

An Exact Combinatorial Analysis for the Performance Evaluation of Framed Slotted Aloha Systems with Diversity Transmission Over Erasable Wireless Channels

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Abstract

Framed Slotted Aloha (FSA) protocols are widely used in various communication systems. This paper investigates the performance of FSA systems that employ diversity transmission (DT) techniques over erasable wireless channels. Two DT schemes, DT-SWIR and DT-SWOR, differentiated by the underlying channel sampling procedures, i. e., sampling with/without replacement (SWIR/SWOR), are proposed. Modified versions, MDT-SWIR and MDT-SWOR, in which new and backlogged users use different diversity factors are also presented. To further exploit the advantages of using DT, we introduce a new PMDT-SWIR scheme in which the transmitting power of a packet can be varied. Using a probabilistic retransmission model, we develop exact combinatorial analyses to evaluate the throughput and activity factor. Characteristics of all schemes are comprehensively studied through numerical examples. For a dynamically controlled system, the optimal retransmission probabilities that result in maximal throughput for the MDT-SWIR, MDT-SWOR, and PMDT-SWIR are determined. All mathematical analyses are validated via computer simulations.

Keyword : Activity factor · Diversity transmission · Erasable channels · Framed slotted Aloha · Sampling with/without replacement