TNI Journal of Engineering and Technology
Vol.3 No.1 January-June 2015

Optimization Channel Control Power in Live UMTS Network

Thananan Numatti[†‡1], Saiyan Saiyod[‡2]

[†]True move Co.,Ltd
CP LAND, Malivan Rd. Muang District, Khon Kaen 40000, Thailand
[1] Thananan_num@truecorp.co.th

[‡]Department of Computer Science, Faculty of Science, Khon Kaen University
123 Mittapap Rd., Nai-Muang, Muang District, Khon Kaen 40002, Thailand
[2] saiyan@kku.ac.th

***Abstract*— The proposed approach to improvement on the UMTS (Universal Mobile Telecommunications System) network radio, there are many ways we propose another way of reducing power control channel slightly to provide improved signal quality, which is a measure of quality is EcIo (energy per bit) / (Own cell interference +. Noise density) principle when the power control channel down a bit to make the quality better, because the denominator less energy than ever before, and open the extra capacity in the network in the body, this is the reason for the optimization this principle can be applied in a live network.**

It is important to maintain signal quality are durable and resistant to interference. Probability to the good benefits for imply network must be physical tuning coverage complete before and area dense urban or urban is good to the imply this parameter. For area rural should not imply because the cell edge a foot print coverage is too large . However this paper presents a science so that the results can be applied to real work.

***Keywords*— WCDMA, EcIo, RSCP, Power Control, Interference**

I. INTRODUCTION

There are numerous ways to improve the performance [1] UMTS Network(Universal Mobile Telecommunications System)[2] based on the WCDMA(Wideband Code Division Multiple Access) technology is the 3rd generation telecommunication system [3] both physical and parameter in this article are the parameters which will reduce the power control to better signal quality, respectively. WCDMA the operating principles input signals are converted into digital signals. And sent a pass band signal to spread into different frequency band WCDMA technology is used in a wide 5 MHz wideband such features makes WCDMA transmission over. In addition, the WCDMA technology is also suitable for use in the city has a high density and WCDMA has been developed to move forward with technology, HSPA (High-Speed Packet Access), which is a protocol calls were made. To increase the ability to pass on information technology, HSPA is also divided them into 2 standard is HSDPA[4] (High Speed Downlink Packet Access) and HSUPA[5] (High Speed Uplink Packet Access) .HSDPA used a lot in commerce since most users will focus on the current download over HSDPA supports transmission speeds up to 1.8 Mbps - 14.4 Mbps, and is currently being used for HSDPA for dual carrier that can deliver up to 42 Mbps. Tree part the WCDMA system.

-Spreading:[6] is the use of high bandwidth. Due to the large bandwidth it will make a low-density waves.The waves are further divided and information. Each user of the code (code division multiple access).Spreading code using OVSF code ,orthogonal all coder, the size using Spreading Factor[5] (SF),Downlink using SF=4-512and Uplink using SF = 4-256.

-Modulation[6] is digital signal '0', '1' in the maper format binary sequence on the high-frequency carrier using QPSK form downlink and uplink usung BPSK. modulation of the carrier waveform as well as have noise and interference including.This is part transmitted.

-Despreading: [6] Decreasing high speed wideband signal by demodulating(multiplying) with same sequence(same code in the transmitter) used for spreading.In reality the channel is not noise-free but WCDMA system employ Forward Error Correction techniques to combat the effect of noise and enhance the performance of the system .This is part receive.

Principle of the WCDMA network[7] to measurement.

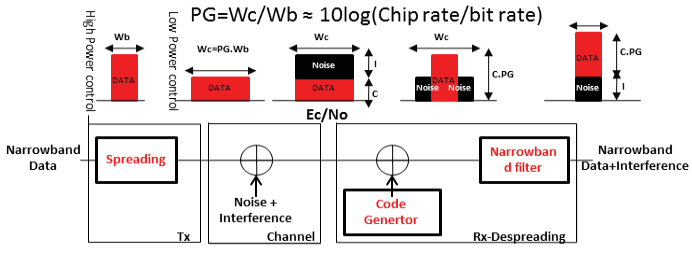

Fig. 1 Principle of Spreading Spectrum WCDMA Network

A. *Eb/No,Unit:dB[8]*

Eb/No is measured at the receiver system and serves to indicate how 's strong of signal to noise ratio (Bit Error Rate and depend with modulation techniques(BPSK, QPSK, etc) Ec/No is positive value .

Eb= Bit Energy.(energy per bit)

No= Noise Spectral Density.(mWatts/Hz)

Definition

Eb/No=Bit Energy on the Spectral Noise Density.

B. Ec/Io,Unit:dB from UMTS Network [8]

Ec/Io is quality radio via measured the ratio of the energy per chip in CPICH power (Chip Energy in the presence of the interference generated by all other user).Ec/Io is negative value

Ec= Chip Bit Energy.(energy per bit)

Io= own cell interference + surrounding cell interference + noise density

Definition

Ec/Io=Bit Energy on the Spectral Noise Density.

Actually Ec/Io and Ec/No has different?

Io = own cell interference + surrounding cell interference + noise density

No = surrounding cell interference + noise density

Because WCDMA system measurement to type CS and PS service than used for Ec/Io should be the correct.

Eb/No in to the baseband after despreading and demodulation per user should be positive value amount of energy on the total noise. Measured at the output of receiver system.

Ec/Io in the free space focus is spread across the spectrum should be have negative value to the ratio of energy on the total noise (Energy is lower than the total interference) then Ec/Io is negative value. Measured at the input of receiver system as well.

C. RSCP Unit:dBm from UMTS Network[8]

RSCP it is stands for Received Signal Code Power from the energy per chip in CPICH power averaged over 512 chips to measured in the downlink /uplink.

Actually RSCP and RSSI has different?

RSCP = Received Signal Code Power measured from receiver (UE)on a particular CPICH power from NodeB station and defined generally for CDMA system.

RSSI=Received Signal Strength Indicator measured for generally all system.Unit:dBm.

Anyway Ec/No relationship with RSCP and RSSI as formula also.

Ec/No= RSCP / RSSI (dB)

Ec/No=10LOG10(CPICH Power/Total Transmit Power)

D. SIR Unit:dB[8]

SIR is the Signal-to-Interference Ratio defined ratio of the energy in dedicated physical control channel bits to the power density of interference and noise from after dispreading as well as require by Rx complete.

Formula the SIR

SNR=Psignal Power/Pnoise

Or we can find as below to easy

SIR=Eb/No - PG

if Eb/No = 5dB

PG = 25dB(12,2kbps)

SIR=5-25

= -20dB or better.

Or at PG =14dB(128kbps)

SIR=5-14

= -10dB or better.

E. PG Unit:dB[9]

PG is Processing gain the ratio of chip rate over data bit rate and related with service bearer rate if service bit rate greater PG is smaller.

PG =10*LOG10(Chip rate/bit rate per user)

if assume user rate =12.2kbps(Voice call) then

PG=10*LOG10(3840000/ 12200)

=25dB

if user rate =128kbps (PS traffic)

PG=10*LOG10(3840000/ 12800)

=14dB

II. UMTS SYSTEM WITH POWER CONSUMETION

CPICH power consume 10% and Control Channel power consume 10 % from total power on the UMTS Network.

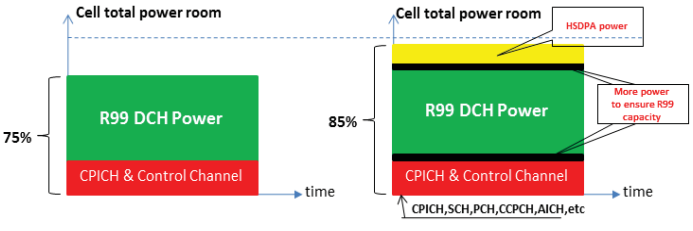

Fig. 2 Power Control Allocation with R99 and HSDPA

Tree part the DL power consists at first part HSDPA physical channel(HS-PDSCH,HS-SCCH) consume total power room 85% second part R99 or DPCH power consume power room 75% and tree part CCH(Common Channel power) consume power 20%.

UMTS have 2 part power control[8] first part is open loop power control is mean RRC(Radio Resource Control)[11] about the access UMTS network and two part is close loop power control is mean RAB(Radio Access Bearer)[12] to get each the service from network such as real time service AMR to conversation ,non real time service is web service etc.

III. WCDMA RADIO INTERFACE CHANNEL

WCDMA Radio Interface Channel have tree interface channel.[13]

A. Physical channel

Layer1 providing the real transmission resource, frequency,code (spreding and scramble) and phase.

1) UL. Physical Channels :

- Physical Random Access Channel(PRACH) uplink common channel to the carry random when access information.
- Uplink Dedicate Physical Data Channel(DPDCH) carry dedicate data coming from layer2 and above coming from DCH about power control.
- Uplink Dedicate Physical Control Channel(DPCCH) carry dedicated control information general in layer 1about power control.

- High Speed Dedicate Physical Channel(HS-DPCCH) it is used to feedback message to HS-PDCSH.

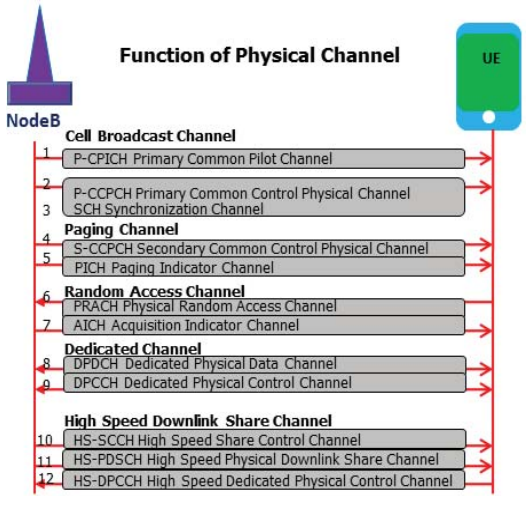

Fig. 3 WCDMA Function of Physical Channel

2) DL. Physical Channels :

- Downlink Dedicate Physical Channel(DPCH) carry dedicate data coming from layer2 to above(coming from DCH).
- Primary Common Control Physical Channel (P-CCPCH) carry BCH transport channel but P-CCPCH not transmitted during the first 256 chip of the slot fixed channel code SF:256,30kbps.
- Secondary Common Control Physical Channel (S-CCPCH) carry FACH and PCH as code SF:4 to 256 not broadcast continuously transmitted but when PCH or FACH information to transmit.
- Synchronization Channel (SCH) for cell search procedure from two sub channel (P-SCH,S-SCH) as well is transmitted at the first 256 chips of every time slot(time slot 0 to 14).
- Page Indication Channel (PICH) carry paging indicators(PI).Used by nodeB to inform UE or group of UEs ,fixed channel code SF:256,30kbps.
- Acquisition Indication Channel (AICH) carry Acquisition Indictor(AI) SF256 as will 16 kinds of signature to generate AI .In form the UE that the network has received access request.
- Common Pilot Channel (CPICH) is physical control channel broadcast to entire the cell and fixed channel code SF:256, 30kbps.
- High Speed Physical Downlink Share Channel(HS-PDSCH) bearing service data and layer2 overhead bits mapper from transport channel fixed at SF16 but can conFigd several code to improvement throughput (transferred in 2ms sub frame)
- High Speed Share Control Channel (HS-SCCH) carry signalling to single UE consist modulation,channel code,transport block site, HARQ process number, redundancy version, new data indicator and UE identity fixed SF128,60kbps based on a sub-frame of length 2ms.

IV. EXPERIMENTATION DESIGN ADN SCENARIO

We designed experiment from EcIo and traffic load[8]

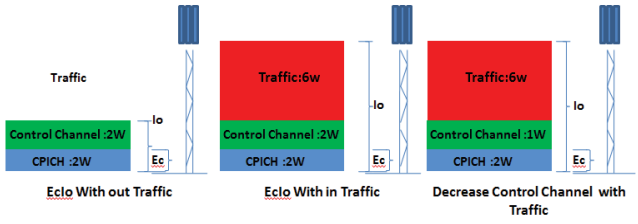

Fig.4 Assume EcIo with out and with in traffic consume 6watt

At EcIo with out traffic
Ec = 2 watt
Io = 0+2+2 =4watt
Ec/Io = 2/4 = 0.5watt; = -3dB
at EcIo with in traffic consume 6watt
Ec = 2 watt
Io = 6+2+2 =10watt
Ec/Io = 2/10 = 0.2watt; = -7dB
Decrease power control channel to optimization
Ec = 2 watt
Io = 6+2+1 =9watt
Ec/Io= 2/9 = 0.22watt; = -6.5dB is good EcIo.

This is methodology to the measurement of decreased Power Control Chanel in Live UMTS Network(UMTS-FDD).
-Network configuration by main operator from table I.
-Chose two site to the cell edge has light load and drive test on the night time.
-One mobility test via Voice long call(VOL) speed 20 km/h.
-Round 1 drive before decrease power control channel.
-Round 2 drive after decrease power control channel.
-Good radio environment from physical tuning foot print.

TABLE I
WCDMA NETWORK CONFIGURATION

WCDMA NETWORK CONFIGURATION AND PARAMETER SETTING		
Carrier Frequency (Downlink/Uplink)		881.6 MHz/836.8MHz
Total power NodeB	43 dBm(20Watt)	43 dBm(20Watt)
Radio of each channel transmission power to NodeB transmission power	CPICH power	33 dBm(2Watt) or (10%)
	PSCHPower	Decrease from -5 to -8dB
	SSCHPower	Decrease from -5 to -8dB
	BCHPower	Decrease from -2 to -5dB
	AICHPowerOffset	Decrease from -6 to -9dB
	PICHPowerOffset	Decrease from -7 to -10dB
	PCHPower	Decrease from -2 to -5dB
Maximum SF code	Code Channel reserv	5
Node B antenna	Frequency Range	824-960 ;1710-2170 MHz
	Gain	18 dBi
	Horizontal BW	65'
	Vertical BW	7'
	Antenna height	45 m

V. ANALYSIS EXPERIMENT RESULT

The result to measurement from drive test coverage RSCP, EcNo, SC, TxPower, SIR before and after decreased power control channel.

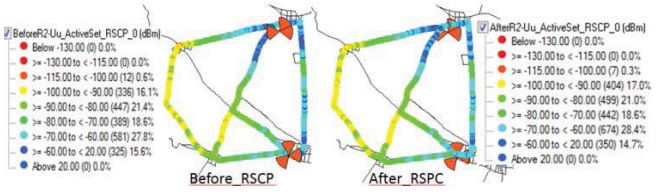

Fig.5 Legend RSCP(dBm) Before and After

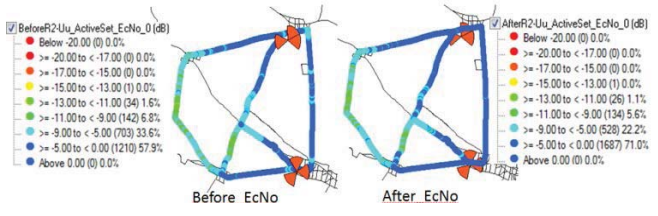

Fig.6 Legend EcNo(dB) Before and After

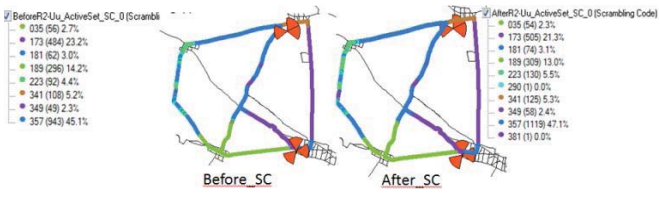

Fig.7 Legend SC Before and After

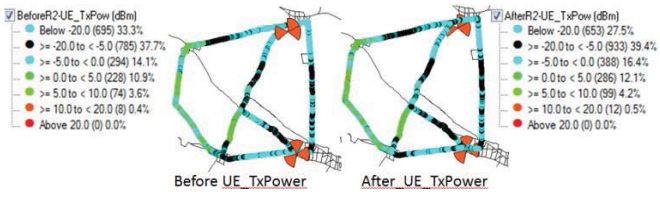

Fig.8 Legend UE_TxPower(dBm) Before and After

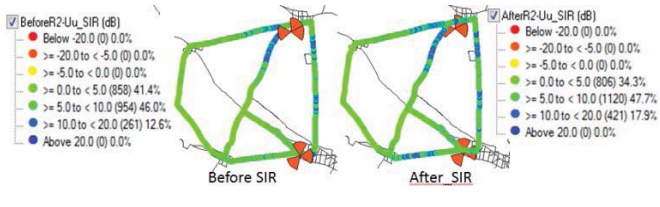

Fig.9 Legend SIR(dBm) Before and After

Describe the optimization for research via decreased power control channel from the legend show result.

Fig.5 RSCP result before left hand and after right hand remain the legend footprint coverage not impact because this research do not adjust cpich power can see Fig.10 as well.

Fig.6 EcIo result the right hand is after decreased power control channel is good quality more than the left hand from definition or can see designed experiment that Ec/Io=Bit Energy on the Spectral Noise Density .The noise lese than energy can see Fig.11 as well.

Fig.7 SC code to the left hand before and right hand after best serving is clamp to remain SC legend.

Fig.8 UE_TxPower the right hand after good more left hand before to save power more than can see Fig.12 as well.

Fig.9 SIR the right hand after good more left hand before too.

Distribution data from Fig.10 to Fig.13

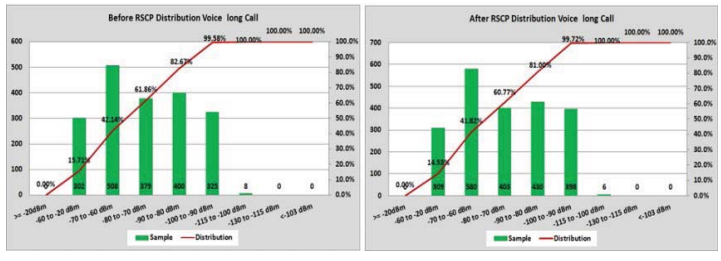

Fig.10 RSCP Distribution

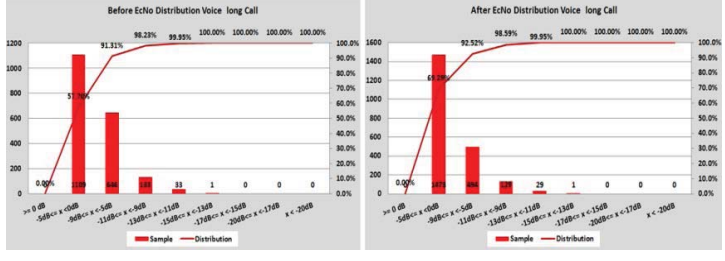

Fig.11 EcNo Distribution

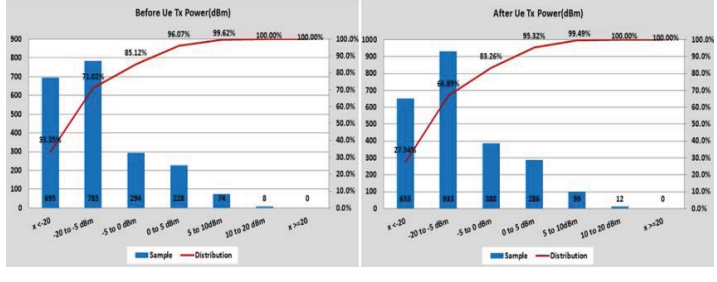

Fig.12 UE TXPower Distribution

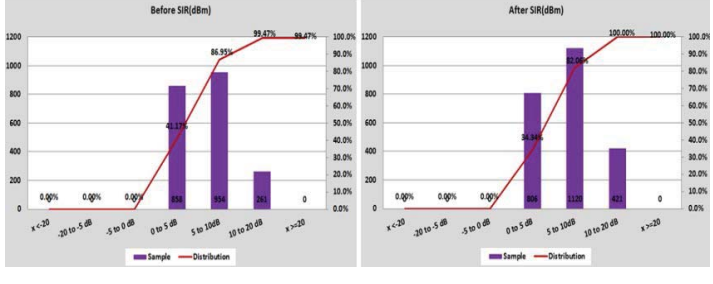

Fig.13 SIR Distribution

We can analysis distribution from Fig.10 the RSCP all rang is remain this paper research aboute improvement EcIo than can see Fig.11 the EcNo range 0 to -5dB before result has 57.7% but after result has 9.29% good more than the left hand. Fig.12 UE_TxPow range -5 to -20 dBm before result has 71.02% but after result has 66.89% good more than the left hand to save energy UE. And Fig.13 SIR remain result before and after.This is analysis result from log file first round drive and second round drive in the live UMTS network from main operator Thailand.

TABLE II
RSCP DISTRIBUTION RESULT

RSCP	Before		After	
Range	Sample	Distribution (%)	Sample	Distribution (%)
>= -20dBm	0	0	0	0
-60 to -20 dBm	302	15.71279917	309	14.53433678
-70 to -60 dBm	508	42.14360042	580	41.81561618
-80 to -70 dBm	379	61.86264308	403	60.77140169
-90 to -80 dBm	400	82.67429761	430	80.9971778
-100 to -90 dBm	325	99.58376691	398	99.71777987
-115 to -100 dBm	8	10000	6	100
-130 to -115 dBm	0	100	0	100
<-103 dBm	0	100	0	100
Total	1922		2126	

TABLE III
ECNO DISTRIBUTION RESULT

EcNo	Before		After	
Range	Sample	Distribution (%)	Sample	Distribution (%)
>= 0 dB	0	0	0	0
-5dB<= x <0dB	1109	57.70031217	1473	69.28504233
-9dB<= x <-5dB	646	91.31113424	494	92.52116651
-11dB<= x <-9dB	133	98.23100937	129	98.58889934
-13dB<= x <-11dB	33	99.94797086	29	99.95296331
-15dB<= x <-13dB	1	100	1	100
-17dB<= x <-15dB	0	100	0	100
-20dB<= x <-17dB	0	100	0	100
x < -20dB	0	100	0	100
Total	1922		2126	

TABLE IV
UE_TXPOWER DISTRIBUTION RESULT

Uu_TxPower	Before		After	
Range	Sample	Distribution (%)	Sample	Distribution (%)
x <-20dBm	695	33.34932821	653	27.54112189
-20 to -5 dBm	785	71.01727447	933	66.89160692
-5 to 0 dBm	294	85.12476008	388	83.25601012
0 to 5 dBm	228	96.06525912	286	95.31843104
5 to 10dBm	74	99.61612284	99	99.49388444
10 to 20 dBm	8	100	12	100
x >=20 dBm	0	100	0	100
Total	2084		2371	

TABLE V
SIR DISTRIBUTION RESULT

SIR	Before		After	
Range	Sample	Distribution (%)	Sample	Distribution (%)
x <-20 dB	0	0	0	0
-20 to -5 dB	0	0	0	0
-5 to 0 dB	0	0	0	0
0 to 5 dB	858	41.17082534	806	34.34171282
5 to 10dB	954	86.94817658	1120	82.06220707
10 to 20 dB	261	99.47216891	421	100
x >=20 dB	0	99.47216891	0	100
Total	2073		2347	

Final summary on the table II about RSCP distribution result before and after is remain result ,table III ECNO distribution result at range -5dB<= x <0dB can imporvement more 69.28% from after decreased power control,table IV UE_TxPower distribution result at range-20 to -5 dBm can improvement save energy UE ,but table IIV SIR distribution result (the Signal-to-Interference Ratio) same before and after. However this paper research decreased control channel power only live network have many factor impact too time.

VI. SUMMARY RESULT

Before imply group parameter to network Should be verify radio environment from physical tuning.

PSCH Transmit Power Offset of the PSCH transmit power from the P-CPICH transmit power in a cell level[3].

If the value is very low ,UEs at the edge of cells will be fail in network searching, and influence on coverage of the downlink common channel. If the value is very too high, the power resources of cell edge impact to capacity too.

SSCH Transmit Power. If the value is very small ,UEs at the edge of cells will be fail in network searching, and influence on coverage of the downlink common channel. If the value is very too high, the power resources of cell edge impact to capacity too.

BCH Transmit Power.

If the value is very small ,Properly the messages cannot send to the UEs at the edge of cells will be cannot receive system messages . If the value is set too great, downlink transmit will be effect causes interference occupies and the power resources of cell edge impact to capacity also.

AICH Power Offset.

No effect on the UE state the idle mode.

PICH Power Offset

Difference between the transmit power of PICH and that of PCPICH and no effect on the UE state the idle mode.

PCH Power

If the value is very small ,Properly the messages receive the paging message at the edge of cells from downlink common channel. If the value is set too great, downlink transmit will be effect causes interference occupies and the power resources of cell edge impact to capacity also.

For detailed information of this group parameter, refer to 3GPP TS 25.433.

VII. CONCLUSIONS

The decrease Power Control Channel in live UMTS Network advantage part to improvement EcIo of quality more. This is due to the PG is Processing gain the ratio is less and make resource power is increased.

The disadvantage is that an impact on the access systems WCDMA KPIs about access RRC.FailConnEstab.NoReply, RAB.FailEstabCS.UuNoReply is worst case no tuning coverage footprint physical coverage objective.

Therefore parameter set is suitable for the area through the tuning coverage footprint part physical successfully.Rural area should not imply because cell edge to large can deployed in areas large number of cell serving and contiguous coverage or small cell.

Finally, consider the capacity of the systems are adequate. Depending on bandwidth and the impact on other parts that are not mentioned. However, in the future we will see the effects of the WCDMA system capacity and the impact of customer complaint further.

ACKNOWLEDGMENT

The authors would like to thank True Move Co., Ltd (Thailand) for their technical support.

REFERENCES

[1] Seung Chan Bang and Youngnam Han,."Performance of a fast forward power control using power control bits for the reverse power control s power measure".0-7803-4320-4/98/$5.00 0 1998 IEEE.

[2] Amandeep Singh Thethi,R.S. Sawhney."Performance Evaluation of QoS parameters in UMTS Network Using Qualnet".International Journal of Distributed and Parallel Systems (IJDPS) Vol.1, No.2, November 2010.

[3] W-CDMA-3GPP.http://www.3gpp.org/technologies/keywords-acronyms/104-w-cdma.

[4] Shinya Tanaka,Hiroyuki Ishii,Tomoki Sao,Yousuke Iizuka and Takeshi Nakamori."HSDPA Throughput Performance Using an Experimental HSDPA".NTT DoCoMo Technical Journal Vol. 6 No.4.

[5] DAVID MULVEY EXPLANS HOW 3G HIGH SPEED PACKET ACCESS WORKS.,"HSPA" IET Communications Engineer February/March 2007.

[6] 3rd Generation Partnership Project (3GPP),"Spreding and modulation (FDD)",3G Technical Specification 25.213 v3.1.1,December 1999.

[7] Stefan Parkvall, Janne Peisa, Johan Torsner, Mats Sågfors, Peter Malm ,."WCDMA Enhanced Uplink – Principles and Basic Operation".0-7803-8887-9/05/$20.00 (c)2005 IEEE.

[8] telecomHall,WhatisEc/Io(andEb/No)?,.http://www.telecomhall.com/

[9] M. Jevrosimovi´c*, E.R. Fledderus*†, L. Jorgu˘seski†, M.H.A.J. Herben* and G. Brussaard* "Power Control with Antenna Array Processing for UMTS " 0-7803-8521-7/04/$20.00 (C) 2004 IEEE

[10] *Ying Sun,Fredrik Gunnarsson,Kimmo Hiltuneii,."CPICH Power Settings in Irregular WCDMA Macro Cellular Networks" .0-7803-7822-9/03/$17.00 02003 IEEE.*

[11] Perälä1, Antonio Barbuzzi2, Gennaro Boggia2, and Kostas Pentikousis1,."Theory and Practice of RRC State Transitions in UMTS Networks".978-1-4244-5626-0/09/$26.00 ©2009 IEEE.

[12] Yieh-Ran Haung,."Pekka H. J. Performance Analysis for UMTS Networks With Queued Radio Access Bearers".IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 51, NO. 6, NOVEMBER 2002.

[13] UMTS channels .http://en.wikipedia.org/wiki/UMTS_channels.