

Chapter 24

A Location-Based Power Conservation Scheme for MANETs:

A Step towards Green Communications

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ABSTRACT

In a Mobile Ad Hoc Network (MANET), a mobile node consumes its power in message communication, message processing, and other operation missions. The amount of power a mobile node consumes for communication is the highest and the dominant as compared to what a node consumes for other tasks. The power consumed in communication is proportional to the square of the nodes' radio transmission range (R); therefore, minimizing R contributes to a significant reduction in power consumption and consequently increases node battery-power lifetime. This chapter presents a description and performance evaluation of a new efficient power conservation scheme, namely, the Location-Based Power Conservation (LBPC) scheme. It is based on the concept of reducing R by utilizing locally available nodes' location information to adjust R according to one of the three proposed radius adjustment criteria: farthest, average, and random. So that instead of transmitting with full power to cover up to its maximum radio transmission range (R_{max}), the transmitting node adjusts R to less than R_{max} , which provides a power conservation factor equivalent to $(R/R_{max})^2$.

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INTRODUCTION

Information and communications technology (ICT) usage is growing at almost exponential rate worldwide contributing to a significant increase in power consumption to operate the different components of this technology. In particular, network expansion and mounting figures of mobile network users have recently highlighted the importance of energy management solutions for existing and emerging network technologies. Radio network normally shares a huge amount of the total electricity usage; therefore the power consumption of each node is coming under intense scrutiny and the mobile wireless network industry is striving to improve the energy efficiency of the next generation of mobile nodes.

Wireless technology specialists have focused technological developments primarily on meeting the demands of the consumer for increased bandwidth. However, the recent dramatic increase in energy costs and greater awareness of their impact on the environment (global warming) is shedding new urgency on improving power efficiency in communications leading to the emergent of new type of communication, namely green communications. Green communications or green networking aims to help reduce power consumption and consequently reduce carbon emission by the ICT industry (Mobile Group, 2008).

In this work, we concern with the development of a power conservation scheme for wireless mobile nodes in Mobile Ad Hoc Networks (MANETs) as a step towards green communications. A wireless mobile node in a MANET consumes its limited battery power in two missions: processing and communication. The amount of power consumed for transmitting one-bit is much higher than the power consumed for one-bit processing (Zarifzadeh, et al., 2008). Therefore, in order to increase the life-time of a node, it is so vital to minimize communication power consumption. From radio communications theory, it is well approved that the power consumption in message

passing is directly proportional to the square of radio transmission range. Thus, reducing the radio transmission range can significantly reduce the node power consumption and increase its life-time on one hand and help with providing green communication on the other hand.

The node consumes its power during communication to exchange data, route discovery messages, or control messages. The cost of information exchange (in terms of power consumption, overhead, and delay) during route discovery is higher than the cost of point-to-point data forwarding or control messages exchange (Al-Bahadili, 2010a). Therefore, minimizing the power consumed for route establishment is a vital requirement to extend the lifetime of the battery-powered nodes, and can be considered as a step towards green communications.

This chapter describes a new power conservation scheme, in which each transmitting node utilizes the location information available on its first-hop neighbors to adjust its radio transmission range. Therefore, it is referred to as the Location-Based Power Conservation (LBPC) scheme (Halasa, 2010; Kaabneh, et al., 2009). In this scheme, for example, each node can obtain its location information using a built-in GPS, and then exchange this location information with its first hop neighbors, so that each node is aware of the location of its first-hop neighbors (Ko & Vaidya, 2000), or a node estimates the distances from its first-hop neighbors through gossiping. Gossiping approach includes a lot of instability and inaccuracy that may degrade the overall performance of network (Kohvakka, et al., 2006).

The LBPC scheme adjusts the radio transmission range (R) of the transmitting node using one of the following criteria:

1. The farthest first-hop neighbor criterion,
2. The average distance of the first-hop neighbors criterion, and
3. A random distance between the nearest and farthest first-hop neighbors criterion.

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