Throughput Optimal Scheduling in Energy Constrained Wireless Networks

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Abstract

We consider a cross-layer packet scheduling problem in fading channels in which the channel state information at the transmitter (CSIT) is known at the transmitter. Packets arrive according to a Bernoulli process at the transmitter, and each packet is required to be timely-delivered at the receiver, within a delay of d time-slots, and is dropped, if the delay deadline is not met. Since the transmitter has CSIT, an optimal control on energy can be used for transmission. *The problem is to decide the transmit-energy in each time-slot such that the timely-throughput is maximum for a given average transmit-energy constraint.* We pose this problem as a Markov decision process, and provide an optimum policy based on value iteration. We obtain the structure of the optimum policy, based on which we propose a computationally simple policy GREP that requires no CSIT. We show that the timely-throughput of GREP is close to the optimum policy. We also provide a naive randomization policy, and compare the throughput performance of the proposed policies.

We also consider a wireless network with multiple nodes, and pose a scheduling problem where each packet of each flow is required to reach the destination before a delay deadline. We ask the following question: given an energy budget of each node, what is an optimal timely scheduling strategy that maximizes throughput of flows. The problem is to choose a set of non-interfering links in each time-slot so that packets of various flows reach their destinations before the deadline. The links experience fading, and thus, the problem is also one of choosing links that correspond to minimum total energy for transmission. We provide scheduling algorithms based on the optimal energy expenditure in each time-slot.