Large Deviations of Wireless Scheduling: Incomplete State Information and Optimality

Sanjay Shakkottai
UT, Austin

We consider a server serving a time-slotted queued system with multiple flows, and with time-varying and user-dependent service rates. In our setting, the server can observe instantaneous service rates for only a subset of flows. The objective is to determine a joint subset-selection and user-scheduling algorithm that minimizes the maximum queue-length (more precisely, minimizes the large-deviations rate-function). This problem is of interest in downlink wireless scheduling with a large number of channels and with limited feedback capacity. This also has connections to the stochastic bandit, where the channels evolve over time (whether chosen or not), and the "reward" for selecting a user is a decrease in the corresponding queue-length; however, the performance objective is to minimize the max-queue-length.

In this talk, we present algorithms that achieve the best exponential decay rate (large-deviations rate-function), among all scheduling algorithms using partial information, of the tail of the longest queue in the system. As a special case, when the observable subsets are singleton flows (i.e., when there is effectively no a-priori channel-state information), our algorithm reduces to simply serving the flow with the longest queue; thus, our results show that this greedy scheduling policy is large-deviations optimal.