A SINGLE ANTENNA WITH WIDEBAND AND NARROWBAND FUNCTIONS

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To the absent Sheikhs; Taken from us just because they preached the truth, for the North and especially the muslims to go to school. Specially dedicated to the great Governor. Engr. (Dr.) Rabiu Kwankwaso.

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ABSTRACT

Wireless communication is the process of exchanging information between two or more entities over air facilitated by wireless devices. Antenna serves as the interface between the hardware and free space. To achieve high data rates and high capacity it is essential that a system capable of attaining such rates be complemented with the appropriate wideband antenna, for specific applications requiring less adjacent channel interference and also concentrated power at certain utilized/desirable frequencies requires antenna with good out of band rejection and precise resonance at the desired frequencies.In this project a CPW fed slot single antenna is proposed to be reconfigurable by implementing switches in order to operate in the wideband(1.7-6.0Ghz) mode and narrowband modes (3.5Ghz and 5.0Ghz). In particular, this antenna will find application in GSM (1800/1900), Bluetooth (2.4Ghz) and WLAN/WiMAX (2.4/3.3/3.5/5.0/5.5/5.8Ghz) bands which can all be found within the considered range of 1.7-6.0GHz.

ABSTRAK

Komunikasi tanpa wayar adalah proses pertukaran maklumat di antara dua atau lebih pihak melalui udara dipermudahkan oleh peranti tanpa wayar. Antena berfungsi sebagai antara muka antara perkakasan dan ruang bebas. Bagi meningkatkan kadar data yang tinggi dan kapasiti tinggi adalah penting bahawa sistem yang mampu mencapai kadar yang dilengkapkan dengan antena dengan jalur lebar yang sesuai, untuk aplikasi tertentu yang memerlukan gangguan saluran bersebelahan dan kurang kuasa juga tertumpu di tertentu digunakan frekuensi / wajar memerlukan antena dengan baik di luar band penolakan dan resonans tepat pada frekuensi yang dikehendaki. Dalam projek ini slot antena tunggal CPW mencadangkan konfigurasi dengan melaksanakan suis untuk beroperasi dalam mod jalur lebar (1.7 - 6.0Ghz) dan mod sempit (3.5GHz dan 5.0Ghz). Khususnya, antena ini akan mendapati aplikasi dalam GSM (1800/1900) , Bluetooth (2.4GHz) dan WLAN / WiMAX (2.4/3.3/3.5/5.0/5.5/5.8Ghz) jalur yang boleh didapati dalam julat yang bersesuaian iaitu antara 1.7 - 6.0GHz .

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LIST OF ABBREVIATIONS

CPW	–	Co-Planar Waveguide
FR-4	–	Fire Redundant standard 4
PIL	–	Planar Inverted L
DC	–	Direct Current
RF	–	Radio Frequency
UV	–	Ultra-Violet
GHz	–	Giga Hertz
dB	–	deciBel
BW	–	Bandwidth
MEMS	–	Micro Electro Mechanical Switch
DSRC	–	Dedicated short-range communications
RA	–	Radiating Antenna
WLAN	–	Wireless Local Area Network
WiMAX	–	Worldwide Interoperability for Microwave Access
GPS	–	Global Positioning System
CST	–	Computer Simulation Technology
IEEE	–	Institute of Electrical and Electronics Engineering
VSWR	–	Voltage Standing Wave Ratio
HPBW	–	Half Power BeamWidth
F-PIFA	–	Fractal Planar Inverted F antenna
GSM	–	Global System For Mobile
UTMS	–	Universal Mobile Telecommunication System

LIST OF SYMBOLS

λ	–	Wavelength
ε	–	Dielectric constant
Ω	–	Ohms
c	-	Velocity of light
dB	-	decibel
fL	-	Lower Frequency Band
fH	-	Upper Frequency Band
Hz	-	Hertz
η	-	Efficiency
E	-	Electric Field
H	-	Magnetic Field
Er	-	Relative Permittivity
εeff	-	Effective Relative Permittivity
Z	-	Impedence
Γ	-	Reflection Coefficient
S11	-	Return Loss

CHAPTER 1

INTRODUCTION

1.1 Introduction

Every wireless communication device requires at least one antenna. This makes antenna an integral component of communication systems. Traditionally wireless systems are designed for a single predefined mission [1]. Thus, the antennas of these systems also exhibits some fixed parameters such as frequency band, radiation pattern, polarization and gain.

In mobile and satellite communications, reconfigurable antennas are useful to support a large number of standards (e.g., UMTS, Bluetooth, WLAN, WiMAX, DSRC) to mitigate strong interference signal and to cope with the changing environmental condition. Therefore, a control over operating frequency, beam pointing direction, polarization, antenna gain, and so forth is required [1]. A single RA can replace a number of single-function antennas. Thereby overall size, cost, and complexity of a system can be reduced while improving performance.

Making antennas reconfigurable so that their behavior can adapt with changing system requirements or environmental conditions can ameliorate or eliminate these restrictions and provide additional levels of functionality for any system. For example, reconfigurable antennas on portable wireless devices can help to improve a noisy connection or redirect transmitted power to conserve battery life [2]. In large phased arrays, reconfigurable antennas could be used to provide additional capabilities that may result in wider instantaneous frequency bandwidths, more extensive scan volumes, and radiation patterns with more desirable side lobe distributions[2].

1.2 Problem Statement

The ability to integrate more than one communication standard into a single system has become an increasing demand for modern portable wireless communication devices [1, 2], as such a single multiband antenna of fixed configuration or reconfigurable is required. Since portable devices are powered by batteries; there is heavy demand for optimal power usage and conserving power in portable devices by redirecting transmitted power to only the band in use. Frequency agility and adaptability coupled with ease of fabrication, good; impedance bandwidth, radiation efficiency, and relatively easy integration with electronics devices than the other antenna techniques make CPW fed slot antenna with re-configurability an excellent choice for solving the aforementioned problems posed to wireless communication devices. Especially those devices designed to operate in GSM, Bluetooth, GPS, WLAN/WiMAX applications.

1.3 Objectives

This project aims to design and fabricate a single antenna with wideband (1.7Ghz - 6.0Ghz) and narrowband (3.5Ghz and 5.0Ghz) functions. The antenna will be useful for GSM/Bluetooth, and WLAN/WiMAX applications. Finally, to realize the re-configurability of the antenna, switches were employed.

1.4 Scope

This project aims to design and fabricate a single antenna with wideband (1.7Ghz - 6.0Ghz) and narrowband (3.5Ghz and 5.0Ghz) functions. The antenna will be useful for GSM/Bluetooth, and WLAN/WiMAX applications. Finally, to realize the re-configurability of the antenna, switches were employed.

1.5 Organisation of the Project

This thesis is organized and presented in five chapters. The chapter one introduces the project background, problem statement, project objectives and scope of work and the organisational structure of the thesis.

Chapter two contains some of the basic theories behind the behaviour of an antenna, an overview of important antenna performance metrics to be considered during design. It also includes a review conducted on some literature regarding past works done in reconfigurable antennas.

In Chapter three, the project methodology is presented. Concise walkthrough on the processes involved in the methodology are given. The fourth chapter presents the discussion and analysis of the simulated and measured results for the three fabricated antenna operational states. Therein, the simulated and measured results were compared. The antenna's performance metrics considered for both simulation and measurement are the return loss (S11), radiation pattern and gain.

Chapter five concludes this thesis write-up by presenting the conclusion gathered from the findings in this exercise and some recommendations were also given for any future work to be endeavoured on this project.

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