

**DESIGN AND DEVELOPMENT OF PLANAR ANTENNA FOR SHORT RANGE  
COMMUNICATIONS**

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**This Report Is Submitted In Partial Fulfilment of Requirements for the Bachelor  
Degree of Electronic Engineering and Computer Engineering (Wireless  
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**Fakulti Kejuruteraan Elektronik dan Kejuruteraan Komputer  
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**Tajuk Projek** : DESIGN AND DEVELOPMENT OF PLANAR ANTENNA FOR SHORT RANGE  
 COMMUNICATIONS

**Sesi Pengajian** : 

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## DECLARATION

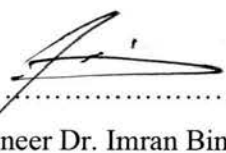
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This report is submitted to the Faculty of Electronic Engineering and Computer Engineering of UTeM as a partial fulfillment of the requirements for the Bachelor Degree of Electronic Engineering and Computer Engineering (Wireless Communication) with Honours. The member of the supervisory is as follow:

Signature :  .....

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## DEDICATION

*Special dedication to:*

*To my mother, Talahah Binti Yeop, my father, Othman Bin Daud, my brother, Farnurhan Bin Othman, he and my friends who always support and encourage me through my education journey.*

*My supervisor, Engineer Dr. Imran Bin Mohd Ibrahim and my Co-supervisor, Dr. Noor Azwan Bin Shairi*

*Alhamdulillah and thank you for everything.*

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## ABSTRACT

Antenna, which also called an aerial, is a conductor that can transmitting and receiving signals such as microwave, radio or satellite signals. In transmission, a radio transmitter supplies an oscillating radio frequency electric current to the antenna's terminals, and the antenna radiates the energy from the current as electromagnetic waves (radio waves). A planar or patch antenna is a low-profile antenna that has a number of advantages over other antennas. It is light weight, economical, ease to fabrication and easy to integrate with the accompanying electronics. However, planar patch antennas suffer from more disadvantages as compared to conventional antennas such as less efficiency and low gain. Therefore, in this project, U slot planar antenna is used due to the fact that overcoming in increasing the gain. U slot planar antenna was designed with the added of air gap between the patch and the ground by using the copper annealed materials. The simulation was using the CST Studio Suites software which is a specialist tool for designing a 3D EM simulation. The simulation was done to analyze the performance of the U slot antenna especially the bandwidth of the return loss, the gain and the directivity.

## ABSTRAK

Antena adalah konduktor yang boleh menghantar dan menerima isyarat seperti gelombang mikro, radio atau isyarat satelit. Dalam penghantaran isyarat, sebuah pemancar radio membekalkan frekuensi radio arus elektrik berayun ke terminal antena, dan antena memancarkan tenaga daripada arus sebagai gelombang elektromagnetik (gelombang radio). 'Planar' antena adalah antena berprofil rendah yang mempunyai beberapa kelebihan berbanding antena lain. Antenna ini begitu ringan, murah, dan mudah untuk diintegrasikan dengan peralatan elektronik yang lain. Walau bagaimanapun, 'planar' antena ini mempunyai beberapa kelemahan berbanding antena konvensional, seperti kecekapan yang rendah dan penerimaan tenaga yang rendah. Oleh itu, dalam projek ini, U slot 'planar' antenna telah di reka bentuk dengan penambahan ruang udara diantara 'patch' dan bumi antenna tersebut. Reka bentuk antenna tersebut disimulasikan dengan menggunakan perisian CST Studio Suites. Simulasi ini adalah dilakukan untuk menganalisis prestasi antena yang telah direka bentuk.



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**LIST OF ABBREVIATIONS, SYMBOLS AND  
NOMENCLATURE**

UTeM	-	Universiti Teknikal Malaysia Melaka
MCMC	-	Malaysian Communications And Multimedia Commission
SRSP	-	Standard Radio System Plan
GOOG	-	Google
FB	-	Facebook
PCB	-	Printed Circuit Board
$R_L$	-	Return Loss
MHz	-	Mega Hertz
GHz	-	Giga Hertz
THz	-	Tera Hertz
WWRF	-	Wireless World Research Forum
BSS	-	Basic Service Set
WLAN	-	Wireless Local Area Network
UHF	-	Ultra High Frequency

Mbps	-	Megabits per second
TV	-	Television
DVD	-	Digital Versatile Disc
LED	-	Light-Emitting Diode
CST	-	Computer Simulation Technology
HPBW	-	Half Power Beam Width
VSWR	-	Voltage Standing Wave Ratio
RF	-	Radio Frequency
EMP	-	Electromagnetic Pulse
EMC	-	Electromagnetic Compatibility
RFID	-	Radio Frequency Identification
LF	-	Low Frequency
HF	-	High Frequency
MMIC	-	Monolithic Microwave Integrated Circuit
PEC	-	Perfect Electric Conductor
SRD	-	Short Range Devices
$W$	-	Width
$f_o$	-	Operating Frequency
$\epsilon_r$	-	Dielectric Constant
$c$	-	Speed of Light
$\epsilon_{\text{reff}}$	-	Effective Dielectric Constant
$h$	-	Substrate Thickness
$W_p$	-	Width of patch
$L_{\text{eff}}$	-	Effective Length
$\Delta L$	-	Length Extension

$L$	-	Length of Patch
mm	-	millimeters
AUT	-	Antenna Under Test
$P_R$	-	Power received from the receiver antenna in dB
$P_T$	-	Power transmit from the transmitter antenna in dB
$G_T$	-	Gain for Transmitter antenna in dB
$G_R$	-	Gain for receiver antenna in dB
$P_{LC1} + P_{LC2}$	-	Cable Loss for transmitter and receiver antenna in dB
ws	-	Width of Substrate
ls	-	Length of substrate
wf	-	Width of feedline
lf	-	Length of feedline
VNA	-	Vector Network Analyzer

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.0 Project Background**

Basically network communications are functioning fully based on base station as their transmitter medium. Therefore, most of the times there happened a heavy traffic between the transmissions of the data. To try figure out the solution due to the issues, there is an idea to design the planar type antenna as a link to this transmission of information.

This system called as short range communication. These short range communication systems are fully operating without a base station. The targeting for this antenna is averagely covering about 1 km of distance. That is mean that the transmission can be transfer or communication can be occur up to 1 km of distance.

Beneficially all the information is going to be kept within the area. This communications are mainly for spreading the information in case there are some incident happen such as system of base station down, or backup power generators failed and also others technical difficulties. Besides, this system also helps by decreasing the number of traffic in networking.

Furthermore, the system also ensuring and increase the security safety of the information. In addition, these applications are functioning to distribute a messages and voice call. The information transfers is not propagated over others areas in a borderless way. Based on Malaysian Communications And Multimedia Commission (MCMC) technical specifications these short range devices must be able to tolerate to any interference caused by other radio-communication services either electrical or electronic equipment.

The frequency selected must follow the standard of Malaysian Communications And Multimedia Commission. Table 1.1 shows the standard frequency stated.

Table 1.1: Short range frequency for short range devices by MCMC

Frequency	Power	Technology Used	Standard Radio System Plan (SRSP)
915 MHz to 923 MHz	2 Watt	RFID	SRSP 530

With the low cost structure and ease process of fabrication are the main reasons by choosing this type of antenna and substrate.

## 1.1 The Definition of Communication System

The wireless communication era began around 1895 when the Guglielmo Marconi had verified the use of the radio waves to interaction between and over large areas of distance. Mainly all the infrastructures system has their goals that are passing the maximum information of data transmission and also reducing the error during the broadcast. Cellular is mainly fastest emergent of devices and are most challenging of telecommunications submissions. According to the Management Study Guide, there are numerous types of communication systems including tactical, half duplex, duplex, and

optical and the radio. Duplex communication systems involve two-way communication. Two-way communication can be conducted either in both directions simultaneously or in only one direction per time.

Two-way communication is when a person is the sender and they transmit a message to another person, which is the receiver. When the receiver gets the message, they send back a response, acknowledging the message was received. Currently the technology evolving the wireless services has been exposed and improved by the cellular system. Due to this matter, it is widely foreseen that in the future an enormous rise in the traffic that will involve the communication system such as mobile and personal communications.

Two-way communication systems vary greatly in sophistication and special features. They range from simple handheld two-way transceivers that using a single dedicated channel to more complex systems that allow a large number of users to share several channels. The type of system chosen depends on many factors, such as the location, the intended use, the frequency band, the number of users and the cost of the system. Regardless of the type of system chosen, the one common feature is that all of the components must be compatible and work together to support a common purpose.

## **1.2 Issues Regarding the Communication System**

Natural disaster has becoming more prominent today. Because of such situation, the connection even the mobile phone cannot be functioning at all due to the infrastructure communication failure. These may be increased in a particular area due to some phenomenon such as during the Cyclone, Earthquake, Flash Flood, Fire-hazards, and also a Traffic Accident. For example the situation given, on April 26th, there have a devastating earthquake hit Nepal, which is taking over 5,000 lives. For these disaster-stricken areas, the first 24 to 48 hours are crucial to saving lives and assessing the situations is really needed. All the aid workers have to scabble around with handwritten

messages. This is because all phone, cellular and internet infrastructures have been hit badly.

The international Red Cross and leading companies like Google, Inc. (GOOG) and Facebook, Inc. (FB) have tried to arrange tools that help to connect people and rescue teams [1]. However, for the large-scale power outages with a long-mile Internet connectivity there is the problems. This impact prevents all the nearly connection between the dispersed rescue teams, people, family members and aid workers.

Generally the congestion is due to the generation of the high traffic such as a sudden increase in the originating and terminating call can cause traffic congestion. Communications becomes a vital which means that a life-saving efforts and critical decision making, without a massive or significant rescues can take place. Besides, another situation is when the capacity was forced on a framework. The congestion of the improper formations of the network sometimes appears congestion in a portion of network although there existed idle equipment in another portion of network. This is which should be conveyed by the framework is characterized as the traffic.

Particularly in transmission links, one link may be in congestion while another link remains idle. In this case excess of traffic from one link may be transmitted through alternate link via transit to another node. Due to the failure of one link, the traffic may be re-routed to another link and causes congestion to that link [2]. For instance, telecommunication traffic and so on. This caused increases in the number of users and also introducing in high rate of services such as internet and also the system of the communications. This rises will put a higher demand on manufacturing and also the operations to deliver the sufficient capacity of the networks. Traffic congestion in media transmission system is characterized as the state of the system where the quick foundation of another association is inconceivable attributable to the inaccessibility of the system component. It might happen immediately for a surprisingly high transmission.

Furthermore the unusual man-made situation like the accidental explosion, mass agitation, strike, and failure of electric supply system also may cause the network problem in the telecommunication system. Disruptions caused by physical damage have the potential to be incredibly costly and time consuming to restore, as they require maintenance or sometimes replacement of complex network hardware to re-establish communications. The major problematic is during the installations such as cell towers or fiber-optic cables. If a cell tower is severely damaged or even knocked down, it not only causes major disruptions in the area's wireless communications but is extremely expensive to replace. By that, they will remain a significant problem until the service provider is able to get a repair crew into the affected area.

Faulty equipment refused towards to carry traffic. When a switching system failed to process a call, the subscriber will keep on try again and again. At the end of this situation occurs the traffic increases and congestion occurs [3]. Moreover, these equipment faces congestion more than that of a good one. Failure of that transmission of the information may cause congestion to the switching equipment as the traffic stored in the memory of the stored program controlled switching system is increased.

### **1.3 Solution to Overcome the Issues**

Therefore to try reduces the next disaster's impacts on the communications system, one main solution has to be figure out. These to ensure at least it can ease the rescue team to manage the access to the situation well in saving the people lives. The system must be able to connect all manner of things, either between human-to-human, human-to-machine, and machine-to-machine connections through the communication [4]. These connections and interactions between things make it possible for people to use energy efficiently while still enjoying comfortable lives. Examples include supplying the help to those who are needed, getting the information you need from a portable device as and when you need it, and communication between vehicles and traffic signals to avoid congestion.