STUDY OF SAFETY AND HEALTH ASPECTS OF BASE STATIONS AND MOBILE PHONES

KASUMAWATI BINTI LIAS

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To those who closed to my heart:

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ABSTRACT

The wide use of mobile phones and also the increasing number of base stations have inevitably raised the question of whether there are any implications for human health. This project focused on study of safety and health aspects of mobile phones and base stations. Much attention is paid to the effect of mobile phones rather than base stations. There are four conditions taking into consideration for this project. First, mobile phone held next to human head, second, loudspeaker and third Bluetooth conditions. Last and forth condition is focused on base stations effects on human health. For the assessment purpose, Finite Difference Time Domain (FDTD) is used in order to find the Specific Absorption Rate (SAR) rating or values of four conditions that have been mentioned. International Commission on Non-Ionizing Radiation Protection (ICNIRP) has been stated the limits of SAR which is 4W/kg. When the limits is exceed, it produces human health effects where it can caused reverse cell membrane polarity, alter brain waves and brain chemistry and damage DNA. This leads to cancer and memory loss. However, both mobile phone and base stations are designed with low power and operate at high frequency where the value of SAR is low than the limits that stated by ICNIRP. Other temporary biological effects produce by mobile and base stations are heating, headache, fuzziness, fatigue and nausea. As a conclusion, there is still no convinced evidence that mobile phone and base stations caused human adverse health effect and shorten human life span.

ABSTRAK

Penggunaan telefon bimbit secara meluas dan pertambahan bilangan pencawang telefon telah menimbulkan persoalan samada terdapatnya implikasi kepada kesihatan manusia atau tidak. Oleh itu, projek ini memfokuskan kajian terhadap aspek keselamatan dan kesihatan yang disebabkan oleh telefon bimbit dan pencawangnya. Pemerhatian bagi kajian ini lebih tertumpu kepada kesan telefon bimbit terhadap manusia berbanding dengan pencawangnya. Kajian ini meliputi empat bahagian. Bahagian pertama ialah situasi dimana telefon bimbit berada disebelah kepala manusia, bahagian kedua ialah situasi apabila pembesar suara digunakan dan bahagian ketiga pula adalah situasi *Bluetooth*. Manakala, bahagian yang terakhir pula memfokuskan kepada kesan pencawang terhadap kesihatan manusia. Bagi tujuan penyelidikan, ”Finite Difference Time Domain” (FDTD) digunakan untuk mencari nilai Tahap Serapan Tentu (SAR) bagi empat keadaan yang telah dinyatakan. Pertubuhan Perlindungan Radiasi Bukan Berion Antarabangsa (ICNIRP) telah menggariskan had SAR iaitu 4W/kg. Apabila nilai SAR melebihi had yang telah ditetapkan, ianya akan memberikan kesan terhadap kesihatan manusia seperti keadaan di mana pembalikan polariti sel membran, perubahan terhadap gelombang dan kimia otak dan merosakkan struktur DNA. Keadaan ini boleh menyebabkan penyakit kanser dan kehilangan memori. Namun, penghasilan telefon bimbit dan pencawangnya telah dicipta dengan nilai kuasa yang rendah dan beroperasi pada nilai frekuensi yang tinggi. Penciptaan teknologi ini menghasilkan nilai SAR yang lebih rendah daripada nilai yang telah dinyatakan oleh ICNIRP. Di samping itu, kesan biologikal yang disebabkan oleh telefon bimbit dan pencawangnya adalah pemanasan, pening kepala, penat dan mual. Melalui hasil kajian dapat dirumuskan bahawa tiada bukti kukuh yang menyatakan bahawa telefon bimbit dan pencawangnya boleh memberi kesan kepada kesihatan dan memendekkan jangka hayat manusia

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LIST OF ABBREVIATIONS

2G	-	Second Generation Mobile Communication
3G	-	Third Generation of Wireless Technology
4G	-	Fourth Generation Mobile Communication
AMPS	-	American Mobile Phone System
AFFSSE	-	French Agency for Environmental Health Safety
AP	-	Access Point
BSC	-	Base station controllers
BSS	-	Base station subsystems
BTS	-	Base transceiver stations
BWA	-	Broadband Wireless Access
CDMA	-	Code Division Multiple Access
EIRP	-	Effective Isotropically Radiated Power
EMF	-	Electromagnetic Field
EMI	-	Electromagnetic Interference
FDA	-	Food and Drug Administration
FDTD	-	Finite Difference Time Domain
GHZ	-	Gigahertz
GPRS	-	General Packet Radio Service
GSM	-	Global System for Mobile Communication
HPA	-	Health Protection Agency (formerly known as National Radiology Protection Board)
HSDPA	-	High speed Downlink Packet Access
HSPDA	-	High speed Packet Data Access
HSUPA	-	High speed Uplink Data Access

Hz	-	Hertz
I	-	Electric current
ICNIRP	-	International Commission on Non-Ionizing radiation Protection
IEEE	-	Institute of Electrical and Electronics Engineers, Inc
IEGMP	-	International Expert Group on Mobile Phones
IP	-	Internet Protocol
ITU	-	International Telecommunication Union
kHz	-	kilohertz
MAC	-	Medium Access Control
MCMC	-	Malaysian Communications and Multimedia Commission
MHz	-	Megahertz
MNA	-	Malaysia Nuclear Agency
MoH	-	Ministry of Health Malaysia
MoM	-	Method of Moments
MSC	-	Mobile Switching Center
NIR	-	Non-Ionization Radiation
NMT	-	Nordic Mobile Telephone
NRPB	-	National Radiological Protection Board
PCS	-	Personal Communication System
RF	-	Radio Frequency
RFID	-	Radio Frequency Identification Device
rms	-	root mean square
SAR	-	Specific Absorption Rate
SARav	-	Average SAR
SARmax	-	Maximum SAR
UHF	-	Ultra High Frequency
UMTS	-	Universal Mobile telecommunications System
UV	-	Ultraviolet
UWB	-	Ultra Wideband
VHF	-	Very High Frequency

WCDMA	-	Wide band Code Division Multiple Access
WHO	-	World Health Organization
Wi-Fi	-	Wireless Fidelity
Wimax	-	World Interoperability for Microwave Access
WLAN	-	Wireless Local Area Network

LIST OF SYMBOLS

E	-	Electric Field
H	-	Magnetic Field
σ	-	Conductivity
ρ	-	Mass Density
ξr	-	Relative Permittivity
c	-	Specific heat capacity of tissue
Δt	-	Change of temperature
D	-	Rectangular volume

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CHAPTER 1

INTRODUCTION

1.1 Introduction

The use of mobile phone has increased exponentially in the recent years and has become the ubiquitous element in daily life. With this growth comes the inevitable increase in the number of base station sites. By the quick introduction of mobile telecommunications devices and technologies, especially among the general public, so there has been a focus on the health problems associated with Radio Frequency (RF) exposure from base stations and mobile phone. In addition, concerns persist that chronic exposure to pulsed and amplitude modulated RF fields may cause specific health effects.

There have been numerous studies on health effects of chronic exposure to the RF fields from base stations and mobile phone. The first extensive review has focused on the radiation exposure from base station and mobile phone based on epidemiological and experimental studies on health effect. This was done by the Independent Expert Group on Mobile Phone (IEGMP), in the year 2000 and known as Steward Report [1].

After IEGMP, National Radiological Protection Board (NRPB) or currently known as Health Protection Agency (HPA) published a report that provide advice to address public concerns about mobile phone technology. This published in year of 2004 [2]. Then, in February 2005, French Agency for Environmental Health Safety (AFSSE)

published a document in the specified field of non-ionization radiation used by mobile telephony system [3].

In Malaysia, public concern on health effect that provide by widespread use of mobile phone stated in the 1990's. Continuous research and review of related documents are needed to ensure that the data or information is not outdated. Electromagnetic energy or frequency of exposure level will always increases with advancing technology. Thus, even small health consequences from electromagnetic frequency exposure could pose a major public health impact.

1.2 Objectives

The objectives of the project are:

1) to study on the mobile phone and base station technology, also the basic concept of electromagnetic energy.
2) to study on human health effect that associated to electromagnetic radiation produce by mobile phones and base stations.
3) to do simulation in order to investigate the effect of mobile phones and base stations on human head.

1.3 Scopes of Project

The scope of this study is listed below:

1) Gathered information on mobile phones and base stations technology.
2) Differentiate between ionization and non-ionization radiation of electromagnetic energy.

3) Searching historical data that done by other countries.
4) Finite Different Time Domain (FDTD) method is used to model mutual effects of mobile phones and base stations on human head in term of human health effect.

1.4 Problem Statement

Study on the health effect that brought by mobile phones and base stations is done due to provide the standard and guidelines for limiting electromagnetic exposure on the radio frequency use. It is also to determine the safety distance of electromagnetic of a base station antenna.

1.5 Project Outlines

Chapter 1 provides the introduction of the project where the background, objectives and scopes of project are presented. Then, the literature review of the project which include the fundamental theories and concept of electromagnetic field (EM), specific absorption rate (SAR), cellular systems and the appropriate literature are all described in Chapter 2. For Chapter 3, the technical background is explained. This part emphasized on Zeland simulator. Proceed with Chapter 4 that justify on the algorithm and implementation of the project. Result and discussion come up in Chapter 5 followed by conclusion in Chapter 6. The conclusion will be summarized all the finding of the project besides the suggestion for further work.

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