.th

Thailand

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Total population	62.42 million (2005)
GDP per capita	USD 2,567 (USD 1 = THB 38)
Key economic sectors	Agriculture, Mining, Manufacturing, Construction, Public utilities, Transportation and communication, Trading, Banking, Insurance, Public service and Defence
Computer per 100 inhabitants	13.7
Computers (on Internet) per 100 inhabitants	6.2
Fixed-line telephones per 100 inhabitants	11.7
Mobile phone subscribers per 100 inhabitants	47.9
Internet users per 100 inhabitants	13
Domain names registered under '.th'	21,976 (in July 2006)
Broadband subscribers per 100 inhabitants	0.9
Broadband users per 100 inhabitants	5.1
Internet domestic bandwidth	37.60 Gbps (in July 2006)
Internet international bandwidth	9.32 Gbps (in July 2006)

Sources: NSO 2005; NECTEC 2006.

ICT and ICT-related industries

The total value of the Thai ICT market, which is composed of four sectors—hardware, software, computer services and communications—was approximately USD 11,090 million in 2005.[1] It is expected that by the end of 2008, the Thai ICT market would be worth USD 19,329 million, which means a 20 per cent annual growth rate in the next three years.

The communications market, which includes both services and equipment, is the largest sector in the Thai ICT industry, accounting for 74 per cent of the total market. Its growth is a direct result of government policy to introduce competition from the private sector in 1993, with TelecomAsia Company (now True Corporation) being granted permission to participate in speeding up the two million-line telephone expansion project. Later, one million more telephone lines were added by TT&T. The entry of mobile service providers resulted in the number of mobile phone subscribers exceeding the number of fixed-line subscribers in 2001.

The hardware market also improved throughout 2005, due mainly to the growth in the notebook computer, personal digital assistant (PDA) and digital camera segments. Notebook sales totalled 280,000 units, up 41 per cent from 2004 levels, while desktop PC sale levels increased only slightly. The growth of the notebook market was driven by declining prices, as well as the notebook's portability and improved features and performance. In the PDA market, the market in 2005 was valued at USD 82.28 million, representing a 186 per cent increase from 2004 figures. The digital camera market also increased significantly, earning USD 184.2 million in 2005, or 56 per cent higher from the previous year.

The software market was valued at USD 1,090 million, representing a 27 per cent growth from 2004. Outsourced software took a 48 per cent share of the market, and the rest was taken by packaged software.

Along with the growth of the ICT market, the hard disk drive (HDD) production was recognized as a driver of national economic growth. The strong manufacturing industry has attracted key global HDD players to Thailand, and the inflows of foreign investment in HDD manufacturing made Thailand the world leader in the production of HDD and HDD components in 2005. The industry generated more than USD 263 billion in export value in 2005, accounting for 9.4 per cent of total Thai exports and 42 per cent of the worldwide HDD market. HDD production volume has more than doubled, from 54.1 million units in 2003 to 119.8 million units in 2006. More than 100,000 workers are currently employed by the industry.

Technology infrastructure

Thailand is making a significant investment in ICT infrastructure. Compared to developed countries which have put in high speed Internet infrastructure typically by adding value to fixed-line telephones and the cable TV business, Thailand had a later and slower start in broadband services. However, since 2005 increased investments in infrastructure have resulted in a big growth in the number of broadband users.

Broadband technology

In 2003, there were 12,700 broadband subscribers in Thailand. But only two years later, the number has jumped to 570,000

subscribers, according to the figures of ADSL service providers. In a survey by the National Electronics and Computer Technology Center (NECTEC) in 2005, about 39 per cent of respondents said they are using broadband services, from which it can be inferred that there are about 3,183,000 broadband users. The increase is due to improved competition among service providers.

IPv6: The Next Generation Internet (NGI)

For developing countries, IP technology promises to make voice and other services available at cheaper rates, compared to traditional networks. However, the rapid migration to IP technology is resulting in the exhaustion of IP numbers in IPv4. IPv6 technology is the solution to this problem. NECTEC runs an NGI laboratory to promote and develop applications over IPv6. The Thailand IPv6 Forum, consisting of local universities and Internet service providers, was established in 2006 and new applications are being developed.

Key institutions dealing with ICTs

The main coordinating organization for ICT development in Thailand is the Ministry of ICT (MICT). Other institutions are tasked with deploying ICT in various sectors.

Ministry of Information and Communication Technology (MICT)

The MICT is responsible for formulating implementation strategies and action plans in accordance with the national IT policy (IT 2010) and ICT Master Plan (2002–06). The vision of the ICT Master Plan is to use ICT for economic and social development and to improve the quality of life of Thai people and transform Thailand into a knowledge-based society. ICT is considered the key to the development of 'e-Thailand', consisting of e-Government, e-Industry, e-Commerce, e-Education and e-Society. Government agencies, led by the MICT, are expected to focus on e-Government, which is the core mechanism to mobilize the other e-Thailand components.

Software Industry Promotion Agent (SIPA)

SIPA is a public organization tasked with promoting the Thai software industry through rapid enhancement of software worker skills, rapid increase in employment and rapid growth both in the domestic and international markets. SIPA has established development guidelines for four main areas: enterprise software, animation and multimedia, mobile application and embedded software. The four areas are in high demand in the domestic and

international markets. The guidelines help software developers to focus more on these strategic areas that build up Thailand's competitive edge in the software development outsourcing industry.

Electronic Transactions Commission (ETC)

The Electronic Transactions Act of 2002 established the ETC of which the Minister of ICT is the chairman and 12 members are appointed by the Cabinet from experts in finance, electronic commerce, law, computer science, science or engineering and social science. NECTEC acts as the Commission's secretariat. The functions of the ETC are to:

1. Recommend to the Cabinet policies for the promotion and development of electronic transactions;
2. Monitor and supervise the operation of businesses relating to electronic transactions;
3. Make recommendations or give advice to the Prime Minister to issue Royal Decrees pursuant to the Electronic Transactions Act of 2002;
4. Issue rules or notifications relating to electronic signatures in compliance with this Act or with the Royal Decrees issued pursuant to this Act; and
5. Perform any other act in compliance with this Act or with other laws.

National Telecommunications Commission (NTC)

The NTC was established on 1 October 2004 as the first independent state telecommunications regulator under the Telecommunication Business Act. Its duties and responsibilities are to regulate all telecommunications services in the country by formulating a Master Plan on Telecommunications Activities, set criteria and categories of telecommunications services, issue permits for and regulate the use of the spectrum for telecommunications services, and grant licenses to telecommunications operators.

National Electronics and Computer Technology Center (NECTEC)

NECTEC is a statutory government organization under the National Science and Technology Development Agency (NSTDA) of the Ministry of Science and Technology. Its main responsibilities are to undertake, support and promote the development of electronic, computing, telecommunication and information technologies through research and development activities. NECTEC also disseminates and transfers such technologies to stimulate economic growth and social development in the country, following the National Economic and Social Development Plan.

NECTEC was a forerunner in developing the national IT policy and IT promotion as mandated by the National IT Committee in 1992. It handed over policy tasks to the MICT after the completion of the first National ICT Master Plan of 2002.

Software Park Thailand

Software Park Thailand (http://www.swpark.or.th) is a software industry community development arm of the NSTDA with strong links to the private sector. Its mission is to be the region's premier agency supporting entrepreneurs and to help create a strong world-class software industry that will enhance the strength and competitiveness of the Thai economy. As of 2005, four more regional software parks were being developed in Thailand following the model of the first software park located in Bangkok, the central city.

Digital content initiatives

Many local websites with local language content have been created. The following are examples.

Search engines in Thai

SiamGuru and SanSarn are two main search engines using the Thai language. SiamGuru (www.siamguru.com) is a free directory and search engine for anyone who needs to find information relating to or about Thailand. It offers basic search, advanced search and multimedia search services. SiamGuru also provides news and Webboard search.

SanSarn (www.sansarn.com) was developed by NECTEC as a search engine for Thai/English documents. It aims to offer faster search and more precise results, particularly from local websites. Due to the non-segmenting characteristic of written Thai, words are written continuously without the explicit use of word delimiters such as spaces. To index Thai texts, Sansarn performs word segmentation to obtain the token terms which are then used as indexes for the search. To help users search more efficiently and effectively, Sansarn has features like word prediction and word approximation. According to Truehits.net statistics (as of 2005), Sansarn is the fifth most popular search engine in Thailand, after Google, Yahoo, MSN and SiamGuru.

ParSit: An online language translator

To help reduce language barriers and bridge the digital divide, NECTEC has initiated a machine translator (MT) R&D project which aims to utilize MT capabilities to translate English to Thai. ParSit (http://come.to/parsit) is a Web-based service through which people can browse Web pages in English and translate short passages of text into Thai. Although the system does not provide a perfect translation, it does provide the gist of the text translated and therefore allows many Thai users to 'read' Web pages in English in translation.

Online services

In recent years, a number of government and private agencies have begun to offer online services and information through their websites, some of which are described below.

The Thailand Central Registration for Missing Persons in Disasters website (www.missingpersons.or.th/) was created for relatives of persons who went missing as a result of the Tsunami disaster in southern Thailand on 26 December 2004. It provides information on missing persons, survivors, the injured and those found dead. The website is fully supported by the Thai Red Cross Society and NECTEC.

The Stock Exchange of Thailand (SET) website (www.set. or.th) runs an online stock trading system (www.settrade.com) to serve and support investors who have an ac-count with qualified brokers. After opening an account with a broker, investors can trade online directly through the broker's website anywhere and anytime using any PC connected to the Internet.

As the country's central bank, the Bank of Thailand (BOT) (www.bot.go.th) has established key financial risk control mechanisms for all financial institutions operating in Thailand. It has carried out two major innovations in electronic payments/settlements and established the Inter-bank Transaction Management Exchange (ITMX). In cooperation with ETC, BOT has completed for the Cabinet's consideration a draft Royal Decree for electronic payments. There are two online settlement systems in place—BAHTNET (Bank of Thailand Automated High-value Transfer Network) and SMART (Interbank Retail Funds Transfer Clearing System). With the operation of ITMX by the Thai Bankers' Association, it is expected that retail financial transactions can be handled online by early 2007.

The website of the Office of the Board of Investment (BOI) (www.boi.go.th) offers a large volume of information, including the ASEAN Supporting Industry Database, information from the Thailand Provincial Investment Gateway and Economic Warning Indices.

e-Commerce

In 2004, over 2,500 websites operated by approximately 1,860 e-commerce entrepreneurs operating in Thailand were registered with the Department of Business Development of the Ministry of Commerce. According to the e-transaction survey conducted

annually by NECTEC, the transaction value of 61 e-commerce key players in B2B and B2C businesses in 2003 was about USD 1.52 billion (THB 58.5 billion), of which 99 per cent was classified as B2B. For B2G, a report from the Comptroller General's Department states the value of government e-auctions in 2003 as USD 129 million (THB 4907 million). Approximately 80 per cent of this amount comes from expenditures of state-owned enterprises. The survey also showed that the size of enterprises, classified by number of employees, is related to the extent to which enterprises absorb new technology. Larger enterprises are more likely to adopt advanced technology. The Thai e-Commerce Association was established in 2006 to help expand the market value of e-commerce in Thailand.

Enabling policies and programmes

Policies promoting investments in ICT and related industries

The BOI is committed to promoting investments in the ICT sector. In the software industry, for example, the BOI announced that software development projects will be classified as a priority activity and will receive exemptions from machinery import duties and corporate income tax, without an upper limit, for a period of eight years. This incentive also supports HDD, wafer fabrication and integrated circuits (IC) manufacturing.

In addition to the extended tax holiday, the BOI has amended its 'Skills, Technology and Innovation' or STI incentive package for projects with components in research, design, development of Thai staff, or support for educational or research institutes. The amendments allow a company with these STI expenditures to get an extension period for corporate income tax exemptions in addition to other privileges.

Industrial cluster development programmes

To strengthen local industries and respond to the demand for R&D, the NSTDA started clustering R&D projects in 2005. Examples of the industry clusters are the food industry, automotive industry and software-microchip-electronic industry. For each industry cluster, the NSTDA aims to improve local producer technology skills to increase local value added and maintain global competitiveness.

The HDD programme, which is part of the software-microchip-electronic cluster, is a successful collaboration between private companies and NECTEC. The latter has established an HDD training institute to develop the skills of HDD suppliers in Thailand. In 2005–06, 2,000 personnel from HDD industries joined the institute's training courses.

The institute also intends to stimulate collaboration in R&D and technology transfer among local universities, state agencies and industries.

National Smart ID Card

The National Smart ID.Card project is part of Thailand's plan to develop a modern e-government system. The concept is to make use of smart card technology for traditional citizen IDs to enable government agencies to share the machine-readable data from each card. The Thai government aims to improve public services, enable electronic transactions and boost the counter-terrorism effort through the national smart ID system.

Legal and regulatory environment

ICT laws

ICT laws have been put in place to nurture e-commerce activities, as well as to increase the confidence of multinational investors in Thailand. Six ICT laws have been developed since 1998. Two have been approved by the Parliament and merged into one Act, while the remaining drafts are in various stages of progress in the parliamentary process.

Enacted in April 2002, the Electronic Transactions Act of B.E.2544 (2001) recognizes the legality of data messages by treating them as the functional equivalent of writing or evidence in writing, to promote the reliability of electronic transactions. The Act combines two original drafts—the Electronic Commerce Law and the Electronic Signatures Law. The Act was drafted following the Model Law on Electronic Commerce 1996 and the Model Law on Electronic Signatures 2001 of the United Nations Commission on International Trade Law (UNCITRAL).

The National Information Infrastructure (NII) Law approved by the Cabinet in 2003 provides for an equitable information infrastructure and for universal access by promoting the right to affordable access to information and communications services. The law aims to reduce Thailand's digital divide, in accordance with Section 78 of the Thai Constitution.

Under consideration by the Parliament since September 2003 are the Computer Crime Law, which criminalizes new types of offences committed in cyberspace, and the Data Protection Law, which protects privacy rights by safeguarding the personal data of individuals.

The Electronic Fund Transfers Law, which aims to facilitate electronic fund transfers, was drafted in 2005. Through the efforts of the ETC, it is now a draft Royal Decree for Electronic Payment that is expected to be enacted in 2007.

The National Smart ID Card: A not-so-smart move

The National Smart ID Card project was approved by the Thai Cabinet in January 2004. The objectives of the project are to improve public service, increase efficiency, reduce wasteful public investment by using one smart card to access all public services and facilitate electronic transactions. The scheme is divided into three phases. The first phase aims to produce 12 million smart cards with a budget of THB 1,670 million (about USD 50.799 million) in 2004. The second phase, with a budget of THB 3.120 billion (about USD 94.9 million), will distribute 26 million cards in 2005. The third phase, also with a budget of THB 3.120 billion, covers the production of the remaining 26 million smart cards. The MICT is in charge of the procurement and management of the multi-purpose identity cards or smart cards, as well as securing cooperation among other government bodies concerning the use of the smart cards.

The first phase was to have been completed in September 2006 by a consortium of ST Microelectronics, InCard Consortium and Cisco Engineering which won the bid to produce 12 million smart cards for the MICT for THB 888 million (about USD 27 million) (*The Nation* June 2004). The MICT is processing the second bid to provide 13 million smart cards within January 2007.

However, many criticisms have been levelled at the Thai smart card project. First, the project was done in a hurry, without any standard interoperability framework. There was insufficient architecture planning and consultation with qualified experts. Second, the procured goods did not meet JavaCard 2.1.1 security specifications. Third, the cards were accepted and used without the critical functions, such as PKI and fingerprint matching, stipulated in the project terms of reference. The recommendations of the experts for the MICT to conduct technical acceptance tests were ignored. Subsequently, the cards delivered were found to have duplicated chip serial numbers and more than 100,000 cards were rejected.

Lesson learned: Skipping key steps in the IT development process does not speed up a project. Although there is an impression of progress in the beginning, the whole project fails in the long term.

Information security standard

The Information Security Subcommittee under the ETC has proposed the adoption of the international Information Security Standard ISO/IEC 17799 and ISO/IEC 27001. The draft Information Security Standard for Thailand is widely accepted in the industry, and key business regulators, including the SEC and BOT, plan to enforce compliance to the ISO/IEC 27001 for all businesses under their control.

In addition, the Information Security Alliance (ISA) was set up recently to help develop and promote knowledge and awareness of information security. ISA was initiated from the collaboration between the major critical infrastructure organizations in Thailand. It is expected to raise public awareness of the International Information Security Standard.

Spectrum allocation for Radio Frequency Identification (RFID)

Radio Frequency Identification (RFID) technology is becoming increasingly widespread in most countries, including Thailand. Four main frequency bands are used for RFID applications: low frequency (LF), high frequency (HF), ultra high frequency (UHF) and microwave. The use of UHF is growing in whole sale, retail sale, transportation and logistics due to the adoption of RFID by large organizations such as Wal-Mart and members of GS1.[2] Due to growing usage of RFID at UHF, the NTC approved in December 2005 NECTEC's recommendation to use the RF spectrum in the band 920–924 MHz for RFID, in addition to LF and HF which were approved by the MICT in 2004.[3] The NTC and the industry expect this to promote the adoption of the RFID system at the international level.

Education and capacity building programmes

Lack of skilled labour in ICT and related industries, such as IC, HDD and consumer electronics, is a serious problem facing high-tech firms in Thailand. A 2002 NECTEC study of demand for IT personnel showed that the ICT industry would need 40,000 personnel in 2002–06. Education and training are very important tools for developing human resources with the skills to make effective use of ICTs. The following are key human capacity building programmes in Thailand.

Thailand Knowledge Park (TK Park)

The Thailand Knowledge (TK) Park was set up as a 'dynamic living library, a provider of good books that is constantly

being updated and improved'. With its wide array of books, information and multimedia learning tools, TK Park has the major role of encouraging Thais to read and to learn. Covering 4,000 sq m at the Central World Plaza, the Park also functions as a cultural hub for young people and as a recreational space for a variety of activities. Approximately 500–800 persons visit TK Park daily. It was opened on 24 January 2005.

National Software Contest (NSC)

Held annually since 1999, the competition aims to stimulate students' interest in developing computer software. Participating students receive financial support during the project development stage. Outstanding projects are showcased at the national competition, which is also a venue for junior developers to meet professional developers and researchers. Winners receive cash rewards, with the top prize being the royal trophy awarded by H.R.H. Princess Maha Chakri Sirindhorn. The NSC project is organized by NECTEC and is sponsored by a number of organizations.

Outstanding NSC projects have been nominated for and have won recognition at the Asia Pacific ICT Awards (APICTA), an international awards programme initiated by the Multimedia Development Corporation of Malaysia to increase ICT awareness in the community and help bridge the digital divide. At the 2005 APICTA, 'Mech Tournament', a game software from Chulalongkorn University Demonstration School, won the Merit Award in the category of Secondary Student Projects, while 'Battle Crossword RPG Game' from Chiangmai University won the Merit Award for Tertiary Student Projects.

Young Scientist Competition in Computer Science and Engineering Project (YSC.CS and YSC.EN)

Organized by NECTEC, these competitions aim to build S&T capacity and standards among Thai secondary students. They encourage and support students to demonstrate their scientific capabilities and research skills in computer science and engineering. Participants submit their creative projects to the competition for a research grant. Qualified students are selected as representatives of Thailand in the Intel International Science and Engineering Fair (Intel ISEF), an international competition organized in the United States. YSC.CS and YSC.EN winners have captured prizes at the Intel ISEF. 'Visible Surface Determination Technique for Moving Camera in First Person 3-D Software VSD' won the Second Award in the Computer Science Category at the Intel ISEF 2000 in Detroit, Michigan while 'Statistical-based Adaptive Binarization for Document Imaging' won the Fourth Award in the Computer Science Category at the Intel ISEF 2006 held in Indianapolis, Indiana.

Embedded Systems Training Alliance for Thai Engineers Project (ESTATE)

ESTATE was launched in May 2006 by the Japan External Trade Organization (JETRO), Association for Overseas Technical Scholarships (AOTS), Technology Promotion Alliance (TPA) and the Thai Embedded System Association (TESA) to prepare Thai Embedded System developers to compete in the world market. The Embedded Systems Training Alliance for Thai Engineers was set up with funding from the AOTS and the Ministry of International Trade and Industry (METI) of Japan. This 12-month training programme in Japan aims to prepare Thai developers to work in the Embedded Systems industry through internships in Japanese companies. The scholarship includes studying the Japanese language in the morning and studying Embedded Systems in the afternoon for six months in Thailand before the one-year training in Japan. The first 15 scholars are scheduled to leave for Japan in January 2007.

Open source software initiatives

Many government and public organizations in Thailand are moving away from complete reliance on proprietary solutions towards partial use of open source software (OSS). The Electricity Generating Authority of Thailand (EGAT) is a success case. EGAT has installed OSS in half of its servers and one-fifth of its desktops, achieving savings in software investment of up to THB 300 million (approximately USD 7.9 million) from 1994 to 2004 (*The Nation* June 2004). EGAT's Internet department is also developing an open source software application, called *EGAT Linux*, for the organization's own use. Other government organizations, such as the Revenue Department, Royal Thai Air Force, Public Health Ministry and NECTEC, are also developing applications on open source software platforms for their online services.

For users who are familiar with the Windows Operating System, SIPA and NECTEC jointly introduced in 2004 an OpenOffice.Org 2.0 package with full support for the Thai language. The software runs well on both Microsoft Windows and Linux platforms. OpenOffice.Org 2.0 is more compatible with the Thai language and is easier to use than the previous versions. In 2005, OpenOffice V2.01 was launched and it is now widely accepted in Thailand.

NECTEC also participated in the development of the Linux Operating System. Initially NECTEC provided technical support to SchoolNet members to install Linux SIS (School Internet Server) on their servers. Linux SIS for the SchoolNet project was so successful that many small businesses also adopted the software. To promote the free-license solution, NECTEC teams up with and introduces Linux SIS to system integrators and small and medium-sized businesses. Under the project, companies

working with NECTEC would offer free consulting and training on OSS and Linux SIS to the first 10 system integrators, enabling them to adopt Linux SIS for future system implementation for their customers.

Campaign for open standards

In addition to OSS development, NECTEC and leading Chief Information Officers (CIOs) in the public sector and a number of companies have initiated the 'Campaign for Open Standards in Thailand'. They organized a regional conference on Open Standards in May 2006.

Thailand has also initiated OpenCARE, an open exchange system for collaborative activities in response to emergencies. OpenCARE is information middleware that enables incompatible systems to work together. It is also an information/alert dissemination system. OpenCARE supports multiple input and output incident/progress reports. It works across borders and supports multiple languages by means of ISO 10646/Unicode. OpenCARE does not replace any of the existing relief systems

but simply extends their reach to wider audiences and creates an open ICT ecology.

Research and development

Lack of technology capacity, especially in small and medium-sized industries, is a problem facing the ICT industry in Thailand. Thus, both the Science and Technology Strategic Development Plan for Thailand (2004) and the National Research Strategies are targeting R&D in key technologies. As a focal point of current and emerging technology development, NECTEC has initiated 10 strategic programmes:

1. RFID technology
2. HDD technology
3. Information and Mobile Applications
4. Embedded Technology
5. Wireless Technology
6. Intelligent Transportation System
7. Biomedical Engineering

Emergency and Educational Communication Vehicle: Cutting-edge technology

From the tsunami disaster in December 2004, Asians learned that an efficient and reliable emergency communication system is a necessity no less critical than food and potable water. In a typical disaster situation, while most basic communication systems cease to function, the need to communicate increases tenfold. To address this problem, the Emergency and Educational Communication Vehicle (EECV) was designed by NECTEC in collaboration with the Interior Ministry (Disaster Prevention and Mitigation Department), Asian Disaster Preparedness Centre (ADPC) and Cisco Systems. The EECV contains 25 notebook computers, 25 WiFi mobile phones, an electricity generator that can provide electricity for three days, and a network connection to high-speed Internet that would allow people in a disaster area to communicate with people outside the area using voice and Web.

The EECV was successfully tested in communities in the north of Thailand that were hit by a big flood in May 2006. Aside from providing basic voice communication for citizens and relief workers, the EECV also sped up the registration of and search for missing persons as people could search online for their relatives instead of making lengthy phone calls. Another Web-based EECV service is matching 'needs' and 'donations'.

The EECV's broadband Internet and mobile phone facilities and its 18-metre tall retractable antenna mast make it a natural choice for a C^3I (command, control, communication and information) centre for any kind of field operation. The antenna can also host older types of analogue communication systems, as well as serve as a sturdy platform from which to view a disaster area.

Aside from addressing urgent problems in disaster areas, the EECV also aims to facilitate distance learning for people in remote areas by providing Rural Wireless Broadband Access (RWBA) to schools and communities when it is not being used in disaster mitigation.

The EECV is a cutting-edge, low-cost and field-proven technology developed by local researchers. Its success highlights the value not only of technology but also of cooperation among the responsible agencies. The initial concept is now being developed for more versatile solutions and for military use.

8. Sensor Technology
9. Security Technology
10. Intelligent/Knowledge Engineering

In 2006, NECTEC completed a number of research projects with significant economic and social impact, such as the smart agriculture system, RFID readers, intelligent transport monitoring system and the Emergency and Educational Communication Vehicle (EECV).

The EECV is a vehicle designed to meet the need for vital communication services during emergency situations. A collaborative project of several government agencies and the private sector, the EECV provides people who are living in disaster areas and remote communities with a long distance communication link via satellite, terrestrial microwave, Wi-Fi or WiMAX, as well as local community services using Wi-Fi.

Challenges

The major obstacles to universal ICT use in Thai society are barriers to Internet access and lack of productive content, including educational materials. Barriers to access include the absence of basic telecommunication facilities and electricity in the rural areas. Moreover, computers are still not affordable for low-income families. Where access is not a problem, lack of useful content for Internet users and students has been identified as a critical challenge for effective ICT use. Although computer density and Internet penetration in Thailand has been increasing over the years, the development of relevant content has been slow. Furthermore, although the Thai government has tried to create a liberal and enabling environment for the growth of ICTs, there are inadequacies that still need to be addressed, such as the lack of transparency in large projects and the shortage of skilled labour in ICT fields.

Thailand needs to become a knowledge-based society and economy through the promotion of innovation and investments in key ICT infrastructure. For example, the government must provide support to ICT projects that seek to place computers within everyone's reach, such as NECTEC's economy-class PC, Computer ICT Project (Ministry of ICT and NECTEC)

and the One Laptop per Child (Ministry of Education, MIT and NECTEC) programme. The cluster approach of the NSTDA and the Ministry of Science can accelerate industrial growth to a certain extent. Thailand must likewise seek new ICT business opportunities such as business process and software outsourcing.

Thailand must address these challenging issues now in order not to get left behind other countries in the region.

Notes

1. The ICT market survey was conducted by the Software Industry Promotion Agency (SIPA), National Statistics Office (NSO) and National Electronic and Computer Technology (NECTEC) in September and December 2005.
2. GS1 is a global organization dedicated to the design and implementation of global standards and solutions to improve the efficiency and visibility of supply and demand chains globally and across sectors. The GS1 system of standards is the most widely used supply chain standards system in the world.
3. Before NTC was established.

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