AIN SHAMS UNIVERSITY

FACULTY OF ENGINEERING

Computer Engineering and Systems

Opportunistic Routing by efficient task management in wireless sensor networks

A Thesis submitted in partial fulfilment of the requirements of the degree of

Master of Science In Electrical Engineering

(Computer Engineering and Systems)

By

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Bachelor of Science In Electrical Engineering

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Statement

This thesis is submitted as a partial fulfilment of Master of Science in Electrical Engineering, Faculty of Engineering, Ain shams University.

The author carried out the work included in this thesis, and no part of it has been submitted for a degree or a qualification at any other scientific entity.

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Signature

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Date: 08 March 2016

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Thesis Summary

Minimizing energy consumption is a fundamental requirement when deploying wireless sensor networks (WSN's). Accordingly, various control protocols have been proposed, which aim to conserve energy by turning off unnecessary sensors while simultaneously preserving a constant level of routing fidelity. However, although these protocols can generally be integrated with any routing scheme, few of them take specific account of the issues that arise when they are integrated with different routing mechanisms.

Also, in numerous applications of wireless sensor networks (WSN), the reliability of the data collected by sensors is cast as specific Quality of service requirements expressed in terms of the minimum number of sensors needed to perform various tasks. Designing a long- lived sensor network with reliable performance has always been challenging due to the modest nonrenewable energy budget of individual sensors. In such a context, energy-unaware task management protocols may result in uneven expenditure of sensor energy by assigning uneven workloads to sensors. This, in turn, often translates into reduced sensor density around those heavily loaded sensors and may, eventually, lead to the creation of energy holes that partition the network into disconnected islands.

In most of the existing sensor networks, the load is not evenly distributed, making it inefficient in field application. Also, the network unaware uneven node density leads to energy holes depleting faster the network energy. To improve this situation research on energy efficient opportunistic routing (EEOR) has been done earlier which focuses on giving priority to few intermediate forwarder nodes from a set of forwarder list, to transmit the data towards destination. In this research, a novel task

management protocol is proposed that distributes task among nodes based on sensor node energy, geographical position, and intermediate forwarder node priority. The proposed opportunistic routing algorithm is simulated using the OPNET network simulator and various scenarios like effect with node density, mobility, geographical positions are analysed. We compared the overall network end to end delay, traffic statistics, packet delivery ratio achieved by efficient task management and equal load distribution among a group of sensor nodes using the proposed protocols against the priority based EEOR technique. Further, simulation manifests that the proposed approach provides better result than EEOR routing protocol in terms of network delay, traffic received, and energy consumption.

Key words: Energy consumption, load balancing, opportunistic routing, task management, wireless sensor networks

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List of Abbreviations

AOR	Adaptive Opportunistic Routing
ASOR	Assistant Opportunistic Routing
CTW	Call to Work
EEOR	Energy Efficient Opportunistic Routing
EBS	Estimated Best Score
EXOR	Extremely Opportunistic Routing
LOR	Localized Opportunistic Routing
MANET	Mobile Ad-hoc Network
MORE	MAC independent Opportunistic Routing
MTS-B	Minimum Transmission Selection
OAR	Opportunistic Auto Rate
ORETM	Opportunistic Routing by Efficient Task Management
QOS	Quality of Service
RSSI	Received Signal Strength
TIE	Task Issuing Entity
UDP	User Datagram Protocol
WSN	Wireless Sensor Networks

Chapter 1 Introduction

1.1 Motivation

Wireless sensor networks (WSNs) are an important and exciting new technology with great potential for improving many current applications in medicine, transportation, agriculture, industrial process control, and numerous future military applications. A wireless sensor network is a network of wireless embedded system elements, which consists of distributed autonomous devices using sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion at different locations. Deploying wireless sensor network for real world applications can be beneficial if the sensors nodes operate for longer time duration yielding maximum network efficiency.

1.2 State of the Art

Multi-hopping is the key feature in these networks. The major concerns for protocol design in this area involve energy conservation, scalability due to the large number of nodes, bandwidth, delay and security. Components of a typical wireless sensor node are shown in Figure 1-1. A sensor node has the following components. A sensor unit to perform the basic sensing operations, a memory unit to store the sensed information, a battery for power requirements, a processor

for data processing operations and a transceiver for transmitting and receiving the data. The transceiver unit is provided with a limited range antenna. The memory provided in the sensor node is normally a limited storage memory to facilitate small size, as normally the node is transmitting the data sensed and does not store it. The battery is loaded with an initial energy and has limited life. With these five necessary units, a sensor node can be equipped with optional units such as a mobilizer, location finding unit and power generator.

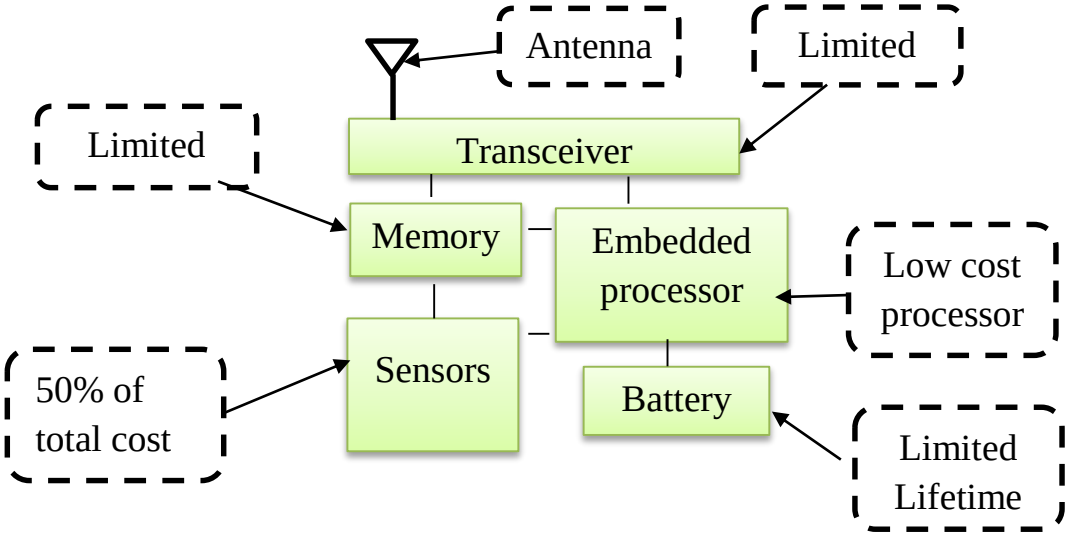

Figure 1-1 Wireless sensor node components [11]

Wireless sensor networks have their own unique characteristics, which create new challenges for the design of routing protocols for these networks. Sensors are very limited in transmission power, computational capacities, storage capacity and most of all, in energy. So, a vital area of research is to implement methods to achieve and maintain a satisfactory level of application specific QoS. The conventional routing protocols available for wired network works on choosing