Available online at www.sciencedirect.com

ScienceDirect

Electronic Notes in Theoretical Computer Science 302 (2014) 29–51

Electronic Notes in Theoretical Computer Science

www.elsevier.com/locate/entcs

Topology Control in Cooperative Ad Hoc Wireless Networks

T. F. Neves[1] J. L. Bordim[2]

Department of Computer Science
University of Brasilia
Brasilia, Brazil

Abstract

Cooperative communication (CC) is a technique that exploits spatial diversity allowing multiple nodes to cooperatively relay signals to the receiver so that it can combine the received signals to obtain the original message. CC can be combined with topology control to increase connectivity at the cost of a small increase in energy consumption. This work focuses on exploring CC to improve the connectivity with a sink node in ad hoc wireless networks. More precisely, this work proposes a new technique, named CoopSink, that combines CC and topology control techniques to increase connectivity to a sink node while ensuring energy-efficient routes. Simulation results show that connectivity and routing to the sink cost can be improved up to 6.8 and 2.3 times, respectively, when compared with other similar strategies.

Keywords: Topology Control, Wireless Networks, Network Protocols, Cooperative Communication.

1 Introduction

Ad hoc wireless networks are networks where the nodes can communicate with each other without resorting to a centralised infrastructure. These networks have a large number of civil and military applications, ranging from communication support in battlefield, search and rescue operations to object monitoring and tracking. One of the major challenges in ad hoc networks is to reduce energy consumption as these nodes are often powered by batteries [2]. As battery replacement may not be a feasible option during operation, alternatives to improve and optimize energy expenditure in wireless networks are of great interest. This facts have driven the quest for power saving strategies aiming to extend the network lifetime [25,5]. These energy saving proposals can be grouped in two main categories: (*i*) techniques that allow the nodes to alternate between active/idle operational modes; and (*ii*) techniques that allow the nodes to adjust their transmission power. Recent works in the first

[1] Email: tfn.thiago@cic.unb.br

[2] Email:bordim@unb.br

http://dx.doi.org/10.1016/j.entcs.2014.01.019

1571-0661 © 2014 Elsevier B.V. Open access under the CC BY-NC-ND license.

category can be found in [34,9,30]. Topology control strategies fall in the second category and have been largely explored in the literature [22,8]. Topology control consists in allowing wireless nodes to select a subset of neighbouring nodes and/or adjust the transmission power with the objective of reducing energy consumption while maintaining network connectivity [7,3,23].

In traditional multiple-hop wireless networks, intermediate nodes cooperate with each other to assist in the task of relying data packets from a source node to the desired destination. Note that this process occurs at the network layer. Cooperative communication (CC), on the other hand, is a physical layer technique that allows single antenna devices to benefit from some advantages of Multiple-Input Multiple-Output (MIMO) systems by exploring the spatial diversity [28]. This technique allows nodes to improve signal quality and transmission range. In CC, when a source node transmits a packet, a set of *helper nodes* in the vicinity of the source overhear the signal and, simultaneously, relay independent copies of the same signal to the destination node. The destination node then combines the received signals to obtain the original packet.

Recent works have explored CC with topology control techniques to reduce energy consumption [5]. Ways to increase network connectivity and improve network lifetime has been investigated [35,33]. However, to the best of our knowledge, no work so far explored CC to increase the connectivity to the sink in ad hoc wireless networks. Link failure due to battery depletion and node failure may prevent wireless nodes to reach the sink. In this context, CC can be explored to improve network connectivity and to allow the establishment of alternative routes to the sink node.

This work presents a new technique, named CoopSink, that combines CC and topology control in an ad hoc wireless network to increase connectivity to the sink while ensuring energy efficient routes. This proposal could be applied to the environment described in [4], where there is a sink node equipped with a large range radio for query broadcast and the nodes cooperate to overcome link failures and report information to the sink. This scenario is similar to that found in the Amazon Tall Tower Observatory (ATTO) project, where the objective is to position a high central tower in the middle of the Amazon forest and, with the help of smaller and strategically placed sensors, to obtain reliable estimates of sources of greenhouse gases like CO_2, CH_4 and N_20 [24]. The proposed technique has been evaluated through simulation and the results have confirmed that CoopSink is able to improve network connectivity and provide energy-efficient routes to the sink. More precisely, the simulation results show that connectivity and routing to the sink improved up to 6.8 and 2.3 times, respectively, as compared with other similar strategies.

The remaining of this paper is organised as following. Section 2 makes an overview of related works on topology control and cooperative communication. Section 3 describes the communication and network models and formalises the main problem addressed in this work. Section 4 describes the CoopSink protocol and Section 5 presents the simulation results that compares the proposed scheme with other similar and prominent strategies. Section 6 concludes the work.

دریافت فوری ← متن کامل مقاله

ISIArticles
مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات