PROBABILISTIC MODEL OF TELECOMMUNICATIONS INFRASTRUCTURE SCALING

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This study considers the problem of scaling telecommunication networks in cloud environments taking into account the random nature of the load. The relevance of the work is due to the increasing variability and unpredictability of network traffic, which complicates the application of classical deterministic methods of resource management. The main attention is focused on describing the load as a stochastic process using a model based on the Wiener process [1].

A stochastic scaling model is proposed, based on the Ito differential equation with a random component, which allows reflecting traffic fluctuations in real time. The scaling process is formalized as a problem of determining the first moment of exceeding the critical level by the load. The Euler–Maruyama method is used for the numerical solution, which made it possible to obtain statistically sound results and analyze the behavior of the system under conditions of stochastic traffic dynamics [2].

The simulation results have shown the feasibility of using a stochastic approach, which provides not only the prediction of possible overloads, but also the support of adaptive scaling strategies. The constructed implementation graphs, confidence intervals and histograms of time to scaling confirm the significance of stochastic influences and the need to take them into account in control systems. The influence of model parameters on load dynamics has been studied, which opens up ways to optimize resource provision.

As a result, the advantages of using a model based on the Wiener process in comparison with deterministic approaches have been proven. Directions for further research have been outlined, in particular, the implementation of the Kalman filter to increase the accuracy of forecasts and the application of Markov decision processes (MDP) to build effective scaling strategies in telecommunication networks.

References:

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