UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE PLANNING OF HANDOVER IN 4G TECHNOLOGY

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Electronics Engineering Technology (Telecommunications) with Honours.

by

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DECLARATION

I hereby, declared this report entitled “The Planning of Handover in 4G Technology” is the result of my own research except as cite in references.

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Bachelor's in Electronics Engineering Technology (Telecommunications) (Hons.)). The member of the supervisory is as follow:

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Mr. Win Adiyansyah Indra

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ABSTRAK

Teknologi mudah alih generasi keempat (4G) telah menjadi salah satu inovasi penting dalam bidang komunikasi. Pembangunan teknologi generasi keempat (4G) yang berlaku hasil daripada teknologi sebelumnya seperti generasi pertama (1G), generasi kedua (2G) dan generasi ketiga (3G). Kelebihan generasi keempat berbanding teknologi sebelumnya adalah ia mempunyai kadar pemindahan data yang lebih tinggi dan rangkaian tanpa wayar. 4G adalah sambungan data tulen. Terdapat dua jenis piawaian 4G iaitu Long Term Evolution (LTE) dan Worldwide Interoperability for Microwave Access (WiMax).

Untuk OFDM (teknologi akses 4G) kualiti dan keupayaan perlu dirancang dengan garis panduan yang betul untuk mengelakkan kerugian atau gangguan perkhidmatan. Untuk mengelakkan masalah seperti Handover yang dijalankan dalam industri telekomunikasi. Handover boleh dikelaskan kepada Hard Handover dan Soft/Softer Handover. Pelaksanaan Soft Handover boleh meningkatkan kualiti dan prestasi keupayaan. Terdapat dua jenis antena umum iaitu antena omnidirectional dan antenna directional. Antena sectoral adalah sejenis antena directional yang digunakan dalam stesen pangkalan. Kajian ini melibatkan kajian asas handover untuk rangkaian selular, perancangan handover dalam teknologi 4G dan jenis antena akan digunakan oleh penghantar Base Transceiver Station (BTS). Handover itu perancangan dijalankan dengan menggunakan perisian yang dipanggil Atoll RF planning tools.

ABSTRACT

The fourth generation mobile technology (4G) has been one of the important innovation in communication field. The development of the fourth generation (4G) technology happens due to previous technology such as first generation (1G), second generation (2G) and third generation (3G. The advantages of fourth generation compared to previous technologies are it have a higher data transfer rate and 4G wireless network is a pure data connection. There are two type standard of 4G which id LTE and WiMax.

For OFDM (access technology of 4G) the quality and capacity should be planned with proper guidelines in order to avoid loss or interruption of service. In order to avoid such problem the handover conducted in telecommunication industries. The handover can be classified into hard handover and soft/softer handover. The implementation of soft handover can increase the quality, and capacity performance. There are two general type of antenna which is omnidirectional antenna and directional antenna. Sectoral antennas are a type of directional antennas that used in the base station. This research involve the basic study of handover for the cellular network, the planning of handover in 4G technology and the types of antenna will be used by base transceivers station (BTS). The handover planning conducted by using software called Atoll RF planning tool.

DEDICATION

To my beloved parents

Bidzani Bin Abdullah and Timani Binti Puteh

To my supervisor

Mr. Win Adiyansyah Indra

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LIST OF ABBREVIATIONS, SYMBOLS, AND NOMENCLATURE

1G	First Generation
2G	Second Generation
3G	Third Generation
4G	Fourth Generation
HSPA+	High Speed Packet Access
WiMax	Worldwide Interoperability for Microwave Access
LTE	Long Term Evolution
TM	Telekom Malaysia
HSDPA	High Speed Downlink Packet Access
TDMA	Time Division Multiple Access
FDMA	Frequency Division Multiple Access
CDMA	Code Division Multiple Access
SC-FDMA	Single Carrier-Frequency Division Multiple Access
OFDMA	Orthogonal Frequency Division Multiple Access
QOS	Quality of Services
OFDM	Orthogonal Frequency-Division Multiplexing
PAPR	Peak-To-Average Power Ratio
MS	Mobile Station
TBS	Target Base Station
HHO	Hard Handover
SHO	Soft Handover
SBS	Serving Base Station
UL	Uplink

DL	Downlink
GSM	Global System for Mobile Correspondence
UMTS	Universal Mobile Telecommunications Service
UE	User Equipment
UTRAN	Universal Terrestrial Radio Access Network
W-CDMA	Wideband Code Division Multiple Access
MRC	Maximal-Ratio Combining
RNC	Radio Network Controller
SNR	Signal-To-Noise Proportion
SMS	Short Message Service
MMS	Multimedia Messages
EM	Electromagnetic
EBG	Electromagnetic Bandgap
FSS	Frequency Selective Surface Layer
ECCD	Electromagnetically Coupled Coaxial Dipole
AP	Access Points
PAN	Personal Area Networks
HPBW	Half Power Beam Width
VLF	Very Low Frequency
LF	Low Frequency
HF	High Frequency
VHF	Very High Frequency
RFID	Radio-Frequency Identification
MIMO	Multiple-Input and Multiple-Output
WLAN	Wireless Local Area Network
WMAN	Wireless Metropolitan Area

LTE-A	LTE-Advanced
GP	Genetic Programming
MSPs	Mobile Service Providers
TCO	Total Cost of Ownership
MNOs	Mobile-Network Operators
OPEX	Operational and Capital Expenditure
DRGs	Digital Raster Graphics
USGS	United States Geological Survey
RSSI	Received Signal Strength Indicator
ASU	Arbitrary Strength Unit

CHAPTER 1
INTRODUCTION

1.0 Research Background

Cellular system was an advanced system, because this system divides an area in a small cell. It is used to ensure that the frequency can be extended to reach to all parts in certain areas so that multiple users can use their mobile phones simultaneously without pause and without falter. While most of us are used to getting high speed Internet connections at home, the workplace or even the local coffee shop. With the fourth-generation wireless, 4G the promise is that you can get real mobile broadband to go.

As we know, there are three type of 4G technologies in Malaysia which is Long Term Evolution (LTE), Evolved High Speed Packet Access (HSPA+), and Worldwide Interoperability for Microwave Access (WiMAX). HSPA+ (Evolved HSPA) has a theoretical download high rate at 168Mbps and it is technically classified as 3.75G which is one step right before 4G. Next, the download peak of WiMAX at 128 Mbps and is offered by the Malaysian telcos YES and P1. Besides, LTE has a theoretical download peak 100Mbps but 4G LTE in technical is 3GPP LTE. Even though the theoretical speed is lower than HSPA+ and WiMAX, but 4G LTE fastest. The 4G LTE is same in speed to the home broadband plans in Malaysia. The true 4G is normally reachs the standards is now known as LTE Advanced, with speed for download is 1 Gbs which in range of 10 times higher than the current LTE. For the information, Maxis, DiGi, and Celcom are serving 4G LTE services in Malaysia. 4G LTE officially launched in Malaysia earlier in year 2013 and the coverage and support are very limit. Maxis launched the 4G LTE service in Malaysia for the first with offered speeds is up to 75 Mbps, it's followed by Celcom

then DiGi. Recently, TM (Telekom Malaysia) has declared its step towards being a 4G LTE provider in the future. One of the application of 4G is virtual presence where the connection must always on to keep people in connection. Another applications of 4G in ordinary life is traffic control, mobile phone and sensor on public vehicles. In addition, their 4G plans are much same with HSDPA (High Speed Downlink Packet Access), a technology which is from 3G.

Nowadays, all people are continuously used their cellular phones and they wants more high quality connectivity at all times. So, in order to have a good quality of services, the handover technique is use for consistent communication. Handover is the technique for exchange an ongoing call (voice) from one channel connected to another channel. There are two type of handover which is soft handover and hard handover. Hard handover is the channel in the source cell is unconnected and only then the channel in the target cell is connected or called break-before make. So, the base stations send the link with the mobile back and forth and it is known as 'ping-ponging'. Now, the hard handover is no more use. Hard handover is supported by Frequency Division Multiple Access (FDMA), Code Division Multiple Access (CDMA) and Time Division Multiple Access (TDMA). (Emuoyibofarhe et al. 2012).

Soft handover, which the channel in the source cell is held then utilized for a while in parallel with the channels are in target cell. Soft handovers can be include using connections to more than two cells which connections to three, four or more cells that can be maintained by one phone at the meantime. In OFDM, the soft handover was essential which used make-before-break method. This is due to OFDM users in the same cell share the same frequency spectrum at the same time. For instance, if the pilot signal is from a new base station is stronger than the threshold value of T_ADD (Adding threshold), it establish a new link to the base station while keeping the original existing link. For this situation, the call are in soft handover condition.

1.1 Problem Statement

There are different types of challenges in the planning of handover in 4G technology. From network provider's view, it would be simpler for them to investigate those issues by using a specially designed troubleshooting tool or with improvements to the existing tools. This research will analyses and propose better planning in handover for 4G technology which is focusing on the required network capacity and quality of services (QoS). The finding from this research is included the network parameters such as transmit power, type of antenna use and antenna height.

1.2 Objectives

i. To study the planning of the 4G network that provides optimum topology.
ii. To investigate the planning of handover which the network service will provide the good quality signal to the customers.
iii. To identify the types of antenna will be used to get a good signal.

1.3 Scope

In this research, the focus is mainly to the soft handover with refer to the overall performance because soft handover is very essential and important aspect of Orthogonal Frequency-division Multiplexing (OFDM). Soft handover effect strict requirement to control power and making capacity enhancement by adding a new cell as easy as no frequency planning in necessary. The soft handover includes configuring the network resources and parameters in a method that provides a good performance to users referring to quality of handover. A selected location for this research is a suburban area (small city) which is Bukit Baru, Melaka. There are four main network provide in this selected location which is Celcom, Maxis, Digi, U mobile which cover 2G, 3G and 4G.

1.4 Research Design

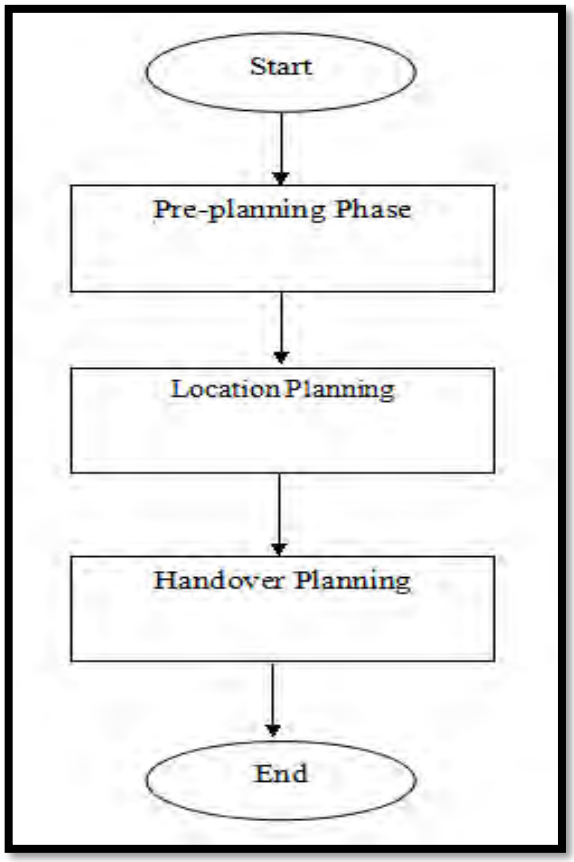

Figure 1.1: The flow chart of Handover Planning Procedures

In pre-planning phase, the basic network configuration parameters are investigated. While in the location-planning phase involved the research area, and the possible location to set up the Base Station are investigated. The location of the research area will be find by the digital map which the information about the point location will be save on that. The digital map will give detailing major road arteries, other points of interest and accurate representations of a particular area. Based on a digital map, the computer simulation will identify the different possibilities to set up the radio network by using some of optimization algorithms. The aim is to achieve a soft handover which is important to gain a good quality of network coverage. The important of handover is depend on the traffic and the capacity. The traffic is determine a quality of services (QoS) while the capacity

determines the population of people in the selected location. After that, the third phase is handover planning. In this phase, the simulated results will be analyses and compare with last analysis until the expected results is achieve.

1.5 Importance of the Research

A focus goal of this research which is handover is to make sure that there always has a network connection in the old Base Transceiver Station (BTS) as the new Base Transceiver Station (BTS) that has ability to control the network connection without any disturbance or connection loss. This method always enhance a good performance for the network. In OFDM, usable bandwidth is divided into a big number of smaller bandwidths using fast Fourier transforms (FFT). One of the benefit feature of this technique is easy for adaptation to different bandwidths. If the bandwidth smaller, unit can remain fixed, even the total bandwidth is changed. Handover consider when a mobile changes its frequency. The main concern about the handover is to make sure that the connection of network is always function without any connection loss. Therefore, all the mobile user can use their telephone where ever they are with a good network connection.

1.6 Conclusion

As a conclusion, this research is mainly focused on the concept of Handover Planning. Handover is very important to avoid the connection loss and to fulfill the people need because the growth in cellular technology increase nowadays. There some people always complaint about the disrupt problem due to traffic. So, this research purpose better solution for stated problem and it carried out by follow the procedure or flow chart. Last but not least, his chapter also discuss about the important of this research to all mobile phone users.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

This chapter will cover a basic introduction of LTE technology and types of handover in cellular network. Besides that, this chapter will view the differences between the type of each handover which are hard handover, soft handover and softer handover of a cellular network. In addition, this chapter also explained the handover of cellular network from 2G until 4G. Next, the explanation about the type of antenna is discuss in this chapter. Last but not least, a detail explanation about network planning is also included in this chapter.

2.1 LTE-A Network Planning Overview

To be able to plan and implement a cost efficient high quality cellular mobile wireless network, very careful radio network planning procedure should be done. Thus, the planning process will carried out in phases and each phase is well documented. The radio network planning procedure needs a good knowledge about the coverage area, propagation environment, traffic load and it also need services in order to analyses the network and to choose the optimal radio network planning strategy. In fact, all the aspects above are not constant and fluctuate in time and it will makes the radio network planning a nonstop process which requires constant monitoring and optimization.

The radio network planning is a technique to define different steps, like measurements, planning, documentation, and so on. It should be done in variety phases to

manage the connections among coverage, capacity and interference. The coverage, capacity or QoS were not possible to maximize simultaneously, but all of them should be optimized in order to get a cost-efficient high quality radio network. To give necessary coverage and, at the same time, optimize capacity and quality, the radio network planning can be participated into three main phases as illustrated in Figure 2.1. These phases can be utilized from initial deployment of the radio networks to their evolution and more to development.

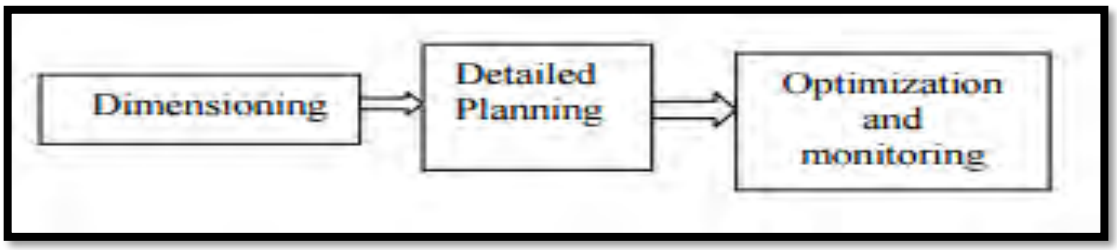

Figure 2.1: Radio System Planning Process Phases

2.1.1 Dimensioning Phase

In the first phase, dimensioning, the planned network configuration was analyzed and an appropriate radio network deployment strategy was defined**.**

2.1.2 Detailed Planning

In second phase, detailed planning, the detailed design and real implementation of the radio network was done. In this phase there are three step which is: