RETRANSMISSION DELAYS OVER CORRELATED CHANNELS

Predrag R. Jelenković, Department of Electrical Engineering, Columbia University, predrag@ee.columbia.edu
Evangelia Skiani, Department of Electrical Engineering, Columbia University, valia@ee.columbia.edu

High variability and frequent failures characterize most of the existing communication networks where retransmission-based failure recovery represents a primary approach for successful data delivery. Recent work has shown that, when data sizes have infinite support, retransmissions can cause power law delays and instabilities even if all traffic and network characteristics are super-exponential. The prior studies have considered a baseline model where the channel switches independently between the available and unavailable states. However, communication channels are highly correlated in reality, and in this paper, we extend the prior work on the i.i.d. model to the dependent case.

We use modulated processes, e.g. Markov modulated, to capture the channel dependencies. We study the number of retransmissions and delays under the assumption that the hazard functions of the distributions of data sizes and channel statistics are proportional, conditionally on the channel state. Our results show that the tails of the retransmission and delay distributions are dominated by the longer channel availability periods, informally implying that the "best case wins". Furthermore, we provide explicit formulas that approximate uniformly the entire bodies of the retransmission and delay distributions, respectively. The exact approximations demonstrate the effects of every channel state on the main bodies of the distributions. These main body approximations may be even more relevant than the tails for specific target applications. The accuracy of our analytic approximations is validated via simulation experiments.