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On Aggregation Based Routing for Mobile Wireless Sensor Networks

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This dissertation is submitted to Ain Shams University for the degree of Doctor of Philosophy in Electrical Engineering (Computer and Systems Engineering).

The work included in this thesis was carried out by the author at Computer and Systems Engineering Department, Faculty of Engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or qualification at other university or institution.

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Abstract

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On Aggregation Based Routing for Mobile Wireless Sensor Networks

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The recent technological advances in the field of wireless sensor networks (WSN) have expanded the range of WSN applications. In some of these applications, sensor nodes are mobile rather than static. Also, the recent advances in personal digitals assistants (PDAs) allow the existence of multiple mobile sinks to collect the sensors data. These characteristics require the design of new routing protocols to meet the existence of mobile sensors and multiple mobile sinks while taking into consideration the limited resources for sensor nodes especially energy. In-network aggregation is one of the important techniques used to save power consumption by aggregating the data on sensor nodes before transmitting towards the sinks and hence reducing the number of transmissions required. This thesis presents ABRM which is an in-network aggregation based routing protocol for mobile sensor networks with multiple mobile sinks. Compared to CCBR, ABRM yields good aggregation results in addition to a great reduction in power consumption and routing cost. The thesis also proposes three enhancements to ABRM, specifically enhancing the reaction of ABRM towards multiple interests and regarding sink movement, and adapting the beaconing period. These enhancements target to improve the aggregation results and reduce the routing overhead and power consumption. These enhancements are compared to ABRM through theoretical analysis and simulation results. The comparisons show that the enhancements reduce routing overhead, energy consumption, and increase the overall performance of ABRM.

Keywords:

aggregation, mobile, sensors, wireless, networks, routing, WSN, MSN

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I would like to thank the authors of “A Context and Content-Based Routing Protocol for Mobile Sensor Networks (CCBR)” paper for their support in modeling CCBR protocol on the simulator. My thanks also to the OMNET++ community for their help and support through the problems I faced with the simulator.

Dedication

I would like to dedicate the work on this thesis to my beloved mother and to Egypt my gorgeous country, hoping it will get rid soon of all the problems it faces, and to evolve and progress to a better prospect with the help of all its loyal sons.

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List of Abbreviations

ABRM	:In-Network Aggregation Based Routing Protocol for Mobile Sensor Networks with Multiple Mobile Sinks
ACE-C	:Algorithm for Cluster Head election by Counting
ACE-L	:Algorithm for Cluster Head election by Location
ACK	:Acknowledgement
ADD	:Adaptive Data Dissemination
CARP	:Cooperative-Aided Routing Protocol
CCBR	:Context and Content Based Routing Protocol for Mobile Sensor Network
CM	:Clustering with Mobility
CMR	:Content-Based Multipath Routing
DB-MAC	:Delay Bounded Media Access Control
DEED	:Dynamic DElay-constrained minimum-Energy Dissemination scheme
DHM	:Data Harvesting Mechanism
DRA	:Data replication Algorithm
DST	:Dynamic Shared Tree
E-ABRM	:Enhanced In-Network Aggregation Based Routing Protocol for Mobile Sensor Networks with Multiple Mobile Sinks
EELIR	:Location based Energy Efficient Intersection Routing Protocol
ELBR	:Energy Level Based Routing
FIFO	:First In First Out
FROMS	:Feedback Routing to Multiple Sinks
GLOBAL	:Gradient-based routing protocol for Load-Balancing in large-scale wireless sensor networks with multiple sinks
GPS	:Global Positioning System
HDRA	:Hierarchical Data replication Algorithm