Chapter 24
Towards Designing High-Throughput Routing Metrics for Wireless Mesh Networks

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ABSTRACT

Routing is an essential mechanism for proper functioning of large networks, and routing protocols make use of routing metrics to determine optimal paths. The design of routing metrics is critical for achieving high throughput and we begin this chapter by proposing the design principles for routing metrics. These design principles are for ensuring the proper functioning of the network and achieving high throughput. We continue by giving a detail analysis of the existing routing metrics. We also look at the pitfalls of the existing routing metrics. We conclude the chapter by outlining the future research directions.

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INTRODUCTION

Routing in ad-hoc wireless networks has been an active area of research for decades. Most of the research work in this area was highly motivated by the need to consider energy constraints enforced by battery powered nodes and their mobility. The main objective was to provide routes that are flexible against dynamic topology. WMNs have a bit different characteristics from an ordinary ad-hoc network. Most of the nodes in WMNs are stationary and therefore changes that are caused by a dynamic topology are of less concern. Therefore there is a need for the focus to shift from maintaining network connectivity to finding high-throughput routes between nodes, so as to provide users with maximal end-to-end throughput. Supporting Quality of Service (QoS) to enable a rich range of applications is foreseen to be very important for the success of wireless mesh networks (WMN) (Akyildiz, I. Wang X. et al, 2005). Routing is about finding the best path (route) between source and destination(s). Finding this path between source and destination(s) involves two steps:

i. Assigning cost metrics to links and paths
ii. Propagating routing information

The second step, route information propagation, is the responsibility of the routing protocol. Routing protocols have received much attention over the past decade (Koksal, C. 2008). There are two widely accepted types of routing protocols: proactive and reactive. Proactive routing protocols establish paths before they are required. Proactive routing protocols calculate routing tables and maintain them before they are even required. Examples of proactive routing protocols include, Destination-Sequenced Distance Vector Routing (DSDV, (Perkins, C. & Bhagwat, P. 1994)), Fisheye State Routing (FSR, (Gerla, M. Hong, X. et al 2002)), and Optimized Link State Routing (OLSR, (Jacquet, P. Muhlethaler, P. et al 2002)). On the other hand, Reactive routing protocols, do not establish paths before they are required. Route discovery follows the communication request. Examples of reactive protocols include Ad Hoc On Demand Distance Vector (AODV, (Perkins, C. & Royer, E. 1999)) and Dynamic Source Routing (DSR, (Johnson, D. Maltz, D. et al 2002)). The Hybrid approach combines properties of both the reactive and proactive routing protocols and is not as well established as the other two types.

In this chapter we address the issue of assigning the cost metrics to links and paths. A routing protocol needs a method for differentiating different paths according to their quality. This differentiation is the responsibility of routing metric (cost metric, path selection metric). Basically the routing metric is the cost of forwarding a packet along the link. The problem of defining a cost metric is significantly harder in wireless networks than in traditional wired networks, because the notion of a "link" between nodes is not well-defined. This chapter focuses on studying how high throughput can be achieved in WMNs through the use of routing metrics.

Background on Hybrid Routing

The IEEE 802.11s working group proposes an Extensible Path Selection Framework. This framework enables flexible implementation of path selection protocols (routing protocols) and metrics within this standard. This framework specifies a default mandatory protocol and metric for all implementations. This framework also allows vendors to implement any protocol or metric to meet special application needs. A mesh point (MP) may include multiple implementations (e.g., including the default protocol, optional protocols, future standard protocols, etc) (IEEE 2006). Unfortunate only one protocol can be active on a particular link at a time. The default path selection protocol for IEEE 802.11s standard is hybrid wireless mesh protocol (HWMP). Every 802.11s device must implement HWMP to ensure interoperability.