PROCESS AND YIELD IMPROVEMENT FOR HSDPA MODEM COLLABORATION WITH CUBIC ELECTRONICS SDN BHD

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ABSTRACT

This thesis will study performance of the product using the HSDPA technology which known as HSDPA Modem. The rapid growth of third generation (3G) telecommunications systems has created the need for getting new test equipment as well as getting measurement techniques up and running in a very short time. In fact, HSDPA (High-Speed Downlink Packet Access) is one example of a packet-based mobile telephony protocol that used in 3G UMTS (Universal Mobile Telecommunication System) radio networks to increase data capacity and speed up transfer rates. Nowadays the growth of the electronic gadgets especially in digital wireless communication is clearly newer on our market. Due to this success, more and more engineers and manufactures are already involved in developing and installing components and systems. Furthermore, to reduce time-to-market, a fundamental issue in a more and more competitive market, they also need to test their designs in a very short time to maintain and optimize the networks carefully. As to ensure the product is significant improved from its transmission quality, the suitable measurement method must be done before the product is launched into the market. Therefore, Cubic Electronics Sdn Bhd must ensure High Speed Downlink Packet Access Modem satisfies the requirement standard before launch in marketing. Trying to satisfy this exigency, a new measurement method for testing High Speed Downlink Packet Access Modem is proposed here for Cubic Electronic Sdn Bhd (CESB). The study will be focused on the development of test procedure for HSPDA Modem using CMU200 Universal Radio Communication Analyzer with directly remoted by CMUgo software application.

ABSTRAK

Tesis ini akan membincangkan tentang kebolehan produk yang menggunakan teknologi *HSDPA* yang dikenali sebagai *HSDPA Modem*. Pertumbuhan yang amat pesat dalam sistem telekomunikasi iaitu *3G(Third Generation)* telah melahirkan alat-alat pengujian yang terbaru dimana teknik yang digunakan boleh mendorong kepada pengurangan dari segi masa. Secara faktanya, *HSDPA* merupakan salah satu contoh protokol telefon mudah alih berasaskan paket dimana ia telah menggunakan aplikasi *3G UMTS* iaitu rangkaian radio yang berkemampuan untuk meningkatkan lagi kapasiti data dan juga kadar kelajuan pemindahan data. Masa kini pertumbuhan alat-alat elektronik terutamanya pengeluaran dalam bidang komunikasi tanpa wayar semakin berkembang pesat dalam pasaran. Bermula dari titik ini, ramai jurutera dan kilang menggembleng tenaga bersama-sama untuk menghasilkan produk baru yang lebih canggih. Tambahan pula, isu masa amat dipandang berat oleh semua pihak kerana pengurangan masa dalam proses penghasilan produk mampu memberi saingan di pasaran, jadi mereka mestilah merancang secara bijak cara yang paling sesuai untuk menguji produk tersebut tanpa mengambil masa yang lama. Untuk memastikan produk ini adalah berkualiti tinggi dari segenap segi, satu langkah pengujian mestilah dilakukan keatas produk ini sebelum ia dipasarkan. Justeru Cubic Electronic Sdn Bhd (CESB) mestilah memastikan produk yang telah dihasilkan iaitu High Speed Downlink Packet Access Modem menepati piawai yang telah ditetapkan sebelum dipasarkan. Untuk memenuhi keperluan ini, satu cara pengukuran yang sesuai untuk menguji High Speed Downlink Packet Access Modem akan dicadangkan kepada Cubic Electronic Sdn Bhd. Kajian ini akan difokuskan kepada pengujian keatas alat HSDPA Modem menggunakan *CMU200 Universal Radio Communication Analyzer* bersama aplikasi perisian *CMUgo*.

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LIST OF ABBREVIATION

ACK	-	Acknowledge Character
ACLR	-	Adjacent Channel Leakage Ratio
ADSL	-	Asymmetric Digital Subscriber Line
AMPS	-	Advanced Mobile Phone System
ARQ	-	automatic repeat request
AWGN	-	additive white Gaussian noise
CDM	-	Code Division Multiplexing
CDMA	-	Code Division Multiple Access
CESB	-	Cubic Electronic Sdn. Bhd.
CF card	-	Compact Flash Reader
CQI	-	Channel Quality Indicator
CSD	-	Circuit Switch Data
CS Data Rate	-	Circuit Switch Data Rate
dB	-	Decibel (Unit)
DIMM	-	Dual Inline Memory Module
DPCCH	-	Dedicated Physical Control Channel
DPDCH	-	Dedicated Physical Data Channel
DPCH	-	Dedicated Physical Channel
DSSS	-	Direct-sequence spread spectrum
DUT	-	Device under test
ETSI	-	European Telecommunications Standards Institute
EGPRS	-	Edge General packet radio service
FCCH	-	Frequency Correction Channel
FRC	-	fixed reference channel
GERAN	-	GSM EDGE Radio Access Network

GPIB	-	General Purpose Interface Bus
GPRS	-	General packet radio service
GSA	-	Global mobile Suppliers Association
GSM	-	Global System for mobile communication
HSDPA	-	High Speed Downlink Packet Access
HS-DSCH	-	High-speed downlink shared channel
HS-PDSCH	-	High Speed Physical Downlink Shared Channel
HS-SCCH	-	High Speed Shared Control Channel
HS-DPCCH	-	High Speed Dedicated Physical Control Channel
IEEE	-	Institute of Electrical and Electronics Engineers
IP-PBX	-	Internet Protocol & Private Branch Exchange
IR	-	Incremental Redundancy
ISO	-	International Organization for Standardization
I/O	-	Input Output
kbps	-	Kilo bit per second
LAN	-	Local Area Network
MAC	-	Media Access Control
Max	-	Maximum
Mbps	-	Mega Bit Per Second
MMS	-	Multimedia Message Service
Modem	-	Modulator and Demodulator
ms	-	Mili second
PCI	-	Payment Card Industry
P-CPICH	-	Primary Common Pilot Channel
PS Data Rate	-	Packet Switch Data Rate
QAM	-	Quadrature amplitude modulation
QPSK	-	Quadrature Phase Shift Keying
RF	-	Radio Frequency
RNC	-	Radio Network Controller
R&S	-	Rohde & Schwarz
SEM	-	spectrum emissions mask
SF	-	Spreading Factor
Sip & VoIP	-	Session Initiation Protocol & Voice over Internet Protocol

SIM	-	Subscriber Identity Module
SMS	-	Short Message Service
TS	-	Technical Specification
TTI	-	transmission time interval
TDM	-	Time Division Multiplexing
UE	-	User Equipment
UMTS	-	Universal Mobile Telecommunications System
UTRA OVSF	-	UTRA uses Orthogonal Variable Spreading Factor
WCDMA	-	Wideband Code Division Multiple Access
WIFI	-	a trademark of the Wi-Fi Alliance for certified products based on the IEEE 802.11 standards
WiMax	-	Worldwide Interoperability for Microwave Access
2G	-	Second generation
2GB	-	2 Giga Byte
3G	-	Third Generation
3.5G	-	Evolution from Third generation
3GPP	-	3rd Generation Project Partnership

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CHAPTER I

INTRODUCTION

High Speed Downlink Packet Access in short term as HSDPA known as the latest 3G (Third Generation) technology which can be able to support downlink speed up to 14.4Mbps. Nowadays HSDPA networks are rapidly being deployed. However a little difficulties are existed which is lack of the knowledge about these networks performance and behavior [1]. In this chapter, all details relate to the project are briefly explained.

1.1 Introduction

Mobile network had evolved significantly since these three (3) last decades. As we can see today, there are too many new technologies evolved purposely for our own benefit especially from telecommunication industry. During the last century ago our ancestors neither imagine nor believe that two persons can be communicated personally in a far distance, even able to see each other. Clearly all these impossibility had been false today. Obviously distance is not a matter anymore for people to get communicate when various facilities are provided through telecommunication technologies.

With the following footsteps invention of GSM, GPRS, and UMTS, now HSDPA (High Speed Downlink Packet Access) has stepped forward as the latest

development in mobile radio technology. HSDPA stands for High-Speed Downlink Packet Access, is a new protocol for mobile telephone data transmission which is enhanced through its data transmission speed. In theoretically, HSDPA can achieve data transmission speeds all over 8 to 10 Mbps (megabits per second) which is evolved from Wideband Code Division Multiple Access (W-CDMA) as an existence 3G Protocol. Essentially the standard will provide download speeds on a mobile phone equivalent to an ADSL (Asymmetric Digital Subscriber Line) line in a home, removing any limitations placed on the use of your phone by a slow connection. As proved, HSDPA improves data transfer rate by a factor of at least five over the data transfer is provided W-CDMA. Even through this speed, it is possible for any application that require high data can be transmitted but it focuses to data transmission such as video and streaming music. Meanwhile for video, it will improve the quality of streaming video, while making video downloads much faster. It will either be quicker to get content, or the operators will be able to up the quality, and get rid of some of that unattractive pixelisation that you see even on a 3G connection. While for music no doubt the full albums can be download rather than individual songs. All these possibilities occurred due to different techniques had been applied to the HSDPA. HSDPA slightly improves on W-CDMA by using different techniques for modulation and coding. It creates a new channel within W-CDMA called HS-DSCH, or high-speed downlink shared channel. That channel performs differently than other channels and allows for faster downlink speeds. It is important to note that the channel is only used for downlink. That means that data is sent from the source to the phone. Otherwise it is possible to send data from the phone to a source using HSDPA. The channel is shared between all users which lets the radio signals to be used most effectively for the fastest downloads. The widespread availability of HSDPA may take a while to be realized, or it may never be achieved [2] [3].

Instant of this new technology, all users surrounding by 3G network coverage can access the higher speed rate data through a various ways. To access the internet while user on the move, they will be able if they have the following items; a 3G HSDPA cellular phone, desktop or laptop that support 3G HSDPA Modem or cellular phone 3G HSDPA itself. As the courage, all the operators are upgrading

their 3G networks to HSDPA to feel this higher transmission speed themselves. In addition the 3.5G also had been deployed through the evolution of 3G.

1.2 Objective

This project is purposely to develop the test procedure in order to measure the HSDPA Modem produced by Cubic Electronics Sdn. Bhd. Once test procedure is created, it can be guidance either for engineers or technician at CESB to refer the suitable standard measurement that can be done to test their product HSDPA Modem. Otherwise, the reliability and quality of this product also can be ensured by focusing more into achieve the standard value as well as can. The test procedure can ensure that the device meets a set minimum acceptable standard.

1.3 Scope Of Project

The main scope of this project basically is to study the test facilities meaning that a suitable method to measure the HSDPA modem. Indirectly it involves detail study about the product together with the tester. It is known that the standard measurement also will be studied in order to compare the result obtained at the end of this project. The comparison is obviously to ensure that the product is slightly achieving the regulation standard provided. To perform this HSDPA measurement, CMU200 Universal Radio Communication Analyzer from Rohde & Schwarz will be used as required from CESB team. It is important to find a way to test the product while considering a less cost and short time.

1.4 Problem Statement

HSDPA is making impressive inroads in the commercial service arena today. On September 22, 2006, the Global mobile Suppliers Association (GSA) reported that 121 HSDPA networks had been planned, were being deployed, or had been launched. Moreover, 59 of these already offered commercial HSDPA services.

Likewise, 58 HSDPA devices had been launched as of September 18, 2006 [4]. Numerous operators thus do already, or will soon, offer mobile data services based on HSDPA. To target mobile as well as fixed usage, many operators have also introduced attractive pricing strategies with flat-rate tariffs. In some cases, HSDPA represents the first opportunity for end users to access broadband services when the available fixed broadband access did not cover at certain place [5][6]. Hence it is a challenge especially for telecommunication engineers in finding a way to prove the reliability of the products. The product must be specifically designed based on the standard. It shows HSDPA measurement must be performed in order to determine the quality and efficiency of each product before entering the market.

Currently, Cubic Electronics Sdn. Bhd. did not have the specific standard test procedure for its product HSDPA Modem or also well known as Axia or Fifth Media. As mentioned by the CESB team, this product is a latest design that provided by their customer known as Fifth Media Sdn. Bhd.; sends this product to be assembled and produced to market. A little difficult is found by manufacture, unavailable specific test as required to ensure the product can give a better performance in and out. For time being, a manufacturer duly performs a simple test to this product (HSDPA Modem) such as networking searching testing. When the 3G SIM card is put inside the modem, if there is a signal founded, the product is assumed in a good condition. Normally the signal is hard to be traced inside the manufacturer perhaps due to the factor of network signal from mobile base station. Even the signal can be traced, it still does not show the performance of the HSDPA modem yet based on the standard.

Testing is definitely a cost-avoidance activity. As the HSDPA modem increase in the complexity, requiring more tests, manufacturer must find the strategies that will keep rising test cost downs. One approach is to design products that can be tested more efficiently. Another is to adopt test equipment with new architectures, faster measurement and calibration techniques that can increase throughput and lower costs. Therefore, this study will help others to determine the best test procedure solution that in line with the standard regulation.