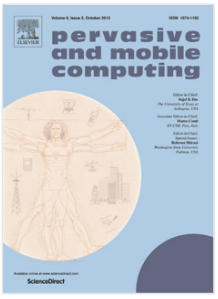
Accepted Manuscript



Level-based approach for minimum-transmission broadcast in duty-cycled wireless sensor networks

Thang Le Duc, Duc Tai Le, Vyacheslav V. Zalyubovskiy, Dongsoo S. Kim, Hyunseung Choo

PII: S1574-1192(15)00186-8
DOI: http://dx.doi.org/10.1016/j.pmcj.2015.10.002
Reference: PMCJ 644

To appear in: *Pervasive and Mobile Computing*

Received date: 21 March 2014
Revised date: 19 April 2015
Accepted date: 2 October 2015

Please cite this article as: T. Le Duc, D.T. Le, V.V. Zalyubovskiy, D.S. Kim, H. Choo, Level-based approach for minimum-transmission broadcast in duty-cycled wireless sensor networks, *Pervasive and Mobile Computing* (2015), http://dx.doi.org/10.1016/j.pmcj.2015.10.002

ELSEVIER

Available online at www.sciencedirect.com

ScienceDirect

Pervasive and Mobile Computing 00 (2015) 1–21

Procedia Computer Science

Level-Based Approach for Minimum-Transmission Broadcast in Duty-Cycled Wireless Sensor Networks

Thang Le Duc[a], Duc Tai Le[a], Vyacheslav V. Zalyubovskiy[b], Dongsoo S. Kim[c], Hyunseung Choo[a,*]

[a] *College of Information and Communication Engineering, Sungkyunkwan University, Korea*
[b] *Laboratory of Discrete Optimization in Operations Research, Sobolev Institute of Mathematics, Russia*
[c] *School of Engineering and Technology, Indiana University-Purdue University Indianapolis, USA*

Abstract

Broadcast is a fundamental activity in wireless sensor networks (WSNs) and many problems related to broadcast have been formulated and investigated in the literature. Among them, the minimum-transmission broadcast (MTB) problem, which aims to reduce broadcast redundancy, has been well studied in conventional wireless ad hoc networks, where network nodes are assumed to be active all the time. In this paper, we study the MTB problem in duty-cycled WSNs where sensor nodes operate under active/dormant cycle and propose a novel scheme to solve it efficiently. The proposed Level-Based Approximation Scheme first identifies the forwarding nodes and their corresponding receivers for all time slots; then constructs a broadcast backbone by connecting these forwarding nodes to the broadcast source. The backbone construction is accomplished by a two-stage traversal on all the forwarding nodes, which successfully exploits transmissions of each forwarding node to its receivers. We have also conducted extensive simulations to evaluate the performance of our proposed scheme. Simulation results indicate that our scheme significantly outperforms existing ones.

Keywords: Broadcast, duty cycle, wireless sensor network, scheduling, approximation algorithm

1. Introduction

Broadcast is one of the most essential functions in wireless sensor networks (WSNs) [1]. On account of broadcasting, sensor nodes can disseminate messages across the whole network for many purposes such as networking configuration, routing discovery, or even coordinating operations of sensor nodes [2], [3]. To evaluate the efficiency of a broadcast strategy, the number of transmissions is commonly used as a measurement metric. Thus, the Minimum-Transmission Broadcast (MTB) problem, which minimizes the total number of transmissions, has been formulated and investigated for a long time [4], [5], [6], [7]. In this problem, network nodes are assumed to be active all the time

☆ A preliminary version of this paper has appeared in the Proceedings of the International Conference on Ubiquitous Information Management and Communication (ICUIMC), 2013.

* Corresponding author.
Email addresses: ldthang@skku.edu (Thang Le Duc), ldtai@skku.edu (Duc Tai Le), slava@math.nsc.ru (Vyacheslav V. Zalyubovskiy), dskim@iupui.edu (Dongsoo S. Kim), choo@skku.edu (Hyunseung Choo)