Chapter XXIII
Effect of Wireless Channels on the Performance of Ad Hoc Networks

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ABSTRACT

Mobile ad hoc (MANET) network is a collection of wireless mobile nodes dynamically forming a temporary network without the use of any existing network infrastructure or centralized administration. To accomplish forwarding a packet to its destination, a routing protocol is used to discover routes between these nodes. This article presents a variety of results for packet-level simulations for the popular protocol—dynamic source routing (DSR)—when different channel models are used. Different radio propagation models representing the wireless channel have been proposed over the years, each one being suitable for a certain situation. The simplest model that represents wireless propagation is the freespace model. Other propagation models are the tworay ground reflection model and the shadowing model. Simulation results show that the performance metrics are highly affected by the channel model used, even the energy left or the number of nodes left alive are also different.

INTRODUCTION

A mobile ad hoc network (MANET) is a collection of wireless mobile nodes that can dynamically form a temporary network to exchange information without using any pre-infrastructure networks (Jayaputera & Taniar, 2005; Woesner, Ebert,

Schlager, & Wolisz, 1998). This may be done either because it may not be economically practical or physically possible to provide the necessary infrastructure or because the situation does not permit its installation. Some classic examples would be situations where friends or business associates would run into each other in an airport terminal and wish to exchange business cards, or in case of an emergency, a group of rescue workers may need to be quickly deployed. In such situations, a collection of mobile hosts with wireless network interfaces may form a temporary network without the aid of any established infrastructure or centralized administration. This type of wireless network is known as a mobile ad hoc network (MANET).

In the case where only two hosts, within the transmission range, are involved in the ad hoc network, no real routing protocol or routing decisions are necessary. But in many practical ad hoc networks, two hosts that wish to correspond may not close enough to be within wireless transmission range of each other. These hosts could communicate if other hosts between them also participating in the ad hoc network are willing to forward packets for them (Waluyo, Goh, Taniar, & Srinivasan, 2005).

In MANET, all nodes behave as routers and take part in discovery and maintenance of routes to other nodes in the network. Route construction should be done with a minimum of overhead and bandwidth consumption. These mobile devices are battery operated so extending the battery lifetime has become an important objective. Many researchers have recently started to consider power-aware design of network protocols for the ad hoc networking environment. As each mobile node in a MANET performs, the routing function for establishing communication among different nodes the "death" of even a few nodes due to energy exhaustion might cause disruption of service in the entire network (Papadimitriou & Tsaoussidis, 2005; Woesner et al., 1998).

Routing protocols in ad hoc networks are divided into two types, proactive (*table driven*), and reactive (*on-demand*) routing. In proactive routing protocols, each node maintains a routing table containing the information for every other node in the network. This leads to a significant overhead on network traffic to keep this information up-to-date. Examples of proactive protocols include destination sequence distance vector (DSDV) (Perkins & Bhagwat, 1994) and the fisheye state routing (FSR) (Pei, Gerla, & Chen, 2000). In reactive routing protocols, a discovery process determines the path to the destination only when the node has a packet to forward, that is, it reacts to a request to send data to a host. These types of routing algorithms are also referred to as on-demand routing protocols. Two prominent examples are dynamic source routing (DSR) (Johnson & Maltz, 1996) (Johnson, Maltz, & Broch, 2001) and ad hoc on-demand distance vector (AODV) routing algorithm (Woesner et al., 1998). In Akkaya and Younis (2004) and Broch, Maltz, Johnson, Hu, and Jetcheva (1998), the performance of some ad hoc routing protocols has been studied and compared using Ns-2 simulator. Simulation result show that DSR performs better than other routing protocols at different mobility rate and movement speed, that's why the performance of DSR has been studied further in (Iyer, Kanodia, & Mahsa, 2005; Nasir, Al-Dubai, & Harous, 2005).

The DSR protocol was developed by researchers at Carnegie Mellon University CMU (Fall & Varadhan, 2003) and is one of the protocols being considered for standardization by the Internet engineering task force (IETF). In DSR, a routing header is prefixed to each packet entering the network that specifies the complete sequence of nodes on which the packet should be forwarded. This route is obtained through route discovery. When a node has a packet to send for which it does not have a route, it initiates route discovery by broadcasting a route request packet. In a re-