UNIVERSITI TEKNOLOGI MARA

GSM BTS IMPLEMENTATION USING OPEN SOFTWARE AND HARDWARE

MOHD KHAIRUL IZWAN BIN CHE SOH

Dissertation submitted in partial fulfilment of the requirements

for the degree of

Master of Science (Computer Networking)

Faculty of Computer and Mathematical Sciences

December 2012

ABSTRACT

This thesis highlights the current achievements of open-source community developers in the area of building GSM-enabled communication in terms of its hardware and software. The main objective of this thesis is to build a GSM telephone network at much lower complexity and cost as compared to conventional GSM network. The combination of the ubiquitous GSM air interface with VoIP backhaul can form a new type of cellular network that could be deployed and operated at substantially lower cost than existing technologies in the developing world. This research is carried out by OpenBTS running in place of USRP that implements Um maps the GSM traffic and control signals to Asterisk to simulate communication through voice calls and SMS between GSM handsets. The end product is a novel cellular network that can be installed and operated at about ten percent the cost of current technologies, but is compatible with most of the handsets that are already in the market today. Potential applications include rural or village telephony and text messaging, cellular coverage in remote areas, rapidly deployable emergency communications, network emulation and handset testing, law enforcement and security operations. This study has given an account of Software Defined Radio and the reasons for the widespread use of open source software and hardware. Essentially, these findings enhance the understanding of the GSM network. This study also serves as a base for future studies of Software Defined Radio. The methods used for this research may be applied to another location that needs GSM communication elsewhere in the world. There are several improvements that can be made for future work such as adding power amplifier and better antenna to extend the coverage, adding an FXO / FXS card to host computer for PSTN connectivity, using an external clock generator for better stability and performing real world implementation in rural area.

ACKNOWLEDGEMENT

In the Name of Allah, Most Gracious and Most Merciful

Alhamdulillah, First and foremost I would like to thank Allah S.W.T for giving me a still functioning body and mind in order to live life and learn particularly to work on my dissertation project, hereby completing my Master's studies.

I must give my high, respectful gratitude to my supervisor, Prof. Dr. Saadiah Yahya for her guidance, supervision and help throughout this project. I have learned a lot throughout this semester, with many challenging yet valuable experiences in order to complete this task. My endless thanks to my coordinator, Dr. Zolidah Kasiran for giving me the chance to explore a new knowledge of mine, as well as for giving me precious advices in order to improve myself to become a better person.

I would love to express my eternal appreciation towards my beloved parents and family who have always been there for me no matter where I am, for all unconditional supports and patience. Thank you for being ever so understanding and supportive.

I would like to thank my dear friends and colleagues, especially fellow students and lecturers of Master of Computer Networking for contribution to the success of the project in term of support, guidance, and valuable comment. It has been great to know all of you during my time here in the UiTM Computer Science Faculty.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Overview

This study emphasizes the concepts and methodology of low-cost GSM Base Transceiver Station (BTS) implementation based on Open Base Transceiver Station (OpenBTS) which is built around a Software Defined Radio (SDR) connected to a PC running on Linux OS for baseband processing. The PC runs OpenBTS that implements a GSM air interface (Um) and maps the GSM traffic and control signals to Asterisk VoIP gateway which can connect the calls to the external world. The analysis of GSM traffic and control signals which is in the gsmtap packet format is done using Airprobe, Wireshark and RF Explorer.

Global System for Mobile Communications (GSM) is a standard set developed by the European Telecommunications Standards Institute (ETSI) to describe technologies for second generation (2G) digital cellular networks. GSM technology is the most widespread communication technology across the world, linking over four billion devices (Guifen GU and Guili Peng, 2010).

Software Defined Radio (SDR) is a technology that changes the software without changing the hardware to implement different communication systems. Universal Software Radio Peripheral (USRP) is an SDR intended to be a comparatively inexpensive hardware platform for software radio. USRP connect to a host computer through a Gigabit Ethernet link which the host-based software uses to control the USRP hardware and transmit or receive data. All USRP products are controlled by the open source Universal Hardware Device (UHD) driver. USRP are commonly used with the