

MEASURING SERVICE QUALITY OF IP DATA OVER UMTS NETWORK

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To

My Beloved Mother, Father, Brothers and Best friend Salem.

and to

*the Souls of ever one who helped me and
devoted their lives towards protectively of Islam .*

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In the name of Allah, Most Gracious, and Most Merciful

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ABSTRACT

Third Generation (3G) services are becoming more and more required by the users for high demanding for higher data rate transfer. In order to ensure that, in the end, the subscriber is served with a proper Quality of Service, certain measurements must be performed. However, the key to have a right evaluation of such services requires a proper definition of the performance indicators that is related to that service. In this project, we present the analysis and performance to data service application (HTTP) aiming to identify the performance of a real WCDMA (Wide Code Division Multiple Access)-mobile telecommunication networks based on live 3G network. We will provide the analysis of the results that are obtained during WCDMA field measurements and some of the statistical measurements that were recorded during the test as well. The network was tested and the data was collected by using QVOICE as a measurement tool. In addition, we will illustrate the impact of some mechanisms that may have effect on the service performance such as coverage. Finally, based on the evaluation results, we provide a set of recommendations that might help to improve the service and fulfill the user's requirements.

Abstrak

Perkhidmatan 3G merupakan teknologi yang amat diperlukan pada masa kini terutamanya kepada pengguna yang memerlukan kadar pemindahan data yang pantas. Untuk menjayakan penyelidikan ini, satu pengukuran telah dilaksanakan supaya semua pelanggan mendapat satu tahap bersesuaian dipanggil “Quality of Service” (QoS) yang memadai. Akan tetapi, untuk mendapat satu skema yang sesuai untuk menilai pengukuran tersebut, pemilihan definisi bagi penilaian tertentu yang tepat mesti ditentukan dengan teliti. Dalam kajian penyelidikan ini, menganalisa dan perbandingan terhadap aplikasi perkhidmatan data (HTTP) untuk menentukan keupayaan WCDMA dalam pergerakan jaringan telekomunikasi yang berdasarkan kepada 3G jaringan yang “hidup”. Seterusnya, keputusan analisis keupayaan bagi bidang WCDMA dan pengukuran secara statistik telah direkod semasa dalam pengujian tersebut. Di samping itu, jaringan ini telah diuji dan kesemua data telah direkod dengan menggunakan alat penguji; “QVOICE”. Tambahan pula, faktor-faktor yang akan mendatangkan kesan kepada perkhidmatan yang sedang dikaji akan turut dibincangkan seperti kawasan liputan. Akhir sekali, berpandukan kepada keputusan yang diperolehi; senarai cadangan akan dikemukakan supaya perkhidmatan kini dapat dipertingkatkan untuk memenuhi kehendak para pengguna pada masa yang akan datang.

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LIST OF ABBREVIATIONS

ASCII	
1G	First Generation
2G	Second Generation
3GPP	Third Generation Partnership Project
AMPS	Advanced Mobile Phone service
APN	Access Point Name
CDMA	Code Division Multiple Access
CN	Core Network
CS	Circuit Switching
ETSI	European Telecommunications Standards Institute
FDMA	Frequency Division Multiple Access
FTP	File Transfer Protocol
GMM	GPRS Mobility Management
GMSC	Gateway MSC
GPRS	General Packet Radio Service
GPS	General Position System
GSM	Global Service Mobile
HLR	Home Location Register
HO	Handover
HTTP	Hypertext Transfer Protocol
IMT2000	International Mobile Telecommunication 2000
IP	Internet Protocol
ITU	International Telecommunication Union
KPI	Key Performance Indicator

MO	Mobile Originated
MT	Mobile Terminated
NMT	Nordic Mobile Telephone
Oper.	Operator
PDP	Packet Data Protocol
PDU	Packet Data Unit
PLMN	Public Land Mobile Network
PS	Packet Switching
QoS	Quality of Service
QVM	QVOIC Mobile
QVP	QVOIC Presentation
RAB	Radio Access Network
RAN	Radio Access Network
SGSN	Serving GPRS Support Node
SQL	Structured Query Language
TACS	Total Access Telecommunication System
TDMA	Time Division Multiple Access
TE	Terminal Equipment
UE	User Equipment
UMTS	Universal Mobile Telecommunications Services
UTRAN	UMTS Terrestrial Radio Access Network
VLR	Visit Location Register
WCDMA	Wide Code Division Multiple Access

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CHAPTER 1

INTRODUCTION

1.1 Project Background

Figure 1.1 shows the evolution paths starting from the 1st generation up to the 3G systems. The first generation systems provided voice transmissions only using frequencies around 900 MHz. These 1st G systems used analogue modulation and provide only for voice transmission. Second generation (2G) GSM (Global System for Mobile Communications) provides voice and limited data services and uses digital modulation with improved audio quality. So-called '2.5G' has introduced the whole advanced upgrades for the 2G networks. These upgrades may in fact sometimes provide almost the same capabilities as the planned 3G systems [1]. The new third generation (3G) known as Universal Mobile Telecommunications System (UMTS) or IMT-2000 has introduced real time applications such as video conferencing and games.

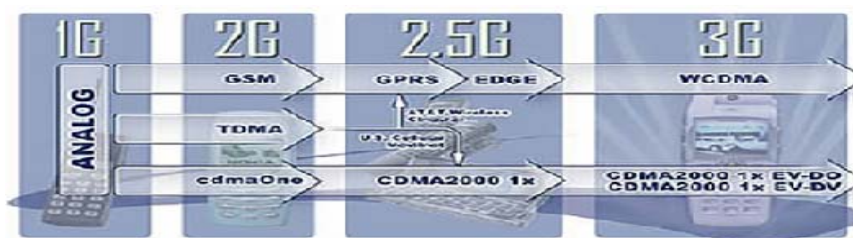


Figure 1.1 3G Evolution Path

The Universal Mobile Telecommunications Systems as specified by the Third Generation Partnership Project (3GPP) was formally adopted by the ITU as a member of its family of IMT-2000 Third Generation Mobile telecommunications Standards. Figure 1.2 illustrates the frequency spectrum of the 3G mobile communication.

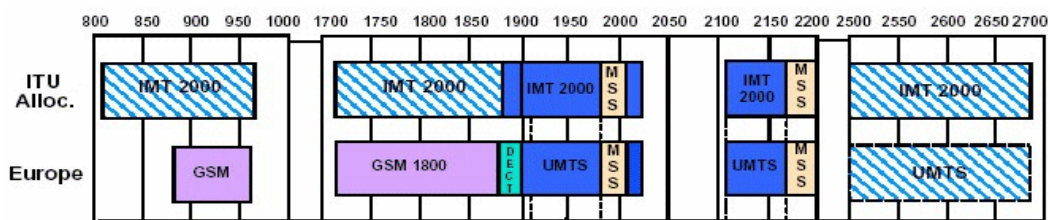


Figure 1.2 Frequency Allocations for IMT 2000

The UMTS spectrum allocated in Europe is already used in North America. The 1900 MHz range is used for 2GT services, and 2100 MHz range is used for satellite communications. Regulators are trying to free up the 2100 MHz range for 3G services, though UMTS in North America will still have to share spectrum with existing 2G services in the 1900 MHz band. 2G GSM services elsewhere use 900 MHz and 1800 MHz and therefore do not share any spectrum with planned UMTS services [1].

Some of the operators here in Malaysia have introduced the 3G services catching up with the latest technology in the mobile communication. The need of understanding the architecture and the components that were deployed in the 3G networks is very essential in order ,eventually, to ensure that the network is working up to the standards that are recommended by 3GPP. Further more, the techniques such as WCDMA is much needed to have a good evaluation of the network which is the target of this project.

1.2 Objective

This project is aiming to identify the performance of a real WCDMA (Wide Code Division Multiple Access)-mobile telecommunication networks based on live 3G network. This will be concluded in measuring the performance of the UMTS network in terms of UMTS Quality of Service (QoS) for IP data. With a proper defining of the key performance indicators, a good evaluation can be obtained from the user's end of view. In addition to this, an analysis will be given based on the data that has been collected during the drive test.

1.3 Scope of the project

In this research, we present the analysis and performance to data service application (HTTP). We will provide the analysis of the results that are obtained during WCDMA field measurements and some of the statistical measurements that were recorded during the test as well. The network was tested and the data was collected by using QVOICE as a measurement tool. In addition, we will illustrate the impact of some mechanisms that may have effect on the service performance such as coverage. The main scope of this research can be summarized in the following points:

- Providing a proper study of 3G performance based on quality of services for live Network.
- Analysis and performance to data service application (HTTP) to identify the performance of real WCDMA Network by using QVOICE.

1.4 Project Methodology

This research is divided into two parts. The first part involved the data collection part and the second one is the analysis part. The data was collected by the use of the QVOICE as a measuring tool. Figure 1.3 shows the two parts of the QVOICE. Part (a) illustrates the data acquisition part which is used to collect the data lively during the drive test. The drive test was done at different time of the day in KL and PUTRA JAYA. The test was conducted for two Malaysian operators which will be noted as operator A and operator B.



Figure 1.3 (a) QVM data collection part (b) QVP data analysis part

The drive test involved the drive test in urban area where the client is accessing the live UMTS Network in Malaysia and recording the data from the air interface. The test was done during morning session, afternoon session (Peak hours), and night session. The average speed of the car is 80 Km. the client is a mobile piece Sagem OT290 which establishes the connection to the public server via live UMTS network. The QVM receives the location information from an external GPS receiver.

During the data evaluation part, once the data has been transferred to QVP for evaluation, it can be imported into database. Data of no interest can be filtered out during the import. All the evaluations are made by querying the relational database using SQL commands. Figure 1.4 illustrates the flow chart of the methodology.

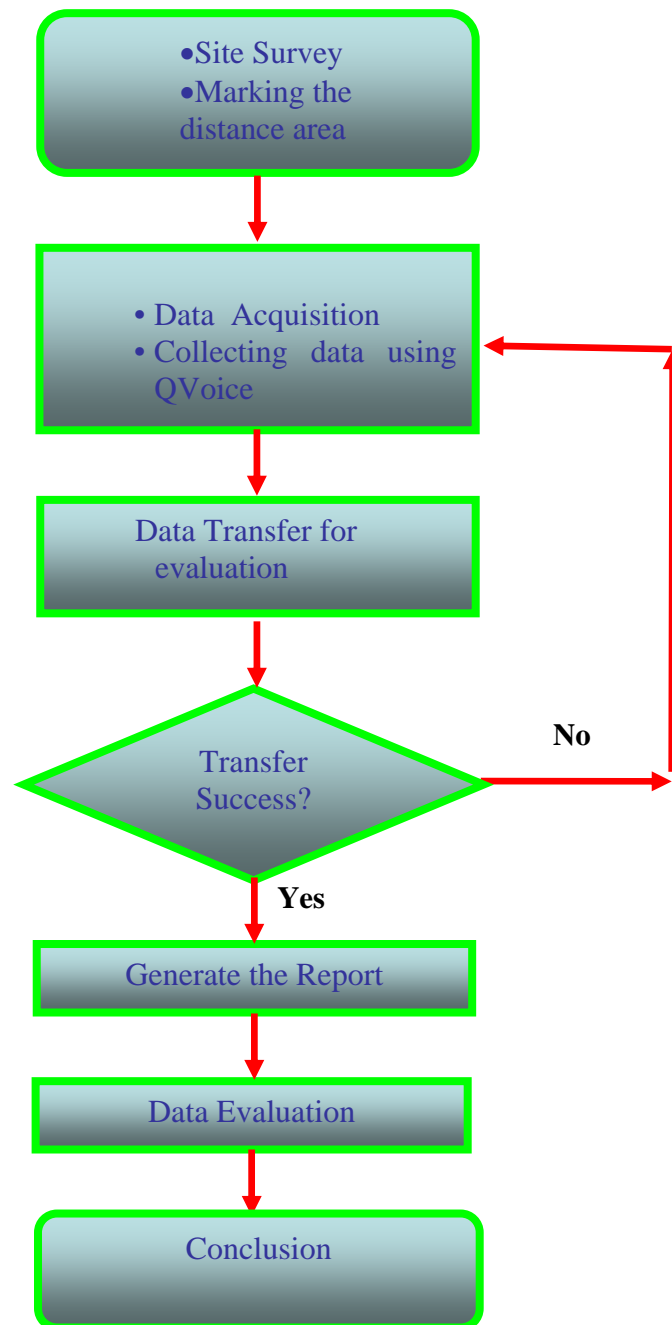


Figure 1.4 flow chart of the network evaluation

1.5 Thesis outlines

This research is organized into 6 chapters that cover the research completely which are entitled measuring the service quality of the IP data over UMTS network.

In chapter 1, some brief history of the mobile communication has been introduced, especially third generation mobile system. In addition to this, the objective and the scope of the research have been described. Finally, the flow chart of how the work of this project has been carried out was also illustrated.

While in chapter 2 and 3 was mainly introducing literature review of this work. A study case on the 3^{PPPPPPPrd} network architecture and the functions of its components that have been introduced in the 3rd generation systems. Besides all this, general investigation on how the quality of service can be measured according to 3GPP standards. Further more, a related work that has been carried out on the evaluation of the UMTS network was also covered in this chapter.

In chapter 4, the sequence procedure of how the test was carried out and the preparation before the drive test was started was also introduced in this chapter. Some of the statistics that have been extracted from the recorded data has been illustrated to show the pre-evaluation of the network.

Chapter 5 shows the analysis of the data collected during the drive test by the use of the analysis component of the QVOICE. This can lead us to some mechanisms such as the coverage and its effect on the radio environment.

Finally, an evaluation on the network performance can be made based on the analysis part and conclusion can be summarized and future work is proposed to enhance the recent work.