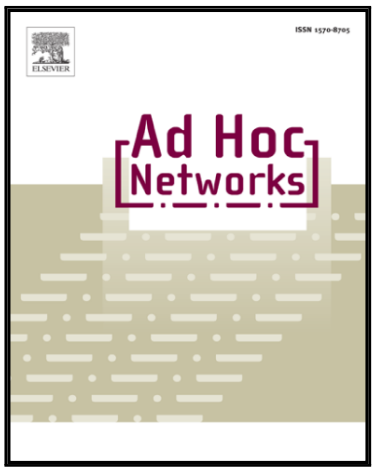

Performance Evaluation of IEEE 802.15.4 with Real Time Queueing Analysis

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Abstract

To provide a tool for performance evaluation of IEEE 802.15.4 with sleep mode enabled, a novel model based on real time queueing analysis is proposed in this paper. A low-rate wireless personal area network (LR-WPAN), composed of multiple nodes which send packets to the coordinator, is considered. The queueing behavior of IEEE 802.15.4 node with sleep mode enabled differs from others because the packet arrivals in sleep period accumulate at the beginning of the active period, which makes a heavier load in the beginning than at any other time. This model analyzes this behavior by dividing the active portion of the superframe into backoff slots and then using an embedded discrete-time Markov chain model. The concept of virtual service time is introduced into this model which makes the proposed queueing model novel and different from typical ones. The accuracy of the proposed model is validated by Monte Carlo simulations in existing typical application scenarios, which indicates that the proposed queueing model can accurately evaluate the performance of IEEE 802.15.4 in the context of the application scenarios described in the simulations.

Index Terms

IEEE 802.15.4, queueing analysis, CSMA/CA, energy consumption, throughput.

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