Chapter 7.30
A Novel Fuzzy Scheduler for Mobile Ad Hoc Networks

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ABSTRACT

As mobile computing gains popularity, the need for ad hoc routing also continues to grow. In mobile ad hoc networks, the mobility of nodes and error prone nature of the wireless medium pose many challenges, including frequent route changes and packet losses. Such problems increase the packet delays and decrease the throughput. To meet with the dynamic queuing behaviour of Ad hoc networks, to provide QoS and hence to improve the performance, a scheduler can be used. This chapter presents a novel fuzzy based priority scheduler for mobile ad-hoc networks, to determine the priority of the packets. The performance of this scheduler is studied using GloMoSim and evaluated in terms of quantitative metrics such as packet delivery ratio, average end-to-end delay and throughput.

INTRODUCTION

A mobile ad hoc network is a cooperative engagement of mobile hosts or routers connected by wireless links. In the performance evaluation of a protocol, for an ad hoc network, the protocol should be tested under realistic conditions with representative data traffic models and realistic movement of mobile users. In order to thoroughly simulate a new protocol for an ad hoc network, it is very essential to use a mobility model that accurately represents the mobile nodes (MNs). MNs within an ad hoc network move from location to location. A mobility model should attempt to mimic the movements of the real MNs. Currently, there are two types of mobility models used in simulations of ad hoc networks: traces and synthetic models (Camp, Boleng, & Davies, 2002; Lin, Noubir, & Rajaraman, 2004). Traces are those mobility patterns that are observed in real-life systems.

Traces provide accurate information when they involve a large number of participants and a long observation period, but privacy issues will prohibit the collection and distribution of such statistics, and new environments cannot be easily modeled. Hence, in these situations, synthetic models are used. They realistically represent MNs without the use of traces. We consider here three of the synthetic models—namely, random walk, random way point, and random direction mobility models (Bettsetter, 2001).

The random walk mobility model is a widely used mobility model and, in this, the current speed and direction of MN is independent of its past speed and direction. It has a memory-less mobility pattern, because it retains no knowledge containing its past location and speed values. Here, we encounter unrealistic generation of movements such as sudden stopping, sharp turning, and completely random wandering.

The random waypoint mobility model includes pause times between changes in direction and speed. An MN begins by staying in one location for a certain period of time (Jardosh, 2003; Camp et al., 2002). Once this time expires, the MN chooses a random destination in the simulation area and a speed that is uniformly distributed between minspeed and maxspeed. The MN then travels towards the newly chosen destination at the selected speed. Upon arrival, the MN pauses for a specified time period before starting the process again. This is also a widely used model. The RWP model is similar to the random walk model if pause time is zero.

The random direction mobility model is a revised version of random walk, and it ensures that every node is assigned the same speed throughout the entire simulation. After a random direction is chosen in the range 0 to 2π, an MN begins moving. If the MN reaches a grid boundary, it bounces off the simulation border with an angle determined by the incoming direction. The MN then continues along this new path.

The choice of a mobility model can have a significant effect on the performance of an ad hoc network protocol. The performance of random walk, random waypoint, and random direction mobility models are compared. Dynamic source routing (DSR) protocol is chosen to be the routing protocol (Royer & Toh, 1999; Das, Castaneda, Yan, & Sengupta, 1998; Das, Perkins, & Royer, 2001). It determines the routes on demand. Here, the packet carries the full route that the packet should be able to traverse in its header.

DSR is chosen since it performs well in many performance evaluations of unicast protocols.

The performance metrics—namely, packet delivery ratio, end-to-end delay, average hop count, and protocol overhead—are used for comparison of these mobility models. The results prove that the random waypoint mobility model has the highest packet delivery ratio, lowest end-to-end delay, and lowest hop count (Camp et al., 2002). The random direction mobility model has the highest average hop count, highest end-to-end delay, and lowest packet delivery ratio since each MN moves to the border of the simulation area before changing its direction. The performance of the random walk model falls between these two. Hence to conclude, the random waypoint mobility model is used in many prominent simulation studies of ad hoc network protocols since it is flexible and it creates realistic mobility patterns for the way people might move in.

Research in the area of ad hoc networks has focused mainly on the routing protocols that decide the routing of packets hop by hop as efficiently as possible and medium access control (MAC), which indicates how to share the medium efficiently. But there is little focus towards the queuing dynamics in the nodes of the networks and on the effects scheduling algorithms in the queues of the nodes. Hence, we believe that choice of scheduling algorithm will certainly improve the performance of the ad hoc network. Here, the different scheduling algorithms and the network's

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