Lifetime Maximization with Restricted Connection Diversity in Wireless Sensor Networks

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Abstract

A Wireless Sensor Network (WSN) consists of autonomous sensors and communication links between them. They are used mainly for surveillance and status tracking in various domains such as military, health, agriculture, geology, and logistics. Their commonality is a natural consequence of their ease of deployment, low cost, and operational advantages. Since sensors are battery-powered devices, efficient use of their batteries for long-lasting network reliability and availability is of utmost importance. To this end, designing energy efficient data transmission protocols is an important research field in the WSN literature. However, the recent emphasis is on considering additional issues at the design stage for improved service quality. In this context, controlled connection diversity facilitates data flow management through the WSN. In this study, we manage connection diversity by limiting, for each sensor, the number of incoming and outgoing links. We use the time until the first sensor dies metric for lifetime definition so that the WSN functions if possible due to more balanced energy dissipation. We construct mathematical models for the relevant problem and discuss the tradeoff between lifetime and diversity. We provide test results on a large test bed and observe that a minor sacrifice from optimal network lifetime leads to significant reduction is path diversity and hence improved control over network management.

Keywords
Wireless sensor network (WSN), Connection diversity, Reliability, Energy efficiency, Mixed integer programming.

Biographies
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