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Electronic Transmission of Fatty Acids Investigation Data

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Introduction

Fast and effective electronic transfer of scientific data and information with contemporary services of telecommunications is very important nowadays. Data of biochemical researches as well. Bio research, like investigations of many other sciences, uses various analyses methods and multiplex modern equipment. Effective exchange of information among scientists of different biochemistry areas, research groups and laboratories all over the world is essential. Today's biochemistry is not generated by several scientists, universities, institutions or separate states. This work is impossible without wide communication of researches. Data transfer with high quality of service empower scientists to make decisions immediately.

In order to ensure the necessary quality of the service it must be reacted adequately into the dynamic changes of the load in the network, i.e. the appropriate recourses of the network and the quality of the service must be ensured [1]. The protection of quality of service (QoS) is the main part of the strategy of network and service providers developing and entrenching in the market while the Internet speed grows [2]. The problems of process management efficiency safety evaluating the influence of network node are solved not enough intensively [3]. In this paper we are proposing the new adaptive (AFQ-Adaptive Fair Queuing) scheduling for QoS management model, reasoned by the virtual queue and dynamic weighted queues service coefficient ϕ, changing according to the evaluation of the packet state in the node, reasoned by delay target time and present network load. This model allowing managing the packet delay in the node and network.

When communicate professionals of several different research fields transmission of huge amount different type and size electronic information is necessary. This can be raw data from laboratories, various statistical analyses or scientific conclusions. The goal of this research was to use real investigation data of fatty acids of human hepatoma G2 cells and show telecommunication service possibilities for data transfer.

Data of investigation

Analysis of fatty acids has been routinely used in many biochemical investigations. Fatty acids take part in various processes in organism. They are the main source of energy for the heart. Fatty acids are essential components of cellular membranes, and are involved in the regulation of cell growth, and differentiation. Long chain fatty acids are associated with energy generation and storage.

Fatty acids, especially omega-3 fatty acids (Fig. 1) are necessary for healthy human nutrition. Humans do not synthesize omega-3 fatty acids, and they are thus provided solely through the diet.

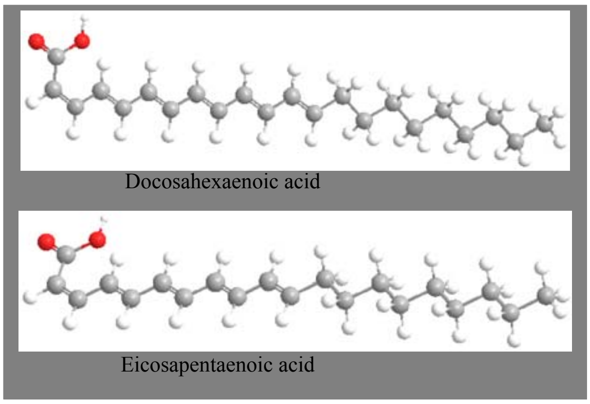

Fig. 1. Omega-3 fatty acids

Usually lipids from biological sources are extracted using traditional method of Folch (with chloroform/methanol) [4]. We extracted fatty acids from cells according to MIDI (Microbial Identification Inc) Technical Note (it is normally used for lipid extraction from bacteria) [5].

Human hepatoma G2 cells were grown in DMEM Ham's F-12 medium supplemented with 1 % penicillin/streptomycin and 10 % FCS in 57-cm^2 dishes at

37°C in a humidified atmosphere containing 5 % CO_2 until confluent. Medium aspirated from plates with confluent cells and 0.5 ml of bidistiled water added. Then cells were harvested and homogenized. Samples prepared as written in Technical Note and using traditional method of Folch [4, 5]. Analysis and quantification of fatty acids methylesters (FAMEs) were conducted by GC as described in previous paper [6]. Data were analyzed using SPSS (Statistical Package for the Social Sciences) and Student's t Test. Results were calculated in ng of evaluated fatty acid for 1μg of cell proteins and compared with data in literature.

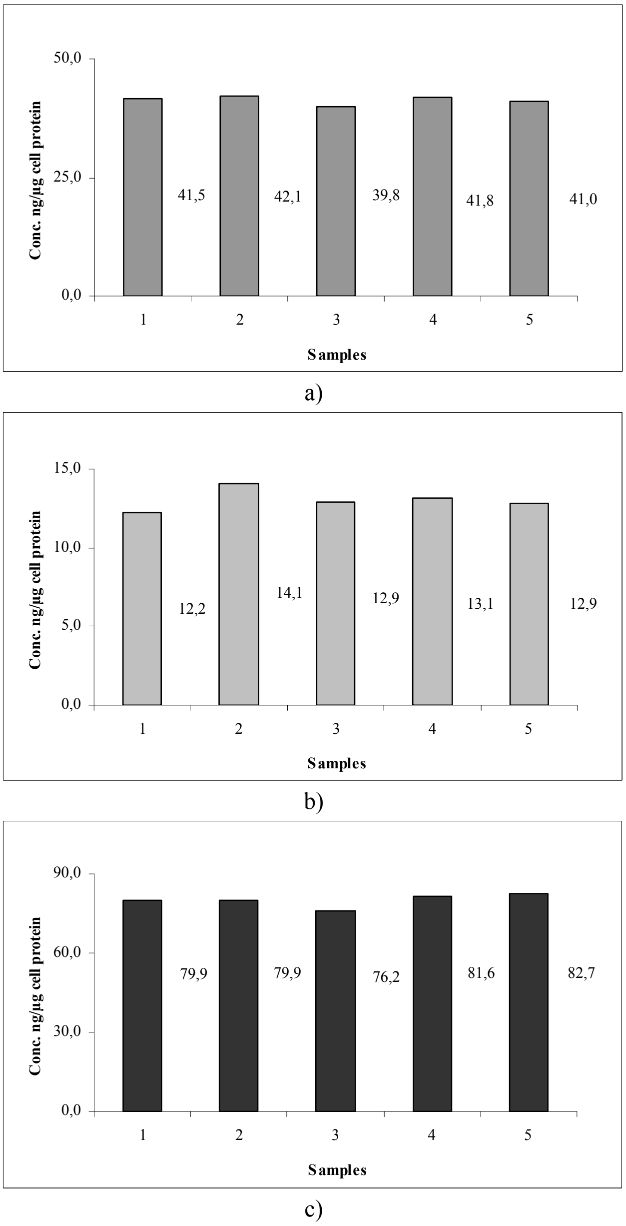

Fig. 2. Concentration of: a – oleic acid in human hepatoma G2 cells; b – stearic acid in human hepatoma G2 cells; c – palmitic acid in human hepatoma G2 cells

Results (Fig. 2, a–c.) showed that concentrations of measured palmitic, oleic and stearic acids are similar in all samples and did not differ significantly ($p<0.05$), n=10.

We compared concentration of three essential fatty acids with literature [7, 8, 9]. Our results showed higher concentration of palmitic acid in human hepatoma cells compare with Lehr et al., data but same concentration compare with Wong et al., and Yu-Poth et al., data.

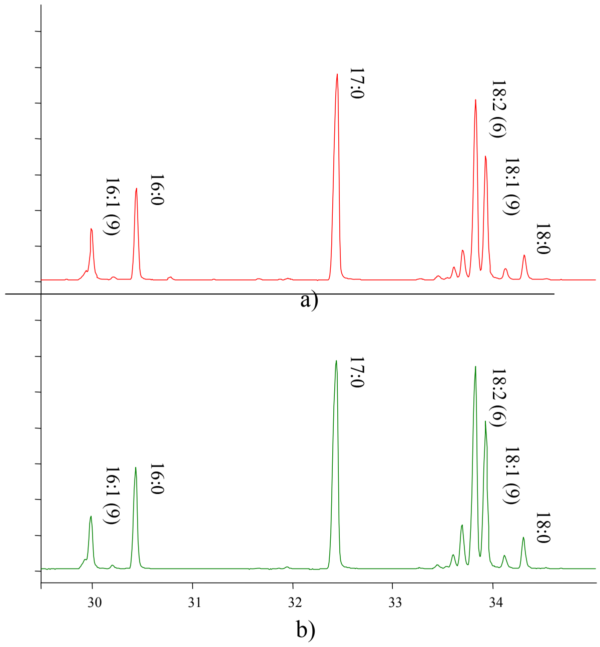

Fig. 3. Comparison of the amounts (gas chromatographic peaks) of fatty acids extracted using Folch (a) and MIDI methods (b). Note, the FAME 17:0 was added as an internal standard.

Oleic acid contributed lower amount in our samples then Wong et al., and Yu-Poth et al. determined, but higher then Lerh et al., wrote in his paper. Our results showed the same concentration of stearic acid in human hepatoma cells compare with literature [7, 8, 9].

Futhermore, we extracted samples with traditional method and compared results together. Fig. 3 shows a representative set of the fatty acid profiles of human hepatoma G2 cells derived from the two methods. The results obtained using the MIDI method for extraction is equivalent to those obtained using Folch method.

The adaptive packet scheduling of IP network

In our case users are creating many short packets in data streams that are irrationally used when transmitting them directly. Other vice, when the channel load is growing, the delay of packets is growing also. Those delay fluctuations negatively influences the quality of the voice, video and data. The main shortage of the Internet network differentiating stream forwarding quality is that it maintains the quality level of the given task (QoS) only inside the domain. So, only the management of one domain router is not enough in order to ensure the service quality between the end to end users and to improve the efficiency of the Internet network. The new or improved version of quality management allowing using network resources more effectively and assuring the quality of the provided telecommunication service to the final users is needed.

Conventional scheduling is about determining the service order of packets in the output link of a router. The packets may be served from a single queue according to First Come First Served (FCFS) principle or there may be several queues among which some form of service differentiation is performed. Various packet scheduling algorithms have been proposed for quality differentiation during the last decades. These algorithms are Priority Queueing, Earliest Due Date (EDD), Generalized Processor Sharing (GPS), Weighted Fair Queueing (WFQ), Defficit Round Robin (DRR), Class Based Queuing (CBQ) and other [2]. The common shortage for these algorithms is that they rely heavily on static parameterization and thus are not able to adapt to changing traffic dynamics.

The adaptive telecommunication service quality management means for differentiating stream transmitting quality ensurance model to the Internet network reasoned by the quality marginal value and evaluation of dynamic network load was proposed for solving this problem in this paper. Stream service disciplines used in nowadays routings are static and does not respond to the changes of the network load, can not always ensure the quality of network service quality between the final users. The new M/G/1K – AFQ model for the service in the queues, reasoned by the virtual queue and weighted queues service coefficient ϕ, changing according to the evaluation of the packet state in the node and allowing to manage the packet delay in the node and network was proposed.

The mathematic model of adaptive packet scheduling in the node

The structure of the analyzed node is given in Fig. 4.

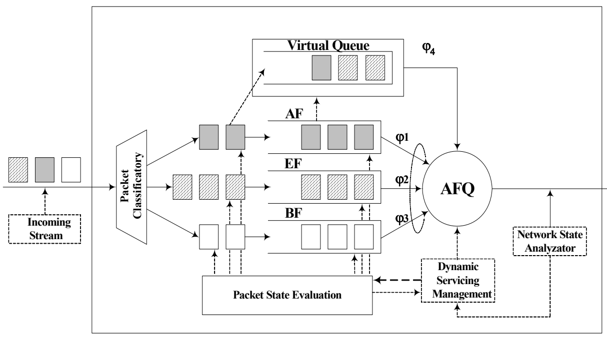

Fig. 4. The structure of the node

M/G/1/K model is used for the queue parameters evaluation as the node in the work is described by the buffers of the finite queue [10]. The proposed stream processing in the router is reasoned by the adaptive quality management changing weighting queue service coefficient ϕ that changes according to the evaluation of the state of packets in the node and allows manage the packet delay in the node and network. M/G/1 model modification with multiple vacations is used for the mathematical description of the node. This modification was chosen according to the adaptive node (router) description proposed adaptive service model M/G/1/K – AFQ reasoned by the disciplines of weighting queue service.

The delay time of analyzed node is described by the equation [11]:

$$D = V + \frac{1}{\mu} \cdot \left(N_l + \sum_{j \in J} N_j \right), \tag{1}$$

where N_l is the number of packets in l-th queue; N_j is the number of packet in all the system, except k-th queue; V is the required time medium for the service of all orders in the system; $\frac{1}{\mu}$ is the average time of packet service.

The parameter V is given by:

$$V = \sum_{j=1}^{K} \left\{ \frac{(1-\rho_{apt})}{\lambda_j \cdot \overline{T_{nutr_j}}} \cdot (1+K) + \frac{\rho_{apt} \cdot (\rho - 1)}{\rho} \right\} \cdot \frac{\overline{T_{apt_j}^{\,2}}}{2\overline{T_{nut_j}}} =$$

$$= \frac{1}{2} \cdot \sum_{j=1}^{K} \left\{ \frac{\overline{T_{apt_j}^{\,2}} \cdot (1-\rho_{apt}) \cdot (1+K)}{\lambda_j \cdot T^2_{nutr_j}} + \frac{\rho_{apt} \cdot (\rho - 1) \cdot \overline{T_{apt_j}^{\,2}}}{\rho \cdot T_{nutr_k}} \right\} =$$

$$= \frac{1}{2} \cdot \left\{ (1-\rho_{apt}) \cdot (K+1) \sum_{j=1}^{K} \frac{\overline{T_{apt_j}^{\,2}}}{\lambda_j \cdot \overline{T_{nutr_j}}^{\,2}} + \frac{\rho_{apt} \cdot (1-\rho)}{\rho} \sum_{j=1}^{K} \frac{\overline{T_{apt_j}^{\,2}}}{\overline{T_{nutr_j}}} \right\} \ . \tag{2}$$

The improved upper and lower bounds of number of packets in node are respectively:

$$N_j \le \min \left(\sum_{\substack{k=1 \\ j=1}}^{J} \left((N_k + 1) \cdot \frac{\phi_j}{\phi_k} \right) + \frac{\phi_j}{T_{serv} \cdot C}; \quad N_j + \frac{M}{C} \cdot \lambda_v \right), \tag{3}$$

$$N_j \ge \min \left(\max \left(\sum_{\substack{k=1 \\ j=1}}^{J} \left((N_k + 1) \cdot \frac{\phi_j}{\phi_k} \right) + \frac{\phi_j}{T_{serv} \cdot C} - 1,\ 0 \right);\ N_j + \frac{M \cdot \lambda_v}{C} \right), \tag{4}$$

where: φ_j – weight coefficient of queue j; φ_k – weight coefficient of queue k; T_{serv} – packet service time; C – link throughput; M – packet size; λ – packet arrive intensity.

The queue scheduling weight coefficient φ are being changed dynamically. The new set of queue scheduling weighting coefficients for *i-th* session is based by the evaluation results of the packet state in the node. The *k-th* queue weight coefficient change can be written as:

$$\varphi_k(t) = \begin{cases} \phi_k^{'}(t) = \varphi_k(t), & \text{if } \forall N_{i+k} \in Q^{+} \\ \phi_k^{'}(t) = \varphi_k(t) - \Delta\phi(t), & \text{if } \forall \mathrm{N_k} \in Q^{+}, \text{ any one } \mathrm{N_i} \in Q^{+-} \\ \phi_k^{'}(t) = \varphi_k(t) + \Delta\phi(t), & \text{if any one } \mathrm{N_k} \in Q^{+-} \text{ and } \forall N_i \in Q^{+} \\ \phi_k^{'}(t) = 0, & \text{if any one } \mathrm{N_{i+k}} \in Q^{+-} \{W_\Lambda < W_k < W_C\} \end{cases} . \tag{5}$$

The change of queue weight coefficient $\Delta\varphi$ is calculated according the equations:

$$\Delta\phi^{+}(t) \ge \frac{N_k \{Q^{+-}\}}{\underset{i \ne k}{N_i}}; \quad \Delta\phi^{-}(t) \ge \frac{N_k \{Q^{+}\}}{\underset{i \ne k}{N_i \{Q^{+-}\}}}. \tag{6}$$

Simulation model and results

Simulation was provided using telecommunication network program package Opnet. The structure of imitational simulation is given in Fig. 5.

Simulation network of differentiated service consists of ten routers: two edge and eight core routers. The 100 Mb/s transmission speed is set between the final network nodes and edge routers. The speed is limited to 2 Mb/s (Fig. 5) in the network of core differentiated service network. Three different services, such as two of real time (transmission of video and voice packets) and one of non real time (transmission of data) are in the simulation network. The routing protocol EIGRP is used in the entire network for the exchange of the data [12].

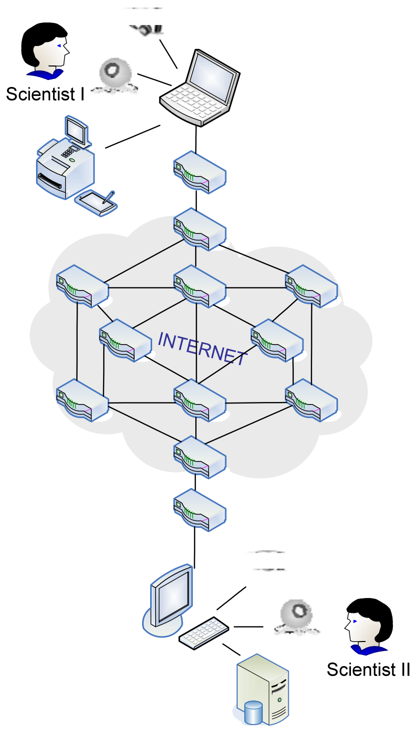

Fig. 5. Structure of simulation network

The initial parameters for service determination are given in Table 1.

Table 1. Service parameters determination

Service	Stream intensity			Prior.
	Codec	File size in bytes	The law of the dynamics	
Voice	G.711	-	Poiss (30)	EF
Video	H.261	-	Poiss (20)	AF43
Data base	-	1072680	Exp(12)	BE

Simulation was made in three cases, when the load of the network (network use) ρ changed: $\rho = 0.2$ to 0.3; $\rho = 0.5$ to 0.7; $\rho = 0.75$ to 0.9.

The main parameters given in Table 2 were set during the imitative simulation using the proposed adaptive quality managing means AFQ.

Table 2. The parameters of AFQ queues service methods

Service	Allowed delay margin T_{max}	The set static medium delay time meaning of one node T_s	Service coefficient ϕ of initial weight queues
Voice	40 ms	2 ms	20
Video	80 ms	4 ms	15
Data base	250 ms	15 ms	5

Taking into account the proposed service parameter for quality evaluation in ITU-T and ETSI recommendations, during experiment was registered:

- Delay time between the final users to the different service classes;
- Network load change during the simulation;
- Weight queue service coefficient ϕ change using the proposed AFQ means.

The obtained simulation results using standard queue service discipline WFQ and proposed adaptive quality managing means AFQ are given. Coding/encoding, spreading and bufferization delay time-frames are not included performing the simulation and analyzing the packet delay time between the final users. The components of delay time-frames are allocated to the fixed delay and do not depend on dynamic load; so during the simulation we analyze only the rotational delay (packet delay in queues of the node). So, the allowed delay margin for the voice is not 150 ms, but 40 ms.

In the case $\rho = 0.20$ to 0.30 we present only average delay time (Fig. 6).

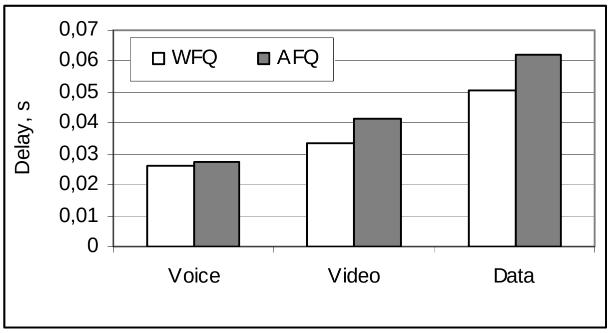

Fig. 6. Average delay time ($\rho = 0.20$ to 0.30)

Analyzing the obtained results of the simulation (Fig. 6) we can observe that all the provided service provided in the network does not exceed posed allowed delay target time when the loading of the network is small ($\rho = 0.20$ to 0.30) using standard quality methods (WFQ) (voice – 40 ms; video – 80 ms; data base – 250 ms). So, in this case the proposed use of the method scarcely enlarges the voice packet average delay time between the end to end users (with WFQ – 26 ms, with AFQ – 28 ms). Analogues situation is with the packets of video, and data base. This can be explained that using the proposed AFQ means, the additional delay related with the information exchange and packet state evaluation is added. Weight queue coefficients remain unchanged as the packet delay time does not exceed the allowed margins. The inconsiderable additional delay related with information processing ads using AFQ means; for this case the packet mean delay time exceeds marginally.

The service of real time (voice and video) not always meets the allowed quality demands when there is medium network use ($\rho = 0.50$ to 0.70). The simulation results are shown in Fig. 7 and Fig. 8.

In this case, the losses of voice service packet because of delay margin exceed is 2.5 % using WFQ. The mean delay in the common case is 51 ms. Having used the proposed adaptive quality managing means, the mean delay decreases up to 28 ms. Using AFQ the packet losses are 1.8 %. The losses occur because of “thrown packets” in transitional routers that are evaluated as having “bad” state. In the transitional nodes providing the packet throw we make the conditions for the other packets better. Another situation is transmitting the non real time service (data base). In the common case the mean delay 93 ms. The mean delay increases up to 102 ms having used the proposed adaptive quality managing means, but the losses are the same 1.1 %. This is very important for the non real time services.

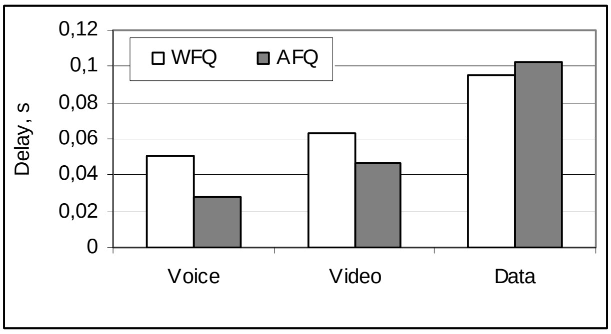

Fig. 7. Average delay time (ρ = 0,50 to 0,70)

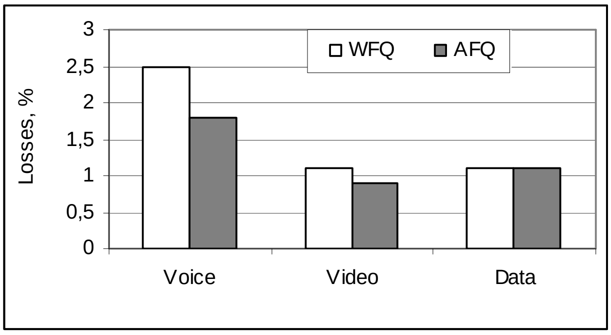

Fig. 8. Packet loses (ρ = 0,50 to 0,70)

Conclusions

Proposed new adaptive (AFQ) scheduling for QoS management model, reasoned by the virtual queue and dynamic weighted queues service coefficient ϕ, changing according to the evaluation of the packet state in the node, reasoned by delay target time and present network load.

The average delay of packets with the highest priorities decrease from 51 ms to 28 ms and losses from 2.5 % to 1.8 % during the imitation simulation when the network is loaded (ρ = 0.50 to 0.70). In this way, the mean delay of data base packet of lower priority increases from 93 ms to 102 ms having used the proposed adaptive quality management means. The losses in both cases are the same – 1.1 %. This assures proper data base quality of service.

Using proposed adaptive QoS management method AFQ, the network users with the ensured services quality number can be increased from 30 % to 65 % with the same network resources.

The study showed that the MIDI extraction and methylation of fatty acids method is effective for analysis of fatty acids composition in human hepatoma G2 cell samples.

Concentrations of measured palmitic, oleic and stearic acids were similar in all samples and did not differ significantly ($p<0.05$).

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12. **Dekeris B., Narbutaitė L., Adomkus T.** Adaptive quality of services management over IP network. WSEAS Proceedings of the WSEAS International Conferences, 8th WSEAS Int. Conf. on Mathematical Methods and Computational Techniques in Electrical Engineering (MMACTEE'06), Bucharest, Romania, October, 2006. – P. 200–205.

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Biochemical research, like investigations of many other sciences, uses various analyses methods and multiplex modern equipment. Effective exchange of information among scientists of different biochemistry areas, research groups and laboratories all over the world is essential. Fast and effective transfer of scientific data and information with contemporary services of telecommunications is very important that empower scientists to make decisions immediately. The Internet with multifunctional and variety of structures and dynamics of development is used to provide complex multiple telecommunication services. The biggest shortage of the traditional “best effort” model is that it does not guarantee the quality of services demands, especially for the interactive real time services. In order to ensure the necessary quality of the service (QoS) it must be reacted adequately into the dynamic changes of the load in the network, i.e.

the appropriate recourses of the network and the quality of the service must be ensured. In this paper we are proposing the new adaptive (AFQ) scheduling for QoS management model, reasoned by the virtual queue and dynamic weighted queues service coefficient ϕ, changing according to the evaluation of the packet state in the node, reasoned by delay target time and present network load. Real investigation data of fatty acids of human hepatoma cells and data transfer with telecommunication service possibilities are shown in this research paper. Ill. 8, bibl. 12, tabl. 2 (in English; abstracts in English, Russian and Lithuanian).

Т. Адомкус, Р. Адомкене, Г. Станкявичус, М. Станкявичене. Электронная передача данных исследований жирных кислот // Электроника и электротехника. – Каунас: Технология, 2009. – № 8(96). – С. 107–112.

Как и в большинстве современных наук, в биохимии применяются различные методы исследования и сложная современная научная аппаратура. Очень важен эффективный обмен информацией между учеными, группами исследователей и лабораториями различных отраслей биохимии во всем мире. Очень важно, чтобы полученную информацию, данные исследований можно было быстро и эффективно передать современными средствами телекоммуникации, чтобы ученые незамедлительно могли принять важные решения. Для оказания различных, особенно многообразных телекоммуникационных услуг всё чаще используется сеть интернета, которая отличается многофункциональностью, разнообразием структур и динамикой развития. Огромным недостатком традиционной услуги “максимального усилия” является то, что она не гарантирует конкретных требований к качеству услуг, особенно интерактивных услуг в реальном времени. Поэтому для обеспечения надлежащего качества услуги следует адекватно реагировать на динамические нагрузки в сети, т. е. обеспечить необходимые ресурсы сети и гарантировать качество услуги. В статье для обеспечения качества услуги предложена новая адаптивная модель обслуживания очередей AFQ, основанная на виртуальной очереди и на весовом коэффициенте обслуживания очередей ϕ, изменяющемся в зависимости от оценки состояния пакетов в узле, и позволяющая управлять запаздыванием пакетов в сети, а также повысить пропускную способность сети. В работе представлены реальные данные исследования жирных кислот клеток гепатомы человека и возможности их передачи по интернету. Ил. 8, библ. 12, табл. 2 (на английском языке; рефераты на английском, русском и литовском яз.).

T. Adomkus, R. Adomkienė, H. Stankevičius, M. Stankevičienė. Elektroninis riebalų rūgščių tyrimų duomenų perdavimas // Elektronika ir elektrotechnika. – Kaunas: Technologija, 2009. – Nr. 8(96). – P. 107–112.

Kaip ir daugelyje nūdienos mokslų, biochemijoje taikomi įvairiausi tyrimo metodai bei sudėtinga moderni mokslinė aparatūra. Visame pasaulyje įvairių biochemijos šakų mokslininkams, tyrimo grupėms, laboratorijoms būtina efektyviai tarpusavyje keistis informacija. Labai svarbu, kad gautą informaciją, tyrimų duomenis būtų galima greitai ir efektyviai perduoti šiuolaikinėmis telekomunikacijų priemonėmis, kad mokslininkai galėtų nedelsdami priimti svarbius sprendimus. Teikiant įvairias, ypač sudėtingas daugialypes telekomunikacijų paslaugas, vis dažniau naudojamas Interneto tinklas, kuris pasižymi daugiafunkciškumu, struktūrų įvairove bei plėtros dinamika. Tradicinės „maksimalios pastangos“ paslaugos didžiulis trūkumas yra tai, kad ji negarantuoja konkrečių paslaugos kokybės reikalavimų, ypač realaus laiko interaktyvioms paslaugoms. Todėl, norint užtikrinti deramą paslaugos kokybę, reikalinga adekvačiai reaguoti į dinaminius apkrovos pokyčius tinkle, t. y. užtikrinti reikiamus tinklo išteklius ir garantuoti paslaugos kokybę. Šiame straipsnyje paslaugos kokybei užtikrinti pasiūlytas naujas adaptyvus eilių aptarnavimo AFQ modelis, pagrįstas virtualia eile bei svoriniu eilių aptarnavimo koeficientu ϕ, kintančiu priklausomai nuo mazge esančių paketų būklės įvertinimo ir leidžiantis valdyti paketų vėlinimą tinkle bei padidinti tinklų pralaidumą. Šiame darbe pateikiami realūs atlikto žmogaus hepatomos ląstelių riebalų rūgščių tyrimo duomenys ir jų perdavimo internetu galimybės. Il. 8, bibl. 12, lent. 2 (anglų kalba; santraukos anglų, rusų ir lietuvių k.).