CHAPTER 1
INTRODUCTION

1.1 Background

Indonesia is one of the countries that having several disasters causing loss of life and environment damage [1]. frequent natural disasters in Indonesia are earthquakes, tsunamis, volcanic eruptions, landslides, floods, and tornadoes. About 13 % of the world's volcanoes in the Indonesian archipelago have the potential to cause natural disasters with varying intensity and strength. Indonesia consists of 3 active moving earth plates, namely the Eurasian plate, the Indo-Australian plate, and the Pacific plate. Indonesia is also part of the pacific ring of fire. This ring of fire stretched from western South America to the West-North American coast, from a circle Canada, Kamsatscka peninsula, Japan, Indonesia, New Zealand, and the southern Pacific. In Indonesia, the ring of fire pacific originated from West Sumatra, Java, Bali, West Nusa Tenggara, East Nusa Tenggara, Maluku to North Sulawesi [2].

The Search And Rescue (SAR) and volunteers had difficulty communicating to evacuate the victims because the disaster area telecommunication infrastructure is broken. Mobile cognitive radio base station (MCRBS) is one of a mobile base station technologies to recover post–natural disaster wireless networks. MCRBS communicate using signals of the 2nd, 3rd, 4th, and 5th generation (2G, 3G, 4G, and 5G) of communications. To achieve this goal, MCRBS requires an antenna having capabilities of communications for the 2G, 3G, 4G, and 5G. Indonesia, 2G–5G mobile communications frequency range was operated on 0.8 – 3.3 GHz. MCRBS can be used to help the victims with detecting the coordinates of telecommunications devices. In disaster area, there are several telecommunication devices still transmit information signals and their locations are unknown, therefore the antenna with omnidirectional radiation pattern and light design is needed.

An antenna that has wide frequency range are log–periodic, vivaldi, and biconical antenna. The log–periodic antenna can produce wider bandwidth because of the structure of an antenna excited by a pair of parallel lines [3]. The vivaldi antenna can produce wider bandwidth because it has a tapered slot like exponential or commonly referred to as exponentially tapered slot antenna (ETSA) [4]. In previous research about the log-periodic and vivaldi antenna for UWB communications, but

the dimension is too large and the antenna produces unidirectional radiation pattern is which has capability to cover a certain area [5] [6]. This thesis proposes biconical antenna because the basic characteristics of the antenna have wider bandwidth and omnidirectional radiation pattern. In [7] proposed biconical antenna for UWB communications, but the dimension is too large to be implement for MCRBS. In [8][9] [10] [11] proposed biconical with wire antenna design that is used to reduce the dimensions but still produce wider bandwidth. In [8] [9] [10], the antenna design can produce wider bandwidth, but has bad performances at low frequencies. In [11], the antenna design can produce wider bandwidth, but has bad performances at high frequencies. This thesis proposes biconical antenna with the designed antenna is expected to have $R_L \leq -10$ dB, gain $G \geq 1$ dB and the antenna can work on 0.8 GHz to 3.3 GHz of the frequency range.

1.2 Problem Identification

Designing an antenna for MCRBS that implement in post–disaster area is very challenging because the conditions in post-disaster areas is different from normal condition. MCRBS communicates using signals of the 2nd, 3rd, 4th, and 5th generation (2G, 3G, 4G, and 5G) of communications. To achieve this goal, MCRBS requires an antenna having capabilities of communications for 2G, 3G, 4G, and 5G. MCRBS can detect the coordinates of victims in natural disasters area by the coordinates of telecommunications devices that are still emitting signals. Some of these devices were buried in the ruins of the building and their location was unknown, so the antenna with and omnidirectional radiation pattern is needed.

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sign can produce wider bandwidth, but has bad performances at low frequencies. In [11], the antenna design can produce wider bandwidth, but has bad performances at high frequencies. This thesis proposes biconical antenna with the designed antenna is expected to have $R_L \leq -10$ dB, gain $G \geq 1$ dB and the antenna can work on 0.8 GHz to 3.3 GHz of the frequency range.

1.3 Objective

The objectives of this thesis is design and realization an antenna that has wider bandwidth, omnidirectional radiation pattern, and light design but the antenna robust to the strong wind. Then, analyze the antennas structure and the antenna parameters characteristics to make sure it is accordance with the minimum requirements for MCRBS.

This study is expected to support the post-disaster wireless networks especially in designing antenna for the MCRBS system and become the foundation for the next research especially in antenna design for future post-disaster communication networks.

1.4 Scope of Work

This thesis focuses on the design and realization of the biconical antenna for MCRBS. The material of OCAB antenna is brass metal to providing a good performance to deliver electromagnetic waves. The antenna is designed and simulated using CST Studio 2017. This thesis does not discuss the MCRBS system, but only focuses on the MCRBS antenna. In this thesis, the antenna design work at an operating frequencies of 2G–5G in 0.8-3.3 GHz. This thesis design the antenna with $R_L \leq -10$ dB for transmit and receive signals with good performance. This thesis design the antenna with gain $G \geq 1$ dB to cover large areas. This thesis design the antenna with omnidirectional radiation pattern to cover all direction of radiations. This thesis measure the proposed antenna not tested at post–disaster area and the anechoic chamber.

1.5 Expected Results

The biconical antenna is an antenna that can produce wide bandwidth to cover 2G, 3G, 4G services to the 5G. The proposed biconical antenna has an omnidirectional radiation pattern in order to serve telecommunication devices from all

direction. So that, the performance of the antenna is accordance to the MCRBS system requirements.

1.6 Research Method

This thesis is divided into four work packages (WPs) to produce high-quality results.

1. WP1: Calculate the antenna dimension for MCRBS antenna
   In this WP, this thesis calculate the initial dimensions of an antenna using an empirical formula.

2. WP2: Design and simulate MCRBS antenna
   The calculation of dimensions from WP1 are used to be designed using CST Studio 2017. This WP also optimize the antenna dimension for achieve the specification of MCRBS.

3. WP3: Performance evaluations
   This thesis realize the antenna has been simulated in WP2 and measure the performances of realize antenna.

4. WP4: Real-field experiment
   This thesis perform a real-field experiments of communications and evaluate the bit error rate (BER) and frame error rate (FER) to measure the effectiveness of the proposed OCAB antenna compared to the omnidirectional monopole antenna.

1.7 Structure of Thesis

The rest of this thesis proposal is organized as follows:

CHAPTER 2: BASIC CONCEPTS

This chapter describes the basic concept of the ultra wide band antenna, including the study of biconical antenna, and link budget analysis.

CHAPTER 3: DESIGN OF ANTENNA FOR MCRBS

This chapter consist of MCRBS parameters, antenna configuration, and optimization the performance for MCRBS antenna.

CHAPTER 4: PERFORMANCE EVALUATIONS

This chapter discusses the performance of evaluations the simulated and realized antenna.

CHAPTER 5: CONCLUSION

This chapter concludes all the discussion and analysis of this thesis, so that it can useful to the development of post-disaster area communications.