The Comparative Study of Internet Infrastructure Investment between WiMAX and 3G to Support Incoming Growth of eLearning in Thailand

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Abstract- This study investigates the economic feasibility study with scenario analyze the implementation of 3G Technology or WiMAX on Thailand mobile operator and Internet Service Provider. The analysis is limited to the Thailand telecommunication market. This study analyses the Thailand telecommunication market with a financial model, which shows annual cash flows, net present values (NPV), Return On Investment (ROI), payback period and scenario analyze.

Nowadays, most Thailand Mobile Network Operators and Internet Service Provider are keeping their eyes on 3G technology and WiMAX in order to provide high speed data service. The mobile phone market is on saturating stage so mobile phone operators try to seek new business which, will optimize their resources and make profit. The data service will be a good service which can optimize network resource and give opportunity in penetrating the market. On the other hand Internet Service Provider (ISP) is sourcing new technology which can provide more coverage and increasing data transfer speed. There are many alternatives on the prospects of wireless technology. 3G mobile digital communication systems and WiMAX have a good potential in providing high speed data transferring.

Keywords- 3G, eLearning, Internet Infrastructure Investment, WiMAX

I. INTRODUCTION
Currently the popular issue in Thailand Telecommunication industry is new technologies which are Third Generation Mobile Phone (3G mobile phone) and Worldwide Interoperability for Microwave Access (WiMAX). What technology will be come a killer technology for high speed communication network in next decade. Thailand is on transition period in changing existing technology 2.75 G (EDGE) to 3 G for the mobile phone side and WIFI (Wireless Internet) and Asymmetric Digital Subscriber Line (ADSL) to WiMAX. Mobile Network Operators and Internet Service Provider (ISP) in Thailand are keeping their eyes on 3G and WiMAX technology in order to evaluate which technology is most valuable for the investment. There are many different opinions on the prospects of 3G mobile telephone systems and WiMAX. This study investigates the financial (Economic Feasibility) consequences of the implementation of 3G mobile phone and WiMAX technology in providing data service. The analysis is limited to the Thailand telecommunication market especially in providing data service only.

II. INDUSTRY AND TECHNOLOGY BACK GROUND
Mobile Phone Industry Background
The 2008 Thailand mobile telephone service industry registered service revenue growth of 4% with 8 million new net subscribers. The total amount of mobile
subscribers reached 61 million by the year end 2008, representing a 15% increase from 53 million in 2007, pushing mobile market penetration to 94%. The increase in subscribers in recent years has mainly been driven by the surge of multiple SIM users, who carry more than one SIM and/or mobile phone to reduce their calling costs by taking advantage of different tariff plans. This is added to by free or low-priced SIM card distribution as well as low-tariff plans to encourage new consumer trials.

Although mobile penetration in Thailand is heading towards 100%, the saturation point and the penetration in each region is varied. While Bangkok and other major cities have reached 100-120% penetration rate, the upcountry areas, mainly in North and Northeastern provinces have only achieved 50-60% penetration (AIS Annual report 2008).

The Thai mobile phone service industry consists of 3 main mobile operators, which occupy more than 97% of mobile service revenues in total. The market is dominated by Advance Info Service Plc. (AIS) with 45% share, followed by DTAC 31%, True Move 23% and other 1%.

As a high competition in mobile market every operator try differentiate themselves form other and avoid price war by launching new value added service (VAS). The table as follow will show number of revenue moves in short range. On the other hand the number of revenue non-voice service increases continuously. The number of VAS and revenue especially in Data service are increase continuously. This information may imply that voice service is saturated and non-voice service is in growth stage. The non-voice service will become the new cash cow for mobile operator in making revenue.
Internet Industry

The current International bandwidth for the whole country is 11Gbps. The domestic exchange total bandwidth is close to 100Gbps. The number Internet users, according to the National Statistical Office, seem to be too conservatively estimated, with less than 2% growth for the year 2005/2004.

The average growth of the Internet bandwidth in the past two years (2005/2006/2007) is about 45%, a slow down when compared with the 2002-2005 period, and it is even more conservative as a statement: “growth of the Internet users is one-third of the growth of the International bandwidth”, then may apply 15% growth in the past two years. The result in the green curve is shown in the graph below, with the number of Internet users in Thailand in 2007 to be around 13.15 million people (Important Internet Statistics of Thailand Thaweesak Koanantakool, August 24, 2007 page 3).


Figure 3: Internet user and bandwidth of Thailand

The growth of Internet in Thailand, likes many other countries, are due to popularized applications which attracts young and casual users. Entertainment and games shares 50.33% of all web clicks each day. Usage of the Internet (web visits) relating to getting information about the social aspects, reading news and business is among the second category, having 24.9 of shares. Using the web to access websites of the government is very low, 1.75%, and even worse for educational contents 1.71%.

The main service providers in Thailand are United Broadband Technology (UBT), Q-Net by Samart, CS Loxinfo, TOT, TT&T, Advance Datanetwork Communication (ADC) and True Corporation. In Thailand there is a population around of 63 million users but the number of internet users is around 13.5 million, so it may imply that the market still has a potential in growing. Consumer behavior is another reason that accelerates the internet usage. Consumers use more email, search information, entertainment, or event, and do business via online. Government also supports people to use more internets by reducing license fee and international gateway fee. These reasons show opportunity that the internet market in Thailand has a potential to be highly expanded in nearest future.
Technology Background

3G Technology

The 3rd generation (3G) technologies are designed to provide high-speed wireless data and enhanced voice capacity. CDMA2000 and WCDMA 3G technologies based commercial networks are now providing service to tens of millions of paying subscribers. As of October 2004, there are 108 3G CDMA deployments worldwide serving more than 140 Million subscribers. KDDI in Japan had recorded over 15.8 million CDMA2000 subscribers after two years of service. Korea has accumulated a total of over 31 million CDMA2000 subscribers, over 9 million of which are 1xEV-DO.

The new enhancements in WCDMA standards include significantly improved data capabilities for the downlink communications using the HSDPA mode. HSDPA offers downlink peak data rates of up to 10 Mbps is mainly aimed at providing data applications with enhanced end-user experience with shorter connection and response times (Yaliapragada and Naidu, 2005).


Figure 4: 3G evolution

Worldwide Interoperability for Microwave Access (WiMAX) technology

WiMAX is one such technology and it is said to be a broadband wireless access technology, offering an alternative to infrastructure dependent telecommunications technologies such as DSL (Digital Subscriber Line) or fiber.

WiMAX was initially introduced as a cable/fiber replacement technology and able to provide large bandwidth wireless access to a distance of approximately thirty kilometers. This is known as fixed wireless access that is ideal for situations where broadband access is desired but without the complication and cost of DSL or fiber. With fixed WiMAX, 3G operators have seen this
to be complementary and is expected to work hand in hand with 3G networks and used to supplement the 3G network when it is overloaded. However, there is a second part to the 802.16 standard, known as the 802.16e which has a mobility context added to it. This revised standard is expected to be approved soon and it is the mobility option in WiMAX that could be viewed as a threat or competitor to 3G. Wireless technology really started to take off with WiFi (Wireless Fidelity). The number of WiFi hotspots increased manifold during the past 2 years and this is an indication of the attractiveness of being 'unwired'. WiFi was originally thought of as an alternative to the numerous LAN cables in offices, universities and other institutions. WiFi was to replace all these and once a hotspot was established in a particular area or building, authentic users could log on to their network with use of a wireless card. This concept is replicated with WiMAX though on a much bigger scale. With WiFi, coverage was limited to 10s of meters while with WiMAX the possible coverage area is in the tens of kilometers (thirty to fifty kilometers). The transmission speed of WiFi is 54Mbps in the 802.11g standard. In WiMAX, this is anything from 10 to 100Mbps. WiFi is known more as a LAN technology while WiMAX address a different type of network called a MAN (Metropolitan Area Network). Therefore, WiMAX has been said by some to be an extension of WiFi. The 802.16 standard is part of the IEEE standards for wireless technologies or the 802 standards. Work on WiMAX began in 1999 but only this year will WiMAX products and equipment be introduced to the market. Equipment introduced this year refers only to those of the fixed wireless specification. The mobile WiMAX is still being standardized and this is being closely watched by industry members. WiMAX may be categorized into two parts; first there is the fixed wireless access provided by 802.16a and there is 802.16e, the mobile form of WiMAX. The later is still in the process of being standardized and products may be introduced to the market in 2006. 802.16a works at frequencies below 11GHz and with a throughput of up to 75Mbps while the 802.16e is an extended version of the 802.16a but works in the licensed 2 to 6GHz spectrum with a possible throughput of up to 72Mbps. It will also allow users mobility capabilities that the 802.16a does not have. It is this mobile form of WiMAX that presented possible competition to 3G and other present day mobile standards (Tan, 2006).

**Methodology**

This research carried out by three mains feasibility technique which, are Marketing Feasibility, Financial Feasibility and Risk analysis in order to examine 3G or WiMAX technology is more suitable to invest.

This feasibility study concerns about benefit of all stakeholders which are comprised of investors (included all people in organization), society, regulations, and finance. In financial model will include Universal Service Obligation charge which consequence from regulation. This Universal Service Obligation will be a funding for government in providing public services such as transportation system or medical service. The profit of investors and all people in organization are included in this financial model also

- Marketing Feasibility of 3G and WiMAX technology in providing data service will focus on 2 main categories as following:
  1. Marketing analysis
  2. Demand forecast
- Financial Feasibility of 3G and WiMAX technology in providing data service will focus on 4 main categories as an input for forecasting model in next 25 years by following:
  1. Revenue Module (ARPU model)
  2. CAPEX Module (Capital Expenditure)
  3. OPEX Module (Operating Expenditure)
4. Accounting Module which is profit and loss, and cash flow model

- Risk analysis
  1. Scenario analysis

Feasibility Study

Assumption
1. The fluctuation of exchange rate will not be included in this model
2. Universal Service Obligation charge is at 10% of total revenue (same between 3G and WiMAX)
3. Initial cost for licensing is 3,000 Million baht (up front)
4. Source of investment will be derived financial intuition
5. The duration of license is 25 years for both 3G and WiMAX
6. The revenue from voice service will not be included in this model
7. The useful life of equipment is 10 years
8. Market structure will be based on historical data (5 years later from year’s 2009) of internet data service
9. Thai population prediction is performed until Year 2020 according to National Economic and Social Development Board. After Year 2020, trend projection method will be used.
10. Moving average and trend analysis technique will be applied for demand forecasting
11. The maximum penetration rate of internet user is 75% of total population based on Korea and Japan penetration rate (Maturity stage) (http://www.internetworldstats.com/asia/)
12. The maximum penetration rate of each technology is 80% of total Internet user
13. Network will cover all areas in 11 years (since beginning the project) for 3G but WiMAX need 7 years
14. Average revenue per user will be based on 590 Baht (as a minimum charge) upon current rate of internet speed at 1 Mbps
15. A number of WiMAX users in the first year will be assumed from a number of true internet users because customer profile quite similar
16. A number of WiMAX users use the Moving Average technique for forecast, based on true internet growth rate structure
17. A number of 3Gs user in the first year will be assumed upon number of AIS data (EDGE and GPRS) user because customer profile is quite similar
18. For number of 3G users use Moving Average technique in forecast by based on Singapore 3G market growth rate structure
19. CAPEX forecast will be based on base station section only not included core network
20. Interest will be based at 6.50% BBL rate (Jan, 2009)
21. CAPEX investment will invest in bi-yearly basis

Marketing feasibility

Possible ways to the marketing study in the research are use the data from the service provider, and both of government sector institute and the private sector that related, bring study the possibility with marketing tool, such as Remote environment of telecommunication industry, SWOT Analysis and Five Force Model. From tendency growth of using hi-speed Internet (Data Service), and number of existing mobile phones and high-speed internet subscribers. Internet (Data Service) has a lot potential in the expanding market because to penetration number of Internet users is quite low when compared to number of Thai population. As the current market situation every player tries to expand network coverage and does marketing activities for gaining more market share and expand market.

As mentioned earlier about potential of Internet (Data Service) market in Thailand, it will be a good opportunity for 3G and WiMAX technology to serve a huge demand of data users in nearest future. The 3G technology has an advantage in terms of customer adoption rate because customer are quite familiar with the mobile phone technology. The number of existing devices 3G (HSPDA device), and clear technology road map 3.5G and 4G which make confidence to service providers and users in relying on this technology. On the other hand, WiMAX has an advantage in terms of data transfer rate (speed) which is the most important criteria for customers to choose data service. The capacity of network equipment (Base station) is greater than 3G.
in terms of coverage area which will save service providers investment cost in a long term. The weakness of WiMAX technology is number of devices which supported this technology is still quite low and unclear about technology road map when compared to 3G technology. These factors may cause of uncertain of end user and service provider in choosing this technology.

The technology value grid can concluded advantages of 3G and WiMAX technology in term of marketing clearly.

Financial feasibility

<table>
<thead>
<tr>
<th>Criteria</th>
<th>NPV (Million Baht)</th>
<th>ROI</th>
<th>Pay Back Period</th>
<th>Amount of loan (Million Baht)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3G Base Case</td>
<td>70,977.92</td>
<td>3283%</td>
<td>5 years 1.6 months</td>
<td>5,000</td>
</tr>
<tr>
<td>3G Moderate Case</td>
<td>53,690.43</td>
<td>2606%</td>
<td>6 years 1.65 months</td>
<td>5,000</td>
</tr>
<tr>
<td>3G Worse Case</td>
<td>27,678.85</td>
<td>1591%</td>
<td>9 years 7.4 months</td>
<td>5,000</td>
</tr>
<tr>
<td>WiMAX Base Case</td>
<td>45,560.44</td>
<td>2798%</td>
<td>11 years 7.7 months</td>
<td>6,000</td>
</tr>
<tr>
<td>WiMAX Moderate Case</td>
<td>31,838.55</td>
<td>2219%</td>
<td>13 years 0.02 months</td>
<td>11,500</td>
</tr>
<tr>
<td>WiMAX Worse Case</td>
<td>10,767.44</td>
<td>1349%</td>
<td>17 years 7.95 months</td>
<td>20,100</td>
</tr>
<tr>
<td>WiMAX with 3G demand (Moderate case)</td>
<td>54,472.65</td>
<td>2715%</td>
<td>5 years 10.79 months</td>
<td>5,000</td>
</tr>
</tbody>
</table>

Source: Developed for this research

Cash flow is positive every year and NPV is also positive. ROI is also high in every scenario in both 3G and WiMAX technology. In reverse 3G makes it better in Pay Back Period. Another key factor which indicates the suitable alternative for investment is the amount of loan. WiMAX has a disadvantage in amount of loan because it is quite new when compared to 3G, so it need some time in gaining new users and the cost of equipment is still high. Therefore, 3G technology has more advantage in terms of investment because of a plenty of supportive device when compared to WiMAX. It will reflect a number of users who are ready to use 3G Technology in the beginning of the investment term.

On the other hand in case of the same demand between 3G and WiMAX the financial statement look pretty good as shown in the table above. The main factor
which affects all financial calculations is number of demand forecast in both 3G and WiMAX.

III. RECOMMENDATIONS

As the financial feasibility result shown in marketing and financial feasibility for both 3G and WiMAX are feasible and profitable in every case. The most suitable investment is on 3G technology because it requires amount of loan lower than WiMAX and pay back period does not take so long even in worst case scenario.

In reverse, if demand is the same between 3G and WiMAX as shown in scenario 2 WiMAX is attractive to invest also. Because WiMAX requires less investment cost which makes financial ratio more feasible when compared to 3G technology. The main criteria which should be considered before choosing between 3G and WiMAX is number of the forecasting of potential users. It will affect financial calculation.

IV. LIMITATIONS OF THE STUDY

This study considers economic dimensions only, so the result may not be applied to the technical dimension. The forecasting model is based on the assumption that license is based on frequency with Initial License Fee of 3,000 Million Baht under Universal Service Obligation charge (10% of revenue) and voice service is excluded in this model. Political factor is one factor that can’t be controlled which will affect regulations for both technologies.

Some data in this research are partly derived from the interview of many well-known mobile operators’ executives and other data are derived from internal department of mobile operator and inter service provider. Attitude and/or perspective of each interviewee (executive management level) may change in the future when the digital cellular industry situation or related industry situation changes.

REFERENCE