

СЕКЦІЯ 2

ЗАСТОСУВАННЯ ТА ЕКСПЛУАТАЦІЯ ТЕЛЕКОМУНІКАЦІЙНИХ СИСТЕМ ТА МЕРЕЖ

Керівник секції: д.т.н. проф. Г. А. Кучук, НТУ “ХПІ”, Харків
Секретар секції: к.т.н. доц. С. С. Бульба, НТУ “ХПІ”, Харків

RESEARCH CHARACTERISTICS OF THE THROUGHPUT MULTISERVICE TELECOMMUNICATION NETWORKS

Ibrahimov B.G.^{1,2}, Dunyamaliyev T.O.²

¹Azerbaijan Technical University, Baku, Azerbaijan

²Baku Engineering University, Baku, Azerbaijan

This paper examines and studies the characteristics of the throughput of multiservice telecommunication networks, taking into account the quality indicators packet flow processing in the case using such service methods as FIFO (First-In, First-Out). It is assumed that priority queues (PQ) are used to allocate a fixed bandwidth ΔF_k to each load class, for queuing systems (QS) M/M/1/m [1-3].

By applying the adaptive bandwidth sharing service method proposed by [2], it is possible to increase the loading coefficient of the channel resource N1 by using the free resource N1 to process class-2 packets. For this model servicing two classes narrowband telecommunication networks flows, there are expressions that allow us to determine the waiting time for class-2 packets. However, the proposed mathematical expressions are not applicable to assessing the quality of service for traffic packet flows in multiservice telecommunication networks.

The model under consideration is a queuing system with M₁/M/N_r/N_b data integration - M₁ is a load class with a Poisson distribution of the input flow, M is an exponential distribution of service time, N_r is the number channel resource units, N_b is the buffer capacity [2-7].

The first load class has the highest priority. The second load class has a higher priority in relation to the third. Each load class is allocated its own buffer - N_{b1} is the maximum permissible queue length of the 1-st class, N_{b2} is the 2-nd class, N_{b3} is the 3-rd class.

In this system, we introduce the concept of a unit channel resource n as the greatest common divisor of the requirements for the amount transmission bandwidth required to service the message each of the information load flows located in a multiservice telecommunications network. As a result, we have an integer representation of the channel speed in the form of units channel resource [2]:

$$N = V_n(N) = \frac{1}{n} \cdot V_k, \quad (1)$$

where V_k – is the channel transmission speed, bps.

A channel with a capacity $C_{\max}(N)$ units of channel resource is divided into three parts:

$$C_{\max}(N) = C_{\max}(N_1) + C_{\max}(N_2) + C_{\max}(N_3), \quad (2)$$

Where $C_{\max}(N_1), C_{\max}(N_2), C_{\max}(N_3)$ – the number units channel resource allocated for processing the 1-st, 2-nd and 3-rd load classes, respectively.

The signs of a moving boundary (adaptive division) are that class-2 load packets can occupy a free channel resource N_1 . If there is a channel resource that is not occupied by processing higher class loads, it can be used to transmit class-3 packets.

We obtain analytical expressions as probability-time characteristics for studying the throughput of the service method with adaptive resource sharing. For this, we consider the model in the region without overloads:

$$\rho(N_2) = [(\lambda_2 / C_{\max}(N_2))] \cdot L_n < 1, \rho(N_3) = [(\lambda_3 / C_{\max}(N_3))] \cdot L_n < 1, \quad (3)$$

where $\rho(N_i)$ – is the loading coefficient N_i number units of the channel resource [1–3].

Thus, using the results given by formulas (1), (2) and (3) it is possible to determine some important probabilistic-time characteristics throughput capacities taking into account the number of units channel resource.

References

1. Merindol P. Improving Load Balancing with Multipath Routing // Proc. of the 19-th International Conference on Computer Communications and Networks, IEEE. 2018. pp.54–61.
2. Ibrahimov B.G., Humbatov R.T., Alieva A.A., Ibrahimov R.F. Approaches to the analysis of performance indicators of multiservice telecommunication networks based on SDN technology//Information Technologies, Vol. 27, No. 8, 2021. P. 419–424.
3. Ibrahimov B.G. et al Research throughput multiservice telecommunication networks // Сучасні напрями розвитку інформаційно-комунікаційних технологій та засобів управління. Матеріали 10-ї міжн. НТК, 9-10 квітня 2020. Том 1. Баку-Харків-Жиліна, 2020, с.30.
4. Bianchi G. Performance analysis of the IEEE 802.11 distributed coordination function //Selected Areas in Communications, IEEE Journal on. 2010. V. 18. No.3. pp. 535-547.
5. Ibrahimov, B.G. et al. Analysis and Selection Performance Indicators Multiservice Communication Networks Based on the Concept NGN and FN // -Kharkiv: Computer and information systems and technologies, -2021.–p.96-98.
6. Hasanov A. H. et al. Comparative analysis of the efficiency of various energy storages //Advanced Information Systems. – 2023. – Т. 7. – №. 3. – С. 74-80.
7. Ibrahimov B. G. Research quality of functioning of the efficiency optical telecommunication systems using spectral technologies / B. G. Ibrahimov, E. G. Hashimov // Проблеми інформатизації : тези доп. 11-ї міжнар. наук.-техн. конф., 16-17 листопада 2023 р., м. Баку, м. Харків, м. Бельсько-Бяла : [у 3 т.]. Т. 1 / Нац. ун-т оборони Азерб. республіки [та ін.]. – Харків : Impress, 2023. – С. 29-30.
8. Hasanov M. H. et al. Research efficiency optical transport networks with use transferring and reception optoelectronics module //International Journal of Research-Granthaalayah. – 2018. – Т. 6. – №. 2. – С. 324-330.