UDC 621.39

ANALYSIS OF DATA AND REAL TIME TRAFFIC MODEL

K.O. POPOVSKAYA
Kharkiv National University of Radioelectronics

Abstract *- In the article the experimental study of a multi-service network is carried out. In the assumption of a Poisson entrance flow of demands likelihood characteristics of multiservice system are received by transfer of real time traffic and traffic of data. These characteristics allow forming indicators of service quality of various services. Dependence of average of the macro packages being in turn, on intensity of an arriving traffic of data is received at its aspiration to limiting value. At aspiration* λ_8 *to limiting value the average of macro packages in turn sharply increases. At the same time serving system passes to an unstable, critical mode. Dependence of probability of the lost macro packages on the size of the buffer and on pulse nature of receipt of macro packages is investigated. Results show that pulse nature of receipt of macro packages leads to considerable growth of losses in comparison with the maleficiated traffic. At the same time, buffer existence damp pulse character of traffic and leads to reduction of losses. Researches of transmission quality of multiservice flows with use of machine experiment and the ns-2 program are carried out. The given results allow knowing about cross impact of different services flows, and their difficult character speaks features of the used technologies. Obviously, the greatest influence renders increase of real time flows. Results of the carried-out machine experiment allow choosing correctly loading of routers and can be used at design and balancing of network.*

Анотація *– У статті було проведене експериментальне дослідження мультисервісної мережі згідно з вихідними даними. Результати проведеного машинного експерименту дозволяють правильно вибирати навантаження маршрутизаторів і можуть бути використані при проектуванні і балансуванні мережі.*

Аннотация *– В статье проведено экспериментальное исследование мультисервисной сети. Результаты проведенного машинного эксперимента позволяют правильно выбирать нагрузку маршрутизаторов и могут быть использованы при проектировании и балансировки сети.*

Introduction

Personal computing facilitates easy access, manipulation, storage, and exchange of information, and these processes require reliable data transmission. Communicating documents by images and the use of high-resolution graphics terminals provide a more natural and informative mode of human interaction than do voice and data alone. Video teleconferencing enhances group interaction at a distance. High-definition entertainment video improves the quality of pictures, but requires much higher transmission rates. These new data transmission requirements may require new transmission means other than the present overcrowded radio spectrum. A modern telecommunications network (such as the broadband network) must provide all these different services (multi-services) to the user.

I. Analysis of researches and publications

Now there is a convergence of networks, and the companies develop new strategy for successful provision of new services in Next Generation Network [1, 2]. Process of convergence is connected to the concept triple play [3, 4], implying provision in one network of services which can be divided into three large categories — "voice", "video" and "data". Each category actually is large package service: "voice" – the IP telephony, Skype, a SIP telephony; "video" – IPTV (IP Television), video on demand, stream P2P-video; "data" – a file transfer, e-mail, instant messaging. Thus often, the concept "triple service" identify with end-to-end solution of IPTV [2]. It is necessary to mark that "triple, service" is implemented on basis both wire, and wireless networks of NGN – cellular networks of the 3rd and the subsequent generations – UMTS (Universal Mobile Telecommunications System), WiMAX (Worldwide Interoperability for Microwave Access), LTE (Long Term Evolution) и LTE-Advanced . The traffic generated by so various services, enjoying different popularity, differs not only on volume, but also sensitivity to losses of packets, bit-by-bit speed, transmission time and so forth.

II. Traffic model synthesis

Modern telecommunication networks are under construction in such a manner that on knots of processing various information streams arrive: speech, video, data, each of which demands specific methods of transfer. Owing to limitation of network resources, there is a need of minimization of losses of each of streams. Let's analyze nature of the specified losses. Let's consider, that on processing the Poisson flow of demands arrives, containing demands of real time, possessing intensity λ_p and intensity of their service μ_p, the data flow has parameters respectively λ_d and μ_d. The traffic of real time has an absolute priority and is limited only to capacity of system, stopping if necessary a traffic of data.

For the data transmission, arriving in the form of x-macro packages, the free channel resource is used. In the absence of that, unlike traffic of the real time, the remained macro packages take empty seats in the buffer. Average of the macro packages, containing in one demand:

$$n_g = \sum_{x=1}^{C+Q} xP(x), \tag{1}$$

where C — speed of transfer, expressed in terms of a channel resource;
Q — volume of buffer in terms of macro packages.

Owing to a Markov property of service process, research of this process can be carried out in the assumption of its stationarity. Let's define probability of a condition of service process of demands:

$$p(n_{p1}, n_{p2}, \ldots, n_{pn}, n_g), \tag{2}$$

where $n_{pi}, i=1,2,\ldots,n$ — number of a channel resource connected with implementation of the i — demand of real time traffic.

This probability can be interpreted, as a time share of staying system in a condition with n_p demands of i —streams on transfer of real time traffic and n_g macro packages, being on transfer or in turn.

Let's define losses of real time and data traffic. Probability of the lost demands of this traffic:

$$\pi_r = \sum_S p(n_{p1}, n_{p2}, \ldots, n_{pn}, n_g), \tag{3}$$

where S — conditions at which there is no free channel resource for transfer of this traffic. These conditions satisfy to a condition $n_p + i > C$.

Average of the channel resource, spent for transfer real time traffic:

$$m_p = \sum_S p(n_{p1}, n_{p2}, \ldots, n_{pn}, n_g) n_p. \tag{4}$$

Loss of data traffic, transferred out of real time, consists of the following components:

— losses of the macro packages, which have occurred owing to lack of a free resource and employment of all places in turn π_c;

— losses of the macro packages, which forced out from service by the arrived priority demand f real time traffic and haven't found empty seats in turn π_b;

— losses of macro packages because of waiting time excess in the buffer π_d;

All these losses we will define as the relation of intensity of the corresponding events to intensity of receipt of macro packages on transfer. It allows to interpret indicators of losses π_c, π_b, π_d as the corresponding probabilities at aspiration of number of events to a limit. As the specified probabilities are independent, the general probability of losses of macro packages is defined in a look:

$$\pi_M^{(-)} = \pi_c + \pi_b + \pi_d. \tag{5}$$

From here the probability of successful delivery of macro packages is defined as addition to (5):

$$\pi_M^{(+)} = 1 - \pi_c - \pi_b - \pi_d. \tag{6}$$

For definition of average time of staying macro package in waiting on transfer we will use Little's formula. This time:

$$T_M = \frac{m_k + m_d}{\lambda_g n_g (1 - \pi_c)}, \tag{7}$$

where m_k, m_d — average value respectively: units of the channel resource, allocated for transfer of macro packages and places in turn, taken with macro packages.

III. Traffic model analysis

For demonstration cross impacts process between services machine experiment with use of the standard program ns-2 was made. As basic data the following parameters were taken:

— duration = 10 s;
— VoIP codec is G.729A;
— number of hops = 2;
— delay = 1ms;
— BW = 10 Mbit/s;
— GW BUFF = 25;
— PKTSZ = 500 bytes;
— MAXWIN = 50;
— traffic rate for video = 512 Kbit/s;
— VoIP users = 5;
— TCP users = 5.

In a fig. 1 the version of the skeleton diagram of the telecommunication network which traffic consists of three types of service is provided: speech, video and data. Analysis results are provided on diagrams (fig. 2, fig. 3 and fig. 4).

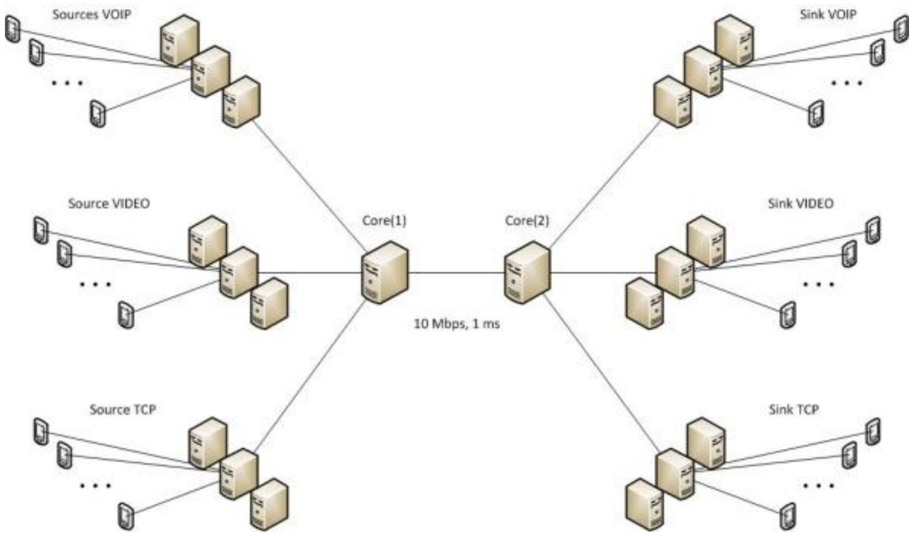

Fig. 1. Network topology

In a fig. 2 dependence of change of packets losses on quantity of TCP flows is shown. From the diagram follows that almost constant there are the losses connected to voice transmission. At the same time losses of TCP flows and video flows in proportion increase. The persistence of losses of speech flows speaks, obviously, specifics of technology of voice transmission.

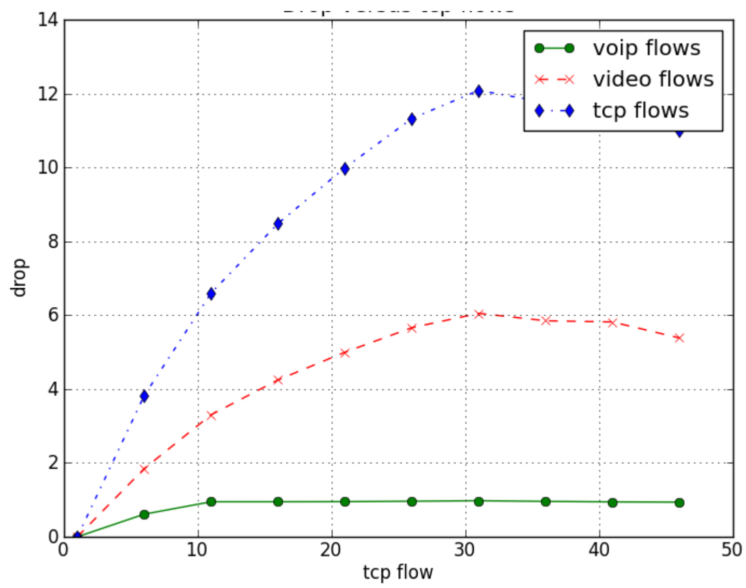

Fig. 2. Drop versus TCP flows

In a fig. 3 the close dependence of losses is provided in case of different change of number of video flows. Diagram shows proportional growth of losses of VoIP and data. However, dependence of these losses other, than in the previous case.

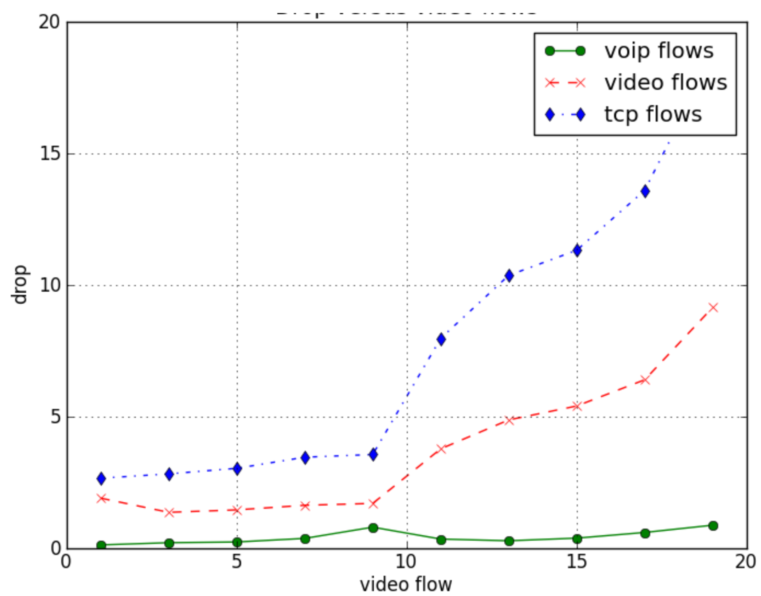

Fig. 3. Drop versus video flows

In a fig. 4 the diagram of a time delay of packets is provided in case of different number of video flows. The curve of voice packets is characteristic. Time delays for video packets increase, at the same time, delays of time of TCP flows packets have almost inverse relation in relation to video.

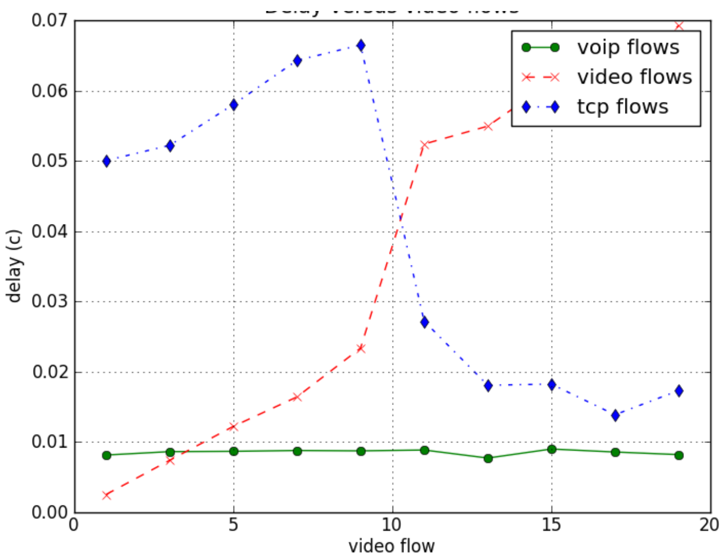

Fig. 4. Delay versus video flows

Conclusion

In the assumption of a Poisson entrance flow of demands likelihood characteristics of multiservice system are received by transfer of real time traffic and traffic of data. These characteristics allow forming indicators of service quality of various services.

Dependence of average of the macro packages being in turn, on intensity of an arriving traffic of data is received at its aspiration to limiting value. At aspiration λ_g to limiting value the average of macro packages in turn sharply increases. At the same time serving system passes to an unstable, critical mode.

Dependence of probability of the lost macro packages on the size of the buffer and on pulse nature of receipt of macro packages is investigated. Results show that pulse nature of receipt of macro packages leads to considerable growth of losses in comparison with the smoothed traffic. At the same time, buffer existence damp pulse character of traffic and leads to reduction of losses.

Researches of transmission quality of multiservice flows with use of machine experiment and the NS2 program are carried out. The given results allow knowing about cross impact of different services flows, and their difficult character speaks features of the used technologies. Obviously, the greatest influence renders increase of real time flows.

References

1. *Andrianov G., Potyazov S., Tsitovich I.* On a problem of QoS characteristics interpretation in telecommunication network // Information Science and Computing. – 2009. – Vol. 11. – P. 59–61.

2. *Popovsky V., Barkalov A., Titarenko L.* Control and Adaptation in telecommunication systems. Mathematical Foundations. – Springer-Verlag Berlin Heidelberg, 2011. – 173 p.

3. *Delcoigne F., Proutiere A., Regnie D.* Modeling integration of streaming and data traffic // Performance Evaluation. – 2004. – Vol. 55, No. 3—4. – P. 185–187.

4. *Benameur N., Fredj S.B., Oueslati-Boulahia S., Roberts J.W.* Quality of service and flow level admission control in the Internet // Computer Networks. – 2002. – Vol. 40, No. 1. – P. 57–59.