APT Report on Best Practice of Connectivity

- Village Broadband Internet Project (Net Pracharat) of Thailand -

August 2019

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Through its various programmes and activities focused on 5 Strategic Pillars as follow, the APT continues to support and assist its 38 members, 4 associate members and 136 affiliate members (as of April 2018) to realize the positive benefits of ICTs and cope with the challenges of rapidly evolving ICT environments.

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- **a. Connectivity:** Developing the digital Infrastructure;
- **b. Innovation:** Enabling conducive environments and harnessing the benefits of new technologies;
- **c. Trust:** Promoting security and resilience through ICT;
- **d. Capacity Building:** Promoting inclusiveness and enhancing expertise; and
- **e. Partnership:** Solidifying strategic cooperation with stakeholders.

38 Members and 4 Associate Members of the APT

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EXECUTIVE SUMMARY

The Village Broadband Internet project or Net Pracharat is a flagship digital infrastructure development project of Thailand. The main objective of Net Pracharat is to strengthen National Broadband Network by expanding high-speed Internet network to reach all villages in the country, so that local Thai people who live in the remote areas will be able to access broadband or high-speed Internet as those who live in the cities. To achieve this objective, the Government of Thailand provided budget for the deployment of high-speed Internet network to villages in rural and non-marketable areas nationwide. In December 2017, the Ministry of Digital Economy and Society (MDES) and Telephone of Thailand Public Company Limited (TOT) completed the installation of fiber optic cable network (Net Pracharat network) to 24,700 target rural villages throughout the country. In addition, the government provided 24,700 free public Wi-Fi hotspots at the speed of 30/10 Mbps (Download/Upload) (one hotspot per village). As of July 2019, there are about 6.6 million users registered to access Net Pracharat Wi-Fi, with newly registered increasing around 200,000-300,000 users in every month.

To increase awareness and promote the use of Net Pracharat, MDES has developed a curriculum on Internet fundamentals (Basic Use of Internet), and Internet applications for income supplement. MDES trained around 1,000 teachers from the Office of the Non-Formal and Informal Education, the Ministry of Education. This was to create a group of Net Pracharat trainers. Then, these trainers went back to their communities to provide trainings to around 100,000 community leaders in Net Pracharat villages. In collaboration with the Ministry of Interior, the trainings were expanded and reached more than 1.2 million local people in September 2018. Furthermore, MDES established a group of Net Pracharat volunteers recruited from local people with digital skills in the target villages to help promoting the Net Pracharat usage to obtain benefits in their communities.

With Net Pracharat, local people can access useful information and services in many areas, such as education, public health, and government services – leading to improvement in quality of life. It will also offer local people opportunities to e-commerce and the use of online shops in order to generate employment, income, and business opportunities in local communities.

To further expand high-speed Internet service to Thai people, MDES is in the process of opening the Net Pracharat network based on the Open Access Network (OAN) model – allowing any telecommunications service provider who obtain a telecommunications license to connect to the Net Pracharat network without fees and provide last mile Internet service to household customers with fair and affordable prices. This will also promote infrastructure sharing that helps reduce redundant infrastructure investment cost in rural areas. Furthermore, MDES is now expanding the Net Pracharat network by installing fiber optic cable network to reach rural schools and hospitals nationwide that have no fiber optic networks.

With these results achieved, Net Pracharat is a driving force that propels Thailand toward a path of long-term stability, prosperity, and sustainability.

ACKNOWLEDGEMENTS

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Name	Position, Affiliation, Country
Dr. Pichet Durongkaveroj	Former Minister of Digital Economy and Society
Dr. Pansak Siriruchatapong	Former Vice Minister
Assoc. Prof. Dr. Chaowalit Limmaneevichitr	Former Secretary to the Minister
Ms. Ajarin Pattanapanchai	Permanent Secretary
Gp. Capt. Somsak Khaosuwan	Deputy Permanent Secretary
Mrs. Arthidtaya Sutatam	Former Deputy Permanent Secretary

The authors also would like to acknowledge with much appreciation the crucial roles of the Telephone of Thailand (TOT) executives and staff that fully dedicated themselves on the implementation of the Net Pracharat project. Last but not the least, the authors expect to share the contents to promote the best practice of conntectivity - Village Broadband Internet Project (Net Pracharat) of Thailand. The authors hope that this report will be beneficial in promoting the digital connectivity in other countries.

TABLE OF CONTENTS

FIGURES

Village Broadband Internet Project (Net Pracharat) of Thailand

1. Background and Introduction

The Village Broadband Internet Project or so called Net Pracharat is a Thailand flagship digital infrastructure development project to promote availability, accessibility, and affordability to access broadband Internet services for people in rural areas across the country. This project is one of the most significant investment projects of the Government of Thailand to strengthen Thailand digital (or ICT) infrastructure. In Net Pracharat, the Thai government constructed high-speed Internet network to villages in rural and non-marketable areas that private telecom operators would not offer their services under the current market conditions. Net Pracharat helps reduce digital divide so that all Thais will have equal opportunities to access and make use of digital technology (e.g., digital content and services) to increase their income and improve their quality of life through broadband Internet service.

1.1 Net Pracharat Initiative

The main initiative of the Net Pracharat is to build a National Broadband Network, a fundamental digital infrastructure that enables all Thais in every village to access and make use of broadband Internet service. The Net Pracharat project aligns with 7 Government of Thailand's policies and strategies: 1) Thailand 4.0, 2) Digital Economy, 3) the 20-year National Strategies, 4) the 12th National Economic and Social Development Plan, 5) the National Digital Economy and Society Development Plan, and 6) the National Broadband Policy.

1.1.1 Thailand 4.0

The Government of Thailand has issued the Thailand 4.0 policy as the new direction of economic and social reform under the vision of prosperity, security, and sustainability. Thailand 4.0 is an economic model with the objective to unlock the country from several economic challenges, including "a middle income trap", "an inequality trap", and "an imbalanced trap". To overcome these challenges, the country needs to improve its creativity and innovative capacity that will allow Thailand to compete with more advanced economies (Royal Thai Embassy, Washington DC, 2019a).

Thailand 4.0 model is developed by building on past economic development models which placed an emphasis on agriculture (Thailand 1.0), light industry (Thailand 2.0), heavy industry (Thailand 3.0), and currently innovative/value-based economy (Thailand 4.0) (Royal Thai Embassy, Washington DC, 2019a). Thailand 4.0 uses digital technology as one of the key instruments. With digital technology, Thai economy system will be driven toward **digital economy** that uses digitized information and knowledge as a key factor of production (ADB Institute, 2018). The Thai society will be changed to be **digital society** in which all members have equal opportunities to access useful content and public services (e.g., education, public health, and social welfare) online, resulting in improving Thais' quality of living. For public service, digital technology provides opportunities to transform the government system to become a **digital government** that utilizes digital technology to create public values (e.g., effectively and efficiently provide goods or services according to the desires of businesses and citizens) (OECD, 2014). In addition, Thai workforce will be developed to become **digital workforce** who possess necessary competencies to apply digital technology to their jobs (Colbert, et al., 2016). With Thailand 4.0, Thailand will propel toward the long path of prosperity, security, and sustainability. Figure 1 shows the Thailand 4.0 model.

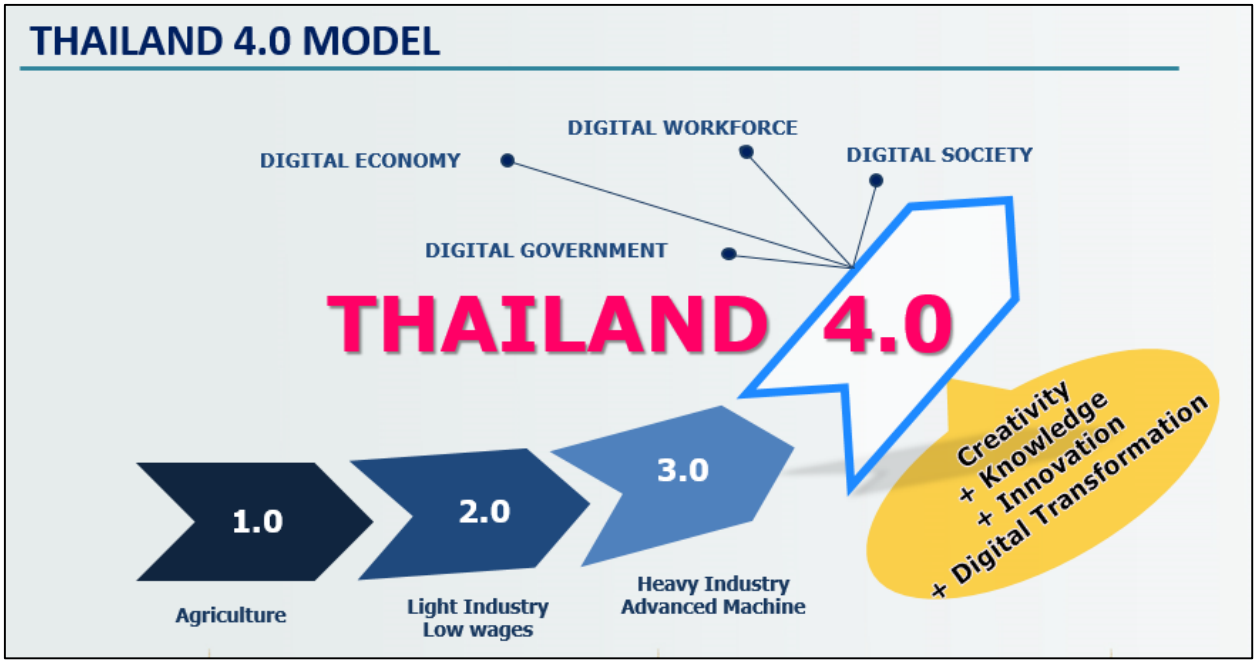

Figure 1. Thailand 4.0 Model

The aim of Thailand 4.0 is to fulfill the country with knowledge, creativity, science, technology, research and innovation. In this model, public and private partnerships play an important role. While, the private sector takes the lead through its business activities and investments, the public sector (government) serves as a facilitator and a promoter. In this ecosystem, more investment in digital technology-based industries is encouraged by the government's providing sufficient incentives to invest in the targeted industries. Thailand 4.0 includes the 4 following objectives (Royal Thai Embassy, Washington DC, 2019a).

1) Economic Prosperity: driving the country through value-based economy with the use of innovation, technology, and creativity. The goals are to increase spending of Research and Development (R&D) to 4% of GDP, increase economic growth rate to 5-6% within 5 years, and increase national income per capita from 5,470 USD in 2014 to 15,000 USD by 2032.

2) Social Well-being: increasing living quality of all Thais with an aim to move the country forward without leaving anyone behind (inclusive society). All members in the society will be able to utilize their full potentials. The goals are to reduce social disparity from 0.465 in 2013 to 0.36 in 2032, transform social welfare system within 20 years, and develop at least 20,000 households into "Smart Farmers" within 5 years.

3) Raising Human Values: increasing Thais' competencies that fit in the 21st Century. The goals are to raise Thailand Human Development Index (HDI) from 0.722 to 0.8 or the top 50 countries within 10 years, and enhance Thai education system with an aim that at least 5 Thai universities are ranked amongst the world's top 100 higher education institutions within 20 years.

4) Environmental Protection: creating a livable society with the economic system that can adapt to climate change and low carbon society. The goals are to promote at least 10 cities in Thailand to be the world's most livable cities.

To achieve the above objectives, the government has identified 5 industrial sectors as the new engines of growth (Royal Thai Embassy, Washington DC, 2019b) as follows:

1) Food, Agriculture and Bio-tech
2) Health, Wellness, Biomedical
3) Smart Devices, Automation, and Robotics
4) Digital, Internet of Things (IoT), Artificial Intelligence (AI), and Embedded Technology
5) Creativity, Culture, and High-Value Services

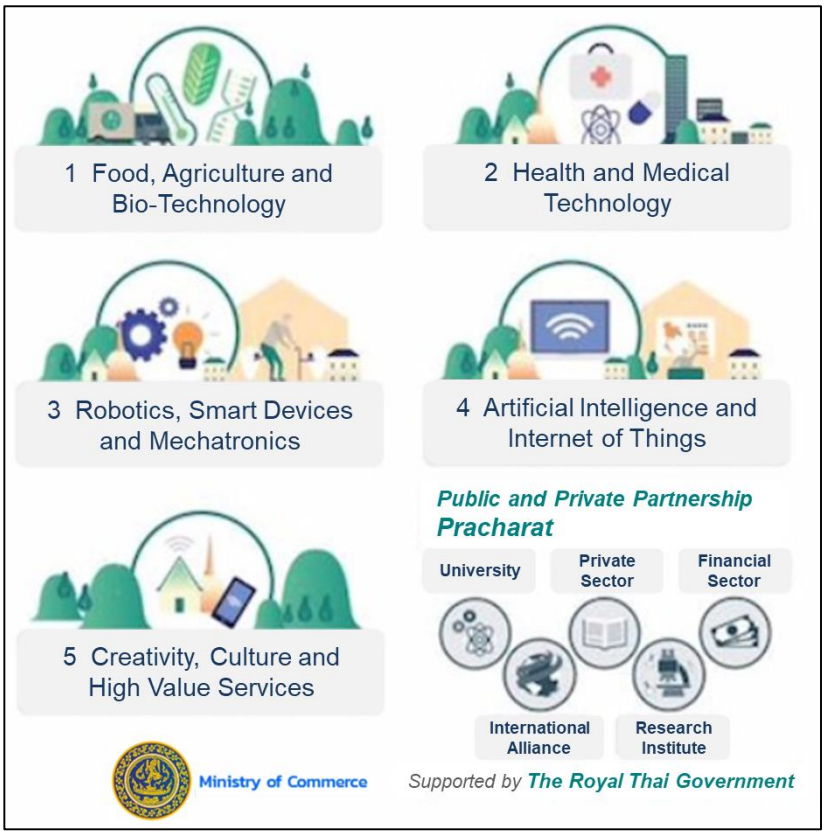

Figure 2. Five Groups of Technology and Targeted Industries in Thailand 4.0 (Source: Ministry of Commerce, Photo by The Royal Thai Government)

As shown in Figure 2, among the 5 new engines of growth, Digital, Internet of Things (IoT), Artificial Intelligence (AI) and Embedded Technology serve as fundamental platforms and key enablers for the enhancement of productivity, quality, and innovation in the other industrial sectors (e.g., agriculture, industrial, service and education sectors) (Royal Thai Embassy, Washington DC, 2019b). According to this approach, the government gives high priority to digital foundation layout related to enhancing the quality of the digital infrastructure (i.e., broadband Internet network), which is a crucial factor to develop innovation and improve the quality of lives of people in remote areas. This is to enable all Thai people across the country to access digital technology equally regardless of their physical locations.

1.1.2 Digital Economy

Digital Economy refers to an economy and society that utilizes digital technologies to reform manufacturing, business, service, education, healthcare, and public administration, and other activities that aim to enhance economy of the country and social welfare of citizens (Ministry of Information and Communication Technology, 2016). At present, digital economy has a major influence on the global economy. There have been changes in the investment policies and strategies of many countries around the world because the considerably rising numbers of digital consumers. Since we are in the information age, Information and Communication Technology (ICT) or digital technology has played an important role in business and is now part of our everyday lives. In the past decade, the number of Internet users worldwide has exponentially increased due to a number of technology advancements (e.g., smart phones, social networking, and e-commerce). With digital technology, we can do various activities such as reading online newspaper, viewing online maps, banking, searching information for class assignments, buying and selling goods and services online. This trend represents a fast-growing demand for digital infrastructure and services (Thailand Investment Review, 2018).

Southeast Asia is the world's fastest growing Internet region with more than 350 million users in 2018. Based on the research conducted by Google and Temasek, ASEAN's Digital Economy is estimated to reach USD 200 billion by 2025, mainly driven by 3 e-businesses including 1) online travel (e.g., Online Vacation Rentals), 2) e-commerce, and 3) online media (e.g., music subscriptions and video on demand) (Google and Temasek, 2018). In addition to the fast growth of Internet adoption, ASEAN has huge economic potential from its considerable amount of 640 million consumers, 40% of which is young generation with the age below 30 and digitally literate. The high ratio of young people in ASEAN represents a huge capacity for building on the ASEAN digital economy in the future (Thailand Investment Review, 2018).

Thailand is one of the largest digital economy countries in ASEAN. The main drivers of the rapid digital market growth in Thailand are e-commerce market and online advertising and gaming (Google and Temasek, 2018). The advancements in digital technology and communication devices and price reduction of those devices and digital services have resulted in Thai people having more online access. The growth of e-commerce platforms by Thai and international businesses, as well as sellers' promotions and credibility gained from customers have accelerated the growth of e-commerce market in Thailand. According to the Electronic Transactions Development Agency (ETDA), Thai e-commerce value grew 14% in 2018 with the value around 3.2 trillion baht (USD 100 billion), and is expected to reach 20% in 2019. The growth was the highest in ASEAN. The value of Thai e-commerce was around 2.7 trillion baht in 2017, 2.5 trillion in 2016, and 2.24 trillion in 2015, respectively as shown in Figure 3 (Leesa-Nguansuk, 2019).

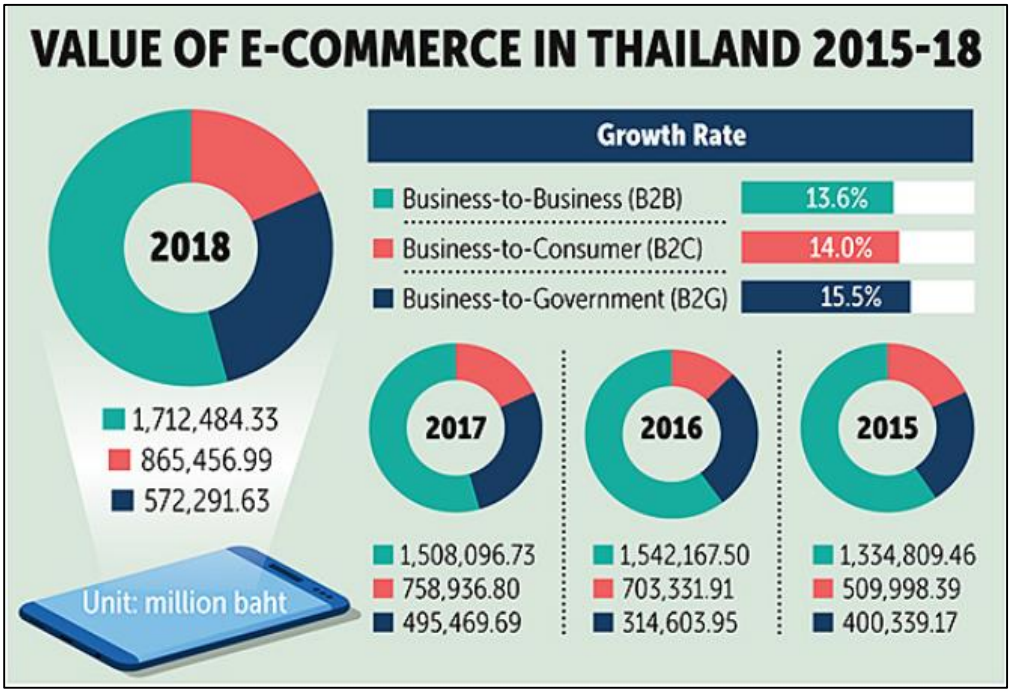

Figure 3. The Value of E-Commerce in Thailand 2015-2018
(Source: Value of E-Commerce Survey 2018, ETDA and Picture: Bangkok Post Graphic)

In addition, Thai Internet users are the most engaged in the world, spending around 5 hours per day using mobile Internet - more than in any other countries in the world (Google and Temasek, 2018).

To accommodate the high demand of digital economy, the Government of Thailand has been actively promoting technology and innovation through "Thailand 4.0" economic model. In addition to Thailand 4.0, the government established the 20-year National Strategy (2018-2037), and the 12th National Economic and Social Development (2017-2021). Both of the national strategies adopt digital economy as a primary mechanism to develop the country toward prosperity and sustainability.

In 2016, The National Digital Economy and Society Development Plan was established. The plan covers a period of 20 years with four major phases, ranging from 1.5 years in the first phase (laying the digital foundation) to 20 years in the fourth phase (achieving global digital leadership). In addition, to support the implementation of the digital economy policy, the Thai government launched various new bills, such as the Digital Economy Promotion Bill and the Cyber Security Bill in 2015. Both of the bills became Acts in 2017 and 2019, respectively. The government also enacted the Act on Digital Development for Economy and Society B.E. 2560 (2017 C.E.), which included the establishment of the National Digital Economy and Society Committee chaired by the Prime Minister. The national committee is responsible for providing the guidelines for digital development and steering the implementation of digital economy. The Act also established the Digital Economy and Society Development Fund to provide financial support for related development projects and to promote digital growth.

1.1.3 The 20-year National Strategy (2018-2037)

The Government of Thailand has issued the 20-year National Strategy, the first national long-term strategy to drive the country development toward security, prosperity, and sustainability in accordance with the Sufficient Economy Philosophy (Office of the National Economic and Social Development Board, 2018). There are 6 key strategies:

1) National Security
2) National Competitiveness Enhancement
3) Human Capital Development and Strengthening
4) Social Cohesion and Just Society
5) Eco-Friendly Development and Growth
6) Public Sector Rebalancing and Development

Digital technology plays a major role in the national strategies.

The 1st strategy: National Security includes the development of technologies and big data systems to prepare the country for mitigation and prevention of threats and disasters.

The 2nd strategy: National Competitiveness Enhancement takes the approach of preparing the future through national infrastructure development. Digital technology is one of the key national infrastructures to support developing future industries and services.

The 3rd strategy: Human Capital Development and Strengthening has a guideline for improving learning processes to accommodate changes in the 21st century by using digital platforms for enhancing learning system bases.

The 4th strategy: Social Cohesion and Just Society plans to promote social empowerment by promoting development of information technology and creative media to accommodate digital society.

The 6th strategy: Public Sector Rebalancing and Development aims to use big data and digital technology to help improve the public sector's performance in accordance with international standards. Through digital technology, public sector will be capable of effectively delivering responsive, fast, and convenient services with transparency.

1.1.4 The 12th National Economic and Social Development Plan (2017-2021)

In adherence to the 20-year National Strategy, the 12th National Economic and Social Development Plan was developed to translate the National Strategy into the 5-year national development plan. The national economic and social development plan includes 10 development strategies as shown in Figure 4 (Office of the National Economic and Social Development Board, 2017; Vimolsiri, 2017).

Figure 4 The 12th National Economic and Social Development Plan

Each strategy sets out several development agendas. Digital economy and the use of digital technology were included in various national agendas (Office of the National Economic and Social Development Board, 2017) as shown in the following examples.

Strategy 2, Strategy for Creating a Just Society and Reducing Inequality utilizes digital technology to reduce inequality in education and healthcare services. Not only will Internet enable students residing in remote areas to access useful information and services for their learning, but also facilitate long-distance medical consultation (telemedicine), helping reducing patients' traveling expenses to hospitals in cities and increasing effective transfer of severe patients.

Strategy 3, Strategy for Strengthening the Economy and Underpinning Sustainable Competitiveness promotes the use of digital technology for industries to shift toward more high-economy and innovation-based production. The government will raise new service businesses such as digital businesses, international education, entertainment content businesses, and occupational services by making use of new technologies such as cloud services, financial applications, and e-learning. In addition, the government will support entrepreneurs to invest in digital systems, using e-commerce to improve business productivity in various sectors (e.g., manufacturing, finance, marketing, and logistics)

Strategy 5, Strategy for Reinforcing National Security for the Country's Progress towards Prosperity and Sustainability has agenda to employ digital technology in various aspects, for example, developing an intelligent system to analyze the trends of threats including a database for sharing news and information between locals and international agencies; developing a system for compiling and sharing data and information related to terrorism; and developing integrated preparedness system for emergency response to disasters including a knowledge management system that links and shares information from the national level to the provincial and the community levels.

Strategy 6, Strategy for Public Administration, Corruption Prevention, and Good Governance in Thai Society uses digital technology to enhance efficiency of public management systems. The digital service systems will be developed to reduce work process, replace paperwork with electronic documentation, and facilitate public one-stop services that allow citizen to access via websites. In addition, a digital system will be developed to link and integrate data across public agencies to support information sharing and co-working among different agencies. Useful information such as statistical data in digital format will be open and readily accessible to the public for further economic and social development.

Strategy 7, Strategy for Advancing Infrastructure and Logistics plans to expand country's infrastructure and logistics capacity. This is to support the expansion of urban areas and economic zones as well as improve the quality of lives. In terms of digital infrastructure, the target for this strategy is to expand the high-speed Internet services across country; to increase the number of digital businesses and innovations; and to enhance cybersecurity systems in compliance with international standards.

1.1.5 Thailand Digital Economy and Society Development Plan

To translate the digital economy policy into practice, the Government of Thailand issued the Thailand Digital Economy and Society Development Plan or Digital Thailand Plan to set a framework for driving digital economy to success. The plan aims at transforming Thailand toward Digital Thailand - the country that maximizes the use of digital technology to drive the country towards stability, prosperity, and sustainability (Ministry of Information and Communication Technology, 2016).

Figure 5. Digital Thailand Definition

As shown in Figure 5, Digital Thailand refers to "the country's brilliance in taking full and creative advantage of digital technology to develop infrastructure, innovation, data capability, human capital, and other resources, thus propelling the country's economic and social development towards stability, prosperity, and sustainability." The Digital Thailand Plan aims at 4 major goals in 10 years as shown in Figure 6.

Figure 6. Digital Thailand 10-Year Goals

1. Raising the country's competitiveness through digital innovation – within 10 years, Thailand will employ full advantage of digital technology to drive business with innovation to be capable of competing in the global stage. Digital industry will become one of the main driving forces in raising Thai economy.

2. Creating equal opportunities with information and digital services – within 10 years, all Thais will have equal opportunities to access digital technology and information, improving quality of life through useful digital information and public services.

3. Developing human capital towards the digital age – within 10 years, Thais will be digitally competent by international standards, creatively utilizing digital technology for their jobs.

4. Reforming government operations for better transparency and effectiveness – within 10 years, government operations will make full use of digital technology, ensuring efficiency, transparency, and good governance.

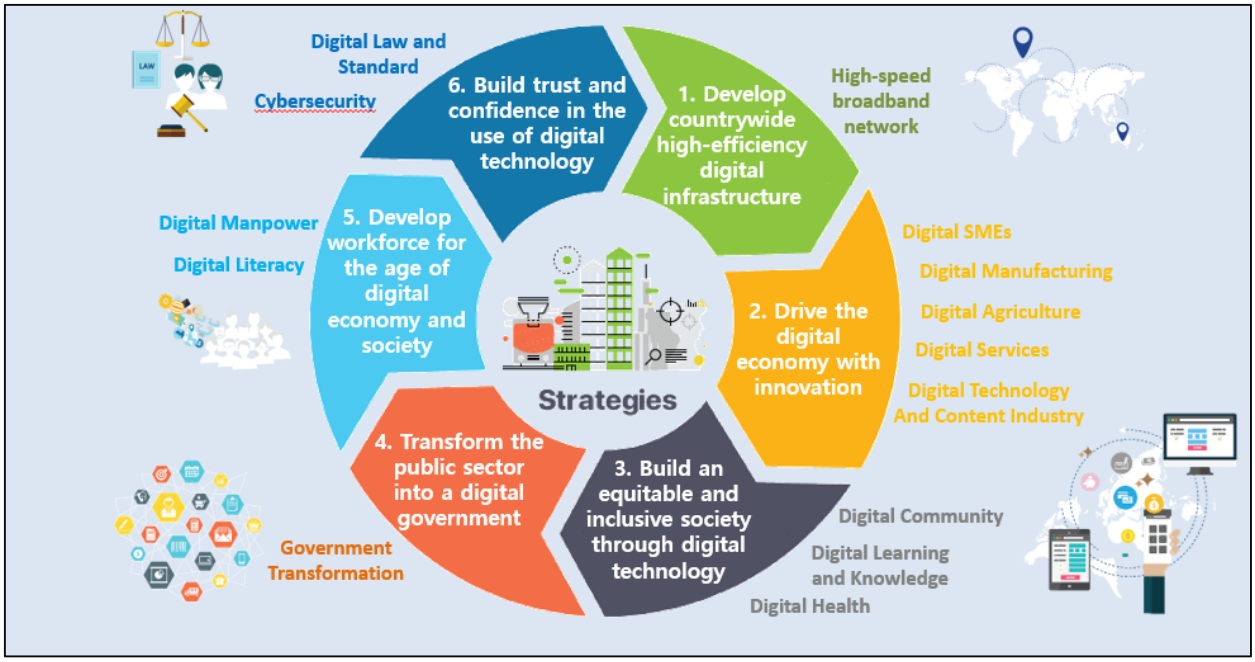

Figure 7. Digital Thailand Strategies

As shown in Figure 7, there are 6 strategies and several initiatives under the Digital Thailand Plan.

1) Develop a country-wide, high-capacity digital infrastructure to ensure accessibility, availability, and affordability of digital infrastructure for all Thais, with various initiatives to advance the digital infrastructure, for example, expanding nationwide high-speed broadband Internet connectivity throughout the country (i.e., Net Pracharat).

2) Develop the economy with digital technology to raise the country's competitiveness by building new business and creating economic value by the full use of digital technology, with several initiatives to innovate new businesses such as Digital SMEs, Digital Manufacturing, Digital Agriculture, and Digital Industry.

3) Build an equitable and inclusive society through digital technology to create a knowledge-driven digital society. This is to encourage participation to ensure inclusive and equal usage. The key initiatives for this strategy are Digital Community, Digital Learning and Knowledge and Digital Health.

4) Transform the public sector into a digital government. Government operations will be digitized, which will create an open government and facilitate the people and business sectors to integrate into 'one government'.

5) Develop the workforce for the digital era to improve digital skills and literacy in all sectors, develop the digital specialists, and enhance executives' skills for digital leadership.

6) Build trust and confidence in the use of digital technology by updating laws, rules, standards, and regulations to encourage investment and to ensure security in using online transactions.

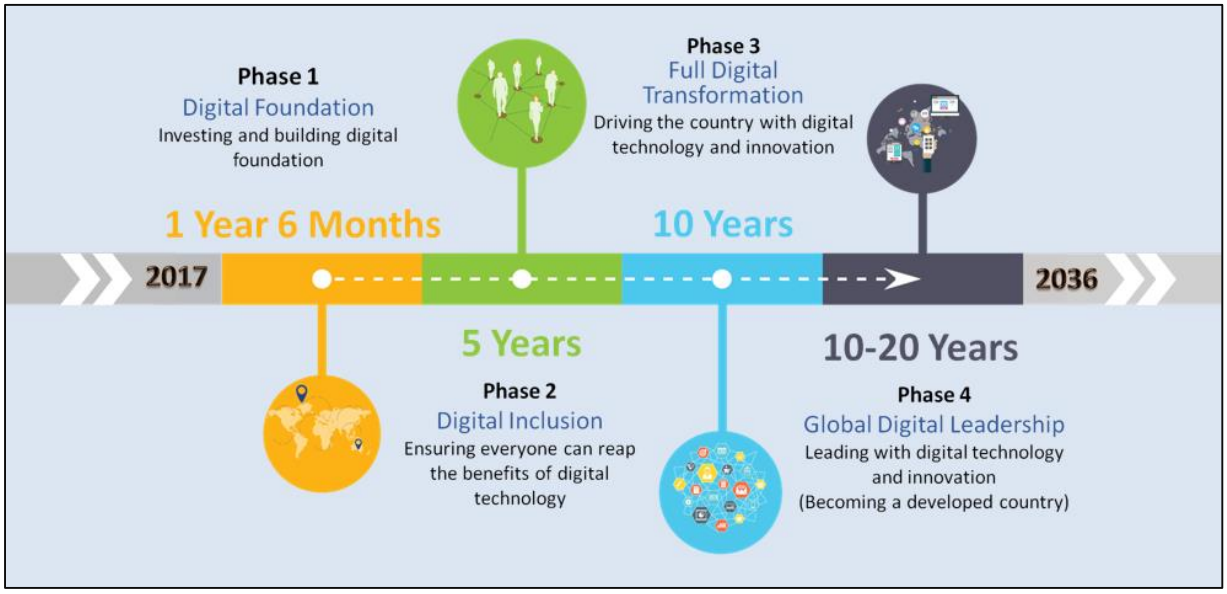

Figure 8. 20-Year Thailand Digital Landscape

To achieve the goals, the plan sets out a 20-year Thailand digital landscape that comes with four phases:

1) Digital foundation – investing and building digital foundation. In the first 1 year 6 months, high-speed broadband network will be deployed countrywide; international bandwidth capacity will be increased to meet the rapid growing demands; and digital infrastructure laws and policies will be developed and updated.

2) Digital Inclusion – ensuring everyone can access and make full use of digital technology. In 5 years, Thais are able to use digital technology to boost their businesses (i.e., using digital services to reduce operation cost and increase business revenue) and improve their living qualities (i.e., accessing useful digital content and services such as education, public health, government service online).

3) Full digital transformation – driving the country with digital technology and innovation. In 10 years, the country will be driven by digital technology and innovation. All 4 major goals mentioned above must be achieved in this phase.

4) Global digital leadership – using digital technology to create long term value and sustainability. This phase aligned with the 20-year National Strategy, which sets the course for Thailand to become a developed country in 20 years.

For Thailand, the development and enhancement of digital infrastructure is the foundation of digital economy and Thailand 4.0 policy. Digital infrastructure development will create new opportunities for Thais to access useful online content and services that provide benefits in both economic and social aspects, resulting in further development of digital economy in the long term. This is the main rationale behind Net Pracharat, a flagship digital infrastructure development project that lays the foundation of national broadband throughout the country.

1.1.6 The National Broadband Policy

The current Thailand Digital Economy and Society Development Plan and Net Pracharat were built on the earlier frameworks and policies. One of the national policies directly related to development of high-speed Internet network is the National Broadband Policy (Ministry

of Information and Communication Technology, 2010). Established in 2010, the National Broadband Policy was to serve as the framework for implementing and driving the development of broadband service throughout the country. The government realized the significant impact of broadband service in economic and social development, public services, security and safety of people's lives. Broadband service contributes to the increase of Thailand's Gross Domestic Product (GDP) and the reduction of inequality and digital divide between people in urban and rural areas. The Thai government focuses on providing high-speed Internet network to villages in rural and non-marketable areas where private telecom operators would not offer their services under the current market conditions.

The main objectives of the National Broadband Policy are to develop the broadband network that can provide service with standard quality and affordable fee to more than 80 percent of the population by 2015 and more than 95 percent by 2020. In addition, regional economic zones and major cities nationwide should be equipped with high-speed broadband service with fiber optics at a minimum speed of 100 Mbps by 2020. With broadband services available, people will be able to use broadband to access education, public health, disaster monitoring and early warning, and other government services equally and thoroughly.

To achieve the above objectives, there is a pressing need to develop broadband infrastructure and service. The National Broadband Policy provides several guidelines of the infrastructure development. Some of the guidelines are 1) expanding broadband services in the rural areas; 2) promoting free and fair competition among broadband service providers; and 3) promoting the investment on broadband network development as well as the telecom infrastructure sharing in order to lower the redundant network deployment cost. These guidelines align with the objectives of the Net Pracharat project – expanding high-speed Internet network with fiber optic cables to reach every village in the country, specifically the villages in the rural and non-marketable areas. In addition, the constructed fiber optic cable network is open for any licensed operators to connect and provide last mile services to households in the areas, promoting telecom infrastructure sharing.

1.2 National Broadband Network

Broadband is commonly refers to high-speed Internet access with several data transmission technologies (e.g., fiber optic, wireless, satellite) (Federal Communications Commission, 2014). As we are living in digital age, Internet is playing an important role in the economy and society. It enables users to access a variety of online services and information (e.g., social media, education, government and financial services). Internet services also promote innovation that will provide business convenience and improve quality of life for the people. Therefore, the development of high quality high-speed Internet is a driver for the improvement of the overall economy and society. Broadband development offers a number of benefits. For example, high speed Internet helps drive economic growth (i.e., increasing Gross Domestic Product (GDP)) by creating employment and attracting local and foreign investments especially in industries related to digital technology. Broadband can also provide several online services to citizen such as telemedicine service in public health, life-long learning service in education, and e-farming in agriculture. In addition, the government can benefit from integration of data via broadband networks. This implies that broadband services can help improve the efficiency of operations for citizen and government agencies.

The Government of Thailand has given priority and importance to driving the Digital Economy forward with focus on incorporating technology to support and drive economic and social development. One of the key driving activities is the development of the country's basic telecommunications infrastructure, National Broadband Network to make broadband (or high-speed Internet) services available to all Thais across the country. **National Broadband Network (NBN)** refers to broadband networks that provide nationwide coverage and broadband service quality that meets international standards and demands of Thai people with affordable prices. NBN integrates existing network infrastructure from State Owned Enterprise (SOE) and new network expansion nationwide. With NBN, the government will be able to manage the network effectively, reduce government's duplicate telecommunications infrastructure investments, and promote competition and cost reduction in order to provide affordable broadband service and access for Thai people (Ministry of Digital Economy and Society, 2016). Figure 9 shows Thailand's definition of National Broadband Network.

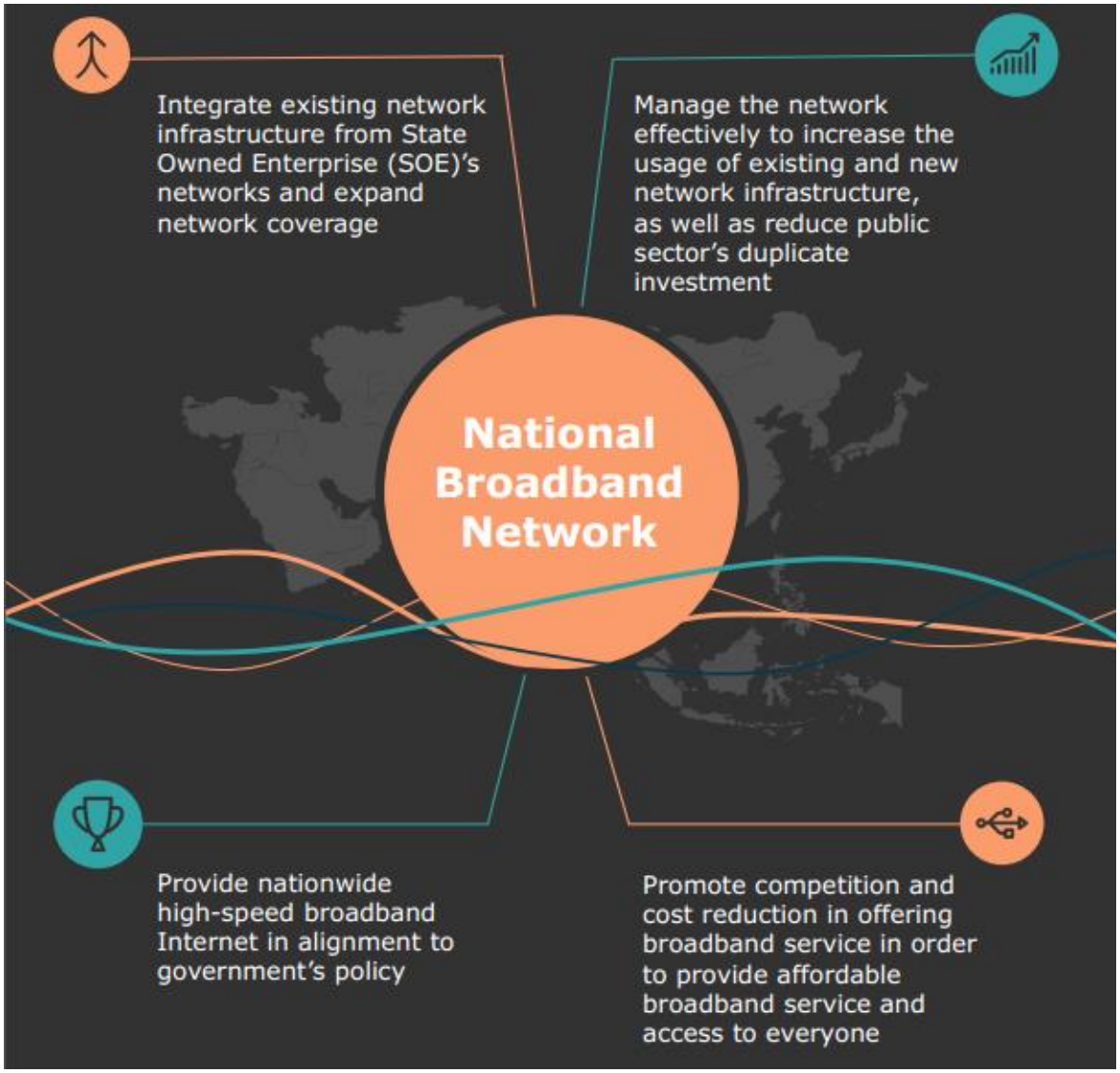

Figure 9. What is the National Broadband Network?

2. Net Pracharat

The name "Net Pracharat" consists of 2 words: "Net" and "Pracharat". Net refers to the Internet service. Pracharat originally comes from 2 Thai words: "Pracha" and "Rat". Pracha" means "people" and "Rat" means "government." Pracharat refers to the collaboration of every sector (i.e., public, private, and people sectors) to drive the country forward with creativity in every aspect, leading to sustainable development (Prasertpakdi, 2018, p. 19). Therefore, Net Pracharat refers to Internet service for everyone that requires collaboration from every sector to generate positive economic and social development, leading the country toward long-term sustainability.

2.1 Challenges of Thailand Broadband Development

Although the Government of Thailand realizes the benefits of broadband development, there are significant limitations in improving and increasing broadband speed, difficulties in network expansion to cover rural and non-marketable areas, and challenges in promoting broadband market competition to provide consumers services with affordable prices. The three key challenges of broadband development in Thailand are as follows:

1) Lack of infrastructure – lack of sufficient telecommunications infrastructure impedes Thailand's ability to compete in the global stage. The problem is related to inadequate network coverage nationwide, especially in the rural and non-marketable areas that private telecom operators consider not worth their investment. Those areas are intensively affected by the digital divide – unequal opportunities for underprivileged and rural population to use broadband to access useful digital content and services as urban population.

2) Lack of integration between agencies and redundant investment – lack of integration between agencies results in rise in complexity and obstacles for broadband management. This brings about redundant investment in broadband network deployment between agencies (e.g., telecom state enterprises and private operators). In addition, broadband access does not cover all areas especially villages, important state agencies such as sub-district schools, hospitals, and management authorities.

3) High price of broadband access - the price of broadband access in Thailand is high resulting in a slow and undesirable rate of broadband penetration.

To address these challenges, the Government of Thailand sets out Village Broadband Internet Project or so called Net Pracharat Village Broadband Internet Project – rolling out high-speed broadband Internet network to rural and non-marketable areas throughout the country, enabling all Thais to access equitable and affordable broadband service.

2.2 Objective

The Net Pracharat project is aimed at strengthening National Broadband Network by expanding high-speed Internet networks to reach every village in the country, so that local Thai people who live in the remote areas will be able to access broadband or high-speed Internet as those who live in the cities, resulting in bridging the digital divide and building an inclusive and sustainable connected society. In Net Pracharat, the Thai government constructed high-speed Internet network to villages in rural and non-marketable areas. The objectives of Net Pracharat include:

1) To enhance telecommunication infrastructure by installing a high-speed Internet network with Fiber-To-The-X (FTTX) technology to targeted villages and support effective network expansion in the future;

2) To decrease inequality for people in the targeted villages to access high-speed Internet network and provide opportunities to obtain public services equally and thoroughly, leading to better quality of life; and

3) To enhance the economic and social potential of the targeted villages such as career building, income generation, as well as access to education, public health, agriculture, and online trading services.

With Net Pracharat, local people are able to access useful online content and services such as e-Commerce, e-Education, and e-Health. This generates beneficial impact on both society and economy (e.g.,creating job opportunities, increasing income for local communities, and reducing skilled labor migration). Figure 10 shows the overview of the Net Pracharat project.

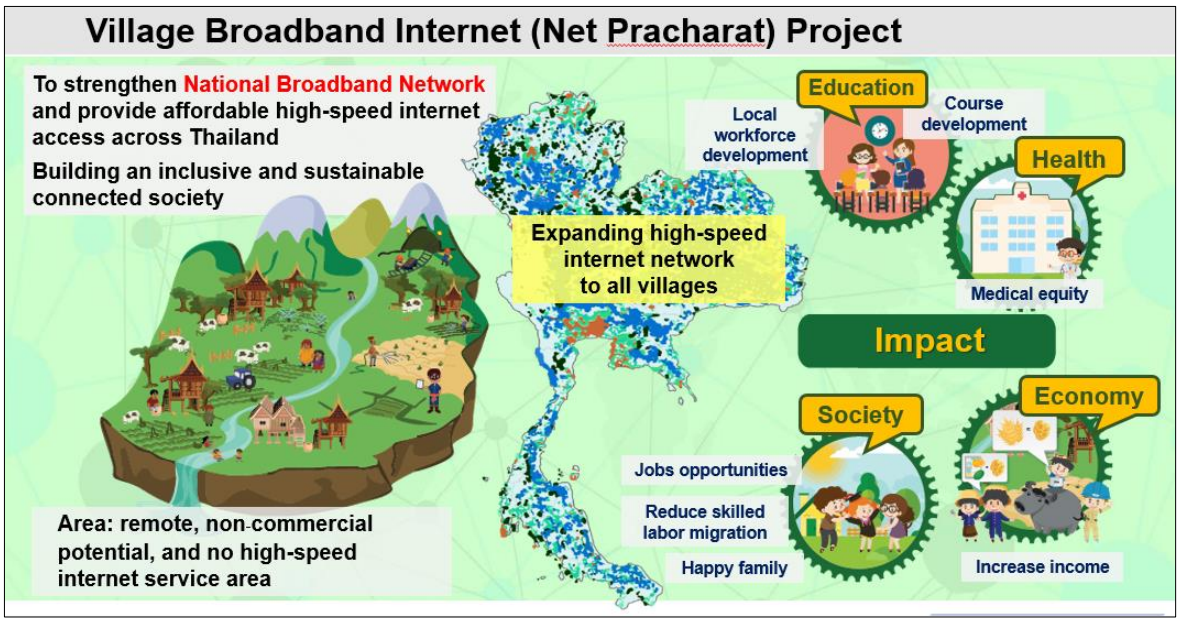

Figure 10. The overview of Net Pracharat

2.3 Project Stakeholders

Several stakeholders have involved in the development of Net Pracharat. Each stakeholder has facilitated and coordinated in the implementation of the project. Figure 11 shows the Net Pracharat project's stakeholders with their roles and responsibilities.

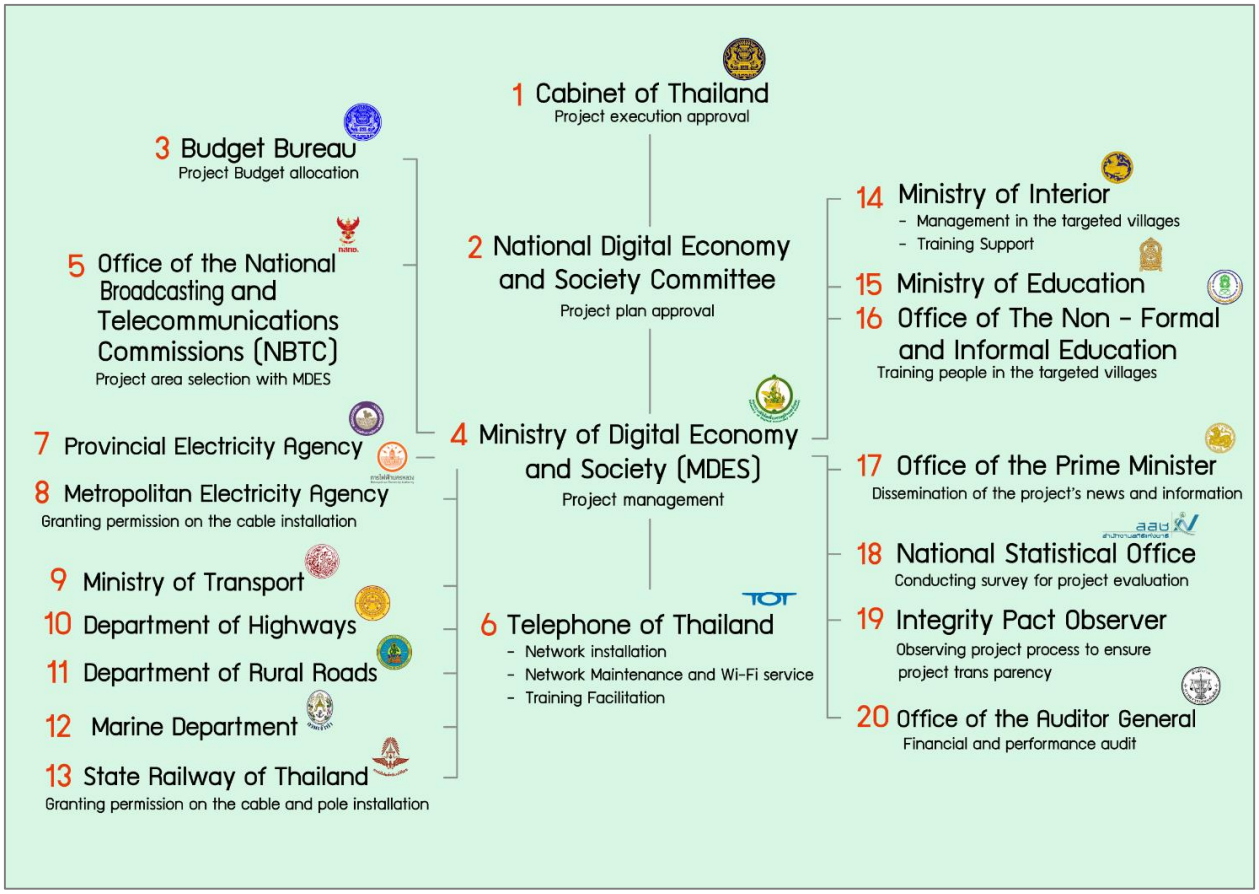

Figure 11. Net Pracharat Project's Stakeholders

(1) Cabinet of Thailand

The Cabinet of Thailand is the executive sponsor of the Net Pracharat project. The Cabinet endorsed the project, made the ultimate decision to give approval on project execution, and monitors the project progress. In addition, the Cabinet assigned other ministries and government agencies to cooperate and contribute in the project.

(2) National Digital Economy and Society Committee

Established in 2016, the National Digital Economy and Society Committee, chaired by the Prime Minister, is primarily responsible for steering the implementation of Thailand's digital economy. The committee provides guidelines and policy based on the Thailand Digital Economy and Society Development Plan. The committee is responsible for reviewing relevant policies, projects, and investment related to the development of digital economy, and then proposing to the cabinet.

For the Net Pracharat project, the committee reviewed the project scope, technology, budget and implementation plan, then gave approval of the overall project plans and details.

(3) Budget Bureau

The Budget Bureau has the main mission of preparing budget expenditure that responds to government policy. In the Net Pracharat project, the Budget Bureau provided budget to the Ministry of Digital Economy and Society for the Net Pracharat project implementation.

(4) Ministry of Digital Economy and Society (MDES)

Established in 2016, the Ministry of Digital Economy and Society (MDES) is the main government organization to drive Thailand's digital economy policy. MDES is responsible for developing national policy and plan on digital development for economy and society; developing and managing the country's telecommunication network; promoting the use of digital technologies and innovation to support the growth of business sectors, social development, and government administration; and elevating the people's knowledge of digital technologies.

In Net Pracharat, MDES is the project manager responsible for the project's successful completion. Cooperating with TOT, MDES developed the project plan, budget expenditure, project schedule and timeframe, and proposed the project proposal to the cabinet and the National Digital Economy and Society Committee, proposed the project budget to the Budget Bureau for approval, and provided regular updates of project progress to the cabinet and the committee.

After analyzing project scale, complexity, time constraints, and objectives of building Thailand's national broadband network, MDES assigned TOT, a telecommunications state owned enterprise, to implement the Net Pracharat project and collaborated with several government agencies to take part in several activities related to the fiber optic cable network (Net Pracharat Network) installation and promotion of Net Pracharat usage.

(5) Office of the National Broadcasting and Telecommunications Commission (NBTC)

NBTC, the telecommunications regulator of Thailand, is primarily responsible for licensing and regulating the telecommunications business to ensure quality services for users as well as prescribing licensing criteria, procedures, conditions, and licensing fees.

In Net Pracharat, MDES has collaborated with NBTC in selecting the project target areas and expanding high-speed Internet network to remaining rural villages without redundant investment, resulting in efficient government budget spending.

(6) Telephone of Thailand (TOT)

TOT, a telecommunications state owned enterprise under MDES, is one of the largest telecommunication service providers in the country. TOT provides a number of telecom services such as Internet service, fixed line and mobile telephone, and IPTV services. TOT has an existing fiber optic cable network that reaches to all sub-districts in the country.

MDES assigned TOT to implement the Net Pracharat project – installing fiber optic cable network to provide high-speed Internet service to 24,700 target villages across the country. TOT performed the procurement of fiber optic cable and other related network equipment and installed the fiber optic cable network to reach 24,700 target villages with a free Wi-Fi hotspot per village. After completing the installation, TOT has provided network maintenance and Wi-Fi service to local people in the target villages as well as facilitated and supported the trainings for local people on how to use Net Prachart Wi-Fi.

(7) Provincial Electricity Agency (PEA)

PEA, a state owned enterprise under the Ministry of Interior, is responsible for the provision of electricity services and related business in provincial areas throughout the country.

In Net Pracharat, PEA has provided MDES with great collaboration in many activities related to fiber optic cable installation such as conducting on-the-field area surveys with TOT, shortening permission processes in the cable installation on the PEA's electricity poles, giving permission to use electricity for the constructed Net Pracharat network, and waiving several related fiber optic cable installation fees.

(8) Metropolitan Electricity Agency (MEA)

MEA, a state owned enterprise under the Ministry of Interior, has main duties of producing and providing electricity services in metropolitan areas (i.e., Bangkok, Nonthaburi, and Samut Prakan provinces).

Similar to PEA, MEA has contributed to Net Pracharat implementation in activities related to fiber optic cable installation such as shortening permission timeframe in the cable installation and waiving several related fees.

(9) Ministry of Transport (MOT)

MOT, a cabinet ministry of Thailand, have responsibilities for overall Thailand transportation and related business including traffic planning and transport infrastructure development. MOT helped MDES to coordinate with its departments and state owned enterprises to grant permission on installation of fiber optic cable and poles.

(10) Department of Highway (DOH)

DOH, a government department under MOT, is responsible for development and maintenance of state highways throughout the country. In Net Pracharat, DOH helped grant permission on installation of fiber optic cable poles and installation of cable underground along state highways.

(11) Department of Rural Roads (DRR)

DRR, a government department under MOT, is responsible for development and maintenance of rural roads across the country. Similar to DOH, DRR helped grant permission on installation of fiber optic cable poles and installation of cable underground along rural roads to target villages.

(12) Marine Department (MD)

MD, a government department under MOT, is responsible for development of water transport infrastructure and systems in Thailand. In Net Pracharat, MD helped grant permission on installation of submarine cable pipelines to some target villages that are located on islands.

(13) State Railway of Thailand (SRT)

SRT, a state owned enterprise under MOT, is responsible for development and maintenance of Thailand state railways. SRT helped grant permission on installation of fiber optic cable poles and installation of cable underground along state railways.

(14) Ministry of Interior (MOI)

MOI, a cabinet ministry of Thailand, has a wide range of responsibilities such as local administration, internal security, citizenship, and public works. MOI is the government organization that interactively works with the local people in every village. All 76 governors of the provinces of Thailand, district chiefs, deputy district chiefs, down to village headman are working under the MOI. These MOI officers work closely with local people to alleviate problems and improve quality of life of the people in the areas day by day.

MOI has collaborated with MDES in local management of Net Pracharat, for example, providing a contact list of village headman for TOT and MDES; managing the Wi-Fi hot spot location selection in the village; promoting the use of internet in the target villages; and organizing the trainings of how to make use of Internet for local people.

(15) Ministry of Education (MOE)

MOE, a cabinet ministry of Thailand, is responsible for providing quality education to all Thais (i.e., children, youth, disabled and disadvantaged) with equality regardless of whether they live in cities, rural, or remote areas.

MOE collaborated with MDES in providing trainers, organizing and facilitating trainings for local people in the Net Pracharat 24,700 villages.

(16) Office of the Non-Formal and Informal Education (NFE)

NFE is a government department under MOE. NFE has a main mission of providing non-formal and informal education in order to enhance knowledge and skills in different target groups of age, preference, and living environment. This is to cope with economic and social changes as well as to promote life-long learning in Thai society.

In Net Pracharat, NFE has contributed in providing trainings to local people on how to use Internet to their advantage in the Net Pracharat villages.

(17) Office of the Prime Minister (OPM)

OPM has the authority to perform the general administrative work of the Prime Minister and the Cabinet. In Net Pracharat, OPM has helped with the dissemination of Net Pracharat news and information and promotion of the use of Net Pracharat through OPM's media channels.

(18) National Statistical Office (NSO)

NSO is a government department under MDES. NSO's main missions are managing statistics and information to develop and support country's competitiveness and conducting census or survey to obtain national statistical data on socio-economy, technology, and others.

In project evaluation, NSO conducted a field survey to collect opinions and measure satisfaction of local people in 24,700 target villages toward the Net Pracharat project.

(19) Integrity Pact Observer

To prevent and suppress corruption in the public sector, the Cabinet of Thailand has approved and initiated the use of Integrity Pact in government projects' procurement processes to ensure transparency in the project implementation. Integrity Pact is an agreement among 3 parties (i.e., project owner, project bidder, and Integrity Pact Observer) to implement the project with transparency according to related laws, rules, and regulations. During a project implementation, the project owner has to invite Integrity Pact Observers to join and observe every step of the project procurement and implementation process. In a project, a group of Integrity Pact Observers are gathered from a number of experienced and knowledgeable experts in different fields (e.g., engineering, law, and business) and sectors (i.e., public and private sectors). The observers will report any suspicious activities to the government and related agencies.

Integrity Pact Observers observed and provided helpful guidance in every step of the Net Pracharat project implementation (e.g., Terms of Reference (TOR) development, project procurement and implementation). This is to ensure project transparency and desirable project outcome.

(20) Office of the Auditor General (OAG)

OAG is an independent government organization that performs financial audits and assessment of economy, efficiency, effectiveness, and incomes of government agencies. In Net Pracharat, OAG has collaborated with MDES and TOT to conduct financial audit and an assessment of project performance.

2.4 Net Pracharat Target Areas

For target area selection, Ministry of Digital Economy and Society (MDES) has collaborated with the National Broadcasting and Telecommunications Commissions (NBTC) to select Net Pracharat's target areas and expand high-speed network to every village in Thailand. The target areas of the Net Pracharat project are the rural areas where the high speed Internet service is not yet available. Figure 12 shows the result of Net Pracharat target area selection.

<table>
<tr><td colspan="4">Total 74,987 villages* (100%)</td></tr>
<tr><td colspan="2">30,635 villages
(41%)</td><td colspan="2">44,352 villages
(59%)</td></tr>
<tr><td>Zone A
Urban Area</td><td>Zone B
Suburban Area</td><td>Zone C
Rural Area
40,432 villages</td><td>Zone C+
Border Area
3,920 villages</td></tr>
<tr><td colspan="2">Commercial Area</td><td colspan="2">Non-Commercial Area</td></tr>
<tr><td colspan="2" rowspan="2">Non-Target Area</td><td>MDES (24,700)
NBTC (15,732)</td><td>NBTC (3,920)</td></tr>
<tr><td>Fiber Optic</td><td>Fiber Optic
Satellite</td></tr>
</table>

Note* Number of total villages referred from NTBC's GIS map (Feb 1st, 2017)

Figure 12. Net Pracharat Target Area Selection

From the total number of 74,987 villages, MDES and NBTC jointly identified the non-commercial area (44,432 villages, 59% of the total) as the project target area. Due to the large project scale, MDES and NBTC divided areas under each party's responsibility. MDES is responsible for 24,700 villages in the rural area (Zone C). NBTC is responsible for the remaining 15,732 villages in the rural area (Zone C), and 3,920 villages in the very remote or border area (Zone C+). The technology used in Zone C is fiber optic technology. However, the technology in Zone C+ is the mix of fiber optic and satellite technology due to limitations of geographical location. Some villages in Zone C+ are located in the mountains or natural parks that fiber optic cable cannot be installed.

Since the commercial area (30,635 villages, 41% of the total) is the competitive market area with several Internet service providers, it is considered as high-speed Internet available area and therefore non-target area for Net Pracharat.

Figure 13 shows the Net Pracharat in a GIS map. MDES already completed the installation of Net Pracharat network equipped with free Wi-Fi hot spots to the 24,700 target villages in December 2017. This network is an Open Access Network that allows telecommunications operators to connect and provide Internet service to households in the target areas. NBTC is now implementing the project in the remaining Zone C 15,732 villages and Zone C+ 3,920 villages, which is expected to be completed by the end of 2019.

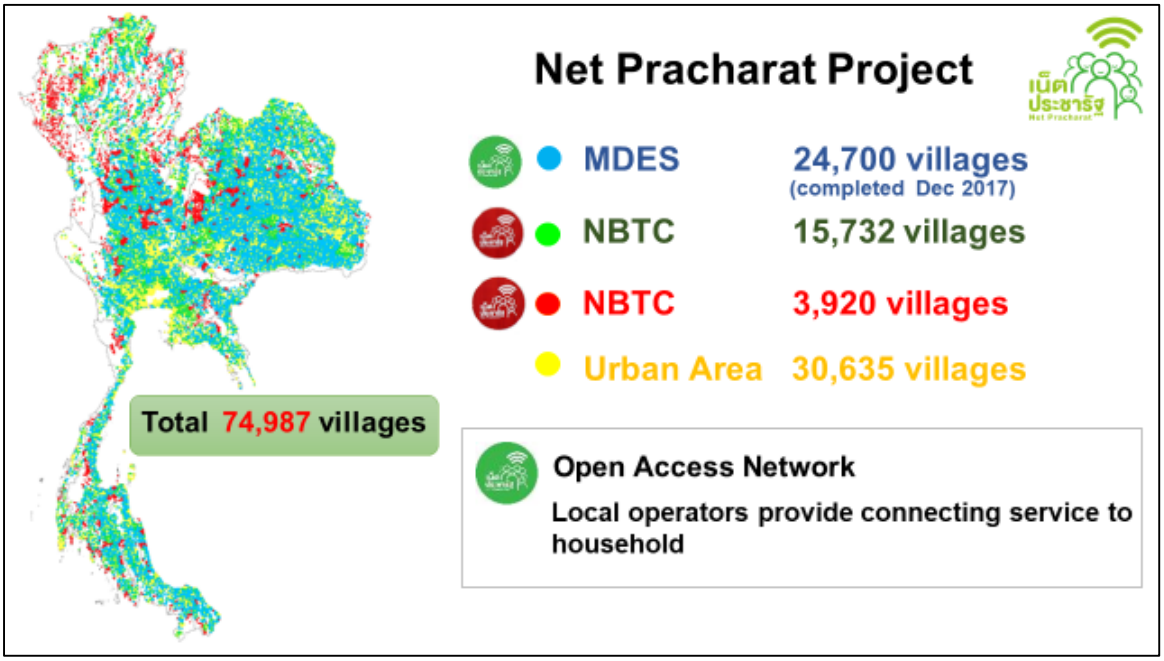

Figure 13. GIS map view of Net Pracharat Areas

2.5 Net Pracharat Financial Plan

For network installation, the government budget covers the costs around $318 million USD of the following activities.

1) Network and System Installation – constructing a fiber optic cable network and installing public Wi-Fi hotspots at 24,700 target villages (1 hot spot per village).
2) Network Maintenance and Wi-Fi service (2017-2018) – providing network maintenance operation and Wi-Fi service at the speed of 30/10 Mbps (download/upload) after completing network installation in the year of 2017-2018.

For the next 5 years (2019-2023), MDES will use Universal Service Obligation (USO) funds to support maintenance of Net Pracharat network and Wi-Fi service to 24,700 target villages. This will sustain the project and promote the growth of broadband Internet market in the areas until they turn to be commercial zone that can be self-sustaining without government support in the future.

2.6 Net Pracharat Implementation

Given that the Government of Thailand gives high priority to developing digital infrastructure to ensure availability, accessibility, and affordability of broadband Internet service to all Thais, Net Pracharat has been attentively implemented with careful project implementation plan, network design, and timeline and mile stones.

2.6.1 Project Implementation Plan

MDES and TOT developed the Net Pracharat project implementation plan. The goal of the project was to expand a high-speed Internet network using fiber optic technology to cover 24,700 target villages. Each village was equipped with a public Wi-Fi hot spot at the speed of 30/10 Mbps (Download/Upload).

As mentioned above, those 24,700 target villages, identified by the MDES-NBTC joint working group, are located in the rural areas where high-speed Internet services are not widely available and expected to continue to have no potential or opportunity to be developed as a commercial area where Internet service providers would offer their services under the current market conditions.

The project scope included:

1. Conducting the field survey and designing the fiber optic network to the target villages based on the designed network architecture
2. Expanding the fiber optic network from the last node of TOT's existing network that is nearest to the target villages or most cost-effective and budget saving.
3. Installing a Wi-Fi hot spot in each target village and providing public free Wi-Fi service at the speed of 30/10 Mbps (Download/Upload). The Wi-Fi hotspot location should be a public place that is convenient for villagers to use the service such as a community center, office of the village headman, temple, school, or hospital.
4. Installing an instruction signage and producing documents that show simple steps of how to connect and use public Wi-Fi service and call center contact number in each target village.
5. Providing network management systems with regular project progress and monthly reports.

Since the Government of Thailand demanded the availability of the high-speed Internet service to every village at the earliest, the Net Pracharat project duration was set to be completed in 12 months. Figure 14 shows the Net Pracharat project plan and timeline.

No.	Project Plan	Duration	Month											
		(days)	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17	Jun-17	Jul-17	Aug-17	Sep-17	Oct-17	Nov-17	Dec-17
1	Get Approval from the Cabinet of Thailand	1													
2	Create a techical specification document	30													
3	Set out Project Opening Ceremony and sign MOU with related govern agencies	1													
4	Conduct field survey and network design	120													
5	Install fiber opitc cable and network equipment	120													
6	Complete installation 1,599 villages	30													
7	Install fiber opitc cable and network equipment	120													
8	Complete installation 4,300 villages	30													
9	Install fiber opitc cable and network equipment	200													
10	Complete installation 8,200 villages	30													
11	Install fiber opitc cable and network equipment	180													
12	Complete installation 10,601 villages	30													
13	Provide internet service and network maintenance	365													

Figure 14. Net Pracharat project plan and timeline

As shown in the project plan above, after MDES received the Cabinet approval on the Net Pracharat Project implementation in December 2016, TOT created a technical specification document and launched the Net Pracharat Project Opening Ceremony on December 27th, 2016. In the ceremony, MDES, TOT, and the Integrity Pact Observers co-signed an Integrity Pact agreement to prevent corruption and ensure transparency in the project implementation. In addition, MDES also signed Memorandum of Understandings (MoU) with PEA and MEA to support the installation of fiber optic cable on the PEA and MEA's electricity poles. Figure 15 shows the Net Pracharat Opening ceremony.

Figure 15. The Net Pracharat Project Opening Ceremony (October 27th, 2016)

After the project was launched, TOT provincial offices across the country conducted field surveys and designed the operational network in the area based on a designed conceptual network architecture. According to the plan, TOT divided the network installation to cover 24,700 villages into 4 deliverables – 1) completed installation to cover 1,599 target villages, 2) 4,300 villages, 3) 8,200 villages, and 4) 10,601 villages respectively. TOT has provided Internet service and network maintenance since the network installation was completed in each target village.

2.6.2 Network Architecture

TOT designed a network architecture of Net Pracharat that connected a fiber optic network from a TOT's existing node to a target village with a public Wi-Fi hot spot as shown in Figure 16.

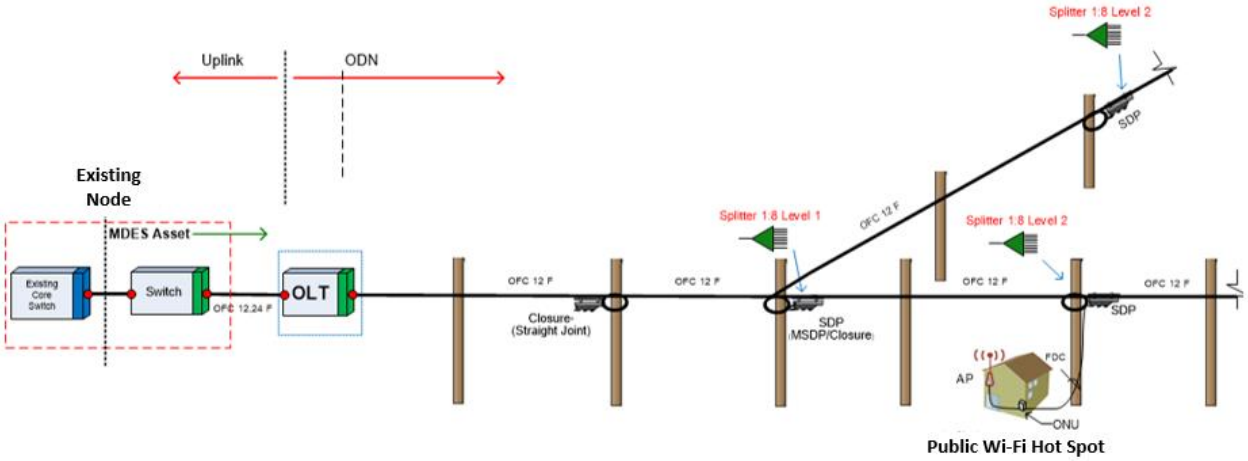

Figure 16. Net Pracharat Network Architecture

Note:

ODN : Optical Distribution Network
Uplink : Network to the Internet
OLT : Optical Line Terminal
MSDP : Main Splitter Distribution Point
SDP : Splitter Distribution Point
ONU : Optical Network Unit
OFC : Optical Fiber Cable
FDC : Fiber Drop Cable (Fiber Drop wire)
AP : Wireless Access Point

Net Pracharat deploys Passive Optical Network (PON), a telecommunications technology that employs fiber optic cable to provide Internet service to end users. As shown in Figure 16, In Net Pracharat, Optical Fiber Cable (OFC) size 12F (12 fiber cores contained in a single cable) and 24F (24 fiber cores) were used to expand fiber optic network from existing nodes: Switch to OLT down to a destination SDP nearest to residence. Then, Fiber Drop Cable (FDC) was used to connect from a destination SDP to a public Wi-Fi hot spot location.

2.6.3 Net Pracharat Network Equipment

There are 8 main types of network devices in the Net Pracharat Project as follows.

1) Switch – A switch is a computer networking device that receives, processes, and forwards digital data packet to the destination device. A switch is the first device in the Net Pracharat network that connects to the TOT's existing network.

2) Optical Line Terminal (OLT) – An OLT is a main device used in the Passive Optical Network (PON) technology. An OLT performs conversion between electrical signals used by regular computer network devices and fiber optic signals sent through fiber optic cable to the destination point devices (Optical Network Units (ONUs) located at customer premises. In addition, the device also performs multiplexing, combining multiple fiber optic signals from several ONUs, and sending this signals to a switch and Uplink (Internet).

3) Optical Network Unit (ONU) or Optical Network Terminal (ONT) – An ONU is a user side equipment (termination point), located at a customer premise (e.g., community center and house) of a fiber optic network. An ONU receives/transmits optic signals from/to an OLT and converts optic signals to electrical signals that provide Internet access to users. In Net Pracharat, an ONU connects to a Wi-Fi Access Point (AP) to provide public Wi-Fi service in a target village.

4) Optical Splitter – An optical splitter splits an optic signal (a light beam) into several beams distributed to multiple customers. In addition, the optical splitter also integrates several beams into a single light beam and sends up to network equipment in a network. In Net Pracharat, an optical splitter splits 1 light beam into 8 beams (splitting ratio 1:8). The network was designed to have 2 levels of distributed splitting as shown in Figure 17.

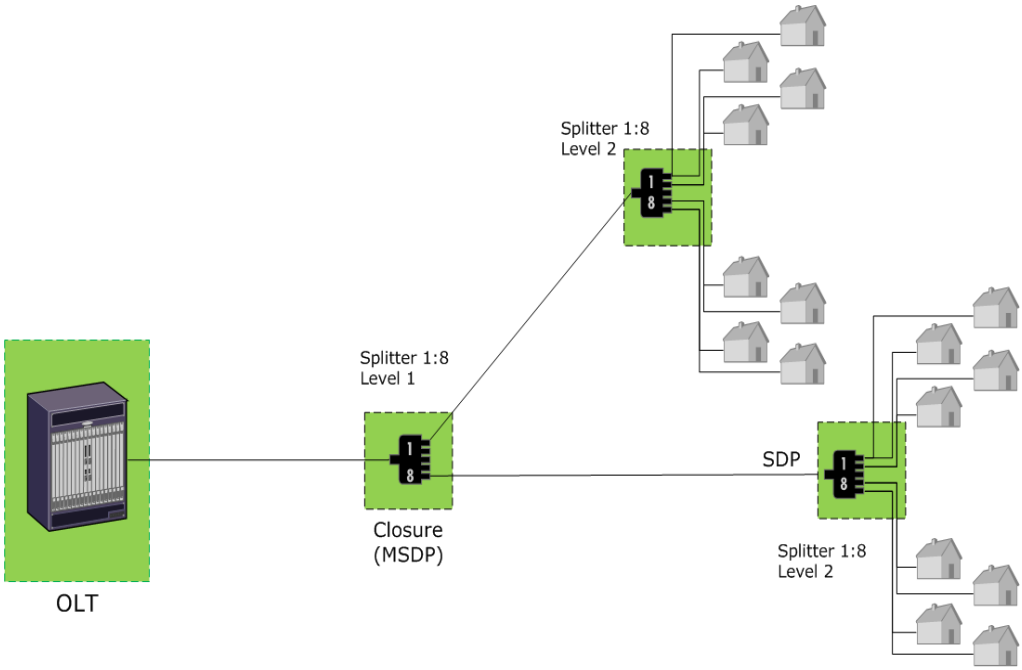

Figure 17. Net Pracharat design of 2-level distributed splitting

5) Closure or Straight Joint Closure – A closure is a connector between two fiber optic cables. Since the Net Pracharat network deploys a large amount of fiber optic cable, a number of closures are required to connect (splice) fiber optic cables together to cover 24,700 target villages in rural areas.

6) Main Splitter Distribution Point (MSDP) – An MSDP is a distribution box (or closure) that installs a level-1 optical splitter (1:8) as shown in Figure 17. A MSDP distributes fiber optic cable to several paths (e.g., streets, intersections) on the way to target villages.

7) Splitter Distribution Point (SDP) – An SDP is a distribution box that installs a level-2 optical splitter (1:8) in the end termination to residence as shown in Figure 17. From a SDP, Fiber Drop Cable is used to connect to ONU at a customer premise.

8) Access Point (AP) – An access point or wireless access point is a network hardware that allows wireless devices (e.g., mobile phones, tablets, and notebooks) to connect to

Internet access through Wi-Fi service. In Net Pracharat, an AP is installed per one target village to provide villagers with public free Wi-Fi service.

2.6.4 Network Installation and Mile Stones

In the installation phase, TOT provincial offices across the country simultaneously installed the fiber optic network in order to complete the installation in line with the project plan. Figure 18 shows pictures of Net Pracharat Network installation (24,700 villages).

Figure 18. Installation of Net Pracharat Network (24,700 villages)

According to the project implementation plan, MDES and TOT completed the installation of fiber cable network to 24,700 target villages in rural areas with milestones as shown in Figure 19.

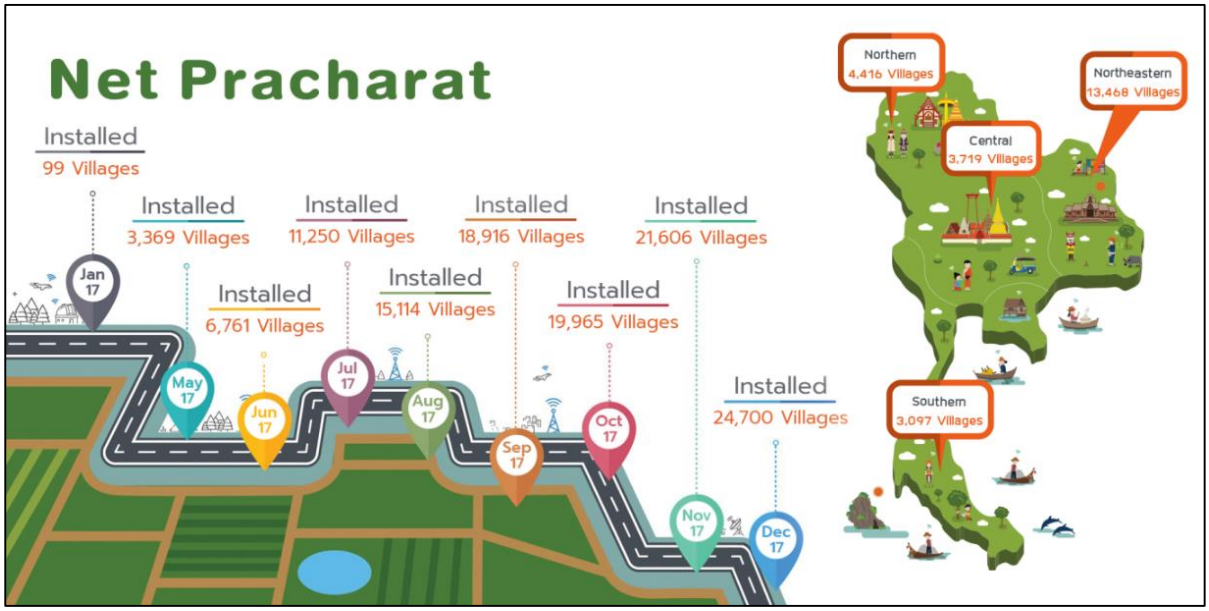

Figure 19. Net Pracharat network installation and milestone

During the installation, TOT regularly reported the progress and accomplishment of each installation milestone to MDES as shown in Table 1. The installation of the Net Pracharat network covering 24,700 target villages can be divided into regions as shown in Table 2.

Timeline	New Installation	Accumulative Installation
January 2017	99	99
May 2017	3,270	3,369
June 2017	3,392	6,761
July 2017	4,489	11,250
August 2017	3,864	15,114
September 2017	3,802	18,916
October 2017	1,049	19,965
November 2017	1,641	21,606
December 2017	3,094	24,700

Table 1. Net Pracharat installation milestones

Region	Number of Villages
Northern	4,416
Northeastern	13,468
Central	3,719
Southern	3,097

Table 2. Net Pracharat target villages by region

2.6.5 Public Wi-Fi service

In addition to providing network, each village was equipped with Wi-Fi for community with a public free Wi-Fi hotspot at the speed of 30/10 Mbps (Download/Upload). Locations of the Wi-Fi hotspots were selected based on the community preferences. Most of the Wi-Fi hotspot locations were village halls, a public building typically used to arrange several activities in the village. A Net Pracharat signage showing steps of how to connect and use public Wi-Fi service was installed in every hotspot location as shown in Figure 20. Figure 21 and 22 show sample village halls with installed public Wi-Fi hotspots.

Figure 20. A Net Pracharas Signage with Wi-Fi connection steps

Figure 21. Village halls selected to be Public Wi-Fi hotspot sites

Figure 22. A village hall with installed Wi-Fi hotspot equipment and Net Pracharat signage

To use public Wi-Fi service, villagers need to follow 6 simple registration steps.

STEP 1 - Select Wi-Fi "Thailand Wi-Fi by MDES"
STEP 2 - Enter citizen ID number and mobile phone number
STEP 3 - Press "Register" button
STEP 4 - Receive SMS containing One Time Password (OTP)
STEP 5 - Enter OTP and press "Confirm" button
STEP 6 - Press "Accept All Terms and Start the Service" button

Once a user registers to use Net Pracharat public Wi-Fi service, he/she can use the public Wi-Fi service at any other Wi-Fi hotspots in the target 24,700 villages across the country. In addition, the user will be able to automatically use the public Wi-Fi service without a need to log-in or register again because the system will memorize the user's device after the registration. Figure 23 illustrates a screenshot of Net Pracharat Wi-Fi registration system requiring a user to enter his/her citizen ID number and mobile phone number.

Figure 23. Net Pracharat Wi-Fi Registration system

As of July 2019, more than 6.6 million users have registered to access Net Pracharat Public Wi-Fi. One user can connect up to 5 devices. The number of newly registered users have increased around 200,000-300,000 users every month as shown in Figure 24.

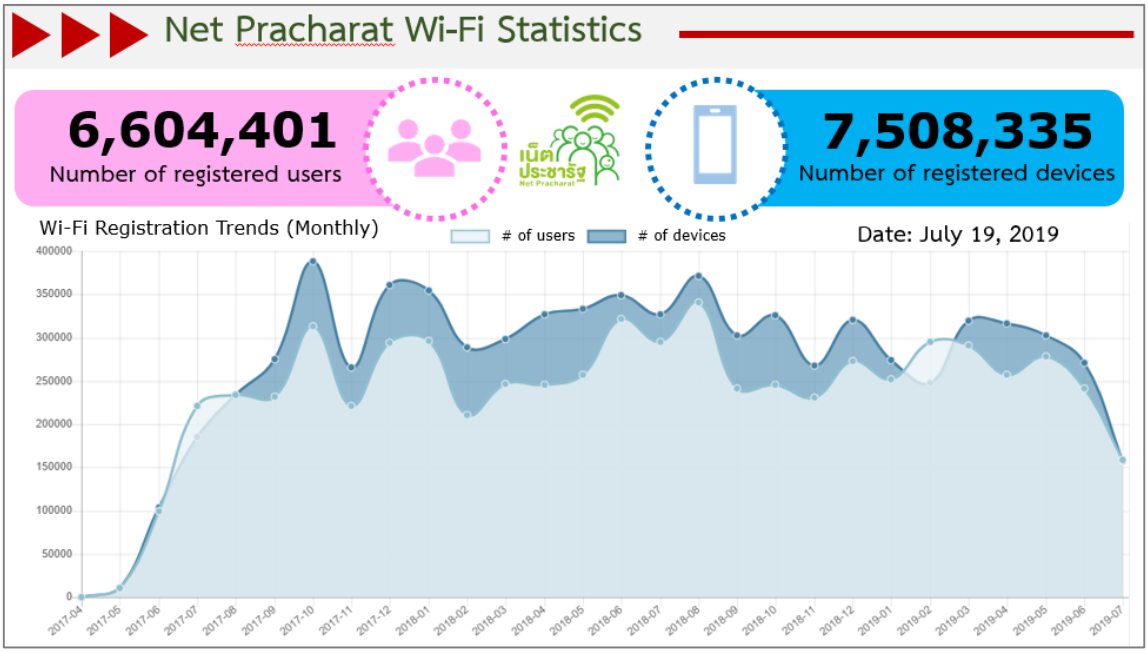

Figure 24. Number of registered users to access Net Pracharat Public Wi-Fi

2.6.6 Network Operation Center

After the network installation, TOT established a Network Operation Center (NOC) to provide maintenance service to ensure efficiency of the Net Pracharat network and the public Wi-Fi service. NOC monitors the Net Pracharat network status through the Network Management System (NMS) and provides preventive maintenance when problems are found (e.g., connecting broken fiber optic cable and repairing inoperative network equipment). NOC also offers call center service answering questions and providing information related to how to use Wi-Fi. The Net Pracharat call center number is 1111 Extension 88. After receiving a call, a call center representative will open a case in the Service Complain Management System (SCOMS), ask a caller about problem status, provide an instruction on how to connect to the public Wi-Fi and initial problem analysis and troubleshooting. If the problem still persists, the call representative will forward the case to TOT technicians in the area for further investigation and monitor the case status. When the problem is resolved, the call representative will check the service status, record the problem solution in SCOMS, and notify the caller. Users also have another option to notify a problem by sending an email to tot_csoc_gov@tot.co.th instead of making a phone call. NOC with the call center operates 24 hours 7 days (24/7) to ensure the availability of network, Wi-Fi service, and user support at all time. Figure 25 illustrates an overview of NOC process. Figure 26 shows NOC operation.

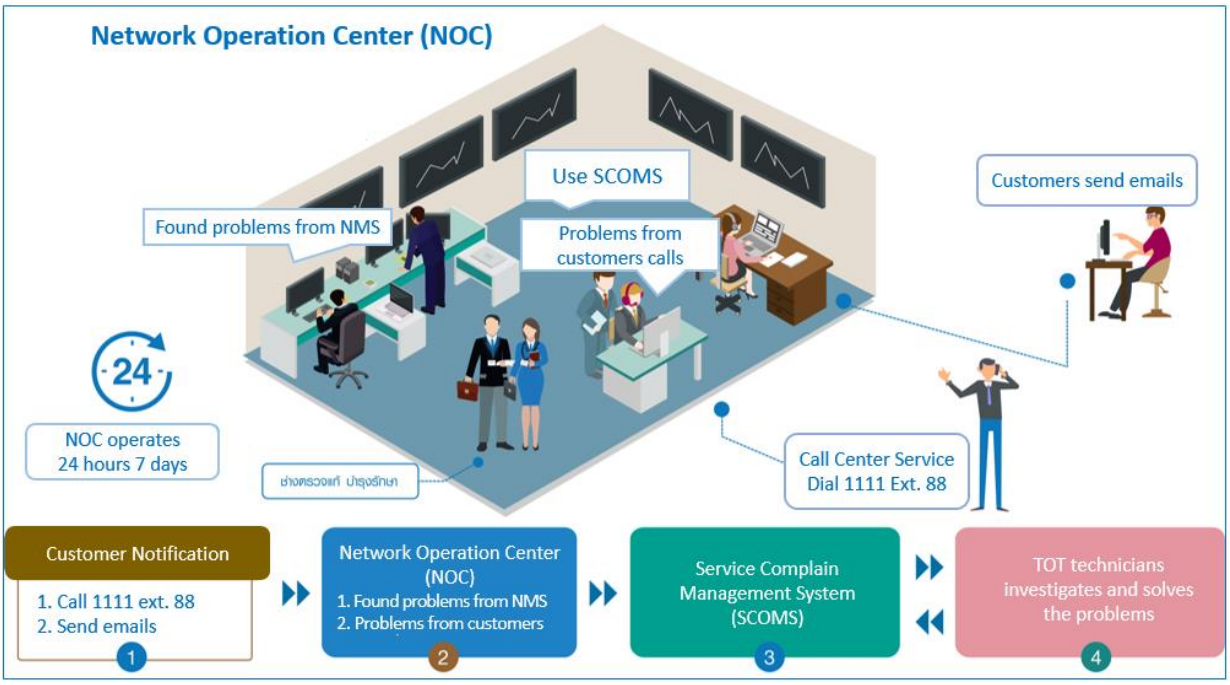

Figure 25. An overview of Network Operation Center (NOC) process

Figure 26. Network Operation Center (NOC) operation

2.6.7 Network Management System

Network Management System (NMS) is a set of applications that enable network administrators to monitor the working status of the entire network and manage equipment that are components of the network. In Net Prachrat, MDES and TOT employ several applications to monitor the network status and the 24,700 public Wi-Fi service sites across the country, for example, Access Point Information System, Network Monitoring System, and MDES Service Management System.

1) Access Point Information System

A Web application that shows the Wi-Fi access point working status that are installed at 24,700 target villages. The system dashboard shows real-time information of the total number of installed access points, number of online access points (working), and number of offline access points (having problems) with percentage of the total. The system also shows the number of users' devices (e.g., mobile phone, tablet, and notebook) that are currently connecting to the Net Pracharat Wi-Fi across the country. A user can click a refresh button in a Web browser to update access point working status information or the system will automatically refresh the page every 10 minutes. The user can further drill down by selecting a province to view number of online/offline access points in the province with the access points' individual locations. The system helps MDES and TOT to gain an overview of Wi-Fi service status and quickly probe and respond to occurring access point incidents in a timely manner. Figure 27 shows the Access Point Information System dashboard.

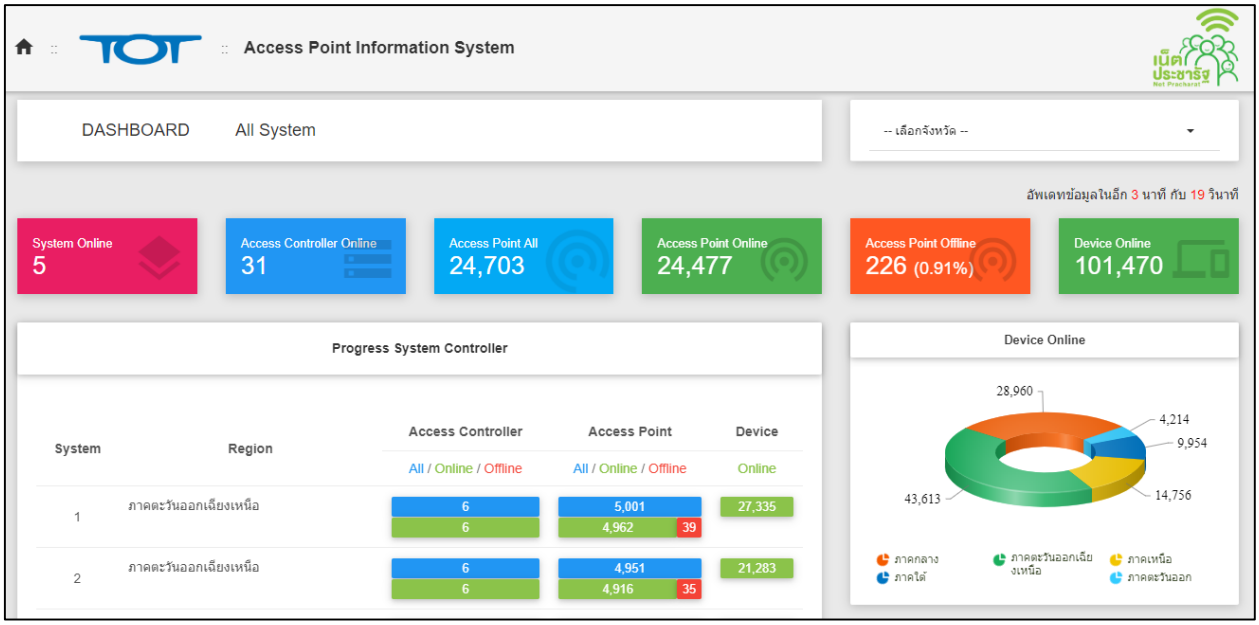

Figure 27. Access Point Information System dashboard

2) Network Monitoring System

A Web application that shows the working status of switches and Optical Line Terminals (OLTs) - two main devices in the Net Pracharat network. The system shows information of number of online and offline switches and OLTs, including the devices' installed locations on a GIS map. A user can further drill down or use a provided search function to view detailed information of an individual device. MDES and TOT employ the Network Monitoring System to gain an overview of the Net Pracharat network status and probe to individual devices for further investigation when an incident happens. For example, when a tropical storm struck the northeastern part of Thailand, the system showed a number of offline switches and OLTs in the northeastern area of the GIS map. The system helped MDES and TOT to monitor the storm incident, check the storm's impact on devices, and view the device recovery progress back to normal operation. Figure 28 shows a screenshot of the Network Monitoring System.

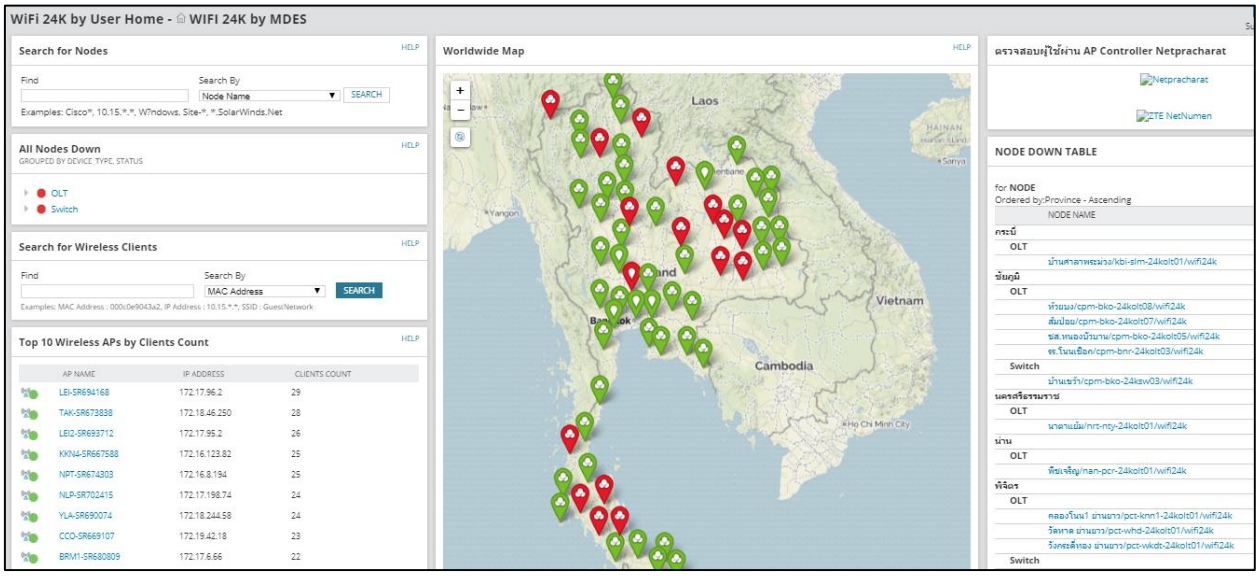

Figure 28. Network Monitoring System

3) MDES Service Management System

A Web application that shows information of fiber optic cable, network equipment, and Wi-Fi hotspot installation on a GIS map. MDES and TOT use this system to manage asset of the Net pracharat project. The system collects information of fiber optic cable path, locations (i.e., address and GPS coordination) of all installed network equipment and Wi-Fi hotspots. To view Wi-Fi hotspots, the GIS map shows markers of all installed 24,700 Wi-Fi hotspot locations in the project. A user can click a marker to view detailed information of a Wi-Fi hotspot. In a new page, the user can view several pictures of the selected Wi-Fi hotspot location such as a public place of installation (e.g., a village hall), an installed Optical Network Unit (ONU) and wireless access point, and a Wi-Fi test-speed of 30/10 Mbps (download/upload) result. In addition, the page also displays date and time of the Wi-Fi hotspot complete installation. Figure 29 shows a GIS map of Wi-Fi hotspot locations in the MDES Service Management System.

To view fiber cable installation and network equipment, a user can select network devices (e.g., switch, OLT, SDP, pole) that he/she wants to display on the GIS map. Each device has its distinct colored marker. The system also allows the user to view installed fiber cable path that

connects from switch to OLT down to SDP. To ensure the location accuracy, MDES uses the GIS map with 1:4000 scale throughout the country. The map resolution of 1:4000 scale meets Thailand national standard. Figure 30 shows a GIS map of the Net Pracharat network installation in the MDES Service Management System.

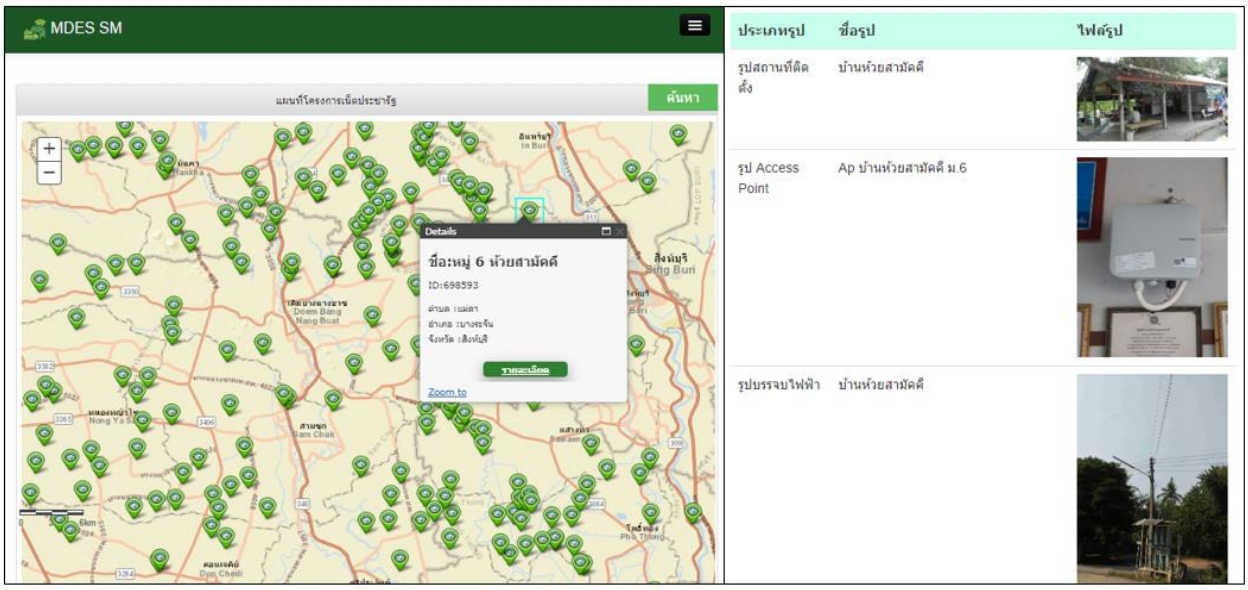

Figure 29. MDES Service Management System - Wi-Fi hotspot installation

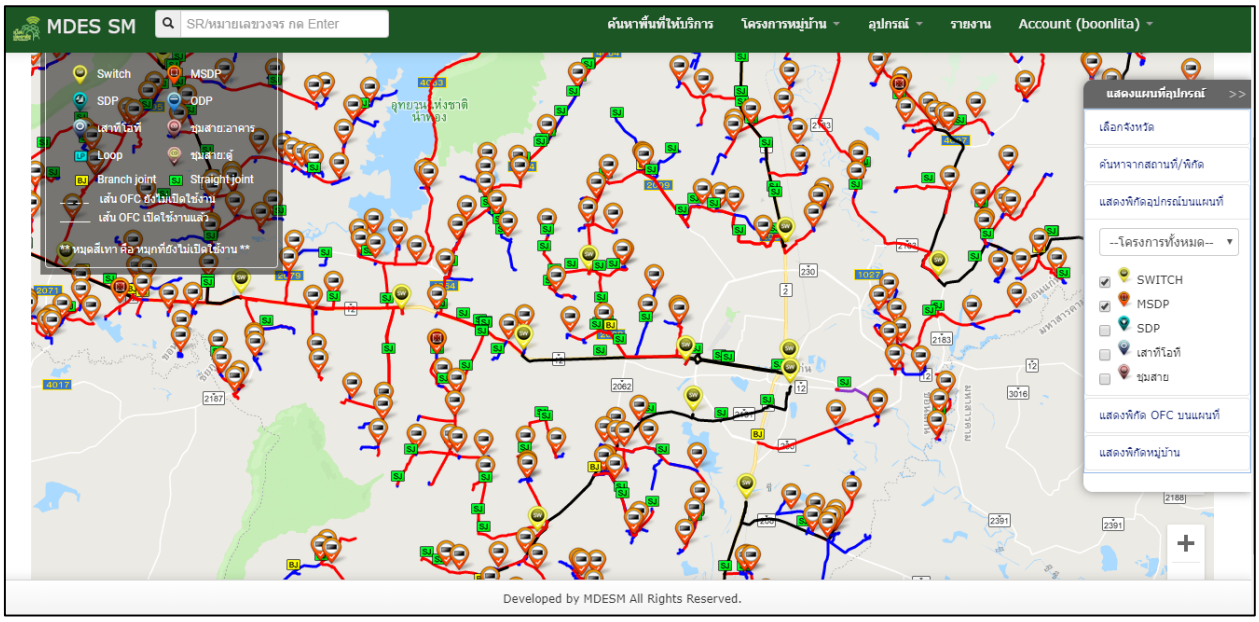

Figure 30. MDES Service Management System – Network installation

2.7 Net Pracharat Training programs

MDES has recognized the significance of the Net Pracharat usage promotion. Without the proper and correct use of Net Pracharat, the project investment and implementation would not be worthwhile. After completion of the network and Wi-Fi hotspot installation, MDES collaborated with the Ministry of Education (MOE), the Ministry of Interior (MOI), and the Office of the Prime Minister (OPM) to promote the use of Net Pracharat to local people.

To increase awareness and promote the use of Net Pracharat, MDES developed a curriculum on Internet fundamentals (Basic Use of Internet), social media, and Internet applications in healthcare, agriculture, government services, and income supplement as shown in Figure 31. MDES also developed two additional E-Books (i.e., E-Commerce and Digital Literacy) for local people and anyone who has interest in further learning as shown in Figure 32.

Figure 31. MDES Curriculum – Internet Fundamentals

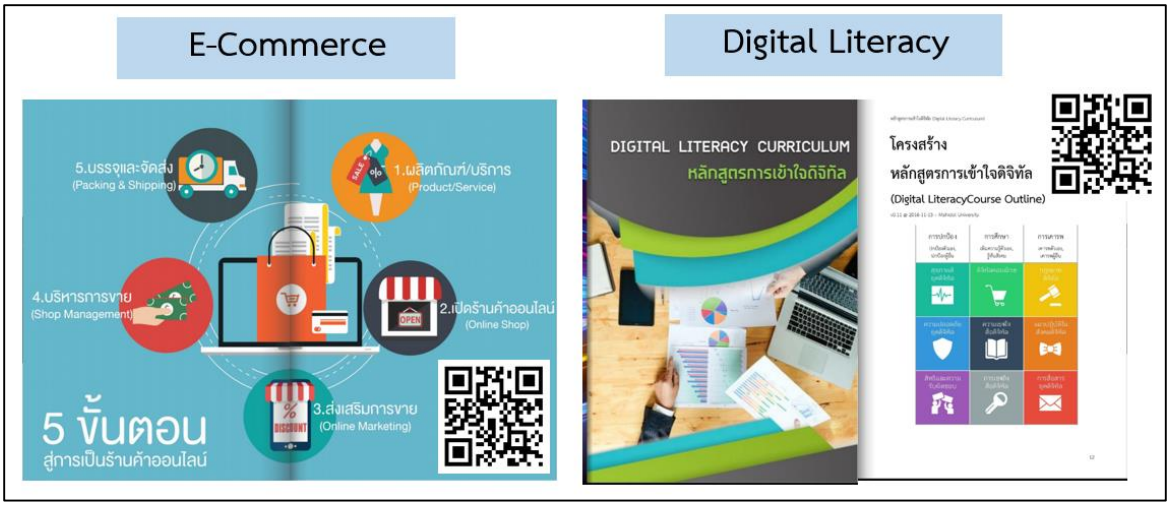

Figure 32. MDES' E-Books: E-Commerce and Digital Literacy

With the Internet Fundamentals curriculum, MDES followed the following 3 major steps in training people in order to increase awareness and make use of Net Pracharat.

1. Train the trainers – MDES collaborated with MOE in providing trainings to 1,033 officers from the Office of the Non-Formal and Informal Education (NFE). This was to create a leading group of Net Pracharat trainers.

2. Train the community leaders - the NFE officers (trainers) went back to their communities and provided trainings to 100,446 community leaders (around 4 leaders per village) in the Net Pracharat villages. In addition, MDES provided trainings to 8,400 MOI officers in the sub-district level to help promote the use of Net Pracharat.

3. Train the villagers - in collaboration with MOI, the training was extended to reach 1,224,623 villagers in September 2018.

Figure 33 illustrates the 3 major steps of the Net Pracharat trainings and Figure 34 shows sample figures of Net Pracharat trainings.

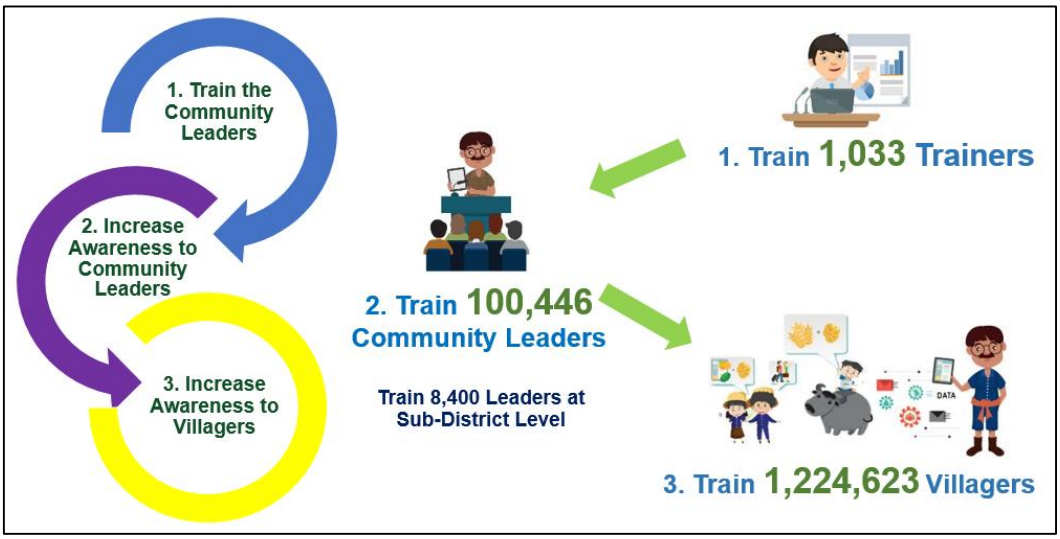

Figure 33. Three major steps of the Net Pracharat Trainings

Figure 34. Net Pracharat Trainings

To make the trainings more engaging, MDES employed the Augmented Reality (AR) technology by embedding the AR code in the training documents. With the AR code, a trainee can use his/her mobile device with a camera pointed at the document. Then, the AR application will display living animation and infographic that describe the content on the device's screen. Not only the AR code did make the trainings more enjoyable, but also help to make the content more flexible. MDES can update the animation on the system without a need to reprint the training documents. Figure 35 shows the use of AR technology in the Net Pracharat trainings.

Figure 35. The use of AR technology in Net Pracharat trainings

In addition to providing trainings, MDES developed a number of E-books and media to further support additional resources for villagers and other people to drill down on the topics of their interests. All E-books and media are open for anyone on the Net Pracharat website (https://netpracharat.com/News/Media/AllNews.aspx). Examples of those E-books are NetPracharat for Public Health Volunteers, Elders, E-Commerce, Education, and Agriculture as shown in Figure 36.

Figure 36. Examples of MDES's Net Pracharat E-Books

2.8 Net Pracharat Volunteer Network

MDES recruited volunteers from 24,700 target villages (one volunteer per village) and formed a Net Pracharat volunteer network. These volunteers are local people who have digital skills and are interested in making use of the Net Pracharat Internet service to improve well-being of their communities. The main purpose of the Net Pracharat volunteer network is to create a channel for communications among the government and people. With the volunteer network, both the government and people can share information, knowledge, ideas on how to make the optimal use of Net Pracharat, leading to sustainability of the project. Trainings for the Net Prachrat volunteers were provided during November 2018 – February 2019.

Furthermore, MDES has developed a mobile application called "Net Pracharat Volunteer". The main purpose of this application is to provide an effective tool for the Net Pracharat volunteers in 24,700 target rural villages to communicate (e.g., reporting problems, asking questions, and sharing knowledge and experiences) with MDES. Figures 37 and 38 show the Net Pracharat volunteer trainings and the Net Pracharat volunteer application respectively.

Figure 37. Net Pracharat Volunteer Trainings

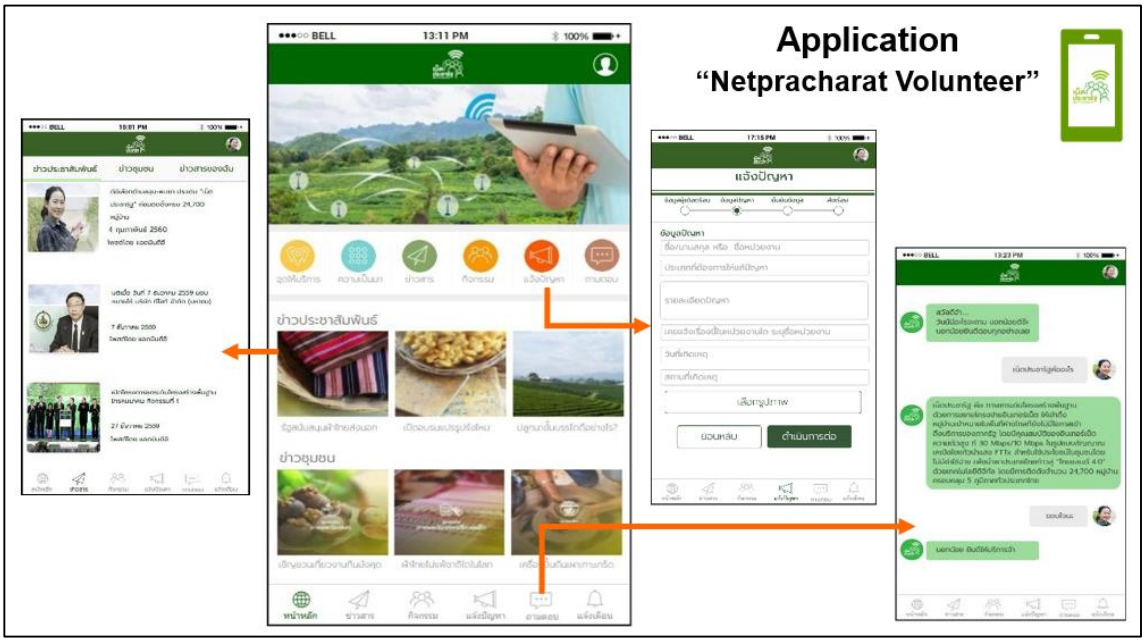

Figure 38. Net Pracharat Volunteer Mobile Application

2.9 Project Evaluation

In July-September 2018, NSO helped MDES conduct a field survey to collect villagers' opinions and satisfaction toward Net Pracharat. NSO interviewed 2,577,231 local people in the 24,700 Net Pracharat villages. The main findings showed that more than 73% of participants recognized benefits of high-speed Internet networks. Local people expressed that Net Pracharat helped enhance quality of life for local villagers, provide opportunities for earning a living, generate income supplement, and facilitate the search for useful information related to health, agriculture, and education. More than 86% thought that more numbers of public Wi-Fi hotspots should be installed throughout their villages.

2.10 Challenges

The Net Pracharat project implementation experienced the following challenges.

1. Project scale and time constraint – since the Net Pracharat project scale was large and MDES needed to complete the network installation within 12-month time, MDES had to collaborate with several government agencies to provide assistance on several aspects, for example, collaborating with NBTC to identify project areas, PEA and MEA to accelerate the cable installation permission process, and MOE and MOI to provide assistance on the Net Pracharat trainings to local people. With strong support from the government, all related government agencies provided great assistance to the project success.

2. Public Wi-Fi hotspot site environment – in the rural target villages, some Wi-Fi installation sites have environment limitations to provide Wi-Fi services to villagers. For example, installation sites have obstacles (e.g., walls, poles, or trees) that obstruct Wi-Fi signal. The electricity is not stable, resulting in power outage from time to time. For the unstable electricity issue, MDES and TOT already installed surge protection equipment at the installation sites in order to prevent damage to the network devices (e.g., ONU and access point).

3. Wi-Fi hotspot relocation – MDES has received several requests from some target villages to relocate installed Wi-Fi hotspot location due to several reasons. For example, an installation site is not convenient for villagers to commute to use the Wi-Fi service, or the site building is demolished and under new construction. To address this issue, MDES developed a guideline for Wi-Fi site relocation which sets out that to relocate a Wi-Fi hotspot, a village community needs to have a meeting agreement of a new site location. Then, the village sends a relocation request attached with the meeting agreement report to MDES for consideration.

4. Demand for additional public Wi-Fi hotspots – MDES received requests for additional public Wi-Fi site installations. For some villages with relatively large area and high demand of Wi-Fi service, one public Wi-Fi hotspot may not be sufficient to serve villagers. In addition, some rural villages were absent from Net Pracharat, and new villages were established after the year of 2017. Therefore, MDES has a plan to install more public Wi-Fi hotspots for new villages, absent villages, and large villages with high demand of Wi-Fi service.

5. Local management of Wi-Fi service – some public Wi-Fi sites (e.g., temple and office of village headman) do not open the service 24 hours, especially during late night time, due to inconvenience in site management. However, some villagers want to use the service during the closing hours. On this issue, MDES informed the villages to have meeting agreements in the communities.

3. Achievement

3.1 Digital Thailand Statistics

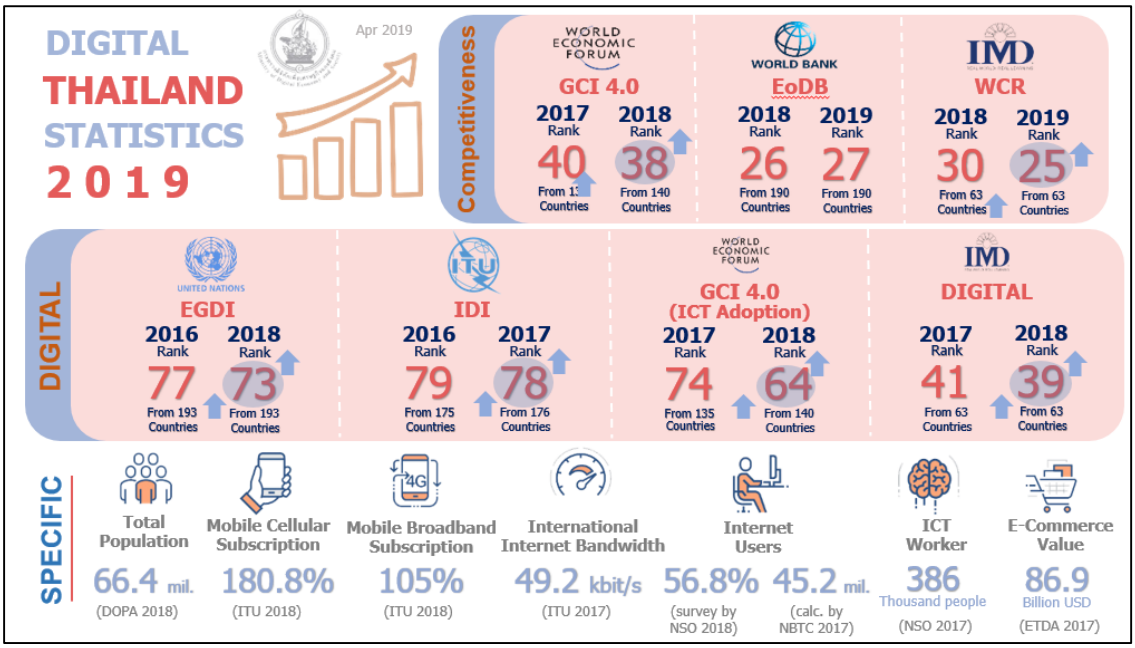

Figure 39. Digital Thailand Statistics

Based on Digital Thailand statistics (Figure 39), most of Thailand international digital rankings have changed in a better direction as a consequence of the implementation of digital economy development policy and the government investment in the digital infrastructure of the country, specifically, Net Pracharat, in recent years. The statistics on Thailand's Internet behavior suggest a robust digital connectivity that is reflected in Thailand's 2018 IMD World Digital Competitiveness ranking in the 39th globally, risen from the 41st spot in 2017 due to the improvement that the country has made in terms of knowledge and technology on the back of strong performance in talent training and education and in the development of its regulatory and technological frameworks.

For some specific statistics, number of mobile cellular subscription in Thailand is about 181% of the country's total population of 66.4 million people, while mobile broadband subscriptions are about 105% of the total population. From the NSO survey, about 57% of the total population have access to the Internet. According to the Electronic Transactions Development Agency (ETDA), Thai E-Commerce value reaches about 87 billion US dollars. All of these figures have increased every year as a result of Digital Economy Development in Thailand.

3.2 Net Pracharat Use Cases

Several villages have adopted and applied Net Pracharat to provide added-up values and services to their communities. MDES has visited a number of Net Pracharat villages to check the working status (e.g., installation quality and Wi-Fi service performance), to discuss with villagers about problems, people's needs and preferences, and to learn the outcome of the project. In this report, MDES selected 4 exemplary villages that make use of Net Pracharat for their communities

both in terms of economic (i.e., income supplement in local communities) and social developments (i.e., improvement of living qualities).

3.2.1 Baan Nong Klong Village, Sing Buri Province

Baan Nong Klong village is located at Moo 1, Ban Ja sub-district, Bang Rachan district, Sing Buri province. After receiving Net Pracharat, Baan Nong Klong village community has created several activities and employed high-speed Internet service as a primary tool to improve quality of life in the community and generate income for the locals. Examples of those activities include:

1. Launching a tourism village campaign – the community created a tourism campaign with several activities that attract visitors who want to experience the natural beauty and culture of the village. With high-speed Internet service available through Net Pracharat, the community promotes the village tourism activities through social media and other online news and media. The community created a Facebook page, Baan Nong Klong Tourism community, and has posted the village activities on the page. The village has quickly received high popularity and become a well-known tourist attraction in the Sing Buri province. A number of tourists have visited the village, generating higher income for the community. Figure 40 shows the Baan Nong Klong village's Facebook and other online media.

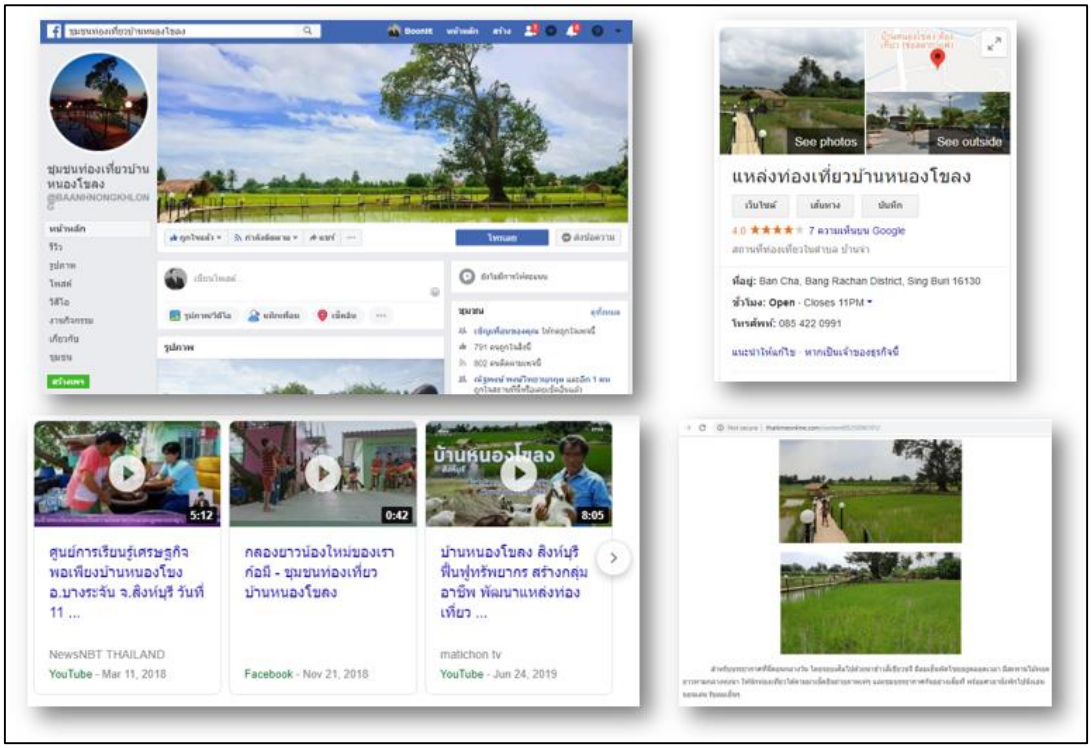

Figure 40. Baan Nongklong village's facebook and online media

2. Promoting social and cultural learning in the village – the community has trained children in the village of Bang Rachan cultural performances (e.g., long drums, Thai boxing dance, and sword dance). Bang Rachan is famous and remembered in Thai history for the heroic resistance against the Burmese military invaders in the Burmese-Siamese war that ended the Ayutthaya kingdom. Further than the village natural beauty, these youth cultural performances help attract several tourists and give impressions to visitors. In addition, the children learn to take responsibilities

by using their free time to generate income, helping their parents and community. Figure 41 shows examples of youth cultural performance and other activities.

Figure 41. Children in the village show a cultural performance and other local activities

3. Promoting income generation – due to popularity of Baan Nong Klong village tourism, villagers have opportunities to sell local agricultural goods, food, and products to visitors. In addition, they also sell their products (e.g., Riceberry) online through the community Facebook page as shown in Figure 42.

Figure 42. Selling Riceberry through the community facebook page

3.2.2 Baan Ta Sumrong Village, Chai Nat Province

Baan Ta Sum Rong village is located at Moo 1, Bang Kood sub-district, Sankhaburi district, Chai Nat province. A community of Baan Ta Sum Rong, led by a village headman, utilizes Net Pracharat to tackle poverty and low income problems. In the past, villagers had to go out and sell their agricultural products in a market. They had difficulty in traveling and carrying goods (e.g., fruits), which cannot be sold much at each time, resulting in high cost but low income for the locals. After receiving Net Pracharat Internet service, the community makes use of provided high-speed Internet service to expand their selling channels online (E-Commerce). Examples of E-Commerce and related activities through Net Pracharat include:

1. Using social media as a primary selling channel – the community made use of social media (e.g., Facebook, Line, and Youtube) to promote and sell their local products online. Facebook pages and Youtube video clips were generated for online marketing. Those Facebook pages have become virtual markets for locals to interact with customers. With Facebook, customers can easily view and order products online. It also gives sellers convenience, reducing difficulty for villagers to carry goods to the market. The villagers can sell their products faster, increase sale, earn more, and expand more trading channels. Figure 43 shows community's Facebook pages and Youtube video clips.

Figure 43. Baan Ta Sumrong village's Facebooks and Youtube video clips

2. Selling the community flagship product – In Baan Ta Sum Rong village, villagers grow a variety of fruits and vegetables. In the old days, there was a local dessert that a group of people gathered to make it together. While making the dessert, they saw a buffalo slumped into the mud. The look of slumped mud is similar to the dessert topping. Therefore, those people named the dessert "Khao Neaw Nah Kwai Lui" (Sticky Rice with Buffalo Digging Topping). The dessert was formerly made during festival only and not for sale. The community villagers wanted to make the local dessert well-known, so they have promoted the dessert through online social media (e.g., Facebook and Youtube). Since then, the Sticky Rice with Buffalo Digging has become the flagship product of the village. The villagers have received a lot of customer orders, generating income to

the community. Figure 44 shows examples of the Sticky Rice with Buffalo Digging Topping selling on Facebook.

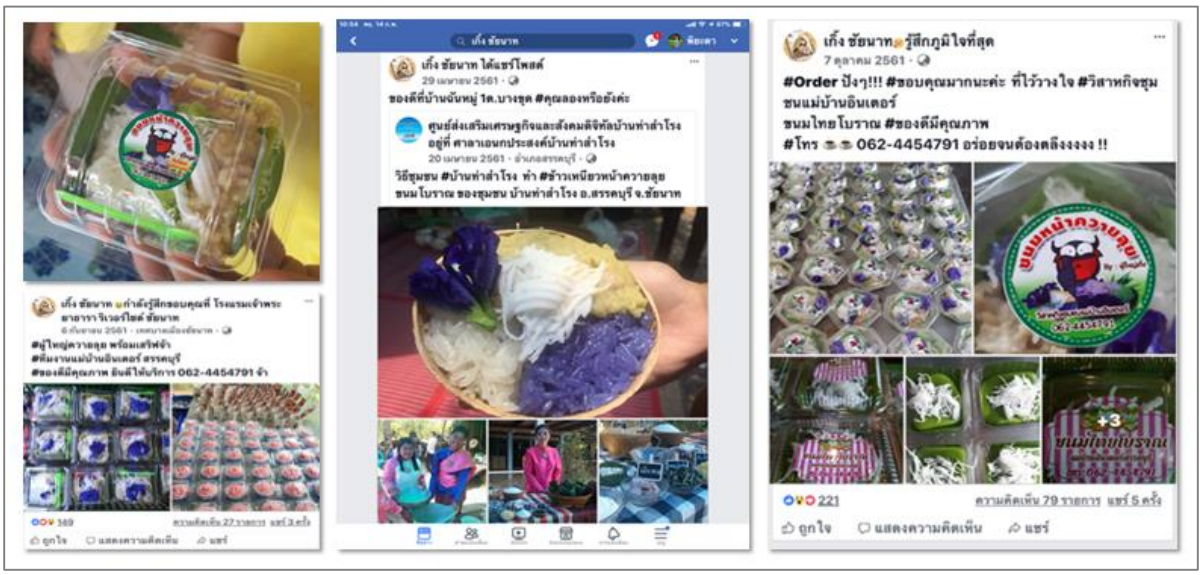

Figure 44. The village's flagship product – Sticky Rice with Buffalo Digging Topping

3. Providing public health information – villagers can receive updated health information. In Thailand, a Village Health Volunteer (VHV) is a villager who received trainings from the Ministry of Public Health (MoPH). The VHV is responsible for communicating health information, and providing basic health care service (e.g., first aid, health consultation, blood pressure checking, and sometimes patient transportation to a hospital) to people in a community. With high-speed Internet service available, VHVs in the village use Smart VHV mobile application developed by the Ministry of Public Health to get updated health information, and then distribute the information in the community. This information helps prevent spreading of disease in time and provide preventive support healthcare in the community.

4. Learning useful content online – Net Pracharat helps promote life-long learning. Net Pracharat enables villagers to access useful content of their interests and preferences online. For example, a villager uses the Net Pracharat Internet service to access and share online content related to agriculture among a group of farmers in the village.

3.2.3 Baan Kong Dara Village, Chon Buri province

Baan Kong Dara is located at Moo 6, Nong Kham sub-distrcit, Sri Racha district, Chonburi province. MDES executives (e.g., the Minister and the Permanent Secretary) visited the Baan Kong Dara village and had a meeting with villagers. The villagers reported that the community made use of Net Pracharat service for activities. Examples of those activities include:

1. Providing trainings – the community uses the Net Pracharat Wi-Fi service, installed at the village hall, to provide trainings such as agriculture and VHV trainings. While trainers can use related online content to make the training more attractive and interactive, trainees can understand the content easier with pictures and video clips available online. In addition, a number of children always come to the village hall during weekends to use Wi-Fi to search information they need to complete homework or school assignments.

2. Communications with related units to help patients – A VHV reported that she was a member of a health LINE group in the community. With Net Pracharat, she communicated with related health units through the LINE group, and received rapid responses to save patients in time. In addition, patients' pictures and information can be sent online for early diagnosis and guidelines of emergency care before transporting to a hospital. Figure 45 shows MDES executives' visit to the village.

Figure 45. MDES Executives' visit to the Baan Kong Dara village

3.2.4 Wat Jun Village, Nakhon Si Thammarat Province

Wat Jun village is located at Moo 1, Kumlone sub-district, Lan Ska district, Nakhon Si Thammarat. In January 2019, Tropical Storm Pabuk struck the Malay Peninsula, killed 8 people, and caused about US$156 million damages in Thailand (Nguyen, 2019). Nakhon Si Thammarat was one of the Thailand southern provinces that was hit by the Pubuk Tropical Storm.

A group of government executives (i.e., MDES, TOT, MOI, and OPM) visited the Wat Jun village to help disaster victims, restored Net Pracharat back to normal operation, and gave disaster relief packages to the community as shown in Figure 46. During a meeting, a villager reported that she used the Net Pracharat service to receive online news and information of the storm status until the Internet signal was lost due to Pabuk's landfall. The information greatly helped villagers to prepare for situations and reduce damages and casualties. This is an exemplary case of using the Internet in response to disaster.

Figure 46. Government executives' visit to help Pabuk Tropical Storm's victims

In summary, the above four-village use cases show that Net Pracharat has brought about a number of benefits to the village communities both in terms of economic and social developments. Locals make use of Net Pracharat in several ways. In economic development, villagers use Net Pracharat to promote village tourism and E-Commerce, leading to higher income generation to the community. In social development, people employ Net Pracharat as a primary tool for 1) life-long learning – farmers searching for agricultural information and students searching content to do

homework; 2) healthcare service – providing VHVs' online trainings and collaborating with related health units to save patients; and 3) disaster management – following storm status news and information. All of these Net Pracharat social use cases lead to the improvement of the quality of life for villagers.

3.3 A Winner of WSIS Prizes 2019

Figure 47. Net Pracharat won the WSIS Prizes 2019

MDES submitted the Net Pracharat project to the World Summit on the Information Society Prizes 2019 contest (WSIS Prizes 2019), organized by the International Telecommunication Union (ITU). The WSIS prizes 2019 assessment focused on the project implementation that supported the achievement of Sustainable Development Goals (SDGs). Competing with 284 projects worldwide, the Net Pracharat or Village Broadband Internet project was awarded the winner prize in category 2, Information and Communication Infrastructure. The Minister of Digital Economy and Society, the Permanent Secretary, and ministry's executives received the award at Geneva, Switzerland on April 9, 2019 as shown in Figure 47.

Dr. Pichet Durongkaveroj, Former Minister of Digital Economy and Society, stated that Net Pracharat is digital infrastructure that enables Thai people wherever they are to access broadband high-speed Internet with accessibility, availability, and affordability. MDES finished the installation of high-speed Internet network to cover 24,700 rural villages. By the year of 2019, high-speed Internet network will cover all 75,000 villages throughout Thailand. More importantly, local villagers will be able to better use the Internet – selling their local products online (E-Commerce); accessing digital health, e-learning, and smart farming. This shows that Net Pracharat is the flagship digital connectivity infrastructure like information super highway that can do a lot more.

Ms. Ajarin Pattanapanchai, Permanent Secretary of the Ministry of Digital Economy and Society, stated that Net Pracharat is the project that gives opportunities for villagers to access useful knowledge and services such as new farming approaches, E-Commerce, and government services. With high-speed Internet available, youth and new generations will be able to work in their hometowns, thus reducing migration of workers to cities. Local people can acquire, share,

and utilize new knowledge to enhance their communities. In addition, they have opportunities to sell their products online to generate more income via E-Commerce platforms. Villagers receive these opportunities for free in their local areas through Net Pracharat Internet service.

4. Future Plans

4.1 Open Access Network

The Net Pracharat network is considered as a National Boradband Network (NBN). The constructed fiber optic cable network that connects villages across the country is aimed at providing availability, accessibility, and affordability for local people to access high-speed Internet service and digital technologies. With the constructed Net Pracharat network, a variety of last mile networks (e.g., wireless network, fiber optic) can be extended from NBN to deliver high-speed Internet and other telecom services to end users. Asset of the Net Pracharat network (or NBN) is owned by the Government of Thailand and managed by a telecom state-owned enterprise.

To make use of the fiber optic cable network constructed in the project (the Net Pracharat Network) at its full potential, MDES follows the Open Access Network (OAN) model by allowing any telecommunications service provider who obtain a telecommunications license from NBTC to connect and use the Net Pracharat network without fees to provide last mile Internet service to household customers with fair and affordable price for local people. This is to promote infrastructure sharing that helps reduce redundant infrastructure investment cost in rural areas. Furthermore, the government will use Universal Service Obligation (USO) funds to support maintenance of Net Pracharat network for 5 years to sustain the Net Pracharat project. This will foster the growth of broadband Internet access market in the areas until they turn to be commercial zone that can be self-sustaining without government support in the future. Figure 48 shows the Open Access Network in the Net Pracharat network (or NBN).

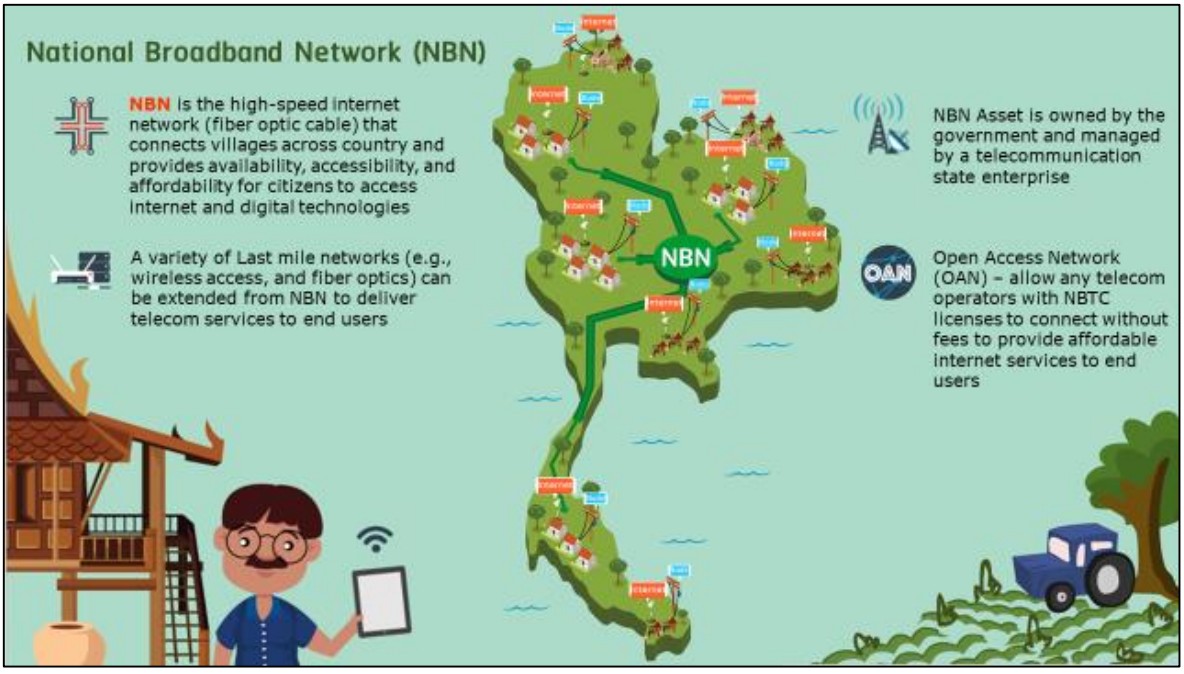

Figure 48. Open Access Network in the Net Pracharat network (or NBN)

4.2 Net Pracharat Network Expansion (Local Schools and Hospitals)

MDES is now implementing the Broadband Internet for Local Schools and Hospitals project. The main objective is to expand the Net Pracharat Network to rural schools and hospitals that have no fiber optic cable networks across the country. MDES has assigned TOT, a state owned enterprise that implemented Net Pracharat, to install fiber optic cable networks to about 1,200 local schools and 500 hospitals (1,700 in total) that have no fiber optic cable networks nationwide. This will promote the use of Internet and digital technologies in education and public health services.

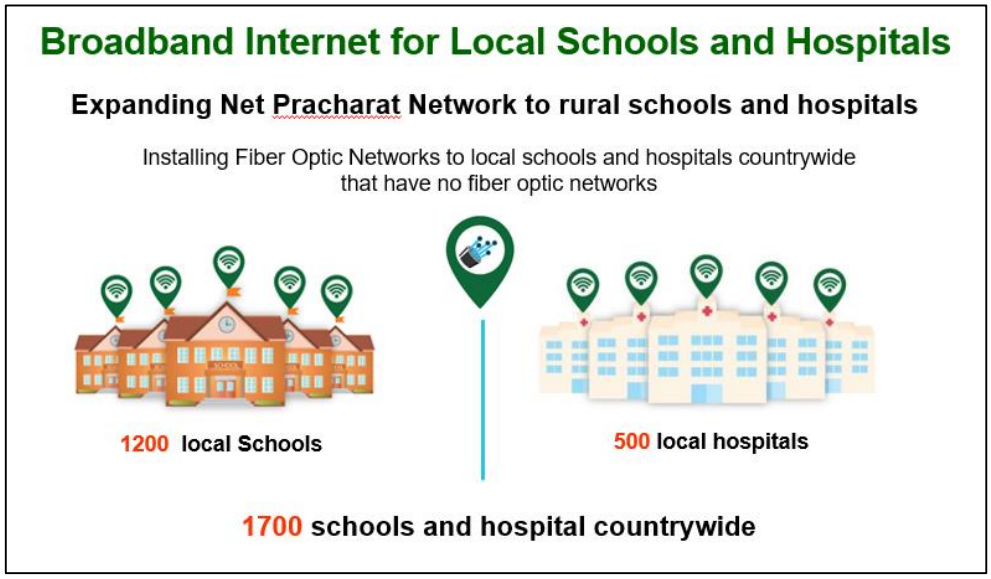

Figure 49. Broadband Internet for Local Schools and Hospitals

4.3 Promoting the Use of Net Pracharat

MDES will continue promoting the use of Net Pracharat in rual villages across country. MDES plans to set up several activities to increase Net Pracharat usage. Examples of those activities include:

1. Promoting local community business – MDES will help develop local business in the community by providing trainings and tools, specifically related to conduct online business (E-Commerce). The goal is to raise local business to become Small to Medium Enterprises (SMEs) or Social Enterprises (SE) in the community, turning the village to be an E-Commerce village.
2. Expanding the Net Pracharat Volunteer Network – MDES now have a group of 24,700 Net Pracharat volunteers (1 volunteer per village). To boost Net Pracharat usage, MDES will recruit more volunteers to enlarge the network, and continue provide trainings to the volunteers, enabling them to help out locals in their villages to make use of Net Pracharat at its full potential. In addition, MDES sets up a campaign to attract the volunteers and other general users to download and use the Net Pracharat Volunteer mobile application. The mobile application acts as a channel to communicate between MDES and Net Pracharat communities, and also among the communities themselves. The communities can report problems, asking questions, and share knowledge, practices, and experiences of using Net Pracharat in their communities. Users will collect more points every time they use the application. With certain numbers of points, they can exchange a variety of prizes.

3. Net Pracharat Village Model Contest – to motivate villages to utilize Net Pracharat, MDES will organize the Net Pracharat Village Model Contest, allowing villages to show Net Pracharat use cases and receive recognition from the government and communities. In addition, the contest provides opportunities for Net Pracharat villages to share and exchange best practices and lessons learned among the communities.

4. Provincial Net Pracharat Caretaker – MDES will recruit TOT personnel to be Net Pracharat Caretakers in every province (2 caretakers per province). A Net Pracharat caretaker is responsible for monitoring Net Pracharat Wi-Fi service status and ensuring the service is working efficiently in his/her province, checking Wi-Fi hotspot relocations, and collaborating with Net Pracharat volunteers in the province to provide knowledge to villagers and stimulate the use of Net Pracharat in the villages.

4.4 Sustainable Development

Net Pracharat ensures reliable digital infrastructure and equitable access to information and communication technology throughout the country. As such, it promotes the effective use of ICT, facilitates lifelong learning and skills development, creates enabling environment for digital innovations as well as boosts the investment in rural communities, which will propel the nation toward stability, prosperity, and sustainability. With Net Pracharat, local people can access useful information and services in many areas, such as education, public health, and government services – leading to improvement in quality of life. It will also offer local people with opportunities to E-Commerce and the use of online shops in order to generate employment and income in local communities. With these results achieved, Net Pracharat is a driving force that propels the country toward a path of long-term stability, prosperity, and sustainability. Figure 50 shows benefits of Net Pracharat.

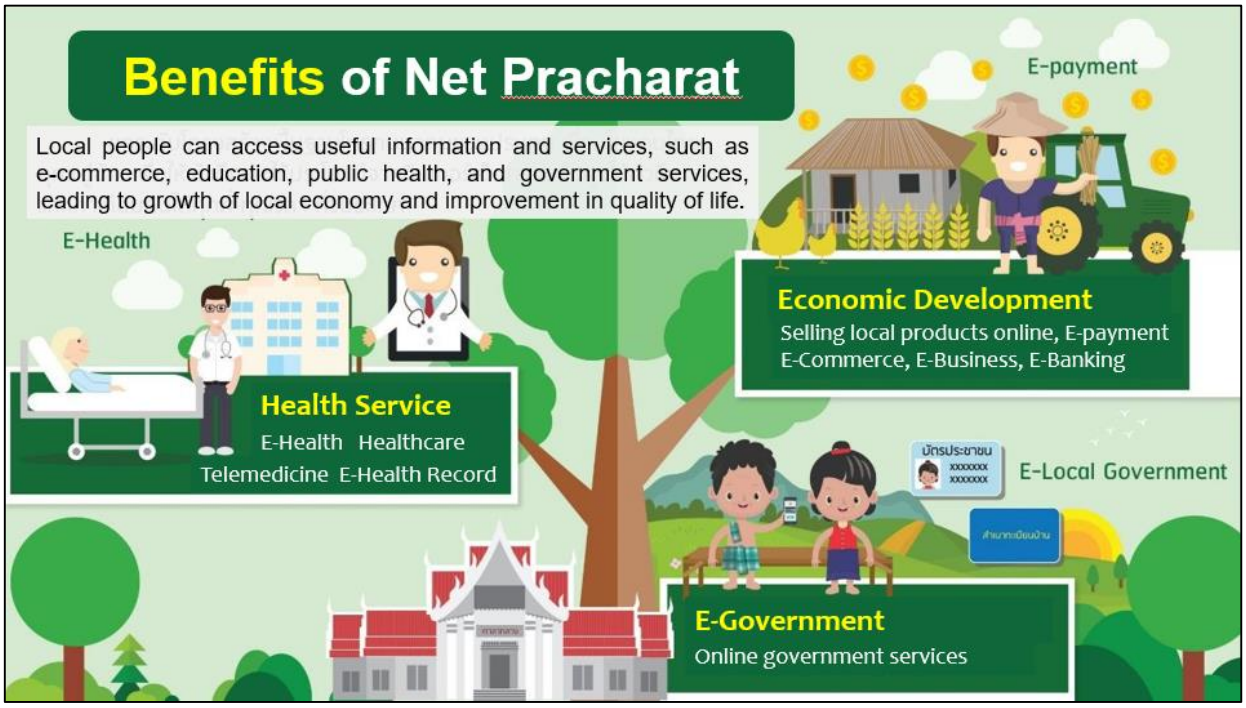

Figure 50. Benefits of Net Pracharat

With Net Pracharat, local people (such as local businesses, SMEs, farmers, and students) who live in the target villages will be the primary beneficiaries of this project. Also, the country as a whole will gain benefits from Net Pracharat. Net Pracharat is a primary driving force that leads the country to Thailand 4.0 in several aspects as shown in Figure 51.

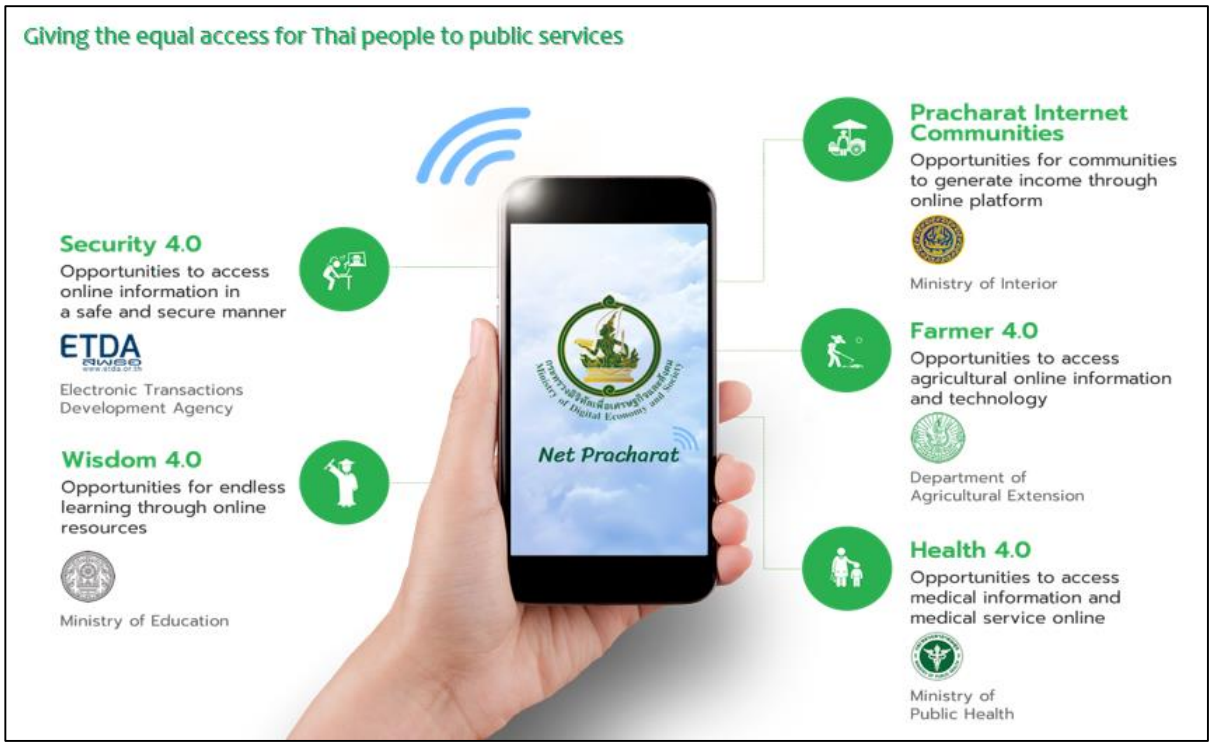

Figure 51. Net Pracharat leads to Thailand 4.0

Toward Net Pracharat campaign, Thai people across the country have equal access to broadband Internet and are equipped with basic digital literacy. Several innovative services can be delivered to Thai people through Net Pracharat. The following are some examples of Net Pracharat's benefits that drive the country toward Thailand 4.0.

- **E-Commerce** – with access to Internet, local people will have more opportunities to use e-commerce to market and sell their local products, resulting in more income generation. With e-commerce, local people can overcome geographical reach constraints. They will be no longer limited to selling to immediate local market, but expand their markets to both domestic and global stages. Currently, MDES is working with Thailand Post to implement an e-commerce system for local communities. The aim is to facilitate villagers to start e-commerce businesses. The project will develop a Point of Sale (POS) system, an e-commerce platform that offers a full range of e-commerce tools and activities, such as e-marketplace, e-payment, and logistic services. This is to support local people to sell their local products online. The collaboration between MDES and the Ministry of Commerce in this regard will further increase opportunities for communities to sell local products (e.g., One Tumbon One Product (OTOP) products) through several online platforms. In addition, working with Electronic Transactions Development Agency (ETDA), Thai people are able to access online information and services in a safe and secure manner.

- **Education** – students can search for information that can help them with their studies, for example, animation that explains chemistry, rules of physics, mathematic calculation and others. Also, they can learn additional topics of their interests through online courses from both domestic and abroad. Teachers can find new information that helps improve their teaching knowledge. They can make use of teaching materials available on the Internet to help students better understand content in class. In addition, students and teachers can learn and practice English with a number of free online websites. For local people, they can access lifelong learning education that can help them improve their knowledge and skills on several aspects, such as household accounting, organic farming, and automobile maintenance. This will give them opportunities for employment and more income generation. At present, there are a variety of Thai and international online resources available for free access (e.g., ThaiMOOC (https://thaimooc.org), and edX (https://www.edx.org/)). In collaboration with the Ministry of Education, MDES can further promote the use of Net Pracharat for endless learning through online resources, leading to Wisdom 4.0.

- **Public Health services** – local people can access health information online. They will be able to access tele-medicine service, such as teleconsultation – consulting between hospitals or patients consulting physicians through video conference. In addition, hospitals will be able to exchange patient's electronic health records without the need for patients to carry their own records to hospitals to get service. In collaboration with the Ministry of Public Health, Thai people will be able to access medical information and medical services online through Net Pracharat.

- **Agriculture –** farmers can view online information related to their planting and harvest. For example, farmers can check agriculture goods price online and then plan what crops they should invest in planting. They can also find a number of planting methods and tips resources online. At present, the Thai government puts an effort to enable every Thai farmer to become smart farmer. Smart Farmer is a campaign that comes in to arm farmers and local producers with knowledge, devices, and applications such as
    - Gardening Applications with IoT (Internet of Things) – farmers can now access reports of their progress from their electronic devices of choice. The applications also allow them to manage, plan, and predict harvesting trends from a distance.
    - Insecticide Drone – a drone can automatically or manually spray insecticide from the air. Not only does the drone economize working hours, but it also minimizes workers' contact with the chemicals.
    - Ag-info application **–** an application designed for data resource pool giving new innovations and knowledge on agriculture.

  In collaboration with the Ministry of Agriculture, Thai farmers will be able to access abundant resources of agricultural information and service online, leading to Farmer 4.0.

- **E-Government services** – local people can access online government services. For example, they can use their identification number to check their health care coverage, pay water and electric bills online, and do tax e-filing, resulting in an increase in government service performance in terms of speed and quality. In addition, all government units in all hierarchical levels (i.e., from central, provincial, district, to sub-district levels) will be able to share and exchange data and information online in both vertical and horizontal lines of operations. This results in generating Government Big Data that can be used to analyze incurring problems and generate government policies that provide optimal solutions that bring benefits to people in various dimensions.

5. Conclusion

The Village Broadband Internet project or Net Pracharat is a Thai flagship digital infrastructure development project. The project aims at expanding high-speed Internet network to reach every village in the country to ensure availability, accessibility, and affordability of Internet service and digital technology to Thai citizen. To achieve this goal, the Thai government undertook to construct high-speed Internet network to villages in rural and non-marketable areas. MDES and TOT installed a fiber optic cable network (i.e., Net Pracharat network) to cover 24,700 rural villages. Each village was equipped with a public Wi-Fi hotspot at the speed of 30/10 Mbps (download/upload). The installation was completed in December 2017. After network installation, MDES developed curriculum and provided trainings to local people in the target villages in the three steps: 1) train the trainers – providing trainings to 1,033 trainers (NFE teachers); 2) train the community leaders – the trainers went back to their communities and trained 100,446 community leaders (about 4 leaders per village); and 3) train the villagers – the training was extended to 1,224,623 villagers. In addition, MDES formed a group of 24,700 Net Pracharat volunteers recruited from local people with digital skills in the target villages (one volunteer per village). MDES also developed Net Pracharat Volunteer mobile application that enabled the volunteers to communicate with MDES, receive Net Pracharat news and information, report problems, and share practices of how to make use of Net Pracharat in the communities. With these results achieved, Net Pracharat won the World Summit on Information Society Prize 2019 (WSIS Prize 2019).

For the future plan, MDES is now expanding the Net Pracharat network by installing fiber optic cable network to reach rural schools and hospitals nationwide that have no fiber optic networks. In addition, to promote infrastructure sharing, MDES is in the process of opening the Net Pracharat network based on the Open Access Network model – allowing any telecommunications service providers to connect and use the Net Pracharat network to provide last mile Internet service to household customers with fair and affordable prices. Furthermore, to promote the use of Net Pracharat, MDES will conduct more activities such as promoting local community business to become E-Commerce villages, expanding Net Pracharat Volunteer network, forming provincial Net Pracharat caretakers, and organizing Net Pracharat Village Model contest. Figure 52 illustrates a Net Pracharat roadmap.

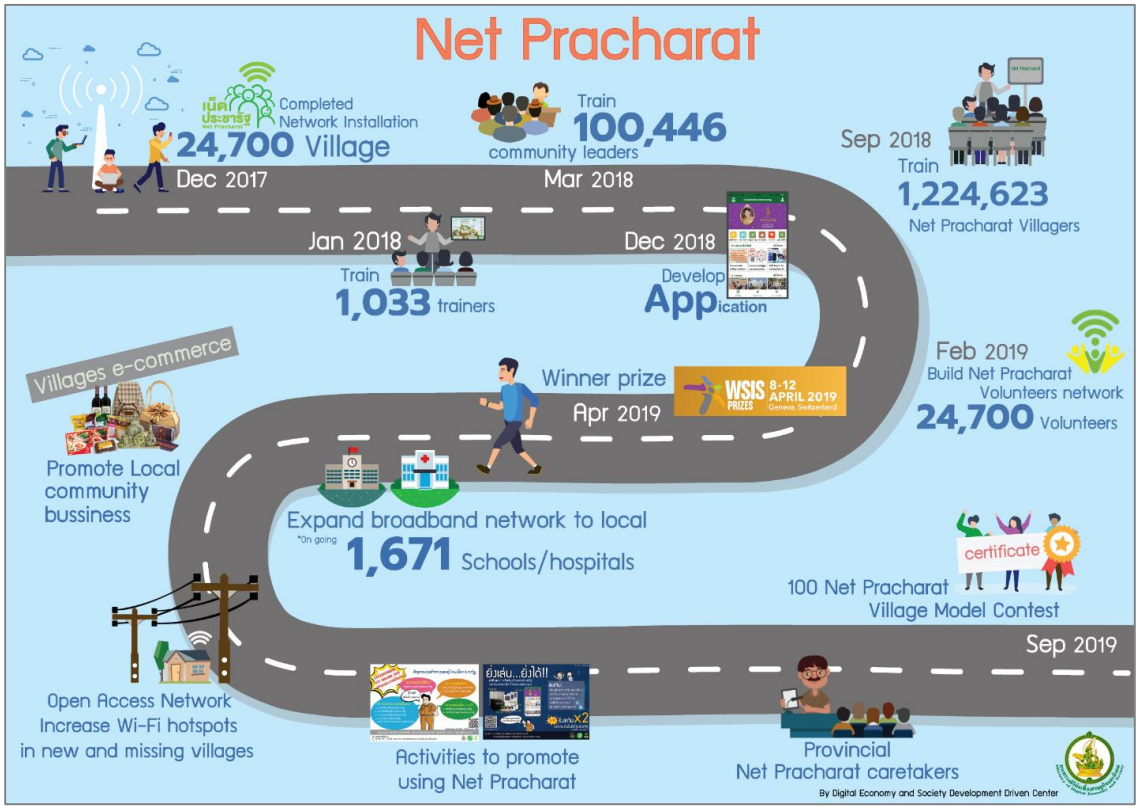

Figure 52. Net Pracharat Road Map

In conclusion, Net Pracharat places an emphasis on providing Thai people with equitable and affordable access to information and communication technology (or digital technology). This is to enable Thai people across the country to access digital technology equally. With broadband Internet access, people can make greater use of broadband to access useful information and services in many areas, such as education, public health, and government services, leading to improvement in well-being of individuals, communities, and the country as a whole. It will also offer local people opportunities to e-commerce and the use of online shops in order to generate employment and income in local communities, accelerating social and economic progress of the country. With these results achieved, Net Pracharat is a driving force that drive Thailand to stability, prosperity, and sustainability.

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