LABORATORY 5
Laboratory of Teletraffic Theory
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The leading researchers of the laboratory include:

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Dr.Sc. (Math.)	I. Tsitovich	Dr.	V. Naumov

DIRECTIONS OF ACTIVITY

The laboratory deals with the development of teletraffic theory and its applications in telecommunications and computer systems. The following problem areas and models are studied at the laboratory in 2002:

• the construction of numerically optimized algorithms of calculation the performance measures of queueing models described by multi-dimensional Markovian processes;

• the development and analysis of teletraffic models for performance evaluation of new cost-effective telecommunication systems;

• the development of the software tools based on the efficient algorithms to support the performance modelling of the teletraffic models;

• the construction of the asymptotically optimal procedures for the sequential design of experiments for statistical problems related to telecommunication networks;

• the analysis of switching systems and interconnection networks for telecommunication and multiprocessing systems.

MAIN RESULTS

Optimized algorithm of estimation the performance measures of ideal gradings is constructed. Optimization is achieved by removing out of calculation the states with small probabilities of existence. Ideal gradings are widely used in construction and planning of telephone networks. It is shown that usage of such approach can decrease the time of calculation up to 10 times and more for cases of large loads and number of trunks. Also it allows to skip problems related to calculation of probabilities with very small numerical values. (S. N. Stepanov)

It is shown how to use the methodology derived for estimating the performance measures of multirate connection-oriented networks for solving the similar problems appeared in telecommunication networks based on MPLS technology and considered on connection level. The corresponding model that can be used for MPLS network dimensioning is described. Constructed model can be used for study the performance measures of networks with differentiated services. Examples of such models having one or two nodes with several traffic flows are studied with help of constructing corresponding Markov processes. (S. N. Stepanov, E. O. Naumova, E. I. Melik-Gaikazova)

Models of subscriber's access system are constructed which are compatible with other parts of multiservice communication network. They take into account a traffic flours dividing, a level of mixing the channels cluster and can be used for analyzing a network's structure. (A. D. Kharkevich, E. I. Melik-Gaikazova)

An asymptotic extension for the risk function of asymptotically optimal sequential strategy for hypothesizes testing for markov chain's distributions was analyzed when the maximal probability of error tends to zero and a small parameter exists. An accuracy of a model for possible distributions as the small parameter was considered. A bound for likelihood ratio deviations of discreet distributions under an regularity condition validated for distributions in telecommunication networks was found. (I. I. Tsitovich)

The interconnection switching systems with many different groups of points are considered. Optimal crosspoints for different types of connections are received. (V. A. Garmash)

Properties and applications of z-transformations for elementary discrete signals with multiple poles of their Laplace transforms have been discussed. It has been deduced that in such cases z-transformations are represented by compound structure fractions, denominated V-fractions. V-fractions structure in case any poles multiplicity have been also discussed. The new computed methods for direct and inverse z-transformations have been developed by using V-fractions. (A. A. Vitkova)

It was proposed the Media Switch, which is able to combine different switching disciplines into a compact fabric and provides a platform for multimedia services. Long-term and short-term QoS effects of traffic aggregation and multipath routing in the Internet was investigated. An object/oriented model of multi-layer transport network described with Unified Modelling Language (UML) was proposed. (V. A. Naumov)

A statistical analysis of quality of internet -service for different types telephone stations modem users: step-by-step, crosspoint and electronic were carried out (jointly with "MTU-Inform" (Russia)). Arrival traffic characteristics were investigated : an incoming Internet-calls number, mean number of internet-calls per busy hour, mean duration of internet-session and also dependences of some parameters on time period. The estimates of statistical parameters on grade of service of different types telephone stations Internet-users were obtained. The method to calculate the capacity of corporative network with Internet-service modem pool have been developed; this method takes into account the arrival traffic screening effect. (V. A. Ershov, O. F. Sergeeva)

For Jackson network the necessary and sufficient conditions of presentation of its stationary distribution of state probabilities in analytical form have been obtained. For cases, when parameters of open Jackson network do not depend on and depend on time, its exact nonstationary distribution of state probabilities in analytical form have been obtained in partial case of infinite number of servers in every node and initial conditions (Poisson distribution of queue length in every node). In general case of initial conditions and finite number of servers in every node determination of nonstationary distribution has been obtained by method of iterations. (V. A. Ivnitski)

The necessary and sufficient conditions of product form distribution of queue lengths for network of nodes with generalized processor sharing discipline and network state dependence of nodes parameters and with account the time for customers transmission are suggested. An effective recurrence algorithm of calculation the coefficients of the asymptotic expansion for an arbitrary number of expansion terms is constructed. (O. V. Ivnitski)

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