# A dynamic model of a TCP-session at the management by a length of queue with the use of RED mechanism

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*Abstract* - **a mathematical model of TCP-session of data communication at the management by a length of queue with the use of congestion avoidance mechanism – RED (Random Early Detection) – is proposed. This model is expressed by differential equations, which represent the dynamic of information exchange between hosts.**

*Keywords* - **TCP-session, RED, Telecommunication system.**

## I. INTRODUCTION

The mathematical description of the features of protocol TCP [1, 2] and the RED mechanism [3] collaboration makes it possible to improve the consistency and optimize the performance of TCS (Telecommunication System). Also the analytical approach to the description of the process flow control in TCP and RED makes it possible to identify possible effects of unstable TCS functioning.

## II. A MATHEMATICAL MODEL OF TCP-SESSION

In this paper an approach to the mathematical description of the process of information exchange, organized according to the transport layer protocol TCP is proposed. The logic of TCP algorithm is focused on the data segments flow transmit with the maximum intensity subject to maintaining an acceptable level of losses that allows to provide compensation of them by the retransmissions [1, 2]. Since the use of modern high-speed links there is practically no loss or distortion the cause of the losses may be dropping packets at intermediate nodes with the limited size of the buffer and memory space. It is possible to prevent extreme values of the flow intensity in TCP-sessions at the expense of the additional mechanisms introduction for flow control on communication nodes. The main idea of the most common mechanism RED [3] is in the preventive detection of congestion indications and the subsequent increase of the dropped packets number. As a result, it is prevented actual buffer congestion and initializes a mechanism to reduce transmission rates in accordance with TCP algorithm.

A mathematical model is represented by a nonlinear differential equation of TCP-flow intensity variation that takes into account the dynamic of the data phases changes in accordance with various versions of TCP. Within the scope of the proposed model dependence of the congestion window size variation on the preventive queues length management RED mechanism working result is formalized.

Various TCP algorithms and techniques have been proposed to improve congestion and reduce the non-congestion related packet loss. Due to that fact in the work used TCP Tahoe version which provides common operating principles for all future versions of this protocol. TCP Tahoe algorithm employ three transmission phases: slow start, congestion avoidance, and fast retransmit. In the case of packet loss detection TCP algorithm implements the transition to slow start mode.

A probability of packets blocking (dropping) was received based on the functioning of RED mechanism [3]. Average queue length is calculated in accordance with the expression of queuing theory. This expression displays the relationship of average queue length with delivery and packet processing time, link bandwidth and current link load [4].

Experimental research results of proposed dynamic TCP-session model for different values of the RTT (round trip time) are shown in Fig.1
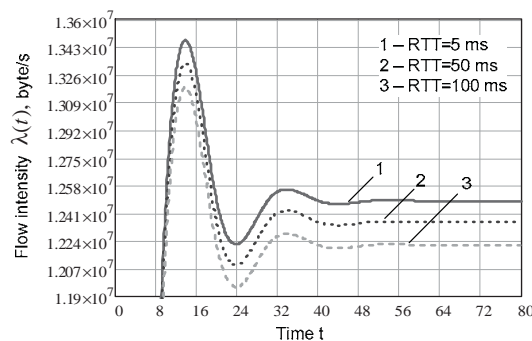


Fig.1 Modeling results

## III. CONCLUSION

Verification of the proposed model showed that it quite adequately describes the TCP-session work and can be used to the performance analysis of TCS within individual connections under variation of such important parameters as the round trip time RTT, link bandwidth, blocking packet model of RED mechanism and maximum buffer size. This model should be used when optimizing of the TCP-session parameters as well as for the analysis of the system functioning stability in the network parameters fluctuations.

## REFERENCES

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