M-Taiwan Program
A WiMAX Ecosystem
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Table of Contents

Table of Figures

Table of Tables

Globally known for its superior Information and Communication Technology (ICT) industry, and wanting to play a lead role in matters of adopting technology in the WiMAX™ world, Taiwan has methodically created a dedicated ecosystem to demonstrate WiMAX™ technology in action through a full-scale value chain.

1   Introduction

Owing largely to state sponsored incentives and ICT product manufacturing capability, Taiwan has elevated itself in the overall global market to an enviable position. Supplying the entire range of IT products ranging from semiconductor, computer, consumer electronics, and networking products, Taiwan is today considered to be the top ICT manufacturer with a very successful Wi-Fi industry enjoying more than 90% of world market share. In the quest to identify the next generation product, the Taiwan government chose WiMAX - the WiMAX Forum-defined implementation of the latest wireless MAN (Metropolitan Area Network) technology - to open up another frontier in the wireless industry. In 2005, the Science & Technology Advisory Group (STAG) of Executive Yuan developed a WiMAX blueprint, which states "WiMAX Technology will be a focus for the future of Taiwan ICT industry, and will be the preferred technology to deliver M-Service, M-Learning and M-Life in the "M (Mobile)-Taiwan Program". The M-Taiwan program and WiMAX acceleration projects, which aim to develop chip set and base stations, were initiated under this blueprint.   Towards this end, Taiwan offers not only world class manufacturing capability, but also an entire service and application test bed, by forming its own ecosystem.

Forming a complete WiMAX ecosystem, including chipset, CPE, network elements, test labs, system integration, application, commercial operation and services, is part of the overall strategy adopted by Taiwan for development of technology. Cooperating with international players, and leveraging the strengths of its indigenous Wi-Fi industry, Taiwan is able to speed up product development, manufacturing and marketing of WiMAX technologies.

WiMAX spectrum with good physical characteristics, which is crucial to network deployment, has been planned and will be released by June 2007 to facilitate the M-Taiwan program and subsequent commercial operation of WiMAX systems. To promote global interoperability Taiwan actively participates in international standards and promotes international collaborations. Taiwan has been working closely with the WiMAX Forum® in promoting WiMAX and sharing M-Taiwan experiences. Section 2 of this case study describes M-Taiwan program, Section 3 discusses Taiwan's WiMAX ecosystem, Section 4 describes current status of the M-Taiwan program, and Section 5 provides conclusions.

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Technology, MSkylink Telecom, Rock Mobile Corporation, SGS Taiwan, Sporton International, TATUNG, TECOM, Telecom Technology Center, Universal Scientific Industrial, VIBO Telecom, and ZyXEL Communications.

2   The M-Taiwan Program

Over the years, Taiwan has progressively exhibited ever-improving skills in the arena of ICT products. Its innovation in design manufacturing can be gauged from various categories of products such as routers, notebook computers, cable modems, Wi-Fi equipment, and LCD panels. To match competition around the world, the Taiwan government has undertaken a challenge to continuously invest in new technologies. The M-Taiwan Program is another example of its initiative to promote Taiwan's ICT industry.

To build further on the success of 'e-Taiwan', a key component of 'Challenge 2008: the 6-Year National Development Plan' that commenced in the year 2002, the government of Taiwan allocated 42 million US dollars for the year 2005, and another 70 million for 2006, to kick off the M-Taiwan Program. A major goal of the program is to build a standard-compliant environment as the foundation for life style applications such as M-Services, M-Learning, and M-Life as depicted at the right hand side in Figure 1 below.
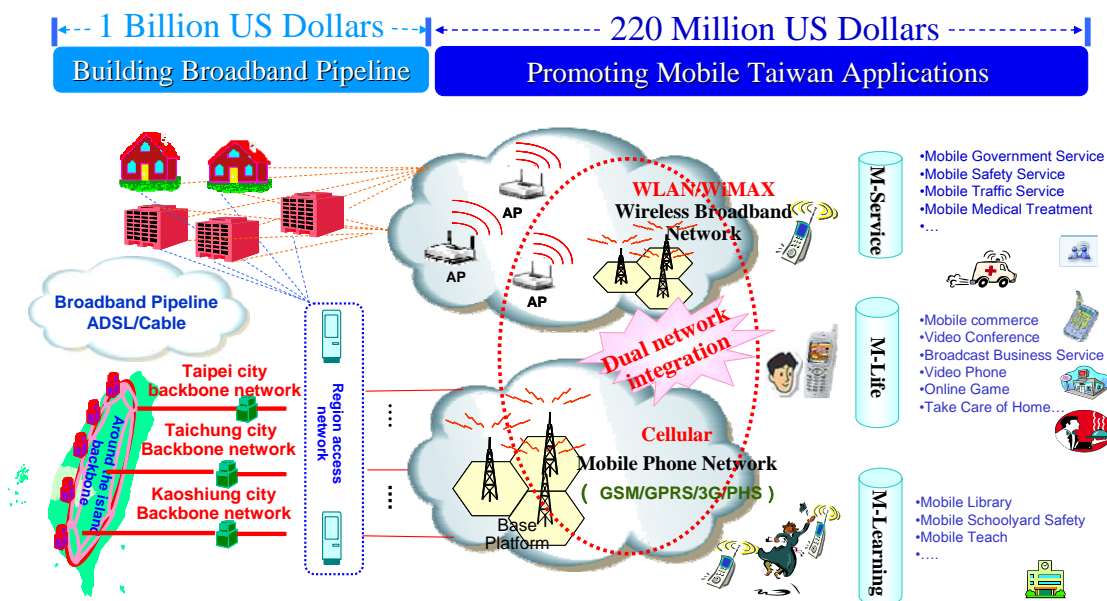

Figure 1. M-Taiwan: A Program to Realize Taiwan WiMAX Blueprint.

The M-Taiwan Program is essentially an ecosystem at work for building demand, supply, and infrastructure in the industry. The government has established an environment to support various facets of the project, such as setting up a regulatory and policy frame work, standardizing applied

technologies, providing the required funding assistance, and opening up suitable frequency spectrums. This environment set up by the Government is visualized to eventually support about eight-million broadband wireless users by the year 2008.

2.1   Objectives of M-Taiwan

One of the major objectives of the Program is to strengthen Taiwan's ICT infrastructure and services to provide a world class wireless broadband access environment for internet users. To achieve this goal, the government encouraged all local corporate entities to collaborate with international companies not only to take on domestic projects, but also to address global business opportunities aggressively. Specifically, M-Taiwan has the following objectives:

- **Enhance Infrastructure:** Reducing digital divide by achieving wireless broadband coverage in the urban area to 80~90% and rural area to 30~40%
- **Upgrade the Capability of the Communications Equipment**: Achieving over 50% usage of domestic equipment and incubating 1~2 system vendors
- **Create a Mobile Data Service Industry:** Establishing domestic mobile data services and incubating 2~3 service solution companies
- **Build a Competitive Mobile Industry Environment:** Selecting 2~3 fixed network operators for WiMAX trials and creating integrated data, video, and IPTV services

2.2   Strategies of M-Taiwan

The M-Taiwan program will create several city-wide broadband wireless networks for providing integrated mobile services. These networks will form a big test-bed for the trials of new technology development and application services. To achieve these goals the following strategies are adopted for the technology development of the M-Taiwan program and WiMAX related projects:

- Form a complete WiMAX ecosystem that includes chipset, CPE, base station, network elements, system integration, applications and commercial operation
- Develop differentiated applications, e.g., IPTV Broadcasting over WiMAX
- Design a coupled WiMAX/Wi-Fi network to leverage strength of Taiwan Wi-Fi industry
- Leverage government sponsored research & development projects for core technologies, e.g., the WiMAX acceleration project
- Participate in international standards activities and collaborate with international organizations or players to speed up product development, manufacturing, and market development

To ensure interoperability of the networks to be created by different M-Taiwan projects, the government has funded an M-Taiwan support center to conduct network entrance and interoperability tests.

3 M-Taiwan WiMAX Ecosystem

Creation of a dedicated ecosystem is a critical requirement for any new technology, since it can shorten the adoption cycle substantially. Such an ecosystem also provides a "cookie cutter" template to promote the use of such technology. Newly formed organizations, partnerships, various lessons and experiences gained from there can be applied elsewhere in the world.

Like other ecosystems, the WiMAX ecosystem also includes demand, supply and infrastructure. To establish any healthy ecosystem, a fair competitive environment is required to drive a full scale industry value chain. Figure 2 shows the ecosystem created in the M-Taiwan Program. The four aspects of the ecosystem are discussed in the following subsections.
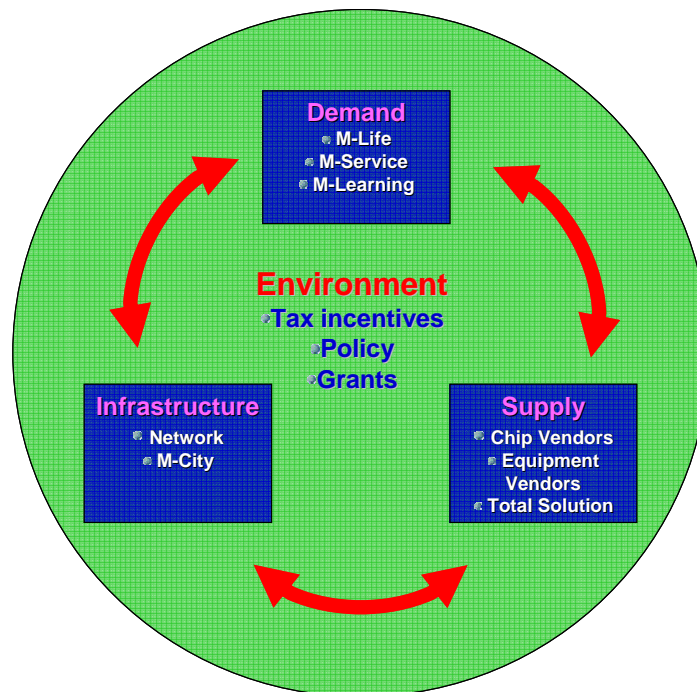
Figure 2. M-Taiwan: Program Ecosystem

3.1 Demand

The M-Taiwan Program generates demand from both public and private sectors to meet the volumes required in the ecosystem. The public sector mainly focuses on government services, or 'M-Service', and the education segment, or 'M-Learning'. The Taiwan Government has actively supported the 'M-Service' initiative by participating in demonstrations of WiMAX applications such as traffic services, medical services and wireless security surveillance. The 'M-Learning' initiative includes distance learning and campus safety. The other 'M-Life' initiative, which is an emphasis of the private sector, promotes the idea of ubiquitous coverage and creative applications such as

entertainment, banking, or even purchases. The Government also encourages early investment in mobile content and service related resources.

3.2 Supply

Many WiMAX application and service demands generated in the early stages of the M-Taiwan Program have encouraged the development of products to satisfy the needs. To propel WiMAX development quickly, the government launched a WiMAX Acceleration Project to focus on WiMAX solutions, including IEEE 802.16e-2005 SS chipset and BS development. The project aims to meet the requirements demonstrated in the M-Taiwan Program. Leveraging the strengths of Taiwan's CPE ODM capability, the project offers a total system solution to meet the market demand.

Besides the WiMAX Acceleration Project, the government also encourages various partnerships to fuel the development of WiMAX. Local private firms are encouraged to team up with international players with different expertise to speed up product manufacturing and market development. Such partnerships not only allow domestic manufactures to complement their own levels of proficiency, but also help establishing viable and bona fide channels for sales in the global market after registering success in the domestic market.

3.3 Infrastructure

A well established infrastructure is crucial to deliver the demand generated in an ecosystem. For an extensive coverage wireless technology like WiMAX, the most essential element is undoubtedly a dedicated frequency spectrum.   For opening up spectrums, the Taiwan government announced on February 13, 2007 that it will adopt a two-phased spectrum release plan for broadband wireless access services. In the first phase, three regional licenses each will be issued for northern and southern Taiwan before the end of June 2007. These licenses will be valid for 6 years and can be renewed once. The bandwidth for each license will be 30 MHz in the 2.5-2.69 GHz band. These licenses may be integrated and exchanged for national licenses. Depending on integration of these licenses, at least one more nation-wide license will be issued after June 2009 which will be valid for 10 years. The licenses will be awarded through proposal review followed by open bidding based on a criterion of percent of revenue to be paid to the government as license fees. These licenses have offered 'good spectrum', in terms of physical characteristics, for M-Taiwan projects and commercial operation and will be dedicated for broadband wireless access technologies including mobile WiMAX networks.

In order to test various WiMAX application services and verify technology, the Government provided the required funding to create selected mobile cities, including Taipei and Taichung, and some special zones for special services and reducing the digital divide. There are more than 20 M-Taiwan projects launched all over the island now.

Besides frequency band and test beds, standardized products are also important in a successful ecosystem. Without standardized products or technologies, there could be fragmentation in the industry that results in an undesirable volume demand. Two testing houses, Advance Data Technology and Compliance Certification Services, have been chosen to provide M-Taiwan network entry testing, and have been encouraged to apply for WiMAX certification labs. A

WiMAX testing technology support center was also established to jointly develop RCT/PCT/IOT test cases with test equipment vendors.

3.4 Environment

Even with all components of an ecosystem being available in the right mix and providing positive feedback to one another, it takes a fair and competitive environment to nurture and grow an industry. Towards this, the Taiwan government's decision to commit a dedicated frequency band to the M-Taiwan Program and WiMAX products has provided a meaningful means in establishing a wireless industry. Various government R&D grants for manufacturers of communication devices, IC chipset design houses, system integration vendors and others provided the necessary motivation to jump-start the industry wide development. In addition to government funding, measures like tax reduction or exemption were also instituted to act as further stimulants for the industry.

Standards participation is another important part of creating a healthy environment. The Taiwan government urges all the M-Taiwan Program participants to follow the industry closely. Any firm that participates in the M-Taiwan Program is highly encouraged to be a member of the WiMAX Forum. This has resulted in a noticeable increase in membership of Taiwanese companies, from only four members in October 2005 to 32 now. These members are involved actively in different working groups, including the Application Working Group (AWG), Marketing Working Group (MWG) and Certification Working Group (CWG).   With Ching-Tarng Hsieh from ITRI (chsieh@itri.org.tw, +886-3-591-7379) as the liaison, the Government of Taiwan is itself an active participant of WiMAX Forum, as a link between the global WiMAX community and the local industry in Taiwan.

4 Status of M-Taiwan Program

M-Taiwan is a four year program launched in December 2005 with a total budget of $212 million US dollars. This program is expected to stimulate Taiwan's industry to invest approximately $630 million US dollars on WiMAX network infrastructure. In addition to traditional telecommunication operators, fixed-line communication operators, mobile communication operators, PHS operators and other new entries in this field are all involved in building Taiwan's WiMAX network. In October 2005, a total of 23 proposals were received; 10 were in the 'M-Service' category, while the balance was in 'M-Life'. 11 of the 23 proposals were funded to build WiMAX infrastructure in various cities to provide VoIP, Video, Surveillance and M-healthcare as the major services. Appendix A shows a list of applications and services for these projects.

4.1   Carrier Pilot Project

In 2006, the emphasis of the M-Taiwan program was shifted to create applications and building large infrastructures. A total of 33 proposals were received in 2006 among which 12 were funded which included 9 infrastructure and 3 application type projects (see Appendix A). FITEL, the only PHS operator in Taiwan, is the most aggressive player in this program representing 39% of

WiMAX networks development in the M-Taiwan program. It is followed by the emerging WISP operator TATUNG with 18%, and by mobile operator FET with 17%. Other carriers such as Chunghwa Teleocm, APBT and VIBO Telcom share the remaining 25%. Many of these M-Taiwan projects will provide interoperability testing services and free field trials for a certain period. The following are typical projects in the M-Taiwan program funded in 2006. These M-Taiwan companies include a PHS operator that wishes to provide data services using WiMAX, a traditional 2G/3G operator that is highly interested in WiMAX, and a 3C product vendor which is interested in entering the service provider business.

FITEL Project

FITEL plans to integrate its PHS service with the mobile WiMAX networks and promises to purchase at least 50% of the equipment domestically. It plans to obtain WiMAX license and develop networks in 2007. FITEL's WiMAX networks will mainly cover the Taipei City area with a total number of 430 base stations. It will reach 80% of the population in northern Taiwan. To facilitate the application services on the converged WiMAX/GSM dual network environment, FITEL will accelerate its R&D schedule for WiMAX/GSM dual mode handheld device using extensive experience on the existing PHS/GSM dual mode phones.

TATUNG Project

TATUNG, an emerging WISP operator, is currently one of the most important 3G product suppliers in Taiwan. It has formed a WiMAX business and is expected to launch WiMAX service by 2008. It will provide VoIP, Mobile web portal, E-map and mobile positioning system, Mobile e-business and multi-media blog, and Traffic surveillance services. TATUNG will cooperate with VIBO Telecom and is expected to have coverage for over 85% in highly-populated area of Kaohsiung in southern Taiwan. In addition, it will also provide surveillance service to monitor dump trucks in the Kaohsiung County.

FET Project

As a traditional 2G/3G operator FET is very optimistic on WiMAX in creating mobile application business opportunities and plans to deploy WiMAX networks in 2007~2008. It will adopt WiMAX as the core technology to build mobile data/multimedia network which covers Banciao and Jhonghe in northern Taiwan with an estimated coverage rate of over 80%. FET plans to provide remote mobile health care services and deploying Intelligent Transportation System over WiMAX networks. It is also interested in providing broadband wireless access on the train that will be built to connect the international airport to the domestic airport in Taipei.

4.2 Taiwan WiMAX Product Development

Riding on the wave of a successful Wi-Fi industry, Taiwan will play an important role in the world-wide deployment of WiMAX systems by supplying varieties of CPE products. It is expected that Taiwan's WiMAX CPE market share will reach 90% in 2012. With an emphasis on enhancing technology capability to develop chipsets and base stations, the WiMAX acceleration project will transform the Taiwan industry from CPE design to base station system development. On WiMAX

chipset, MediaTek has focused on development of an 802.16e-2005 chipset. Table 1 gives the timeline of Taiwan WiMAX product development for various Taiwanese manufacturers.

Company	Product		Status
Accton	CPE/BS	16e	Card and Indoor CPE MP* in Q1 2007
Alpha Networks	CPE/BS	16d	Indoor and Outdoor CPE ready for MP
		16e	Indoor and Outdoor CPE and Card developing, sample in Q1/Q2 2007
ASUSTek	CPE/BS	16d	Indoor CPE ready for MP
		16e	Card and Indoor CPE MP in Q2 2007
Cameo	CPE	16e	Wi-Fi / WiMAX Router sample ready
CyberTAN	CPE	16e	Card and G/W sample ready in Q1 2007, MP in Q2 2007
Delta Networks	CPE	16d	Indoor CPE MP Outdoor CPE developing, sample ready in Q1 2007, MP in Q1/Q2 2007
Foxconn	CPE/BS	16e	Card sample ready, MP in Q1 2007 Indoor and Outdoor CPE MP
Gemtek	CPE/BS	16d	Indoor and Outdoor CPE MP
		16e	Card sample available, ready in Q1 2007, MP in Q1/Q2 2007 Indoor CPE sample available, ready in Q2 2007 Pico BS developing
JStream	CPE	16d	Sample ready, MP in Q2/Q3 2007
Microelectronics Technology	CPE/BS module	16d	Indoor/Outdoor CPE and BS radio unit MP in Q1 2007
MiTAC	CPE/BS	16d	Indoor CPE ready for MP
		16e	Card sample ready in Q1 2007, MP in Q2 2007 Indoor CPE with MIMO sample ready in Q2 2007.
Quanta Microsystem, Inc.	CPE	16e	Card sample ready in Q1 2007, MP in Q2 2007 Indoor CPE sample ready in Q1 2007, MP in Q2/Q3 2007
TECOM	CPE/BS	16e	PCMCIA card, sample ready Indoor Modem, sample ready in Q1 2007 IAD with MIMO, sample ready in H1 2007 Macro BS, sample ready in Q1 2007
USI	CPE/BS	16d	Indoor/Outdoor CPE and micro BS MP

		16e	Indoor/Outdoor CPE and Card sample ready in Q1 2007, MP in Q2 2007
Winstron NeWeb Corp.	CPE	16e	Card and Wi-Fi G/W sample ready in Q1 2007, MP in Q3 2007
Z-Com	CPE	16d	Outdoor CPE MP in Q1 2007 Outdoor WiMAX/WiFi MP in Q2 2007, Indoor CPE sample ready in Q2 2007, MP in Q3
ZyXEL	CPE/BS	16e	Card and Indoor CPE MP Outdoor CPE ready in Q1 2007 Pico BS developing, sample ready in Q1 2007

*MP : Mass Production

Sources: M-Taiwan Project, Company Data, December 2006

Table 1. Taiwan WiMAX Product Development Timeline

4.3 Participation in WiMAX Forum PoC Projects

In October 2006 the Applications Business Task Group (ABTG) made a recommendation to the WiMAX Forum Board of Directors that the WiMAX Forum create a project to develop an application demonstration/development/testing environment to help promote the support, marketing, and adoption of the Mobile WiMAX™ Technology. The objective of this application "sandbox" is to provide an environment that enables vendors, developers and users to create and demonstrate applications that promote the value and use of Mobile WiMAX technology. The environment will be open to all vendors for testing how applications enabled by Mobile WiMAX in an open (real world) environment can exhibit the superiority of Mobile WiMAX versus other wireless technologies.   At the same time, Mobile WiMAX vendor interoperability and legacy network integration will be exhibited.

ABTG has selected two initial locations for the application demonstration environment. The one in Taiwan will be located at National Taiwan University. It was selected to support the WiMAX Forum Member Conference in October of 2007 and to help launch a worldwide marketing effort to showcase Taiwan as a leading manufacturer of WiMAX CPE equipment.   This institution provides virtually unlimited access to a wealth of passionate, creative and curious Mobile WiMAX users.

Focus will primarily be on the application layer while trying to minimize instability and creation of the Mobile WiMAX radio network. University students will use this mobile WiMAX sandbox to develop differentiated Mobile WiMAX applications such as Web 2.0 and YouTube Broadcasting over WiMAX. They will document the feedback on application functionality and robustness.

5 Conclusion

Taiwan supplies over 90% of Wi-Fi products globally and hopes to achieve the same success in the WiMAX product market, by providing a variety of WiMAX CPE equipment through M-Taiwan and related projects. The M-Taiwan program has a goal of creating a WiMAX ecosystem and establishing a test-bed for WiMAX equipment, networks and applications. In the short period since its inauguration, 'M-Taiwan' has undeniably achieved significant initial success. With a direct investment of $ 1.5 billion US dollars, Taiwan now has over 80 companies participating in the program, which strengthens the overall value chain of the industry. The early success of the M -Taiwan Program proves unequivocally that to support a new industry, it takes not only adequate demand, solid infrastructure and plentiful supply, but also a fair and competitive environment. The Government of Taiwan has been mindful of this from the very inception, and thus has made substantial and meaningful investments to create a desirable and encouraging environment for participation in the Program.

Taiwan is moving steadfastly with its planning of WiMAX spectrum and sticking to its original plan to issue a number of regional licenses by June 2007. This will allow green-field operators to participate in the M-Taiwan program to join the ranks of established operators in providing WiMAX services. Several large scale WiMAX networks are expected to be created in 2007, making it easier for these networks to provide commercial services in the near future. In addition, the government is considering innovative WiMAX deployment approaches to create Wireless Cities and begin the study of using WiMAX technology for the newly inaugurated Taiwan High Speed Railway system. The M-Taiwan Program ultimately provides an effective template for any other country wanting to utilize WiMAX technology, and will essentially accelerate the WiMAX adoption process in the rest of the world.

Appendix A – List of Services & Applications

Projects Granted in Year 2005

Category	Project	Area and Company
Mobile Service	Mobile broadband wireless network application in Taichung City	Taichung/ Asia Pacific Broadband Wireless Communications Inc.
	Mountain-Sea Wireless, Dreamland of sea waves	Hualien/ TATUNG
	Mobile broadband wireless application project in Yilan	Yilan County/ Chunghwa Telecom, North Taiwan Business Group
Mobile Life and Service	Taiwan mobile health-care service project based on WiMAX/Wi-Fi infrastructure	Chunghwa Telecom, Northern Taiwan Business Group
	Integration project of PHS and WiMAX dual nets	First International Telecom
	Mobile Application project in Ren-ai country, Nantou	Chunghwa Telecom, Central Taiwan Business Group
	M-Taiwan application and construction project in Hou-pi country, Tainan	Chunghwa Telecom, Southern Taiwan Business Group
	M-Taiwan Application project of Far Eastone Communications Co., Ltd.	Far Eastone Communications
	"New Mobile Generation" Application development and Operation promotion project	Acer
	Integration project of the commercial application of Agricultural 2D bar-code	Acer

Projects Granted in Year 2006

Category	Project	Area and Company
Network Infrastructure	Mountain-sea Wireless Dreamland of Sea wave	Hualien county/ TATUNG
	New technology for tourism and quality of life in Pingtung	Pingtung/ TATUNG
	Mobile Kaohsiung application project	Kaohsiung/ Chunghwa southern Taiwan Business Group
	Mobile Taoyuan application service development project	Taoyuan county/ Chunghwa Telecom

	Charming mountains Mobile Kao-hsiung county	Kao-hsiung county/ TATUNG
	Mobile Taipei Technology Hallway	VIBO
	M-Taiwan application project of Far Eastone	Far Eastone Communications
	Urban mobile broadband network service project of northern Taiwan	First International Telecom
	Broadband wireless news-report platform and exemplary construction project of the interactive handheld TV broadcast system	China Television Company
Application Service	HP M-Taiwan wireless application project	Hewlett-Packard Development Company
	Interactive group of video and audio creation service	Rock Mobile
	High Definition IPTV and Interaction Service Project	Taiwan Television Enterprise

Appendix B – Glossary

3G	Third Generation Wireless System
ABTG	Application Business Task Group (WiMAX Forum)
AP	Access Point
AWG	Application Working Group (WiMAX Forum)
BS	Base Station
CPE	Customer Premises Equipment
CWG	Certification Working Group (WiMAX Forum)
IOT	Interoperability Test
MWG	Marketing Working Group (WiMAX Forum)
ODM	Original Design Manufacturer
PHS	Personal Handy Phone System
PoC	Proof of Concept
PCT	Protocol Conformance Test
RCT	Radio Conformance Test
SS	Subscriber Station
WISP	Wireless Internet Service Provider