = L_{ij}^{(p)} / N_{ij}^{(p)} .$$

The probability of choosing alternative management for the telecommunications network can be generally defined as follows:

$$P_{пол} = \left(\sum_{i,j,p} P_{ij}^{(p)}{}_{пол} \right) \Big/ S ,$$

where S – the total number of all possible information flows.

Problem solving routing control information flow and access to the network is conducted in accordance with [2, 3]. Selection of the optimal variant is associated with a complete listing of all possible routes and the throughput communication channels, as well as buffer storage tanks on these routes.

Suppose that in a telecommunications network switching nodes V and links U . Mewait i and j -th network nodes appear informational fluxes of type with intensity. For each such flow p is necessary $\lambda_{ij}^{(p)}$ to solve the problem of who controls the dynamic by providing the necessary network resources to provide the required quality of service. In obtain management solution for a single stream.

Suppose that there is a network of possible routes Q between i -m and j -m nodes. Of these, only the route $Q_{доп}$ can provide the required quality of service. Each route is Aggregate-kupnost channels between nodes and end nodes. On each node l to determine the bandwidth and capacity of buffer storage unit. Selection of the optimal variant is associated with a complete re-bur all possible routes and the throughput communication channels, as well as buffer storage tanks on these routes. Let require emaya storage capacity, as measured by an amount of stored information blocks can be set from 0 to M_i , and the possible values of the ΔC bandwidth can be set in the range, $(C_{ij\,min}, C_{ij\,max})$ bit / s.

Search for the optimal solution is carried out by brute force methods of buffer storage tank and all the possible values of the capacity of communication channels for all possible routes.

For an individual of route q of nodes, the number of options l_q can be defined by the relation:

$$N^{q_{ij}} = \prod_{l=1}^{l_q} M_l \cdot \prod_{l=1}^{l_q} \left\lfloor \frac{C_{max}^l - C_{min}^l}{\Delta C_l} \right\rfloor,$$

$$l = 1, 2, ..., L;\ L = l_q.$$

If the storage capacity at all switching nodes of the route and all the bandwidths are the same, will be given by the expression

$$N_{ij}^{(q)} = M_l^{\ L}\{[C_{max}^{(l)} - C_{min}^{(l)}] / \Delta C_l\}^L.$$

Accordingly, for all Q routes of the total number of options will be

$$N_{ij} = \prod_{q=1}^{Q} N^{q_{ij}} = \prod_{q=1}^{Q}\prod_{l=1}^{l_q} M_l \cdot \prod_{l=1}^{l_q} \left\lfloor \frac{C_{max}^l - C_{min}^l}{\Delta C_l} \right\rfloor;$$

$q = 1, 2, ..., Q$.

The problem of optimal allocation of resources it is necessary to solve for all threads. Then the total number of tasks to be solved within the time interval T will be

$$N_p = \sum_i \sum_j \sum_p \lambda_{ij}^p \cdot T$$

The total number of options that need to be consid-third of the time T,

$$N = N_{ij} * \sum_i \sum_j \sum_p \lambda_{ij}^p \cdot T =$$

$$\prod_{q=1}^{Q}\prod_{l=1}^{l_q} M_l \cdot \prod_{l=1}^{l_q} \left\lfloor \frac{C_{max}^l - C_{min}^l}{\Delta C_l} \right\rfloor \sum_i \sum_j \sum_p \lambda_{ij}^p T. \quad (7)$$

In the above analysis as a parameter characterizing the size of the network, use the number $n = 10, 25, 100$ of switching nodes, which can be set, which is about the small, medium and large networks. Another important parameter is the degree of the telecommunications network connected nodes. Minimal connectivity architecture is a chain of connected nodes switching. In this case, the number of possible routes $Q = 2$. Another extreme case is a fully connected network, in which each node is connected to individual switching chamber nalom with all other nodes switching. In this case, the number of possible routes $Q = C_n^2 = n(n-1)/2$ for the one-way routing and $Q = 2 \wedge C_n^2 = 2 \wedge [n(n-1)/2]$ multipath march rutizatsii [2]. The length of the route l depends on the size of the network and is within $1 \le l \le n-1$.

Storage capacity allocated for each of the Criminal Code for each thread, we will measure the packages. Then the range of values storage capacity can be defined $M = 20$ as that characteristic of queuing algorithm with absolute priority PQ (Priority Queuing). With a value $M = 0$ of memory storage is not allocated. Maxima flax value storage capacity that can be allocated to one thread is 20 ($M = 20$).

The number of possible values of the bandwidth $N_C = \left\lfloor \left(C_{max}^k - C_{min}^k\right) \big/ \Delta C_k \right\rfloor$ depends on the ratio of channel C capacity and capacity increment ΔC. Therefore, for the benefit of our model is the number of possible values of the bandwidth, you can specify a power of two $N_C = 128, 256, 512, 1024, 2048$.

To determine the probability of complete enumeration of all possible options for each flow between the first type and the number p of nodes with the intensity λ_{ij}^p of options is determined by (14). In turn, the number of options considered L_{ij}^p by the intensity of solving μ_{ij}^p the problems of dynamic control of decision-making and can be represented in this form $L_{ij}^p = T \cdot \mu_{ij}^p$. Then for the next simulation important characteristics. If $\mu_{ij}^p \ge \lambda_{ij}^p$ potential $P_{ij}^{p_{пол}} = 1$, in another case $P_{ij}^{p_{пол}} < 1$.

Number of investigated alternatives L determined by the productivity of control center. This value is determined by the productivity of making of the solution. It is determined by the control ($T_{упр}$), which in turn can be represented as the sum of time-men, which control system spends on gathering information ($T_{сбор}$), decision making ($T_{пр}$) and bring the control information to the appropriate network devices ($T_{дов}$).

The length of time depends on the volume of information gathering required information and network resources that are allocated for its transmission. Similarly, it relates to the time of bringing the management of information.

In general, the acquisition time $T_{сбор}$ can be represented as follows:

$$T_{сбор} = (T_p + T_{пд} + T_{обсл}) \cdot \Omega, \quad (8)$$

where $T_p = d/c$ – signal propagation time; $T_{пд} = n_{kk}/M$ – the transmission of information n_{kk} of a block at a rate V of bits per second; $T_{обсл}$ – waiting time in queues/

Thus, in this paper estimate the choice of the refractive efficiency TCN was assessed by such indicators as lam channel capacity (vector C), allocated time and capacity of buffer memory (vector M) in TCN. Which in turn contributes to a favorable allocation of network resources.

Conclusion

In this paper, a mathematical model of the dynamic management of TCN. This model allows us to study the effectiveness of different variants of the building management system with regard to quality of TCN control information, the amount of network resources allocated to the control tasks. A method of selection of the efficiency of TCN, which takes into account the performance-tion performed basic tasks of dynamic control. This con-tangent to tasks such as: access control in the network, flow distribution in TCN (routing), flow control in the network. Also, the proposed method in practical application it allows for analysis of management of telecommunications networks allowing for the construction of various architectures management of TCN.

List of references

1. Dolph R. Modern management system / R. Dolph, R. Bishop. ─ M/: LBZ, 2004. – 832 p.

2. Tarasov V.B. From multi-agent systems to intellectual organization, philosophy, psychology, informatics / V.B. Tarasov. ─ Moscow: Editorial URSS, 2002. – 352 p.

3. Srinivas B. Quality of service in networks IP / B. Srinivas. – M/: Williams, 2003. – 368 h.

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ОЦЕНКА ЭФФЕКТИВНОСТИ ТЕЛЕКОММУНИКАЦИОННЫХ СЕТЕЙ

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Решена задача о выборе параметров управления телекоммуникационной сетью. Математическую модель, которая подходит для анализа сетей различных размеров. В качестве исследуемых параметров выбранного числа узлов переключения характеризует размер сети и степень связности его узлов. Мы анализируем простейшем случае минимальный соединение, которое соответствует архитектуре кольцо, которое представляет собой цепочку связанных узлов коммутации.

***Ключевые слова**: телекоммуникационная сеть коммутационных узлов, многоагентные системы.*

ОЦІНКА ЕФЕКТИВНОСТІ ТЕЛЕКОМУНІКАЦІЙНИХ МЕРЕЖ

А.В. Холодкова

Розв'язана задача про вибір параметрів управління телекомунікаційною мережею. Математичну модель, яка підходить для аналізу мереж різних розмірів. В якості досліджуваних параметрів обраного числа вузлів перемикання характеризує розмір мережі і ступінь зв'язності його вузлів. Ми аналізуємо простому випадку мінімальний сполука, яка відповідає архітектурі кільце, яке являє собою ланцюжок зв'язаних вузлів комутації.

***Ключові слова**: телекомунікаційна мережа комутаційних вузлів, багатоагентні системи.*