MIXING PROPERTIES AND DELAY PERFORMANCE OF RANDOM-ACCESS NETWORKS

A. Zocca, Eindhoven University of Technology, a.zocca@tue.nl
S.C. Borst, Eindhoven University of Technology, s.c.borst@tue.nl
J.S.H. van Leeuwaarden, Eindhoven University of Technology, j.s.h.v.leeuwaarden@tue.nl
F.R. Nardi, Eindhoven University of Technology, f.r.nardi@tue.nl

We consider a stylized stochastic model for a wireless random-access network, which yields a product-form stationary distribution of the activity process for the various users and provides useful estimates for the user throughputs. Even in symmetric scenarios, where long-run fairness is guaranteed, it may take a long time for the activity process to move between dominant states, giving rise to potential starvation issues. In order to gain insight in the transient throughput characteristics and associated starvation effects, we examine the behavior of the transition time between dominant activity states and the convergence rate to equilibrium of the activity process in terms of conductance and mixing times, for various interference graphs. In particular, we establish the order of magnitude of the transition time for a symmetric grid network and demonstrate how these results for the transition times can be exploited to obtain delay bounds. We also prove that in some cases the scaled transition time has an asymptotically exponential distribution as the activation rate grows large, and point out interesting connections with related exponentiality results for rare events, renewal theory and meta-stability phenomena in statistical physics.