Egyptian Informatics Journal (2015) 16, 1–7

Cairo University

Egyptian Informatics Journal

www.elsevier.com/locate/eij
www.sciencedirect.com

ORIGINAL ARTICLE

Cross-Layer Design Approach for Power Control in Mobile Ad Hoc Networks

A. Sarfaraz Ahmed [a,1], T. Senthil Kumaran [b,*], S. Syed Abdul Syed [a,1], S. Subburam [b]

[a] AMET University, Chennai, Tamil Nadu, India
[b] ACS College of Engineering, Bangalore, Karnataka, India

Received 12 January 2014; revised 27 October 2014; accepted 5 November 2014
Available online 15 December 2014

KEYWORDS
RSS;
AODV;
CLPC

Abstract In mobile ad hoc networks, communication among mobile nodes occurs through wireless medium The design of ad hoc network protocol, generally based on a traditional "layered approach", has been found ineffective to deal with receiving signal strength (RSS)-related problems, affecting the physical layer, the network layer and transport layer. This paper proposes a design approach, deviating from the traditional network design, toward enhancing the cross-layer interaction among different layers, namely physical, MAC and network. The Cross-Layer design approach for Power control (CLPC) would help to enhance the transmission power by averaging the RSS values and to find an effective route between the source and the destination. This cross-layer design approach was tested by simulation (NS2 simulator) and its performance over AODV was found to be better.

© 2014 Production and hosting by Elsevier B.V. on behalf of Faculty of Computers and Information, Cairo University.

1. Introduction

A mobile ad hoc network is a collection of wireless nodes that can transfer data without the use of network infrastructure or administration. Such networks have many potential applications, including in disaster mitigation, defense, health care, academia and business. In such a network, every node acts both as a host and a router.

A major limitation with mobile nodes is that they have high mobility, causing links to be frequently broken and reestablished. Moreover, the bandwidth of a wireless channel is also limited, and nodes operate on limited battery power, which will eventually be exhausted. Therefore, the design of a mobile ad hoc network is highly challenging, but this technology has

* Corresponding author.
E-mail addresses: asarfarazahmed@gmail.com (A. Sarfaraz Ahmed), senthilvts@gmail.com (T. Senthil Kumaran), saeedabdul4u@gmail.com (S. Syed Abdul Syed), subburam.kayal@gmail.com (S. Subburam).
[1] Research Scholar.

Peer review under responsibility of Faculty of Computers and Information, Cairo University.

Production and hosting by Elsevier

http://dx.doi.org/10.1016/j.eij.2014.11.001
1110-8665 © 2014 Production and hosting by Elsevier B.V. on behalf of Faculty of Computers and Information, Cairo University.

high prospects to be able to manage communication protocols of the future [1].

A wireless ad hoc network works on the principle of one-hop neighbor node broadcasting, in which a transmission signal from the source node propagates to all neighbor nodes within its communication region [2]. Transmission power-related problems are a common feature affecting the functioning of wireless ad hoc networks. The inability to maintain a steady transmission power, thus, degrades the transmission range and signal strength, and hence the reliability of wireless ad hoc networks is disputed [3,4].

At the transport layer, the node interference affects the level of transmission power and causes network congestion. In such networks, TCP-supported congestion control has been unreliable, the well known transport protocols, such as UDP are unreliable, since no mechanism of congestion detection has been provided. Even TCP supported control is unreliable [5–8].

Transmission power-related problems can affect all the layers of the stack, from physical to transport, and include the following: (i) long delay, (ii) packet losses and (iii) low throughput.

Previously, the design of ad hoc network protocol has been largely based on the ‘‘layered approach’’. In layered architecture, the designer or implementers of the protocol or algorithm focuses on a particular layer, without being required to consider the parameters of the rest of the stack [1,9,10]. However, this has generally resulted in suboptimal performance of applications. To overcome this, the ‘‘cross-layer’’ approach has been found to address transmission power-related issues in wireless ad hoc networks.

The cross-layer design deviates from the traditional network design approach in which each layer of the stack would be made to operate independently. A workgroup of the Internet Engineering Task Force [1,11] has been studying inter-layer interactions and performances in mobile ad hoc networks. The inter-layer interaction metrics and the benefits of information exchange among the lower layers, network layer and transport layer were also reported.

In this paper, a new cross-layer optimization framework is proposed that gathers information about a node's receiver signal strength (RSS) by using hello packet. Using a dynamic transmission power control mechanism, every node computes minimum RSS, average RSS and maximum RSS. This information can help each node to know its neighbor positions and guide it to dynamically manage its power levels. As a result, optimal transmission power and reliable communication range can be achieved.

The remainder of this paper is organized as follows. The cross-layer design approach is presented in section 3. NS2 simulation results are presented in Section 4. Section 5 concludes this paper.

2. Related work

Conti et al. [10] discuss that protocols belonging to different layers can cooperate by sharing the network status information but at the same time maintaining the separation of layers for protocol design.

Al-Khwildi et al. [12] have proposed a routing protocol called Adaptive Link-Weight (ALW), which selects an optimum route based on low delay, long route time and available bandwidth. The technique adapts a cross-layer framework where the ALW is integrated with application and physical layer. This design allows applications to convey preferences to the ALW protocol so as to override the default path selection mechanism.

Addressing the issues related to transmission power, Ramachandran and Shanmugavel [13] have proposed a cross-layer design approach for power conservation based on transmission power control.

Mahlknecht et al. [14] have introduced a method called Energy Aware Distance Vector Routing for Wireless Sensor Networks, which would decrease the impact of mobility and link disconnection. This method relies on route failure notification and route reestablishment notification from the intermediate nodes.

Sergi et al. [15] have also discussed a novel architecture for cooperative communication in wireless ad-hoc networks capable of offering reliable and low-latency services efficiently.

Xia et al. [16] have demonstrated that layer triggers are not sufficient to fix ad hoc network problems due to TCP–IP–MAC interactions.

Sangman Moh [17] proposed a link quality aware routing protocol for MANETs that exploits the strong links by forwarding the RREQ packet with the highest Signal to Noise Ratio (SINR) among the multiple RREQ packets received during route discovery. The performance of the protocol is not appealing in high mobility scenarios.

Sakhaee et al. [18] proposed a self-adaptive and mobility-aware path selection in mobile ad-hoc networks. The limitation of this protocol is that it cannot perform on high mobility scenarios.

Qi and Chakrabarti [19] proposed a routing protocol, taking the node power as the major consideration when selecting paths. In their protocol, either link failure or a too low value in node power may trigger route maintenance.

Qin and Kunz [20] proposed a link breakage prediction algorithm by using signal power strength for DSR protocol. This technique used speed of the node which helped to anticipate link break.

3. Cross-layer design framework

The proposed cross-layer optimization framework allows modification of transmission power to be made at physical layer after knowing a node's one-hop neighbor's RSS information. The modified transmission power will help that node to dynamically vary its propagation range at the physical layer. This is because the propagation distance is always directionally proportional to transmission power. This information is passed from the physical layer to the network layer so that it can take optimal decisions in routing protocols. A major advantage of this framework is that it allows access of information between physical layer and top layers (MAC and network layer). Fig. 1 illustrates the cross-layer interaction between lower and higher layers.

3.1. Dynamic transmission power control

Much of work on power management protocols for mobile ad hoc networks is yet to reflect in the literature. Without an effective transmission power control mechanism in place, packet transmissions can be affected by link instability, weak

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