Chapter 4.8
Network Selection Strategies and Resource Management Schemes in Integrated Heterogeneous Wireless and Mobile Networks

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ABSTRACT

Integrated heterogeneous wireless and mobile network (IHWMN) is introduced by combing different types of wireless and mobile networks (WMNs) in order to provide more comprehensive service such as high bandwidth with wide coverage. In an IHWMN, a mobile terminal equipped with multiple network interfaces can connect to any available network, even multiple networks at the same time. The terminal also can change its connection from one network to other networks while still keeping its communication alive. Although IHWMN is very promising and a strong candidate for future WMNs, it brings a lot of issues because different types of networks or systems need to be integrated to provide seamless service to mobile users. In this chapter, the authors focus on some major issues in IHWMN. Several noel network selection strategies and resource management schemes are also introduced for IHWMN to provide better resource allocation for this new network architecture.

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INTRODUCTION

Wireless and mobile networks (WMNs) attract a lot of attention in both academic and industrial fields. They are also witnessing a great success in recent years. Generally, WMN can be classified into two types, centralized (or infrastructure-based) and distributed (or infrastructure-less) WMNs. Cellular networks are the most widely deployed centralized WMNs and have evolved from the

earliest 1G cellular network to current 2G/3G cellular networks. Generally, the service area of a cellular network is divided into multiple small areas that are called cells. Each cell has a central control unit that is referred to as base station (BS). All the communications in the cellular network take place via the BSs. That is, the communication in a cellular must be relayed through a BS. The IEEE 802.11 WLAN (Wireless Local Area Network) is another type of centralized WMNs, which has much smaller coverage compared to cellular networks. Because WLANs are easy to deploy and can provide high bandwidth service, they have experienced rapid growth and wide deployment since they were launched to the market. In a WLAN, the central control unit is called access point (AP). Similar to cellular networks, the communications in a WLAN must be via the APs. The BSs or APs are connected to the backbone networks and provide connections with other external networks, such as Public Switched Telephone Network (PSTN) and Internet. Besides the cellular network and WLANs, there are also many other types of centralized WMNS such as satellite network, WiMax, HiperLan etc.

Unlike centralized WMNs, there is no fixed network structure in a decentralized (or distributed) WMN. Wireless and mobile ad hoc network is a typical distributed WMN that attracts a lot of research interests recently (Agrawal, 2006). The wireless and mobile ad hoc network is dynamically created and maintained by the nodes. The nodes forward packets to/from each other via a common wireless channel without the help of any wired infrastructure. When a node needs to communicate with other nodes, it needs a routing discovery procedure to find a potential routing path to the destination node. Due to frequent movement of communication nodes, the routing path between two communication nodes is not fixed. When a relay node moves out of transmission range of other communication nodes, the current routing path is broken. As a result, another routing path has to be found in order to keep the communication alive. Wireless and mobile ad hoc networks are very useful in some areas that a centralized WMN is not possible or inefficient, such as disaster recovery and battle field.

Although there are a lot of wireless and mobile networks and they are witnessing a great success in recent years, different types of WMNs have different design goals and restriction in the wireless signal transmission which results in the limitation of the services. Therefore, they cannot satisfy all the communication needs for the mobile users. For example, any single type of existing WMN is not able to provide a comprehensive service such as high bandwidth with wide coverage. In order to provide more comprehensive services, a concept of *integrated heterogeneous wireless and mobile network* (IHWMN) is introduced by combing different types of WMNs.

On the other hand, any traditional mobile terminal only supports one network interface, which can only connect to one type of network. With the advance of the software defined radio technology, it is possible to integrate multiple WMN interfaces (multi-mode interfaces) into a single mobile terminal now. Such multi-mode terminal is able to access multiple WMNs if it is under the coverage of multiple WMNs. For example, a mobile terminal equipped with cellular network interfaces and WLAN can connect cellular network or WLAN if both networks are available. It can further connect to both networks at the same time. However, it is a big challenge since effective and efficient schemes are required to manage the connection.

It is obvious that the introduction of IHWMN as well as multi-mode terminal brings more flexible and plentiful access options for mobile users. The mobile users can connect the more suitable network for different communication purpose. One example is that the mobile user may connect to cellular network for the voice communication and connect to the WLANs to receive email and surf the Internet. However, there is a lot of challenge, such as the architecture of network integration,