GSM RADIO NETWORK PLANNING AND IMPLEMENTATION

NUR HAZWANI BINTI ZAIDOON

This report is submitted in partial fulfillment of the requirements for the award of Bachelor of Electronic Engineering (Telecommunication Electronics) With Honours

Faculty of Electronic and Computer Engineering
Universiti Teknikal Malaysia Melaka

April 2009

UNIVERSTI TEKNIKAL MALAYSIA MELAKA

FAKULTI KEJURUTERAAN ELEKTRONIK DAN KEJURUTERAAN KOMPUTER

BORANG PENGESAHAN STATUS LAPORAN

PROJEK SARJANA MUDA II

Tajuk Projek : GSM RADIO NETWORK PLANNING AND IMPLEMENTATION

Sesi Pengajian : 2005/2009

Saya NUR HAZWANI BINTI ZAIDOON

(HURUF BESAR)

mengaku membenarkan Laporan Projek Sarjana Muda ini disimpan di Perpustakaan dengan syarat-syarat kegunaan seperti berikut:

1. Laporan adalah hakmilik Universiti Teknikal Malaysia Melaka.
2. Perpustakaan dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan dibenarkan membuat salinan laporan ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. Sila tandakan (√) :

☐	**SULIT***	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	**TERHAD***	(Mengandungi maklumat terhad yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☑	**TIDAK TERHAD**	

Disahkan oleh:

_____ (TANDATANGAN PENULIS)

_____ (COP DAN TANDATANGAN PENYELIA)

Alamat Tetap: 10, JLN CEMPAKA 6
TMN CEMPAKA
48200 SERENDAH
SELANGOR

Tarikh: 30th APRIL 2009

Tarikh: 30th APRIL 2009

"I hereby declare that this report is the result of my own work except for quotes as cited in the references."

Signature : .....

Author : NUR HAZWANI BINTI ZAIDOON

Date : 30th APRIL 2009

"I hereby declare that I have read this report and in my opinion this report is sufficient in terms of the scope and quality for the award of Bachelor of Electronic Engineering (Telecommunication Electronics) With Honours."

Signature : .....

Supervisor's Name : CIK NURMALA IRDAWATY BINTI HASSAN

Date : 30th APRIL 2009

To beloved mom and dad

ACKNOWLEDGEMENT

Alhamdulillah, all Praise to thank to Allah SWT the Almighty for giving me an opportunity to finish my Project Sarjana Muda successfully. Special thanks to my supervisor, Cik Nurmala Irdawaty Hassan for giving me a full support and patiently supervising my progress during this project and all Celcom (M) Bhd Mobile Access Department's staff for giving their full support, experiences sharing and cooperation during the project. I also would like to thank my beloved friends for their support and friendship for the whole four years since I've been in UTeM. Last but not least, I would like to thank my family especially my parents for their encouragement and advices.

ABSTRACT

This purpose of this project is to build-up a new Global System for Mobile communications (GSM) radio network area that having high traffic density. The new network will overcome this traffic congestion problem and provide enough capacity with good grade of service. The main objective of this project is to provide an optimum solution in term of cost, traffic capacity and grade of service. Planning process begins with traffic analysis to determine the problem and design the new radio network. The design should consist of capacity, frequency and coverage planning. Capacity is planned based on channel utilization and it will provide enough capacity cater the overloaded of its utilization. Frequency planning is done to set a new frequency to the new radio network to enable the connection between the new network and existing network. The frequency need to plan wisely to avoid interference with the other sites or radio network. Then, coverage planning is done to provide good handover to neighbor cells. Then the system will implement and optimize to observe its performance. Optimization is done by tilting the antenna direction or adjusting the frequency. The system will be tuned until it meet users requirement.

ABSTRAK

Projek ini bertujuan untuk membina rangkaian radio Global System untuk komunikasi telefon bimbit (GSM) yang baru dikawasan yang mempunyai kepadatan trafik yang tinggi. Rangkaian radio yang baru ini akan mengatasi masalah trafik yang berlebihan dan menyediakan kapasiti rangkaian yang cukup dengan kualiti servis yang baik. Objektif utama projek ini adalah untuk menyediakan penyelesaian yang optimum dari segi kos, kapasiti trafik dan kualiti servis. Proses merancang dimulakan dengan analsis kepadatan trafik untuk mengenalpasti masalah dan mereka rangkaian radio yang baru. Rekaan ini terdiri daripada merancang kapasiti, frekuensi dan liputan. Kapasiti dirancang berdasarkan pengunaan saluran dan ia akan menyediakan kapasiti yang cukup untuk menampung lebihan beban pengunaan saluran berkenaan. Perancangan frekuensi pula dilakukan untuk membolehkan komunikasi diantara rangkaian radio yang baru dengan rangkaian radio yang sedia ada. Frekuensi perlu dirancang dengan baik untuk mengelakkan pertindihan dengan frekuensi rangkaian radio yang lain. Selepas itu, perancangan liputan dilakukan untuk menyediakan interaksi yang baik dengan rangkain bersebelahan. Sistem akan dilaksanakan dan ditalakan untuk memerhatikan keberkesanannya. Talaan dilakukan dengan mengubah arah antena atau mengubah frekuensinya. Sistem akan ditalakan sehingga memenuhi kehendak pelanggan.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BTS	-	Base Transceiver Station
TCP	-	TEMS Cell Planner
TI	-	TEMS Investigation
TRX	-	Transceiver
TCH	-	Traffic Channel
SDCCH	-	Stand Alone Dedicated Control Channel
GoS	-	Grade of Service
SDP	-	Site Design Packages
GSM	-	Global System for Mobile
RF	-	Radio Frequency
CCH	-	Control Channel
BCCH	-	Broadcast Control Channel
MS	-	Mobile Station / Mobile Subscriber
GMSK	-	Gaussian Minimum Shift Keying
SIM	-	Subscriber Identity Module
BSC	-	Base Station Controller
MSC	-	Mobile Switching Network
TC	-	Transcoder
TCSM	-	Transcoder and Submultiplexer
BSS	-	Base Subsystem
NSS	-	Network Switching Subsystem
NMS	-	Network Management Subsystem
LoS	-	Line of Sight

CDD	-	Cell Design Data
QoS	-	Quality of Service
EIRP	-	Effective Isotropic Radiated Power
PLMN	-	Public Land Mobile Network
HPBW	-	Half-power Beamwidth
MAP	-	Mobile Access Planning
MAI	-	Mobile Access Implementation
TXP	-	Transmission Planning
CME	-	Civil, Mechanical and Electrical
SIP	-	Site Identification Package
SIF	-	Site Identification Form
BoQ	-	Bill of Quantity
LoA	-	Letter of Award
MAO	-	Mobile Access Optimization
VSAT	-	Very Small Aperture Terminal
MCMC	-	Malaysia Communications and Multimedia Commission
GPS	-	Global Positioning Systems
ARFCN	-	Absolute Radio Frequency Channel Number
VSWR	-	Voltage Stand Wave Ratio

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

Chapter 1 will give a brief idea on the project. This chapter consists of project overview, objectives, problem statement, project scope, and methodology and thesis organization.

1.1 Project Overview

The increases in the number of mobile subscribers in certain area caused traffic congestion and poor signal quality. In order to meet the requirements of that particular area, the radio network must offer sufficient coverage and capacity. The radio network planning process begins with the investigation of new network requirements. Then, site survey will be done to the possible site to set up new Base Transceiver Station (BTS). The process proceeds with coverage and capacity planning for that area and the installation of the equipments. The last stage of the process is optimization that will improve the performance of the new radio network. The goal is to achieve as much coverage as possible with optimal capacity and low cost. This project will use TEMS Cell Planner (TCP) for frequency and coverage planning and TEMS Investigation (TI) for drive test.

1.2 Objective

The aims of this project are:

i. To identify the problems that usually happened in real radio network.
ii. To provide optimum solution in terms of cost, capacity, coverage and signal quality.

1.3 Problem Statement

In Kuala Lumpur, the number of mobile subscribers increase drastically caused by the increasing number of population. This condition results traffic congestion since the existing network cannot provide enough capacity for users to make a call especially during peak time (working hours). Thus, the need for more installed capacity is rising. To provide more capacity for certain area, the possible solutions are installing more Transceiver (TRX) on the existing BTS or implementing additional radio network or BTS.

For urban area, the problem is how to locate the new BTS since there are many obstacles such as high building that will absorbs or reflects the signal. Besides the frequency planning also become important because there are many existing radio network in urban area. So the frequencies need to be plan wisely to avoid signal interference that will reduce service quality.

1.4 Project Scope

The project will focus on site planning and implementation. Site planning is consists of coverage prediction and frequency planning using TEMS Cell Planner. Coverage planning will predict the path loss and radio wave properties while frequency planning is designing the cell patterns and re-use distance to reduce interference. At the

same time there will be a research on capacity dimensioning such as traffic calculation, Traffic Channel (TCH) and Stand Alone Dedicated Control Channel (SDCCH) usage and Grade of Service (GoS). Besides, there will be a study on types and characteristics of suitable antenna for the new network. System optimization will not be cover in this report.

1.5 Methodology

The planning part starts with traffic and coverage analysis, information about the geographical area and the expected need of capacity. Drive test also will be done to determine the actual problem of that area. Using the data from traffic and coverage analysis, a nominal cell plan will produce. Nominal cell plan contains the information such as number of sector, antenna height, location of the new station (latitude and longitude) and antenna direction. The next stage is site survey and the survey will consider the nearby obstacles, space for radio equipment and transmission link. The survey will come out with the actual planned data (antenna height, antenna direction, suitable location). After the site survey, the process will proceed with coverage prediction and frequency planning using planning tools (TEMS Cell Planner).

The implementation part will start with Site Design Packages Survey (SDP). This survey contains the material requirements and the actual position of radio equipment after the new structure (tower or monopole) built. After that, the new antenna system will install and commission using the frequency assigned during planning process. When the site is on-air, system tuning is done. This process will check the system performance and determine whether the site meet customers requirement with good grade of service. If the new system does not meet the objective, some parameter will be change. Drive test will run again to make sure the problem is solved.