Spatial models of ad hoc wireless and sensor networks—Optimizing for energy efficiency

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Abstract

In this talk I'll discus two problems associated achieving energy efficient operation of ad hoc wireless and sensor networks:

- How to optimize trade-offs between minimizing energy consumption and balancing energy burdens across and ad hoc wireless network?
- How to optimize routing among source nodes, nodes with the capability of performing data compression, and sink nodes, so as to minimize the average energy consumption in an ad hoc sensor network?

These questions are addressed explicitly using a combination of stochastic geometric and queuing models which provide reasonable caricatures for the spatial distribution of resources, traffic and energy burdens for such networks.

The first set of results presented in this talk are geared at determining approximate optimal tradeoffs for spatial balancing of energy burdens under random, but spatially homogeneous, traffic loads. Specifically one can attempt to balance the energy burdens across the network by spreading traffic loads, yet by doing so one incurs additional overall energy burdens. To this end we present appropriate limit theorems for the distributions of the spatial random process capturing the energy burdens on the network. These results permit the consideration of different types of networks, e.g., those with and without

energy replenishing capabilities, and consideration of different network design criteria associated with guaranteeing and extending the network's 'lifetime'. The second set of results concern the joint optimization of network routing and compression in a sensor network. For a simplified sensor network model in which traffic loads are fixed, and aggregated through compressor nodes, and sinks we show that the energy optimal hierarchical arrangement is related to Johnson–Mehl tessellations induced by the locations of compressor nodes.

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