

eLearning through Wireless Communication for Rural and Remote Areas in Thailand

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Abstract

In Thailand, various policies and programs have been initiated to bridge the digital divide, including Rural Telephone Project, Tambon Net and School Net. Currently, for rural and remote communities, broad band telecommunications have become equally important to voice connectivity. Nevertheless, wireline solutions are inefficient in most remote areas due to uneconomic returns especially in sparse remote areas. Therefore, the impact of utilizing wireless communications on rural and remote communities is forecasted to be colossal, since it contributes as a major technology in educational development.

The objective of this research is to introduce existing and suitable wireless communication technologies that could potentially provide telecommunication infrastructure, plus enable educational opportunities via e-learning in rural and remote locations. Moreover, this paper summarizes and studies the national educational policies and strategies so as to identify the basic requirements of wireless communication technologies. Finally, the wireless communication technologies that meet the basic requirements are introduced and recommendations to use them are provided in order to achieve educational goals.

Key words: eLearning, WLL, VSATs, and rural and remote areas.

1. Introduction

Communication and Information Technology (ICT) have an enormous potential, especially in developing countries and in attaining sustainable development. Programs are initiated by the governments in most Asian countries to promote the use of ICT at all educational levels. In June 2003, the government of India announced to use the ICT programs to connect 60,000 schools in the country through an online library used to provide academic services and training through the Internet [1]. In the same year, Pakistan launched the program through the Pakistan education network. Vietnam, through its educational network, have invested significant amount of resources to provide online connectivity in order to improve the educational system. In China, advanced distance learning satellite broadband multimedia transmission platform became operational in November 2000 and served the western part of China along with other remote regions [2].

The convergence of the ICT and learning or 'ICT enabled learning' is revolutionizing the way in which education is imparted to students. It uses the wireless communication network technologies to create, deliver, and facilitate learning regardless of the location and time. It enables delivery of comprehensive, individualized, and dynamic learning content in the real time and aids in the development of eLearning, hence linking learners and teachers.

This paper investigates five existing wireless communication technologies that have potential to provide ICT infrastructure in rural and remote areas – Wireless Local Area Network (WLAN), Mobile Cellular Network, Wireless Metropolitan Area Network (WMAN), Wireless Local Loop (WLL) and Very Small Aperture Terminals (VSATs) satellite-based technology. The objective of this paper is to introduce and recommend the wireless communication technologies that meet the basic requirements and enable educational opportunities via eLearning in rural and remote areas in Thailand.

In the next section, education policies and strategies by applying ICT in Thailand is discussed.

2. Overview of Education Policies and Strategies by Applying ICT in Thailand

Over the past decade, ICT has been recognized as a potential enabler for national economic and social development hence strengthening Thailand's competitiveness. In 1996, Thailand developed its first IT policy followed by the "Information Technology Policy Framework" in 2001-2010. In 2010, Thailand introduced the "Thailand Vision Towards a Knowledge-Based Economy", also known as "IT 2010".

The government set up the National IT Committee in 1992 in the form of a high-level policy entity chaired by the Prime Minister. The purpose of the committee is to develop plans and policies that promote ICT utilization and development in the country. The secretarial office of the National IT Committee is hosted by the National Electronics and Computer Technology Center (NECTEC) [3].

During 2002-2006, Thailand's ICT development was also guided by the National ICT Plan, which went hand in hand with the 9th National Economic and Social Development Plan. The recent ICT Master

Plan, spanning 2007-2011, was approved by the cabinet in September 2007 [4].

Under IT 2000, one of the main initiatives implemented was Thailand SchoolNet. The IT 2010 is slated to drive Thailand especially towards a knowledge-based society and economy, and classified e-Education as one of the flagship areas. E-Education includes issues of life-long learning, computer literacy human resource development, and virtual education.

An ICT Master Plan for education was also developed during 2007-2011. The plan focused on three specific areas:

- 1) Quality learning through increased access to new educational resources and improved teaching approaches.
- 2) Educational management and ICT-led management information systems.
- 3) Quality of ICT graduates and the need for ICT specialists.

Furthermore, specific goals for the use of ICT for education are as follows [5]:

- Provide all teachers, college lecturers and professors, students, both in schools and colleges, with opportunities to learn to use ICT. The goal is to employ ICT as an enabling tool to access information and gain knowledge through self-paced learning, or through interactions with teachers and fellow students.
- Link schools, colleges, universities, and libraries electronically to provide students, teachers and lecturers with an enriched environment in which distant resources can be made available remotely at finger tips.
- Make maximum use of ICT and distance education to meet the needs and aspirations of all citizens for continuing education and upgrading skills without constraint regarding age, profession distance, or geographic location.

To achieve the education policies and strategies above, the effective telecommunication technologies need to be considered to ensure the access and availability of eLearning materials and

resources in the rural and remote communities.

3. Requirements Analysis of specific goals for the use of Wireless Communications for education

To ensure that the objective of this paper is met, the basic requirements of the wireless communication technologies need to be analyzed and identified by studying the specific goals for the use of ICT for education as discussed in the previous section. The wireless communication technologies that meet the identified basic requirements are then introduced and recommended to be used in order to serve the specific goals.

Based on Section 2, the basic requirements of wireless communication technologies can be concluded as follows:

- (1) Increasing access to new learning resources
- (2) Enabling remotely interactive learning
- (3) Linking schools, colleges, universities, and libraries electronically
- (4) Enabling distance education without constraint regarding distance or geographic location.

In order to satisfy and assure that learning is kept at an interactive level, the wireless communication technologies have to be able to support *hi-speed multimedia* communications. To increase access to new learning resources, the communication systems are required to have *large coverage* and effectively handle high number of users through the Internet. To link educational institutions to libraries electronically, the wireless communication systems need to be able to serve *data communications* with high capacity. Since these goals are to be accomplished by 2011, time is scarce thus; the infrastructure needs to be properly established with *fast deployment and at an acceptable cost*.

In conclusion, there are four major requirements that needs to be considered; (1)

high-speed multimedia communications, (2) large coverage, (3) fast deployment, and (4) acceptable cost.

In the following section, the characteristics of various wireless communication technologies are overviewed. The section provides essential information related to the characteristics of each wireless communication technology to serve the analysis.

4. Wireless Communication Technologies to Enable Access through eLearning in Rural and Remote Areas

This section analyzes alternate wireless communication technologies that provide telecommunication infrastructure while enabling education through eLearning in rural and remote areas. The wireless communication technology alternatives are briefly discussed below:

Wireless Local Area Network (WLAN) systems, IEEE802.11 standard, provide low-cost and high-speed multimedia services. However, it has a very limited coverage and is therefore not suitable for rural deployments. The limited coverage also causes installation and maintenance cost to be very high.

- *Mobile cellular-based systems* such as GSM (including extended versions: GPRS and EDGE), CDMA2000 (including CDMA2000 1xEVDO) offer medium coverage, carrier-grade voice services and medium-speed data services. The installation cost of base stations and terminals are much lower than that of satellite based systems. However, its coverage limitations make it more costly to invest and maintain in the rural and remote areas. On the contrary, it supports a large number of connections in dense urban areas and seamless mobility, which was considered a relatively unimportant function for current deployments [6], [7].

- Wireless Metropolitan Area Network (WMAN) systems, IEEE802.16 WiMAX standard will extend the potential of WLAN to a far longer distance [8]. It will provide a large coverage area. The system is quite expensive and the design goal appears to be the support of multimedia rather than low cost. The ICT community believes that WiMAX will be a major technology to enable interactive eLearning in the near future with reasonable cost [9]. In Thailand, the WiMAX licensing regulation is still under the NTC consideration.

- Wireless Local Loop (WLL) services may be defined as fixed wireless services. These systems are intended to provide both telecommunications services and Internet access to rural households and act as substitutes to telephone networks. WLL systems can be based on cellular or PCS technology, either analog (AMPS, TACS, ETACS, etc.) or digital (GSM, DECT, PDC, CDMA, etc.) [10]. Analog cellular has some limitations in regards to the capacity and functionality and is not suitable for multimedia communications. Digital cellular, on the other hand, is expected to play an important role in providing WLL. Digital cellular WLL can support a higher capacity of subscribers than analog cellular and it offers functions that enable multimedia applications especially for CDMA WLL. Interestingly, WLL offers a number of key advantages: faster deployment, faster realization of revenues due to lower construction cost, and greater flexibility to meet uncertain levels of penetration and growth rate [11]. A vital economic consideration is the deployment rate which WLL has an advantage over as systems operate within 90 to 120 days.

- *Satellite-based system with Very Small Aperture Terminals* (VSATs) provides both telephony and data services for rural communities and remote areas such as islands. It has the largest coverage area. VSATs are a robust and a well established technology designed for interactive

communications and IP over satellite networks with more than a million units sold and installed worldwide. VSAT solutions are increasingly being recognized as the most cost-effective and efficient method of providing the connectivity, particularly in areas where no terrestrial infrastructure is available. VSATs are economically feasible for large rural projects but not viable for small projects involving a number of lines per system [12].

5. Selected Wireless Communication Technologies: Analysis

In this section, the characteristics of wireless communication technologies and the basic requirements are analyzed. The results are concluded in the Table as follows:

Table 1: Types of wireless communications v.s. characteristics (requirements)

Types/ Characteristics	WLAN	Cellular	WiMAX	WLL	VSATs
High-speed multimedia	✓	✓	✓	✓	✓
Large coverage	✗	✗	✓	✓	✓
Fast deployment	✗	✗	✗	✓	✓
Acceptable cost	✗	✗	✗	✓	✓

In Table 1, the results show that WLL and VSATs networks meet all four basic requirements. When comparing the two technologies, VSAT requires only subscriber units, whereas WLL requires the setup of both the broadcasting towers and the subscriber units. A network evaluator must take into consideration local factors when estimating the cost of a network. For instance, one must investigate any pre-existing network infrastructures.

In areas where no wireline is available or where the population is dispersed, the installation and maintenance costs of WLL will be very high. Therefore, VSAT can be considered as a more viable option, given the backbone network. However, equipment and bandwidth for VSAT satellite networks are expensive and hence should only be used in areas that are unreachable by other communication technologies.

6. Discussion and Concluding Remarks

The objective of this paper is to introduce the wireless communication technologies that are suitable for enabling educational opportunities through eLearning in rural and remote areas. The result of this paper shows that there are four basic requirements that need to be considered; high-speed multimedia communications, large coverage, fast deployment, and acceptable cost. Based on the requirements, analyzed results indicate that WLL and VSATs networks are well-suited to serve people in rural and remote areas in Thailand. However, a research related to project models to implement both technologies should be studied and conducted in the future. In order to make a rural connectivity project sustainable, rigorous planning is required. Therefore, models for estimating cost and revenue based on each location selected and each technology deployed should be studied in the future as well.

The views and opinions expressed in this paper are solely of the author and do not represent the views of the Royal Thai Armed Forces and TOT Corp.

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