Chapter 3
Improving Energy Efficiency and Throughput in Heterogeneous Mobile Ad Hoc Networks

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ABSTRACT

The nodes are expected to transmit at different power levels in heterogeneous mobile adhoc networks, thus leading to communication links of different length. Conventional MAC protocols that unconditionally presume that links are bi-directional and with unvarying energy distribution may not succeed or execute badly under such circumstances. Interference and signal loss resulting out of distance and fading diminish the entire throughput attained in heterogeneous networks to a greater extent. This article presents a MAC protocol, which adaptively transmits data frames using either the energy efficient nodes or a list of high data rate assistant nodes. In addition, a cross-layer based energy level on-demand routing protocol that adaptively regulates the transmission rate on basis of congestion is projected as well. Simulation results illustrate that the proposed protocols considerably diminish energy consumption and delay, and attain high throughput in contrast with the Hybrid MAC and traditional IEEE 802.11 protocols

INTRODUCTION

An autonomous group of mobile users that normally communicates over bandwidth constrained wireless links is referred to as MANET (Nasipuri, Zhuang, & Das, 1999). Due to the mobility of nodes, the network topology might change hastily in an impulsive manner over time. MANET is a temporary infrastructure-less multi-hop wireless network where in the nodes are permitted to move arbitrarily. These networks broaden the restricted wireless transmission range of each node by multi-hop packet forwarding, therefore, are appropriate for scenarios where in pre-deployed infrastructure

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facility is not accessible. The set of applications for MANETs is varied, ranging from small, static networks that are inhibited by power sources, to large-scale, mobile, highly dynamic networks. In case of ad hoc networks, every node forwards packets for its peer nodes, and every flow surpasses several hops of wireless links for a source destination pair.

Given that the network performance rapidly degrades with the escalating number of nodes, a homogeneous ad hoc network is considered poor in terms of scalability. Nodes are commonly heterogeneous in case of realistic ad hoc networks. For instance, in a battlefield network, soldiers carry portable wireless devices, and further powerful and dependable communication devices are carried by vehicles, tanks, aircraft, and satellites; these devices/nodes have diverse communication characteristics in terms of transmission power, data rate, processing capability, reliability, etc. Thus, modeling these network elements as different types of nodes would appear more realistic (Xiaojiang, Dapeng, Wei, & Yuguang, 2006).

The nodes are expected to transmit at different power levels in these heterogeneous mobile adhoc networks, thus leading to communication links of different lengths. Owing to link asymmetry, the transmission of a low power node might not arrive at a higher power node whereas the communication in the reverse direction could be probable (Xiaojiang, & Dapeng, 2007). As a consequence, conventional MAC and routing protocols that unconditionally assume bi-directional links are bound to either be unsuccessful or perform unsuccessfully. Additionally, interference and signal loss resulting out of distance and fading diminish the entire throughput attained in heterogeneous networks to a greater extent.

In this article we project a novel protocol on basis of the IEEE 802.11 Distributed Coordination Function (DCF), which adaptively transmits the data frames either with the aid of energy efficient nodes a list of high data rate assistant nodes. The rest of the article is organized as follows: Section 2 briefs the related works. Section 3 presents the proposed protocol. Section 4 provides a prelude on the enhanced on-demand routing protocol based on the energy levels. Section 5 assesses the performance of the proposed protocols in contrast with the Hybrid MAC and the standard 802.11 MAC protocols through simulation. Section 6 summarizes the conclusion.

RELATED WORKS

An alternate methodology to collision resolution in a CSMA protocol with the introduction of spatial back off was projected by Charles J. Colbourn et al. (2007). They illustrate that collision resolution with the aid of power back off can be extremely successful, outperforming IEEE 802.11 in both static and mobile ad hoc network situations. Nevertheless, these results are obtained on basis of an optimistic centralized power-aware routing strategy and not the distributed power-aware strategy. Aran Bergman et al. (2006) projected a novel utility function which reflects the tradeoff amid the energy consumption brought about by à MAC protocol and its throughput, thereby representing the energy efficiency of the algorithm. They alter the ‘‘0.487’’ algorithm to enhance its energy efficiency.

A new routing protocol called multiclass (MC) routing, which is exclusively designed for heterogeneous MANETs, was presented by Xiaojiang et al. (2006). A new medium access control (MAC) protocol for heterogeneous MANETs, which is more proficient in comparison with the IEEE 802.11b, was introduced as well. Nevertheless, the necessity of information from various layers make the selection of a node which has larger transmission range (power) and data rate, better processing capability, and more reliable and robust than the other type a complicated one.

Vasudev Shah et al. (2007) created a cross-layer framework to deal with the link asymmetry problem at both MAC and routing layers, and they