Chapter 15

Adaptive Sending Rate Over Wireless Mesh Networks Using SNR

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ABSTRACT

Wireless Mesh Networks (WMNs) have emerged as a key technology for the next generation of wireless networking. Instead of being another type of ad-hoc networking, WMNs diversify the capabilities of ad-hoc networks. Several protocols that work over WMNs include IEEE 802.11a/b/g, 802.15, 802.16 and LTE-Advanced. To bring about a high throughput under varying conditions, these protocols have to adapt their transmission rate. This paper proposes a scheme to improve channel conditions by performing rate adaptation along with multiple packet transmission using packet loss and physical layer condition. Dynamic monitoring, multiple packet transmission and adaptation to changes in channel quality by adjusting the packet transmission rates according to certain optimization criteria provided greater throughput. The key feature of the proposed method is the combination of the following two factors: 1) detection of intrinsic channel conditions by measuring the fluctuation of noise to signal ratio via the standard deviation, and 2) the detection of packet loss induced through congestion. The authors show that the use of such techniques in a WMN can significantly improve performance in terms of the packet sending rate. The effectiveness of the proposed method was demonstrated in a simulated wireless network testbed via packet-level simulation.

1. INTRODUCTION

Wireless Mesh Networks (WMNs) provide alternative technologies for last-mile broadband Internet access and high speed connectivity with cost-effectiveness. WMNs have emerged as a key technology for the next generation of wireless networking. Instead of being another type of ad-hoc networking, WMNs diversify the capabilities of ad-hoc networks by integrating additional routing function to support wireless networks such as cellular wireless sensors (Akyildiz & Wang, 2005; Pathak & Dutta, 2011). WMNs have the advantages of being self-organizing, self-config-
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uring, and offering increased reliability. Nodes in WMNs automatically form an ad-hoc network and maintain mesh connectivity. These features bring further advantages to WMNs, such as low up-front cost, easy network maintenance, robustness, reliable service coverage, etc (Akyildiz & Wang, 2005; Pathak & Dutta, 2011). WMNs are comprised of two types of nodes: mesh routers and mesh clients. In the WMN architecture, mesh routers form an infrastructure for various types of client (Figure 1), where dashes indicate wireless and solid lines indicate wired links on the WMN. Various wireless devices (such as laptops, PDAs, cellular networks) equipped with wireless cards can connect to a WMN through a mesh router with gateway/bridge capabilities. The gateway/bridge integrates various exiting wireless networks such as cellular, wireless sensors, Wireless-Fidelity (Wi-Fi), LTE-Advanced and Worldwide Interoperability for Microwave access (WiMAX) (Akyildiz, Wang, & Wang, 2005). As WMNs are self-organized, self-configured with wireless mesh routers, and automatically establish and maintain wireless mesh connectivity (effectively, creating an ad-hoc network), they can provide wireless transport services to data travelling from other users, access points or base stations (access points/base stations are special wireless routers with a high-bandwidth wired connection to the Internet backbone) (Figure 1).

Currently, WMNs are going through rapid commercialization in several application scenarios such as broadband home networking, community networking, building automation, high speed metropolitan area networks, and enterprise networking (Akyildiz & Wang, 2005; Pathak & Dutta, 2011). This is due to the fact that WMNs can be relatively easily established because all the required components are already available in the form of ad-hoc network routing protocols, IEEE 802.11 MAC protocols, Wired Equivalent Privacy (WEP) security, and so on.

Although WMNs could be established straightforwardly, obtaining high data rates in WMNs is still a big challenge since bandwidth in wireless is limited. One way to achieve higher data rates

Figure 1. Wireless mesh infrastructure