CHAPTER 1 INTRODUCTION

1.1 Motivation

A Wireless Mesh Network (WMN) is a multi-hop wireless network consisting of wireless client devices and wireless mesh routers. The mesh routers function as access points to mesh clients. They are almost always stationary and attached to power sources. A few mesh routers typically act as gateway to provide Internet access to the mesh clients. Each node is equipped with IEEE 802.11 a/b/g configured in an ad-hoc mode. While each mesh client only is connected to one specific mesh router at the time, the mesh routers are connected to several other mesh routers to send and receive data in a peer-to-peer mode [1, 2, 3] as shown in the Figure 1.1

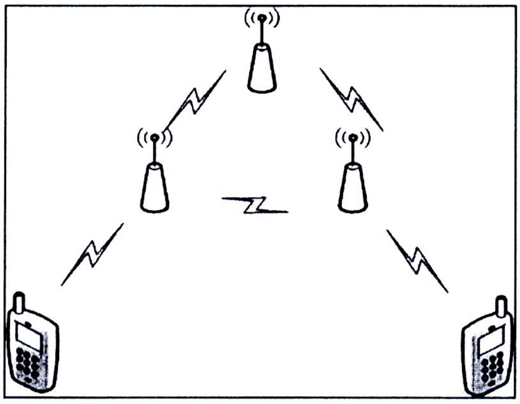

Figure 1.1 Ad-hoc mode in IEEE 802.11

IEEE 802.11 has another mode called infrastructure mode, where wireless client devices have to communicate via an Access Point (AP). The AP is connected to the Internet and acts as a gateway to provider Internet access to other clients, as shown in Figure 1.2. In this case, all APs must have an Internet connection.

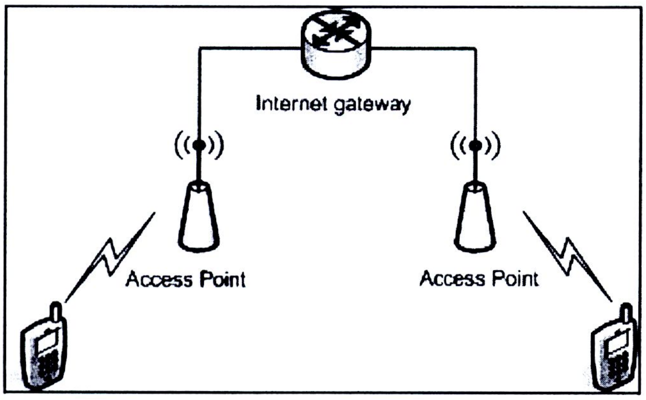

Figure 1.2 Infrastructure mode in IEEE 802.11

From Figure 1.1 and Figure 1.2, we can see that every node in a WMN does not need to have a wired link to connect to the Internet. At least, one of them only needs to have an Internet connection and functions as an Internet gateway to the rest. So, a WMN is easier to deploy and save cost more than the infrastructure mode. Several gateways can be deployed to increase the access capacity.

Although a WMN can be cheaply and easily deployed, high transfer throughput is difficult to achieve the number of hops that increases. It has been shown in [4] that the TCP transfer throughput drops significantly as the number of hops increases. This result agrees with the measurement studies in Roofnet, a WMN testbed developed at MIT [5]. In addition, a WMN usually is equipped with a few Internet gateways. These gateways as well as the nodes around them thus become congestion points in the network.

For a wired network, proxy caching can provide significant performance improvement, especially when clients request the same file copies such as software updates and patches. Hierarchical caching reduces web traffic and alleviates the network bottlenecks on link to the Internet gateway [6, 7]. In proxy caching, all web traffic in a local network are routed through a proxy server, which co-located with or is the same machine as the Internet gateway. The proxy caches all incoming web traffic from the outside. When the proxy detects a HTTP request from a client inside the network, it looks up the cache. If the cache is hit, the cached data will be returned. Otherwise, the proxy generates the HTTP request on behalf of the client to retrieve the data, which is later forwarded to the client. However, if the requested data is not cached, the request has to go through multiple caches in the network. In this case, it is better to send the request directly to the Internet gateway nodes.

Caching in a WMN is different from that of a wired network in each mesh router that can enable the caching function. Using many caches in the network to improve the performance, i.e., delay and transfer throughput by moving the caches closer to the clients, because the wireless medium has much lower bandwidth than the wired counterpart and it is desirable to reduce redundant traffic toward the gateway as much as possible. It is more advantages because in a bandwidth-limited network like in a WMN, the delay occurred in cache-miss would be much lower than that in the network congestion caused by redundant traffic. The cached data may also exist in one of the mesh routers but it is unknown to the others. So, the important issue in WMN caching is how to determine to which proxy a request should be sent in order to achieve good performance while maintaining simplicity. Furthermore, each mesh router may exploit the broadcast nature of a wireless medium to overhear traffic of other nodes in the air and cache them. However, we do not consider this approach in this project.

Besides caching, several other techniques have been proposed to improve the transfer throughput in a WMN. The promising ones include opportunistic routing [8, 9] and network coding [10]. Opportunistic routing lets several neighboring nodes, rather than a single next-hop node in traditional routing, to forward packets, with the one closet to the destination given the highest priority. Network coding is the in-network processing technique that mixes packets together before transmission and the receiver decodes the original packets from those mixed packets. It has been shown that these two techniques could provide throughput improvement over traditional routing in several times. However, the advantage of proxy caching approach such as opportunistic routing [5], [6] and network coding [7] is that it is operated in the user space and thus can be easily deployed with no change in the kernel space.

1.2 Research Objectives

The objectives of research are the following:

1. To study caching techniques in a wireless mesh network for transfer throughput improvement.
2. To improve an existing overhearing caching technique regarding the proxy selection method
3. To evaluate the effectiveness of the proposed method against existing works by means of simulation

1.3 Organization

This report is organized as follows. In Chapter 2, we review previous research works in proxy caching in a WMN. In Chapter 3, we discuss the proposed work on mesh caching – Random-path cache request and Session-count cache request. In Chapter 4, the performance evaluation by simulation is carried out to evaluate the effectiveness of our proposed works compared to simple single-path cache requests. The conclusion and future work are given in Chapter 5.