Chapter XX
Distributed Resources Management in Wireless LANs

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ABSTRACT

This paper introduces a new radio resource management technique based on distributed dynamic channel assignment, and sharing load among Access Points (AP). Deploying wireless LANs (WLAN) on a large scale is mainly affected by reliability, availability and performance. These parameters will be a concern for most managers who want to deploy WLANs. In order to address these concerns, a new radio resource management technique can be used in a new generation of wireless LAN equipment. This technique would include distributed dynamic channel assignment, and load sharing among Access Points (AP), which improves the network availability and reliability compared to centralized management techniques. In addition, it will help to increase network capacities and improve performance, especially in large-scale WLANs. Analysis results using normal and binomial distribution have been included which indicate an improvement of performance resulting from network balancing when implementing distributed resources management at WLANs.

INTRODUCTION

WLAN technology is rapidly becoming a crucial component of computer networks that has been widely used in the past few years. It provides mobility as well as essential network services where wire-line installation has proved impractical. Wireless LAN technology evolved gradually during the 1990s, and the IEEE 802.11 standard was adopted in 1997 (Crow, 1997; IEEE 802.11, 1997). The inclusion of the newer IEEE 802.11g versions of the standard offers a firm basis for high performance wireless LANs. Companies and organizations are investing in wireless networks at a higher rate to take advantage of mobile, real-time

access to information. While first generation IEEE 802.11 technology is adequate for residential and small office/home office (SOHO) customers, the same is not always true for enterprise customers. In fact, some chief information officers (CIOs) and information technology managers are reluctant to deploy wireless LANs. Among their concerns are security, reliability, availability, performance under heavy load, deployment, mobility and network management. While security is often mentioned as manager's greatest worry about wireless, some of their other concerns, such as reliability, availability, performance and deployment, can be addressed through radio resource management techniques. The use of such techniques would encourage the rapid deployment of wireless infrastructure with much greater flexibility than has previously been available. The current wireless network products do not scale as well as they might in large-scale enterprise networks. IEEE 802.11 wireless networks have become increasingly popular and more widely deployed. This puts pressure to expand the functionality of wireless LAN equipment to become suitable for large scale operations. Although IEEE 802.11 task groups and study groups are working to improve the standard, there is a need for much improvement to suit the future functionality that will be added to wireless equipment.

Enterprise managers want to deploy wireless networks with several important qualities. These include: high security, highly reliable and available WLANs with very little downtime and high performance (i.e., capability of high throughput and low latency). The ideal wireless network has reliability, availability and performance criteria similar to wired enterprise networks. In addition, it should be possible to deploy wireless networks very quickly and without the need for extensive and time-consuming site surveys. Furthermore, the networks should have the flexibility needed to support load balance and changes in the radio environment. Radio resource management (RRM) forms the basis of quality of service (QoS) provi-

sioning for wireless networks (Kayiazakos, 2004). It is an intense research area due to the wireless medium's inherent limitations and the increasing demand for better and cheaper services. There are many benefits of RRM: timely guarantees of resources for key applications, enhanced network planning and management and efficient bandwidth utilization. Improving the mobility management has been addressed in Ush-Shamszaman (2005) based on dividing the location management into two levels: intra- and inter- mobility. This will reduce the amount of signaling traffic, but still doesn't address the problem of reliability and availability. Supporting security, reliability and QoS in a dynamic environment has been discussed in DaSilva (2004), using modified routing protocol OSPF-MCDS over WLANs. It manages the bandwidth allocation using a decentralized policy-based network management scheme. In this approach, load balancing would be improved but at the expense of generating more traffic between the APs required to exchange signaling needed for the protocol OSPF-MCDS. In addition, there would be an increase of latency for terminal association moving across the boundary of multiple APs.

WLAN performance is dependent on the radio propagation environment in which the wireless LAN operates. The radio propagation environment may change from time to time, affecting connection speeds and error rates. In a manufacturing environment, for example, where the multipath environment changes as equipment is moved about, it is quite possible for a link to fail completely even if the mobile is stationary. Network management personnel in information technology departments are often unable to manage the network all the way to the user's mobile computer, and may be dependent on users to notify them of some types of problems. On the other hand, many CIOs see network management solutions extending all the way to users' laptops and other handheld devices. In WLANs, when AP is called on to serve a high number of users, it

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