Chapter XI
Routing Algorithms for Mobile Ad Hoc Networks

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ABSTRACT

In this chapter, we will introduce mobile ad hoc networks and issues related to routing data in such networks. Mobile ad hoc networks (MANET) are multi-hop networks made up of mobile nodes cooperating together to maintain the network connectivity. These kinds of network are very useful in situations where a temporary network is needed, such as military area, disaster area, and so on. MANET routing protocols are divided into two categories: proactive (table driven routing) and reactive (on-demand routing) routing. In conventional routing algorithms, if information is to be sent between two nodes, then the shortest path connecting these two nodes is found and used. However this approach does not take into consideration the fact that these devices are battery-operated, so the energy consumed is very important. A number of energy aware algorithms will be presented and their advantages and disadvantages will be discussed in this chapter. Also we will present and discuss the different metrics considered when designing a power aware routing algorithm

INTRODUCTION

Due to the significant improvement and the widespread use of mobile devices, as well as progress in wireless communication, ad hoc networking is being used in many applications. These applications for MANETs are diverse, ranging from large-scale, mobile, highly dynamic networks to small, static networks that are constrained by power sources. In addition to current applications that move from traditional infrastructure environment into the ad hoc context, new services can and will be designed for the new environment.

In many ad hoc networks, though, two mobile devices that want to communicate with each other may not be within wireless transmission range of each other. But they could communicate with each other if other devices within their transmission range are willing to forward packets for them. For example, in the network illustrated in Figure 1, mobile device **Z** is not within the range of device **X**'s wireless transmitter (indicated by the circle around **X**) and device **X** is not within the range of device **Z**'s wireless transmitter. If **X** and **Z** wish to exchange packets, they may in this case request the services of device **Y** to forward packets for them, since **Y** is within the transmission range of both **X** and **Z**. Indeed, the routing problem in a real ad hoc network is more complicated than this example suggests, due to the inherent non-uniform propagation characteristics of wireless transmissions and due to the possibility that any or all of the devices involved may move at any moment (Singh & Raghavendra, 1998).

These nodes are usually PDAs or laptops that are battery operated and are equipped with wireless Ethernet cards. To maximize the lifetime of the node, conservation of battery power is critical. Research is being carried out to reduce energy consumption at various levels, for example, at the operating system level, physical level, and MAC level. Energy can be conserved at the routing level by designing cross-layered protocols and deploying low-power routing algorithms that use the power cost of the route as a metric for routing packets.

Power consumption in ad hoc networks can be divided into two parts: (1) the idle mode and (2) the transmit/receive mode. The nodes in the network are either in idle mode or in transmit/receive mode at all times. The idle mode corresponds to baseline power consumption. Our focus will be on studying and optimising the transmit/receive mode.

The intricate problem of energy conservation in wireless ad hoc networks is of great significance due to the limited battery capacity of the participating mobile devices. The behavior of any protocol entity, and the operations carried out by any such entity, impact the energy costs. Different routing protocols use one or more of a small set of metrics to determine optimal paths. The most common metric used is shortest hop routing as in DSR (Dynamic Source Routing), DSDV (Destination Sequenced Distance Vector), TORA (Temporally Ordered Routing Algorithm), WRP (Wireless Routing Protocol) and in the DARPA packet radio protocol. Some of these protocols, however, can just as easily use shortest delay as the metric. Link quality is a metric that is used by SSA (Signal Stability Based Adaptive Routing) and by the DARPA protocol. Some of these metrics, unfortunately, have a negative impact on node and network life by inadvertently overusing the energy resources of a small set of nodes in favor of others.

Figure 1. Simple ad hoc routing network
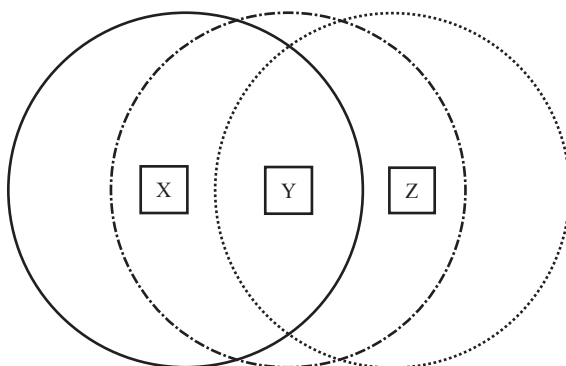
ROUTING PROTOCOLS

Routing protocols in ad hoc networks can be classified into two types: table-driven (proactive) protocols and on-demand (reactive) protocols. Routing protocols without consideration of energy consumption lead to use the same paths for given traffic demands, which results in a quick energy exhaustion of nodes along the paths. This affects the performance of the networks, especially if those traffic demands are lasting for a long period

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