Reliable Load-Balancing Routing for Resource-Constrained Wireless Sensor Networks

A thesis submitted for the degree of
Doctor of Philosophy
by
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Declaration

To the best of my knowledge, this thesis contains no material previously published by any other person except where due acknowledgment has been made.

This thesis contains no material which has been accepted for award of any other degree in any other university.

Signature:

Date: February 07, 2012
Dedicated to my parents, family and friends for their support…
Abstract

Wireless sensor networks (WSNs) are energy and resource constrained. Energy limitations make it advantageous to balance radio transmissions across multiple sensor nodes. Thus, load balanced routing is highly desirable and has motivated a significant volume of research. Multihop sensor network architecture can also provide greater coverage, but requires a highly reliable and adaptive routing scheme to accommodate frequent topology changes. Current reliability-oriented protocols degrade energy efficiency and increase network latency. This thesis develops and evaluates a novel solution to provide energy-efficient routing while enhancing packet delivery reliability. This solution, a reliable load-balancing routing (RLBR), makes four contributions in the area of reliability, resiliency and load balancing in support of the primary objective of network lifetime maximisation. The results are captured using real world testbeds as well as simulations. The first contribution uses sensor node emulation, at the instruction cycle level, to characterise the additional processing and computation overhead required by the routing scheme. The second contribution is based on real world testbeds which comprises two different TinyOS-enabled sensor platforms under different scenarios. The third contribution extends and evaluates RLBR using large-scale simulations. It is shown that RLBR consumes less energy while reducing topology repair latency and supports various aggregation weights by redistributing packet relaying loads. It also shows a balanced energy usage and a significant lifetime gain. Finally, the forth contribution is a novel variable transmission power control scheme which is created based on the experience gained from prior practical and simulated studies. This power control scheme operates at the data link layer to dynamically reduce unnecessarily high transmission power while maintaining acceptable link reliability.
Publications

Journal Articles:


Book Chapters:


Conference Papers:


Posters and Demos:


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