

# .tw

## Taiwan

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### Overview

Taiwan is a major manufacturing centre for global information and communication technology (ICT) companies (Huang 2006). In the *Global Competitiveness Report 2005–2006*, Taiwan ranked fifth among 117 countries in the Growth Competitiveness Index and third in the technology index (FIND 2005). In the 2005 Digital Opportunity Index Ratings of the ITU, Taiwan's overall rating was 0.64, ranking seventh in the world and fourth in Asia Pacific. In March 2006, the *Global Information Technology Report* of the World Economic Forum also showed that Taiwan ranks seventh in the world and fourth in Asia Pacific in terms of network readiness. With respect to e-government performance, Taiwan ranked first among 198 countries surveyed by Brown University in 2002, 2004 and 2005. The Point Topic Survey in March 2006 ranked Taiwan number five worldwide in terms of broadband household penetration and number six in terms of DSL lines.

To meet the science and technology standards of a developed nation by 2010, Taiwan has been working to increase R&D funding to 3 per cent of GDP and the number of research personnel with college or advanced degrees to 32 persons per 10,000 by 2007.

Meanwhile, R&D work on IPv6 is ongoing in line with the implementation of the e-Taiwan policy.

### Technology infrastructure

The ongoing integration of the fixed network and mobile communications networks aims to create a ubiquitous broadband network service environment in Taiwan. The Broadband Development Project for the establishment of next-generation fibre-

Total population	22,879,132 (as of February 2007) <sup>1</sup>
GDP per capita	USD 16,098 (NTD to USD: 32.167) (2006) <sup>2</sup>
Computers per 100 inhabitants	52.78 (2005) <sup>3</sup>
Main fixed-line telephones per 100 inhabitants	59.79 per cent (2005) <sup>4</sup>
Mobile phone subscribers per 100 inhabitants	100 per cent (as of June 2006) <sup>4</sup>
Internet users per 100 inhabitants	58.1 per cent (by 2005) <sup>3</sup>
Domain names registered under '.tw'	4.32 million (as of July 2006) <sup>5</sup>
Broadband subscribers per 100 inhabitants	20.21 per cent (2005) <sup>4</sup>
Internet domestic bandwidth	1,740 Gbps (as of June 2005) <sup>4</sup>
Internet international bandwidth	148 Gbps (as of September 2006) <sup>4</sup>

Sources: 1. Ministry of the Interior 2007  
2. Ministry of Economic Affairs 2007  
3. International Telecommunications Union 2005  
4. National Communications Commission 2005, 2006  
5. Internet Systems Consortium 2006

to-the-home (FTTH) broadband networks was initiated in June 2004, supporting integrated connectivity of wired and wireless access, as well as voice and data services.

### Broadband network

The total bandwidth of Taiwan's main broadband backbone network (running the length of the island) reached 1,740 Gbps in June 2005. The bandwidth of the international submarine cable network reached 629 Gbps, of which 87.77 Gbps was allocated for Internet connection (FIND 2005).

In accordance with the 'Broadband Conduit Deployment' plan, more and more apartment complexes in Taiwan are being wired with fibre optic networks, leased lines or high-speed ADSL connections. The total number of broadband Internet accounts in Taiwan, including ADSL, cable modem, leased line and PWLAN (Public Wireless Local Area Network), reached 4.19 million in August 2005. Less than a year later, by June 2006, the number of broadband subscribers was close to 4.3 million (FIND 2005). The Taiwanese government is aiming for six million broadband subscribers by 2008.

### IPv6

Academic networks (TANet and TWAREN) and ISPs in Taiwan have been upgraded to IPv6, and have thus acquired 20 IPv6 network segments supporting 114/32 addresses. In 2005, Taiwan ranked eighth in the world in IPv6 network segment volume. Domestic IPv6 links were connected to 23 firms with a total of 11.13 Gbps, and international IPv6 links were connected to

93 firms with a total of 11.5 Gbps. By 2005, Taiwan had obtained 23 IPv6 Ready Logo Phase I international accreditation logos and two IPv6 Ready Logo Phase II international accreditation logos, which made Taiwan fourth and third worldwide, respectively. By the end of June 2006, the number of IPv6 addresses issued in Taiwan had reached 2,243 (Taiwan Network Information Center).

### Mobile communications

There were 22.17 million mobile phone numbers (including GSM, PHS and 3G) in Taiwan as of the fourth quarter of 2005. The mobile phone penetration rate remained unchanged at 97 per cent. However, the number of mobile Internet subscribers has grown rapidly with a compound annual growth rate (CGAR) of 126.6 per cent from 2001 to 2005. The number of mobile Internet users in August 2005 was 7.5 million, representing 33.6 per cent of all mobile phone subscribers (National Communications Commission).

Dual-network technology integrating conventional GSM and 3G networks with WLAN or WiMAX is being developed. Seamless broadband mobile communications with dual-network handsets is viewed as the next-generation mobile communication networking.

### Digital radio and digital TV broadcasting

Taiwan's five terrestrial TV stations currently operate a total of 14 digital TV channels. The projection is for Taiwan to evolve to a new era of digital radio and TV broadcasting by 2010. In 2005, the cable TV penetration rate reached 85.1 per cent (ACNielsen). A forward-looking Multimedia Home Platform (MHP) has been discussed to integrate the emerging hand-held Digital Video Broadcasting (DVB-H) and Internet Protocol Datacasting (IP-DC) service system, and to connect the ongoing IP-TV and IP-DC.

In 2005, a Digital Video Service Platform Systems and Digital Rights Management (DRM) Research Project was initiated, with the aim of establishing DRM technology standards and management methods conforming to international practice integrating interactive TV broadcasting and Internet networking.

## Key institutions dealing with ICTs

One of the key government agencies dealing with ICTs in Taiwan is the National Communications Commission (NCC) established on 22 February 2006. The NCC is an independent regulator governing the telecommunications, media and information sectors.

Article 2 of the NCC Organization Act provides that all laws and regulations dealing with communications, including the Telecommunications Act, Radio and Television Act, Cable Radio and Television Act and Satellite Broadcasting Act, are under the official responsibility of the NCC. Corresponding powers originally under the Ministry of Transportation and Communications (MOTC), the Government Information Office (GIO) and the Directorate General of Telecommunications (DGT) have been transferred to NCC.

The NCC's key functions include licensing, enforcement, spectrum assignment and management, technical standards, regulation of information and communication security and consumer protection. In keeping with its regulatory role, NCC is not a member of the Cabinet and is not even under the supervision of the Executive Yuan (the highest administrative organ of the State). However, the MOTC and GIO still play a role in providing guidance and incentives to the telecommunications and broadcasting industries since, according to Article 3 of the Communications Basic Law, national communications resources planning and provision of guidance and incentives for industry development are to be performed by subordinate organizations of the Executive Yuan.

The National Information and Communications Initiative Committee (NICI), which combines three ICT-related task forces under the Executive Yuan, was established in April 2001. This cabinet-level committee is responsible for accelerating the development of the IT industry, e-commerce and related businesses, improving the efficiency of government services, promoting Internet usage and related applications, and increasing the competitiveness of the IT industry.

Four government agencies are also involved with the development of the ICT industry in Taiwan. The Council for Economic Planning and Development (CEPD) is a ministerial-level agency that is responsible for drafting plans for national economic development, evaluating development projects submitted to the Executive Yuan, coordinating economic policymaking activities, monitoring the implementation of development projects, and implementing the goals set out in Challenge 2008, the Six-Year National Development Plan. The Industrial Development Bureau of the Ministry of Economic Affairs (MOEA) provides assistance to all industries and businesses, and has divisions dealing with industry policy, industry development, knowledge services and electronic information.

The Research, Development and Evaluation Commission (RDEC) runs administrative programmes for the Executive Yuan. Its functions include research and development, overall planning, policy innovation, government restructuring, supervision and evaluation, and information management. It also contracts

academics and experts to conduct relevant surveys and studies on e-government.

The National Science Council (NSC) is the highest government agency responsible for promoting the development of science and technology (S&T). It oversees all S&T programmes of the government. It also plays a major role in developing science parks. It convenes the Science and Technology Strategic Planning Sessions and holds National Science and Technology Conferences regularly (Dahl and Lopez-Claros 2005). In May 1998, it established the National Science and Technology Programme for Telecommunications (NTP) focusing on wireless communications, broadband Internet, applications and services, and telecommunication industry promotion and development.

Four non-profit organizations—the Industrial Technology Research Institute (ITRI), Institute for Information Industry (III), Telecommunications Technology Center (TTC) and Taiwan Network Information Center (TWNIC)—are vital to the development of Taiwan's ICT industry. ITRI was founded in 1973 by the MOEA to meet the technological requirements of industrial development through applied research and technical services. It serves as the technical centre for industry and makes recommendations regarding industrial policy to the government.

III, which was founded in 1979, serves as a joint government-private sector think tank to promote the development of the ICT industry. III provides the private sector with market analysis, ICT training, interoperability standards, services and technology transfers. To the government, III proposes ICT policies (Dahl and Lopez-Claros 2005). It assisted the Science and Technology Advisory Group (STAG) of the Executive Yuan to implement the e-Taiwan Programme which is part of Taiwan's Six-Year National Development Plan. III also plays an important role in promoting digital content: it helped the government set up the Digital Contents Industry Promotion Office and the Digital Contents Institute Digital Contents Assets Appraisal and Investment Service Center to attract investment.

TTC is a telecommunications testing and certification centre founded in February 2004. It was chosen by the Association of Telecom Service Providers to be in charge of the construction and operation of the Number Portability Administration Center (NPAC) in its first five years. TTC also provides testing laboratories various services for IT security, digital TV and WiMAX.

Under NCC supervision, TWNIC oversees domain name registration and IP address allocation in Taiwan. It collaborates with international network information organizations such as ICANN and APNIC, as well as other national Internet organizations such as JPNIC, CNNIC and KRNIC. TWNIC also contracts academics and experts to conduct telephone surveys about broadband use and wireless and mobile communication use twice a year.

## Digital content initiatives

Along with the spread of broadband connections and wireless networks in Taiwan, the demand for digital content on the Information Superhighway has grown exponentially. The Taiwanese government pays very close attention to the development of the digital content industries. In June 2002, the government initiated the Two Trillion and Twin Star programme, which envisions the digital content industry as one of the strategic (or rising-star) industries that would contribute an annual production value of over NTD 1 trillion (about USD 30.287 billion). In line with the vision, several digital content programmes have been formulated and designated agencies are working closely with the private sector.

### National Digital Archives Program

The National Digital Archives Program (NDAP) is one of the nine National S&T programmes sponsored by the National Science Council. The first phase of this five-year initiative began on 1 January 2002. It aims to digitize cultural collections stored in Taiwan's major museums, libraries and universities. Sixteen content themes are covered: Anthropology, Archaeology, Architecture, Archives, Artefacts, Botany, Calligraphy and Painting, Chinese Classics Full-text Database, Geology, Journalism and Mass Media, Linguistics, Maps and Remote images, Rare Books, Stone and Bronze Rubbings, Video and Zoology.

One of the more noteworthy digital museum projects involves the National Palace Museum which is world-famous for preserving the finest artefacts collected by the Chinese emperors and royal families. The museum's collections include a rich variety of jade pieces, ceramics, porcelain, rare books, tapestries, embroidery, ritual bronzes, ancient calligraphic works and paintings from the Stone Age to the present. The goal of the digital museum project is to establish a metadata database of the National Palace Museum's priceless collection and to digitize the 60,000 artefacts, calligraphic works and paintings, and the 190,000 Ching archival documents housed in the museum. The digitized cultural contents would be more accessible to the public, more easily available for academic research and commercial value-added services, and very useful for promoting the museum's collections internationally.

### Digital Content Promotion Office

Under the Two Trillion and Twin Star programme, the government aims to build both real and virtual industrial parks to promote the digital content industry, establish digital content colleges to introduce the newest digital technology, and train new digital

talents and professionals. The Digital Content Promotion Office under the MOEA is the governing agency for all of these activities. Its mission is to promote mobile content/services, online games, 2D/3D animation, software and streaming video products. The industry's digital content production value is projected to reach USD 10.75 billion by 2006 and international sales of Taiwan's digital content industry are expected to grow by 30 per cent. The digital content industry is also expected to create new job opportunities and employ over 70,000 people.

### Cultural and Creative Industries Promotion Office

As part of the government's Challenge 2008 National Development Plan, incentives are being given to industries engaged in innovation, cultural heritage and intellectual property development. It is recognized that the output of such industries will contribute to employment and to the economy as a whole, as well as help improve the overall living environment. Thirteen cultural and creative industries have been designated by the Cultural and Creative Industries Promotion Office under MOEA: visual arts, music and performance arts, cultural exhibitions and performance facilities, handicrafts, motion pictures, radio and television, publishing, advertising, design, digital games and entertainment, brand and fashion designs, innovation lifestyle and architectural design industries.

In addition, the Executive Yuan has launched the Development Fund Investment Plan for Digital Content, Software and Cultural Creative Industries in accordance with the Promotion of Industrial Upgrading Act to financially support and encourage any strategic businesses or projects in digital content, software and culture, as well as the creative industries.

## Online services

With the growing accessibility of broadband connections in Taiwan, a booming online services market for video entertainment services, online music, online gaming and online learning is expected. Taiwan is ranked the third lowest in broadband pricing around the world, with a premium of USD 0.18 per 100 Kbit, which is only slightly higher than Japan's USD 0.07 and South Korea's USD 0.08 and much lower than the USA's USD 0.49 and Hong Kong's USD 0.83 (ITU 2005).

### Online video entertainment

Hichannel, which is owned by Taiwan's largest ISP, has the largest subscriber base on the ARO (access rating online) index with 150,000 paid subscribers as of June 2004. It is among the four most popular video streaming sites (Insightexplorer

2005). Microsoft's Windomedia, which allows users free access to their online videos, has the broadest reach among the three most popular streaming media sites. On the other hand, subscribers who log on to Webs-tv.net, which is partially owned by shareholders from Hong Kong, seem to spend much more time watching online videos per visit. In September 2006, Webs-tv.net was officially merged with the third largest portal site, Yam.com. This merger is expected to capture 54.23 per cent of users in Taiwan, which means that Webs-tv.net will top the online video market with a total of 8.2 million users.

The incumbent fixed network, Chunghwa Telecom, also supports online entertainment services Multimedia on Demand (MOD) through its Hinet broadband ADSL. It has a very competitive basic monthly rate of NTD 100–150.

### Online music

Kuro.com.tw, which is popular among student groups but controversial with its ongoing P2P copyright infringement lawsuit, ranked No.1 in paid usage (21.7 per cent of the market) in a survey conducted in March 2006 (Insightexplorer 2006). Kuro, which charges a monthly rate of NTD 99 (about USD 3), now has over 400,000 paid members.

KKBOX, a local brand supporting licensed online music, reached 16.6 per cent of paid usage. Yahoo! Music (tw.music.yahoo.com) began exploring the local online music market in early 2006 and now enjoys huge popularity with its strong international brand. Yahoo! Music has 9.9 per cent paid market share, which is higher than Ezpeer's 6.4 per cent.

### Online games

With the booming Internet market, a new segment in the gaming industry has emerged—online games. The total revenues from online game services in Taiwan reached NTD 9.81 billion (about USD 297 million) in 2005, representing a growth rate of 17.8 per cent from the previous year (Market Intelligence Center 2006).

Some online game companies, such as Chinesegamer Co., also joined the m-commerce market with mobile games and other mobile value-added services. In addition, many online game companies in Taiwan, such as Gamania Digital Entertainment Co. Ltd., Wayi International Digital Entertainment Co. Ltd. and Soft World International Corp., are competing to be the local distributor of international brands and online game developers.

### Online business

Total revenues from Taiwan's e-commerce market, including online sales and online purchasing, increased by 20.7 per cent

from NTD 177.86 billion (about USD 5.386 billion) in 2004 to NTD 214.7 billion (about USD 445.218 million) in 2005 (FIND 2005).

In a survey (FIND 2005) of online businesses in Taiwan, 8.7 per cent of Taiwanese enterprises were found to be engaged in online selling either through their own website or through an electronic marketplace or EDI (Electronic Data Interchange). The e-selling market increased 1.1 per cent compared to 2004. Among enterprises in online sales, 45.4 per cent of companies employed a secure transaction mechanism, and nearly 30 per cent offered customers online payment services.

The online procurement penetration rate in Taiwanese industry as a whole reached 11.8 per cent in 2005, roughly the same as in 2004. The growth in e-procurement was most significant among large enterprises, where the penetration rate increased from 17.4 per cent in 2004 to 21.9 per cent in 2005. A dramatic growth was also found in the transportation, warehousing and communications industry, where the online purchasing penetration rate rose from 7.4 per cent in 2004 to 13.1 per cent in 2005.

Among Internet services applications, enterprise resource planning (ERP) was the most popular, with 12.9 per cent of enterprises surveyed adopting it and a growth rate of 2.1 per cent from 2004. The next most popular application was customer relationship management (CRM) at 8.6 per cent. In total, however, the penetration rates of e-business applications demonstrated a slightly slow growth in 2005, with an average growth rate of around 2 per cent.

## ICT industries

Taiwan's semiconductor industry plays a leading role in the world. It is strong in its value chain, from IC (integrated circuit) design and manufacturing to packaging and testing. Taiwan is the world's second largest supplier of IC designs (next only to the US) and accounts for 28 per cent of the world's output.

Taiwan's flat-panel display industry grew significantly, with 110 companies creating a value of USD 8.95 billion (47 per cent exports and 53 per cent domestic sales). It is expected to achieve a value of USD 40.53 billion by 2006, which would make it the world's largest TFT-LCD supplier (*Taiwan Yearbook 2005*).

Taiwan is also the fourth largest producer of PCs.

The total production value of Taiwan's ICT industry in 2005 includes USD 5.2 billion for software and services, USD 13.3 billion for communications production, USD 22.6 billion for LCD panels, USD 34.8 billion for semiconductors and USD 81 billion for information hardware (MIC, IEK April 2006).

Taiwan's revenue from telecom services in 2005 was USD 12 billion (or 3.4 per cent of the GDP), of which 58 per cent was due to mobile networks, 22 per cent was due to fixed networks,

13 per cent was for value-added services and 7 per cent was for other services (Li 2006). Chunghwa Telecom (CHT), the state-owned dominant carrier, was privatized in August 2005, although government still owns 41.37 per cent of its shares. As of March 2006, its market share in terms of revenues was 54.47 per cent for international services and 76.18 per cent for domestic long-distance services.

Taiwan's 2G operators and their market share in 2005 are: Chunghwa 39 per cent, Far Eastone 31 per cent, and Taiwan Cellular 30 per cent. Five mobile phone companies provide 3G services.

CHT is the dominant fixed network in Taiwan. Its branch company, HiNet, also dominates 84.27 per cent of the ADSL market (TWNIC 2006.7). Asia Pacific Broadband Telecom (APBT) is a new fixed network that used to have family affiliation with the cable company MSO Eastern Multimedia Company (EMC). It provides both ADSL and cable modem services. It has acquired an ISP named Asia Pacific Online (APOL) and is now the second largest provider in the Taiwanese broadband market. Other new fixed networks include Taiwan Fixed Network (TFN) and New Century InfoCom Tech Co. Ltd. Since they are new entrants and still have problems regarding access to the last mile, they prefer to promote broadband to small and medium businesses and buildings that have access to high-speed Internet. ISPs such as Seednet and SoNet also actively promote ADSL.

EMC and Hoshin GigaMedia Center Inc. also provide broadband service via a cable modem. However, cable modem penetration is only 5.6 per cent of the broadband market. GigaMedia provides both cable modem and ADSL services.

## Enabling policies and programmes

The key role played by the Taiwan government in promoting ICT production and IT use is widely recognized. The Taiwan government continues to initiate critical national programmes for strengthening indigenous production of advanced ICT technologies and upgrading the people's quality of life.

### Challenge 2008 National Development Plan

Encouraged by the two decades of success of the Hsinchu Science-Based Industrial Park, the government of Taiwan in May 2002 aggressively launched the Challenge 2008 National Development Plan, which emphasizes strengthening international competitiveness, upgrading the people's quality of life, and promoting sustainable development. Under the Plan, the government and the private sector have been working closely together to transform Taiwan into a 'green silicon island' in the first decade of the new century.

To speed up the Plan's implementation, the government in November 2003 identified a number of new major construction projects, including:

- Education: Develop top-notch universities and research centres
- Digital Infrastructure: Implement the Mobile Taiwan (m-Taiwan) project
- Transportation: Build up a rapid railway transit network, that is, Taiwan High Speed Rail

### e-Taiwan

In May 2002, the NICI initiated implementation of the e-Taiwan Program as a key component of the Challenge 2008 Program. ICT infrastructure development and e-government initiatives were emphasized during the first stage of the e-Taiwan Programme (implemented in 2002–04). The second stage (2005–07) focused on enhancing the use of ICT applications in Taiwan.

In June 2006, the Intelligent Community Forum (ICF) honoured Taipei as the 'Intelligent Community of the Year' for demonstrating 'sustainable competitiveness' in its use of broadband technology for economic development. Taipei, Taiwan's capital city, was also praised by ICF for its continuous demonstration of 'digital democracy' through its broadband policies. Indeed, e-government supported by broadband infrastructure is making significant contributions to the achievement of a more participatory democracy in Taipei. For example, by logging on to the Taipei e-government portal site (<http://www.taipei.gov.tw>), Taipei citizens can obtain government administrative planning data, project implementation status reports, on-site inspection reports and the results of public opinion surveys. They can also use a wide variety of e-services, from e-education to filing complaints with any government agency. The Taipei city government enables the public to play the role of 'cyber citizens'.

### m-Taiwan for a Ubiquitous Network Society

The NICI in coordination with the Ministry of the Interior (MOI) and the MOEA, proposed the m-Taiwan Program, a key initiative to transform Taiwan into a 'Ubiquitous Network Society' (UNS) in which the public can feel the benefits of 'e-enablement'. The vision of the m-Taiwan initiative, which has a budget of NTD 37 billion (about USD 1.12 billion) from 2005 to 2009, is to develop the infrastructure for wireless Internet access for 8 million subscribers and to provide broadband internet coverage to 80 per

cent of the population in urban areas. Taipei and Taichung are the pioneering 'mobile cities' established in 2005.

The m-Taiwan Program aims to solve the Last Mile problem by further building up seamless wireless networks (including WiMAX), integrating mobile phone networks, implementing the optical fibre backbones and implementing the Integrated Beyond 3rd Generation (iB3G) Double Network Integration Plan (that is, integrating WLAN and cellular communications). The government will soon be issuing licenses for WiMAX, the fourth generation of telecommunications.

Thus, Taiwan has become a WiMAX test bed for global companies like Intel and Nortel. In 2006, Nortel signed an agreement with Chunghwa Telecom to deploy a WiMAX solution in the operator's experimental park to create an environment for testing WiMAX, and integrating the technology with the Nortel Wireless Mesh Network solution deployed in Taipei and Kaohsiung as part of the government's m-Taiwan initiative. In addition, Nortel deployed a WiMAX trial system at the National Taiwan University campus, and established a Center of Excellence for Devices in Taipei. In early December 2006, Chunghwa Telecom also announced its intention to build the first fully integrated broadband wireless network driven by the Yilan local government under the m-Taiwan project. Chunghwa Telem envisions Yilan, a northern county in Taiwan, as a national showcase for ubiquitous wireless broadband services in which WiMAX infrastructure will enable broadband wireless access to services like m-learning, m-commerce, m-tour, as well as video surveillance and IPTV services.

## Legal and regulatory environment for ICTs

In order to liberalize the telecommunications industry, two major Telecommunications Liberalization White Papers were propagated. The first, which was released in 1987, aimed to provide a fair and competitive environment, promoting technological progress, improving industrial efficiency, providing high-quality, diverse and cheaper telecommunications services, and triggering economic development. The second Telecommunications Liberalization White Paper, which was released in 2002, was aimed at constructing an international telecommunications environment, promoting universal service, narrowing the digital divide, promoting competition, providing creative and high-quality telecommunications services and fostering the development of the telecommunications industry (Liu 2003).

The Telecommunications Act is the main law regulating telecommunications enterprises. It was first introduced in 1958, and has been revised several times. The 1996 revised version

was significant in that it separated DGT from CHT, meaning that DGT would become a governing agency and would no longer manage CHT. The Telecommunications Liberalization White Paper and the revised Telecommunications Law emphasized competition by opening up the telecommunications market and applying asymmetrical regulations, such as network interconnections and unbundling, on the dominant player CHT (Liu 2003).

There are three electronic media laws (Radio and Television Act, Cable Radio and Television Act, and Satellite Broadcasting Act) and one Telecommunications Law. With the convergence of telecommunications and broadcasting, many laws and regulations have become outdated. When the former broadcast and telecommunication regulators were merged, there were discussions about whether the telecommunications law and the electronic media related laws should be integrated into one law. The Communications Basic Act, promulgated in January 2004, was enacted to accommodate the convergence of technologies and encourage the sound development of communications. Article 6 of the Act states that the government shall encourage innovation in communication technologies and services and that it shall not impose any restriction on innovation without proper cause. Article 7 states that the government shall avoid any discriminatory administration of different transmission technologies, but this requirement does not apply to the allocation of scarce resources.

To protect the people's right to know and to further people's understanding of public affairs, the Freedom of Government Information Law was promulgated in December 2005. It was enacted to ensure that administrative measures directly related to people's rights and interests as well as other relevant government information shall be made available to the public in a timely way.

The Electronic Signature Act was enacted in April 2002 to ensure the security of electronic transactions, and to facilitate the development of e-government and e-commerce.

## Education and capacity building

The National Science and Technology Program for e-Learning was initiated under the Challenge 2008 National Development Plan with a five-year budget of USD 120 million. The programme aims to:

- create a better e-learning environment to prepare *everyone* for the e-life, including the workforce, the unemployed, schoolteachers and students, government agency staff, retired senior citizens and on-duty army forces;

- bridge the digital divide between information haves and information have-nots;
- promote and develop local e-learning industries; and
- upgrade Taiwan into one of the leading e-learning and knowledge-based economies.

The project transforms established centres and institutions, such as libraries, schools, job training centres, cybercafés and citizen clubs, into e-learning classrooms. It also investigates countrywide digital divide indicators, analyses the factors contributing to the digital divide and formulates strategies for bridging the digital divide, such as e-learning programmes for the less privileged. The project supports advanced mobile learning devices such as multifunctional e-schoolbags, which are mobile learning devices that provide access to e-learning environments regardless of time and place. The project also provides for the establishment of the Network Science Park for e-Learning (e-Park), which supports e-process industries (technologies, markets, platforms and quality control) and links to physical service centres. The e-Park is expected to play an important role in the Chinese e-learning world. Indeed, one of the aims of the e-learning project as a whole is the enhancement of the global competitiveness of the local e-learning industry.

In addition, over 1,000 elementary schools and junior and senior high schools are connected via the Taiwan Academic Network (TANet), one of Taiwan's three major ISPs (the other two are HiNet and Seednet). TANet was built as a collaborative project of the Ministry of Education's Computer Centre (MOECC) and Taiwan's leading universities in July 1990. Today it supports the following Internet services along with Academia Sinica: e-library and e-periodicals, Website services, e-mail, server hosting, over 4,000 English domain names (edu.tw), IPv6, e-learning, academic e-document exchange, videoconferencing and information security for schools. The Taiwan Advanced Research and Education Network (TWAREN), TANet's second generation (TANet2), which began as an initiative under Challenge 2008, has more than 49 research and academic institutions connected to it.

For off-campus ICT education and capacity building programmes, the Digital Education Institute (DEI) under III is a professional training, e-learning and corporate training solution provider with a client portfolio that includes CEOs, CIOs, government officers, consultants, managers and staff. The training programmes offered help a wide variety of individuals improve their computer and ICT skills to meet corporate and government requirements.

The Council of Labor Affairs under the Executive Yuan also provides short-term intensive training programmes in ICT

applications for the unemployed. It offers vocational lessons online through the e-learning platform.

The Ministry of Education under the e-Taiwan project expects to initiate 400 Digital Opportunity Centers (DOC) in 180 rural areas from 2005 to 2008, to provide aboriginal tribes and the elderly with computer literacy courses that introduce Internet access, e-learning fundamentals and e-commerce essentials.

## Open source and open content initiatives

In June 2002, the NICI decided that the Industrial Development Bureau (IDB) under the MOEA would be the agency responsible for initiating free software promotion initiatives, and the Free Software Steering Committee would be formed to promote open source software. Thus the Free and Open Source Software (FOSS) Promotion Initiative was launched. This four-year project from 2004 to 2007 aims to facilitate the development of the Taiwanese free software industry; encourage the use of free software in Taiwan, including Linux, Chinese-language applications or other free software; and further contribute to information sharing and exchange.

The Open Source Software Foundry (OSSF) is a sub-project of the FOSS Promotion Initiative. It is partially funded by the MOEA/IDB, NSC and Academia Sinica to help Taiwan become a hub of the FOSS industry and a major contributor of FOSS worldwide. The OSSF's website ([http://www.iis.sinica.edu.tw/page/research/en\\_OSSF.html](http://www.iis.sinica.edu.tw/page/research/en_OSSF.html)) is a repository of numerous resources in all aspects of free software. Currently it contains:

- OpenFoundry, a FOSS repository and management system where one can access many of Taiwan's FOSS projects as well as create one's own FOSS projects;
- A database on Taiwan's FOSS talents and experts;
- Documents on intellectual property issues, and LicenseWizard, a Web-based tool to assist in the selection of FOSS license agreements;
- Resource catalogues in selected areas, including embedded software, enterprise computing and Chinese language processing;
- Announcements of FOSS-related conferences and events;
- *Open Source Newsletter*, a biweekly electronic publication of the OSSF.

The OSSF also works with government, academic and research institutes, and industry in the release of software source code under FOSS licenses. An emphasis of OSSF work is the analyses of FOSS licenses and national policies worldwide.

It provides training courses for users and helps project owners choose the appropriate FOSS licenses. The OSSF conducts surveys of local FOSS communities, designs training courses, and holds workshops. The OSSF also studies well-known FOSS projects and highlights their successful experiences in OSSF publications in order to encourage Taiwan's software developers to join FOSS.

## R&D initiatives

Taiwan has been working to consolidate its S&T foundation in order to achieve the S&T standards of a developed nation by 2010. To this end, R&D input and output targets include raising R&D funding to 3 per cent of GDP and increasing the number of research personnel with college or advanced degrees to 32 persons per 10,000 by 2007. Local inventors and companies are encouraged to apply for US patents to help Taiwan reach its targeted 3.5 per cent of all US patents granted (not including new design patents) by 2007. Other goals include increasing the number of broadband users to more than six million by 2007.

The IT-led development strategy adopted by the Taiwan government has been generally recognized as one of the critical factors in Taiwan's economic development (Wang 2003). For example, the Hsinchu Science-Based Industrial Park (HSIP) was established in 1980 by the National Science Council to ignite economic development in this island country. The park's high-tech talents collaborating with academic and research institutes in close proximity has clearly created 'cluster effects' and has contributed to significant economic outputs for the last two decades.

Also in line with the IT-led development strategies, the Southern Taiwan Science Parks (STSP) were established in Tainan in 1996 and in Kaoshiung in 2001. These two new science parks have been widely recognized as critical IT R&D incubators serving the same policy function as HSIP in northern Taiwan.

## Challenges and opportunities

Despite its important role in supplying the world with ICT products, the Taiwanese ICT industry is faced with several challenges. First, the revenues for original equipment manufacturing (OEM) and original design manufacturing (ODM) ICT industries have been shrinking. To achieve economies of scale, more companies are merging. The government needs to provide a sound environment for small and medium-sized companies.

Second, Taiwan's ICT industry used to make products for the world's major brands. It needs to cultivate its own brand by engaging in more marketing and promotion.



A third challenge is that although Taiwan's ICT technology is advanced, Taiwan has not done enough to improve industry standards and technology innovation. More R&D needs to be devoted to innovative technology. Also, high technology experts abroad should be attracted into Taiwan, which means that a better working environment—better living standards, good medical care, and an international-standard living environment—should be provided.

A fourth challenge relates to the fact that the Taiwanese ICT industry has built many firms in China where labour is cheap and land prices are low. These firms produce 70 per cent of China's IT output (Lin 2005). Taiwan needs to make the best use of its technology talent and disciplined labour force to contribute more to the higher ends of the value-chain.

In the area of telecommunications, a level playing field for telecom operators and fair competition must be assured. The NCC needs to ensure that the CHT will open its last mile and provide reasonable wholesale prices to competing operators. As for digitization, the Digital Opportunity Centres should provide a good environment for the companies involved in digital entertainment to grow.

The e-Taiwan, m-Taiwan and u-Taiwan initiatives provide a clear direction for the growth of the ICT industry. But determination to implement the above mentioned policies and collaboration among the relevant government agencies, are also crucial to maintain Taiwan's competitive edge in the global ICT industry.

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