UNIVERSITI TEKNIKAL MALAYSIA MELAKA

THE PLANNING OF HANDOVER IN 3G TECHNOLOGY

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor's Degree in Electronic Engineering Technology (Telecommunication) (Hons.)

By

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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 Degree in Electronics Engineering Technology) (Telecommunications) (Hons.). The member of the supervisory is as follow:

Mr. Win Adiyansyah Indra
(Research Supervisor)

ABSTRAK

Generasi ketiga (3G) teknologi mudah alih telah menjadi salah satu inovasi yang penting dalam bidang komunikasi. Pembangunan teknologi generasi ketiga (3G) yang berlaku hasil daripada generasi pertama (1G) dan generasi kedua (2G). Generasi pertama (1G) yang digunakan untuk telefon mudah alih analog. Piawaian generasi pertama (1G) adalah Total Access Communication System (TACS), Nordic Mobile Telephone (NMT) dan Advanced Mobile Phone Service (AMPS) yang berbeza mengikut zonlokasi. Kemudian, generasipertama (1G) teknologi digantikan dengan teknologi generasi kedua (2G). Generasikedua (2G) Teknologi yang digunakan untuk telefon mudah alih digital, yang dengan piawaian seperti Global System for Mobile Communications (GSM), Personal Digital Cellular (PDC), dan digital AMPS (D-AMPS). Kelebihan teknologi generasi ketiga (3G) berbanding teknologi sebelumnya ialah ia mengandungi multimedia digital dengan kadar penghantarandata yang tinggi, mampu melakukan lebih banyak panggilan.

Untuk W-CDMA (teknologi akses 3G) kualiti dan kapasiti perlu dirancang dengan garis panduan yang betul untuk mengelakkan kerugian atau gangguan perkhidmatan. Untuk mengelakkan masalah tersebut Handover dilakukan dalam industri telekomunikasi. Handover boleh dikelaskan kepada Hard Handover dan Soft/Softer Handover. Pelaksanaan Soft Handover dapat meningkatkan kualiti, prestasi dan keupayaan komunikasi. Prinsip Handover digunakan dalam perancangan kajian ini.

Kajian ini melibatkan W-CDMA bersama-sama dengan perancangan Handover dalam teknologi 3G. Perancangan Handover dilakukan dengan menggunakan perisian yang dipanggil Atoll RF planning tool.

ABSTRACT

The third generation mobile technology (3G) has been one of the important innovation in communication field. The development of the third generation (3G) technology happens due to previous technology such as first generation(1G) and second generation(2G). For the first generation (1G) technology used for analogue mobile phones. The standards of first generation (1G) are Total Access Communication System(TACS), Nordic Mobile Telephone(NMT) and Advanced Mobile Phone Service(AMPS) which varied according to location. Then, the first generation (1G) technology replaced by second generation technology (2G). The second generation(2G) technology used for digital mobile phones, which with standards such as Global System for Mobile Communications (GSM), personal digital cellular (PDC), and digital AMPS (D-AMPS). The advantages of third generation(3G) technology compared to previous technologies are it brings digital multimedia handsets with high data transmission rates, capable of providing much more than basic voice calls.

For W-CDMA (access technology of 3G) the quality and capacity should be planned with proper guidelines in order to avoid loss or interruption of service. In order to avoid such problems 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. The principle of handover considered during the planning of 3G networks.

This research involves the basic study of W-CDMA architecture along with the planning of handover in 3G technology. The handover planning conducted by using software called Atoll RF planning tool.

DEDICATION

To my beloved parents

Sukumaran A/L Chellappah Pillai and Saradha A/P Narayanan

To my supervisor:

Mr. Win Adiyansyah Indra

ACKNOWLEDGEMENT

I would like to thank my parents and friends for giving me support from the beginning of this research until the research is completed. Special thanks to my supervisor, Mr. Win Adiyansyah Indra for guiding me along the research's progression.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

1G	First Generation
2G	Second Generation
3G	Third Generation
4G	Fourth Generation
TACS	Total Access Communication System
NMT	Nordic Mobile Telephone
AMPS	Advanced Mobile Phone Service
GSM	Global System for Mobile Communication
D-AMPS	Digital Advanced Mobile Phone Service
PDC	Personal Digital Cellular
W-CDMA	Wideband Code Division Multiple Access
CDMA	Code Division Multiple Access
TDMA	Time Division Multiple Access
FDMA	Frequency Division Multiple Access
BS	Base Station
UMTS	Universal Mobile Telecommunications System
FDM	Frequency Division Multiplexing
SMS	Short Message Service
CSD	Circuit Switch Data
PS	Packet Switching
CS	Circuit Switching

HSCSD	High Speed Circuit Switch Data
GPRS	General Packet Radio Service
GMSK	Gaussian Minimum Shift Keying
NE	Network Element
BSC	Base Station Controller
MS	Mobile Subscriber
GGSN	Gateway GPRS Support Node
SGSN	Serving GPRS Support Node
MSC	Mobile Switching Centre
PSTN	Public Switch Telephony Network
EDGE	Enhanced Data Rate for GSM Evolution
WiMax	Worldwide Interoperability for Microwave Access
LTE	Long-term Evolution
UE	User Equipment
UTRAN	Universal Terrestrial Radio Access Network
RNC	Radio Network Controller
3GPP	3rd Generation Partnership Project
CEPT	Conference on European Post and Telecommunications
HLR	Home Location Register
IMT	International Mobile Telecommunications
MMS	Multi Media Service
QoS	Quality of Service
VLR	Visitor Location Register
RAN	Radio Access Network
<	Less than
>	More than

CHAPTER 1
INTRODUCTION

1.1 RESEARCH BACKGROUND

Cellular phone networks have been growth in their usage due to the widespread improvements in 3G technologies. After the rapid growth of 3G technology, the number of smart phone user increases dramatically. In Malaysia, Huawei Technologies collaborating with Telekom Malaysia became the pioneer 3g operator of Malaysia. The Huawei Telekom has made a success in the soft launch of its pre-commercial W-CDMA network in Malaysia. The network only covers the city of Kuala Lumpur. The Ericsson (NASDAQ:ERIC) become one of the Malaysia's popular mobile operator, Maxis Communications Berhad (Maxis), to develop its WCDMA/HSPA network ensure the operator to provide residential wireless broadband services to all states and cities on mainland Malaysia.

According to the Malaysian Communications and Multimedia Commission (MCMC), 47 per cent Malaysians 3G subscribers own more than 1 mobile phone, which are more than 15 million subscribe to 3G.Therefore, people are continuously used their cellular phones, and always expect to have high quality connectivity at all times. In order to provide the good service, handover is essential for consistent communication. Handover is one of the important technique to enhance the performance of network. Handover is the process that transfers an ongoing call from one cell to another when a user moves through the coverage area of a cellular.

The handover can be classified into two types. The first one is the hard handover. Hard handover is supported by TDMA, FDMA, and CDMA systems. Hard handover is a break-before make method, means a new channel is set up after the release of the old channel. On the other hand, for hard handover a certain amount of margin may be introduced to remove the ping-pong effect. In a W-CDMA cellular network, the soft handover is essential, which used make-before-break method. This is due to W-CDMA users in the same cell share the same frequency spectrum simultaneously. For instance, if the pilot signal 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 existing link. For this situation, the call is said to be in soft handover.

1.2 PROBLEM STATEMENT

There are different types of challenges in the planning of handover in 3G technology. From network provider's point of 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 3G technology, which is strongly driven by the required network capacity and quality of service. These considerations in turn influence network parameters such as transmit power and antenna height.

1.3 OBJECTIVES

i. To study the planning of the 3G network that provides optimum topology.
ii. To investigate the planning of handover which the network service provider satisfy their customers with good quality of signal.
iii. To identify the W-CDMA is best choice for implementation of soft handover.

1.4 SCOPE

In this research, the focus is mainly on the soft handover with respect to the overall network performance because soft handover is a very essential and important aspect of W-CDMA system. Soft handover causes strict requirement to power control and makes capacity enhancement by adding a new cell very easy as no frequency planning in necessary. The soft handover involves configuring the network resources and parameters in a way that guarantee performance for the end users according to the quality of handover.

1.5 RESEARCH DESIGN

The planning of handover in 3G technology process can be categorized into different phases. The first phase is the pre-planning phase. In this phase requirement of services and basic network configuration parameters are investigated. Next, the second phase is location-planning phase. In this phase, the research area, and possible location to set up the base station are investigated. The data identified whether related to the geographical properties and the assumed traffic volumes at various point of the area will be incorporated into a digital map, which comprises of different size of pixel that keeps all the information about the location point. Based on the digital map, computer simulation will identify the different possibilities to set up the radio network by using some of optimization algorithms. The main goal is to achieve soft handover. The important consideration of handover depends on the traffic and the capacity. The traffic determines the quality of service, whereas the capacity determines the population of people in selected location. Then, the third phase is called handover planning. In this phase the simulated results will be analysed and compared with previous analysis until the expected results is achieved.

The process of Handover Planning Procedure is illustrated in the flow chart below:

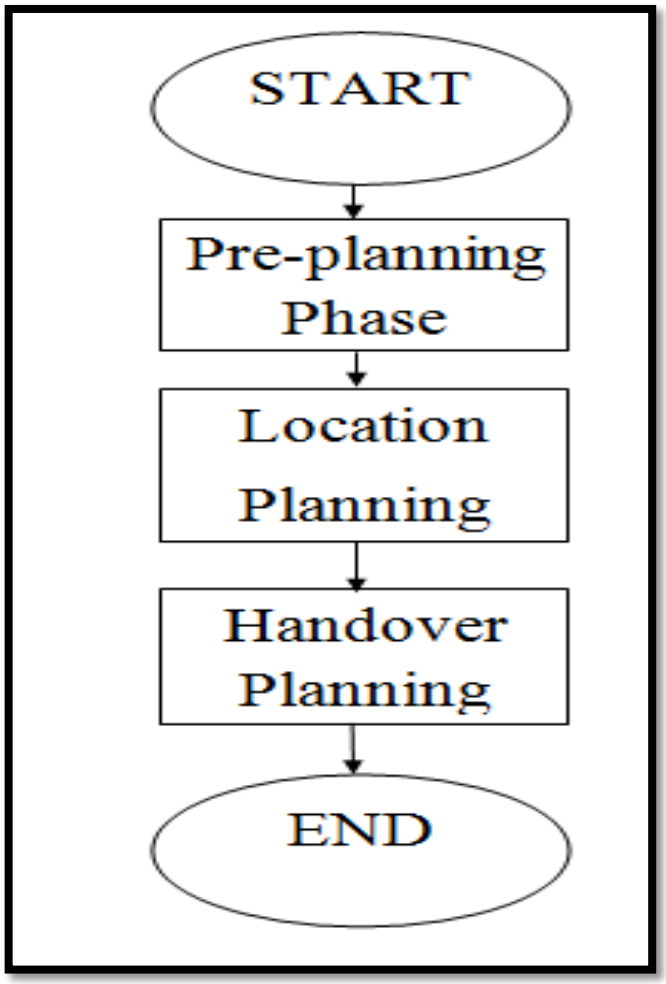

Figure 1.0 : Flow chart of Handover Planning Procedure

1.6 IMPORTANCE OF THE RESEARCH

In UMTS W-CDMA system share the same frequency band between all cells. This means the bandwidth is utilised efficiently. Therefore, the frequency reuse happens to differentiate the signal, which consists of the similar frequency. The Handover situation considered when a mobile change its frequency. The main concern of a handover is to make sure that there is always has network connection with the old Base Station (BS) as the new Base Station (BS) that has ability to control the network connection without any connection loss. This method always maintaining a network connection without any disturbance with one or more Base Station (BS) simultaneously. So that, the mobile user can continue their telephone conversation even though they are travelling.

1.7 CONCLUSION

As a conclusion, this research is mainly focused on the concept of Handover Planning. The rapid growth in cellular technology causes too many cellular users. Therefore, the telephone network always facing some disrupt problem due to traffic. This research purpose better solution for stated problem. This research carried out by following certain processes. Not enough than that, this chapter also discussed about the important of this research to all mobile phone users.

CHAPTER 2
LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will cover a basic introduction of UMTS technology and types of handover in cellular network. In addition, the history of evolution of cellular network also included in this chapter. Besides, this chapter also explained the growth of cellular network from 1G until 4G. Last but not least, a detail explanation about network planning is also included in this chapter.

2.2 OVERVIEW OF UMTS

The planning of UMTS is a difficult task. In order to make the planning task simpler, the planning problem is usually categorised into three sub problems. The sub problems are the access network planning, the core network planning, and the cell planning. There are two methods to solve these problems, which are sequential method and global method. For sequential method, the problems are considered separately, whereas more than one problem considered at a time for global method (Mohammad Reza Pasandideh.2011).

This chapter study about the evolution of cellular network. Besides, this chapter also study the literature in the scope of UMTS network planning, based on handover in the context of sequential method and global method. Firstly, the sequential method identified and all the problems in detail. Then, present the works in solving of each problem in terms of method and algorithm. After that, the global method discussed and present related works in literature review.

2.3 EVOLUTION OF CELLULAR NETWORK

The history of mobile telephony began in 1920's with the use of radiotelephony by the police department in United States. Initially, the equipment were big and phones were not good with obstacles and buildings. In 1930 the frequency modulation (FM) were introduced. It made successful radio communications in battlefield during world war II. In 1940s the first mobile telephony was introduced with limited capacity and manoeuvre. Then, the mobile communications development continued for years to become commercial as we have it today.

The term of generation is used to differentiate the significant technology improvement in cellular network, which resulted in major changes in wireless industry. The first generation (1G) of cellular network was introduced in late 1970s, followed by the second generation (2G) in early 1990s, the third generation (3G) in early 2000 and the fourth generation (4G) nowadays. These growth happen due to the changes from analogue to digital technology, implementing new multiplexing and access techniques, employing new codes and frequencies, introducing IP as a substitution for legacy transmission methods and many other innovations resulted in networks with more services, higher capacity, speed and security (M.Hemanth,T.Mounish Kumar &T.Rishitha Reddy. 2014). In the following section will explain further on different generations of cellular networks and discuss their specifications.

2.3.1 1G CELLULAR NETWORK

The first generation (1G) network was developed in Chicago in 1978 and established in 1983. The advanced mobile phone service (AMPS) technology used in 1G, and it operated in 800MHz band. In Japan, the AMPS technology used in 1979 and they developed Nordic Mobile Telephony (NMT) technology in 1981. It operated in 450MHz and 900MHz band. Besides, the UK used new version of AMPS called Total Access Communication System (TACS), which with 900MHz band. For

1G technology. Frequency Division Multiplexing (FDM) used to separate spectrum into portion called channels. The channels were allocate only one user. Therefore, combination of all these technologies developed 1G cellular network which were only offering analogue voice service (Amit Kumar ,Dr.Yunfei Liu ,Dr. Jyotsna Sengupta, Divya.2010).

The geographical area of network classified into small segments called cell. Based on this theory, the term cellular phone derived. The 1G cellular networks were not suitable with each other due to standards of each network. In addition, networks had problems with frequency use, security, roaming and power. These weakness causes a very low penetration of 1G cellular networks and it became the reason to develop the second generation (2G) networks (M.Hemanth,T.Mounish Kumar &T.Rishitha Reddy. 2014).

2.3.2 2G CELLULAR NETWORK

The second generation (2G) networks were based on digital communication, and developed in early 1990s. For 2G it used shifting technology from analogue to digital. The shifting technology developed the quality, cost, capacity, power, speed, security and quantity of service. For 2G cellular networks, several types of technologies were improved as 1G cellular networks. The 2G depending on the multiplexing technique. The multiplexing technique divided the 2G into three main groups, which are Time Division Multiple Access (TDMA), Code Division Multiple Access (CDMA), Frequency Division Multiple Access(FDMA). For TDMA, the Global System for Mobile Communication (GSM) and Interim Standards 136 (IS-136) are key 2G system. Whereas, Interim Standards 95 (IS-95) is key for 2G system based on CDMA. Most of the 2G standards are GSM (TDMA-based), which originated from Europe but it employed in the majority countries around the world. Now it consists more than 80 of all subscribers around the world. Approximately 60 GSM operators are using CDMA2000 within the 450 megacycle per second band CDMA450 (Mishra, Ajay K.2014).