

ESTIMATING AVERAGE PACKET LATENCY IN WIRELESS NETWORKS USING MIMO AND RANDOM ACCESS

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The growing need for high-speed data transmission leads to the introduction of efficient radio access technologies, among which MIMO (Multiple-Input Multiple-Output) technology is one of the key ones. One of the current tasks in such networks is the analysis of packet delay, especially taking into account the stochastic nature of channel access. The average delay value is an important criterion for quality of service (QoS), especially for applications requiring high reliability.

The purpose of this study is to build a mathematical model for estimating the average packet delay in MIMO systems with random access. The model takes into account both the variability of the radio channel characteristics and the structure of the MIMO environment - in particular, the number of antennas and the dimensions of the channel matrix.

The paper [1] is analyzed, which investigates the performance of MIMO systems taking into account transmission delays and message accumulation in queues under variable communication conditions. In the article [2] the analysis of delays using the theory of large deviations in multi-user MIMO systems with multilayer feedback is considered.

The approach proposed in this work is distinguished by the fact that it allows to formalize the estimate of the average delay in networks with adaptive bandwidth, which directly depends on the statistical characteristics of the channel matrix $H(t)$. This distinguishes the model from traditional approaches, where the service rate is constant or stochastic, but independent of the physical environment.

This method provides adequate modeling of the dynamics of wireless systems, where changes in channel parameters over time have a direct impact on the quality of service. This allows to more accurately take into account the influence of the physical layer on the efficiency of the higher layers of the network architecture.

The results of the study confirm the scientific validity and practical value of the proposed mathematical model. The developed approach to estimating the average delay in MIMO random access systems is an effective tool for analyzing the performance of telecommunication networks. Its advantage is the combination of queuing theory with the physical characteristics of the channel, in particular, the dependence of the service rate on the instantaneous throughput, which is determined by the parameters of the MIMO channel.

References:

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2. J. Chen and V. K. N. Lau, "Large Deviation Delay Analysis of Queue-Aware Multi-User MIMO Systems With Two-Timescale Mobile-Driven Feedback," in *IEEE Transactions on Signal Processing*, vol. 61, no. 16, pp. 4067-4076, Aug. 15, 2013, doi: 10.1109/TSP.2013.2265681.