Chapter 4
Measuring Specific Absorption Rate by using Standard Communications Equipment

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ABSTRACT

Specific Absorption Rate (SAR) is used to measure the body tissue exposure to electromagnetic fields. This chapter describes how SAR values can be estimated from a deployed Wireless Local Area Network (WLAN). We carried out this work using the Received Signal Strength (RSS) obtained from the access points. This parameter is easily obtained by an ordinary wireless network scanner. RSS variations are measured for a different number of people in the same room and without people. It will allow us to estimate how much energy is absorbed by a group of people and by a single person on average. Moreover, we have included the weight of the people in order to know the RSS lost by kilogram. These measurements were taken at the Higher Polytechnic School of Gandia, Universitat Politècnica de València, Spain, in two placements: the library and inside an anechoic camera.

INTRODUCTION

Today, the Electromagnetic Fields (EMF) caused by human technology represent one of the most common environmental features. Its growth is amazing because of the fast advances in the wireless technology. So, speculations and suspicions about the consequences on health are being spread among the population.

In response to this concern the World Health Organization (WHO) established the International EMF Project in 1996 (WHO, 2002). This project

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Table 1. ETSI and FCC comparison

	Band (GHz)				
	2.4	**5.15 – 5.25**	**5.25 – 5.35**	**5.470 – 5.725**	**5.725 – 5.825**
ETSI					
Power	100 mW	200 mW	200 mW	1000 mW	25 mW
EIRP	20 dBm	22 dBm	22 dBm	30 dBm	14 dBm
FCC					
Power	4000 mW	200 mW	1000 mW		P2MP – 4 W (36 dBm)
EIRP	36 dBm	22 dBm	30 dBm		P2P – 200 W (53 dBm)

is focused to analyze the possible health effects of EMF in the frequency range from 0 to 300 GHz.

There are several public directives and recommendations referred to EMF in Europe. One of them is the directive 1999/5/EC of the Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment (EC, 1999a). The one which is related to the human body exposure to EMF is the Council Recommendation of 12 July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz) (EC, 1999b).

The basic restrictions on electromagnetic fields depend on frequency (EC, 1999b). These restrictions are specified by the following physical quantities and their main adverse effects on health:

- From 0 to 1 Hz, magnetic flux density for static magnetic fields (0 Hz) and current density for time-varying fields up to 1 Hz are taken into account. The objective is to prevent effects on the cardiovascular and central nervous system.
- From 1 Hz to 10 MHz, current density to prevent effects on nervous system functions is taken into account.
- From 100 kHz to 10 GHz, restrictions on SAR to prevent whole-body heat stress and excessive localized heating of tissues is taken into account. In the range 100 kHz to 10 MHz, restrictions on both current density and SAR are provided.
- From 10 GHz to 300 GHz, basic restrictions on power density are provided to prevent heating in tissue at or near the body surface.

The objective of this chapter is to analyze the exposure of people to WLANs' radio frequency in the 2.4 GHz ISM band. In order to establish a security measurement, many countries have limited the transmitting power of the WLAN device according to the working frequency. Table 1 shows the transmitting power limitations for the European Telecommunications Standards Institute (ETSI) and for the Federal Communications Commission (FCC) for several radio frequencies.

But, the body exposure limits are given in terms of Specific Absorption Rate (SAR). This rate indicates the radio frequency energy absorption per unit mass of body tissue. Averaged SAR is calculated for the whole body or for some parts of the body (ICNIRP, 1998). It is expressed in watts per kilogram (W/kg). Whole body SAR measures are related to thermal effects caused by Radio Frequency (RF) exposure. On the other