Available online at www.sciencedirect.com
ScienceDirect
Computer Communications 30 (2007) 685–697
computer communications
www.elsevier.com/locate/comcom

A cellular multi-objective genetic algorithm for optimal broadcasting strategy in metropolitan MANETs

E. Alba [a,*], B. Dorronsoro [a], F. Luna [a], A.J. Nebro [a], P. Bouvry [b], L. Hogie [b]

[a] *Department of Computer Science, E.T.S. Ingeniería Informática, University of Málaga, Spain*
[b] *Faculty of Sciences, Technology and Communication, University of Luxembourg, Luxembourg*

Available online 18 September 2006

Abstract

Mobile Ad Hoc Networks (MANETs) are composed of a set of communicating devices which are able to spontaneously interconnect without any pre-existing infrastructure. In such kind of networks, broadcasting becomes an operation of capital importance for the own existence and operation of the network. Optimizing a broadcasting strategy in MANETs is a multi-objective problem targeting three goals: reaching as many devices as possible, minimizing the network utilization, and reducing the duration time of the broadcasting process. In this paper, we study the fine-tuning of broadcasting strategies by using a cellular multi-objective genetic algorithm (cMOGA) which computes a Pareto front of solutions to empower a human designer with the ability of choosing the preferred configuration for the network. We define two formulations of the problem, one with three objectives and another one with two objectives plus a constraint. For our tests, a benchmark of three realistic environments for metropolitan MANETs has been defined. Our experiments using a complex and realistic MANET simulator reveal that cMOGA is a promising approach to solve the optimum broadcasting problem.

Keywords: Mobile ad hoc networks; Broadcasting; Multi-objective optimization; Cellular genetic algorithm

1. Introduction

Mobile Ad Hoc Networks (MANETs) are fluctuating networks populated by a set of communicating devices called *nodes* (or *devices*) which can spontaneously interconnect each other without any pre-existing infrastructure. This means that no organization is present in such networks as it is usual in communication networks. The most popular wireless networking technologies available nowadays for building MANETs are Bluetooth and IEEE802.11 (WiFi). This implies that (a) devices communicate within a limited range, and (b) devices may move while communicating. A consequence of mobility is that the topology of such networks may change quickly and in unpredictable ways. This dynamical behavior constitutes one of the main obstacles for performing efficient communications.

In this paper, we are considering the problem of broadcasting on a particular subclass of MANETs called *Metropolitan* MANETs, which have some specific properties: the density in the network is heterogeneous and dynamic (particularly, high density regions do not remain active full time). The broadcasting strategy we are considering in this work is the so called *Delayed Flooding with Cumulative Neighborhood* protocol (DCFN) [1]. Three real world examples of such networks, a shopping mall, a metropolitan area, and a highway environment, have been taken into account so that, instead of providing a multi-purpose protocol, the originality of our proposal lies in tuning the broadcasting service for each particular network. Optimizing a broadcasting strategy implies multiple goals to be satisfied at the same time, such as maximizing the number of devices reached (coverage), minimizing the network use (bandwidth),

* Corresponding author.
E-mail addresses: eat@lcc.uma.es (E. Alba), bernabe@lcc.uma.es (B. Dorronsoro), flv@lcc.uma.es (F. Luna), antonio@lcc.uma.es (A.J. Nebro), pascal.bouvry@uni.lu (P. Bouvry), luc.hogie@uni.lu (L. Hogie).

0140-3664/$ - see front matter © 2006 Elsevier B.V. All rights reserved.
doi:10.1016/j.comcom.2006.08.033