Chapter 70
Providing Outdoor and Indoor Ubiquity with WLANs

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ABSTRACT

Wireless Local Area Networks are very useful for the most applications based on network. Nowadays, these types of networks are the most powerful in the communication's world. It can be developed in almost all environments and products are cheap and robust. Moreover, these networks can be formed by different devices with wireless interfaces like IP cameras, laptops, PDAs, sensors, etc. WLANs provide high bandwidth at large coverage areas (if high gain antennas are used), which it is necessary in many applications at different research areas. All these characteristics let WLANs be a useful technology to provide ubiquity for any type of service. If they are deployed from a good and exhaustive design, they can provide connection to any device, everywhere at anytime. In this paper we present a complete guideline about how to design and deploy WLANs and to get their best performance. We start from an analytical point of view and we use mathematical expressions to design WLANs in both indoor and outdoor environments. Then, we show a method proposed by some authors of this paper some years ago and how it can be used to design WLANs in indoor environments. Next, we show WLANs design in outdoor environments. Finally, we describe two projects developed by the authors of this chapter in order to provide ubiquity in real indoor and outdoor environments.

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INTRODUCTION

In 1991, first manufacturers of WLAN technology propose create a standard to promote its deployment and development. In 1997, IEEE (Institute of Electrical and Electronics Engineers) published the 802.11 standard for wireless local area networks (WLANs). Next, in 1999, WiFi alliance emerges to certificate those WLAN devices based on 802.11 which can work between them (that is, guarantee interoperability). So, devices that pass a test bed are marked with its registered trademark: WiFi.

In the IEEE there are several workgroups to improve the 802.11 standard (data link and physical layer) and several variations have been published: 802.11a, 802.11b, 802.11c… However, nowadays, networks which work with 802.11b and 802.11g standards are the most popular. So, the most of WLAN products follow these standards.

Since appearance of WLANs based on IEEE 802.11b and 802.11g standards (IEEE Std 802.11g/D1.1, 2001) (IEEE Std. 802.11g, 2003), wireless technologies have experienced a spectacular market growth due to their features and low costs of transmission equipment. Installation of these wireless networks in a house or an office is very easy, that is, it is not technically complex. Thus, a non-expert user would be able to set up a WLAN.

This technology presents several advantages:

- It permits crossing walls, so system could be used in more than one room.
- It is easy and quick to install.
- Costs of IEEE 802.11b/g devices are lower than other technologies.
- It can be used in both indoor and outdoor environments.
- It supports changes in physical topology of network.
- It allows having a high number of users, so these networks are quite scalable.

However, in spite of abovementioned advantages, wireless networks present some disadvantages too:

- It is possible to be in out of coverage although a device is in a theoretical coverage area.
- Signal suffers dispersion because of the multipath effect.
- Speed is lower than wired networks.
- Higher error rate.
- Main disadvantage is security, because it's very easy capture packets. WiFi alliance tried to resolve this problem designing the WPA and, then, WPA2 standard, based on workgroup 802.11i. So, networks protected with WPA2 are considered robust and provide a good security.

Nevertheless, when requirements demanded from a WLAN are increased, for example, to cover a greater distance or more than one house or floor of a building, user has to face several technical limitations. So, it requires tackling a study in depth for installation. However, this complication could be increased when it is necessary to cover a vast area with several buildings or several open areas between buildings.

Nowadays, providing users with connectivity for everything, everywhere at anytime, is one of the most important challenges for technological industry. Although it is not an easy task to provide ubiquity by using WLAN, it's possibly tacking into account all the possible limitations (Lloret, López & Ramos, 2003). In designing these ubiquity networks, it is necessary to comply with all coverage requirements, that is, signal losses because of walls in indoor environments and signal losses because of vegetation in outdoor environments. According to that, it is essential to identify all possible problems that can exist during deployment of a network and to know how to minimize their impact.