

5G



Action Plan for Promoting
the Adoption of 5G Technology in Thailand Phase 1

Preface

5G technology is a digital technology that is currently in line with the global mainstream trend. With its developed technical ability, 5G technology is therefore noticeably different from the 4G technology. The technology can support the application of other technologies which are beneficial to economic development, for instance, the application of low latency automation in industrial plants, the application of internet of thing (IoT) in smart farming, etc. as well as social development, for example, the application in telehealth for greatly enhancing the communication system, the application of Virtual Reality (VR) in education to improve the experience of learning. Therefore, it can be seen that 5G technology has the potential to enhance communication and generate economic added value to various industries as well as improving the quality of life for the populace in Thailand.

Due to the foregoing reason, the National 5G Steering Committee has developed the Action Plan for Promoting the Adoption of 5G Technology in Thailand by taking into account the direction and national development strategy in accordance with the national plans and policies. The primary objective of the aforementioned action plan is to be used as a framework to stimulate 5G technology implementation in Thailand to its maximum extent of benefit and to solve problems and obstacles that impede the effective application of 5G technology based on the driving mechanisms through the integration in various fields so that the cooperation between government, private sector and public sector can be realized in an effective manner.

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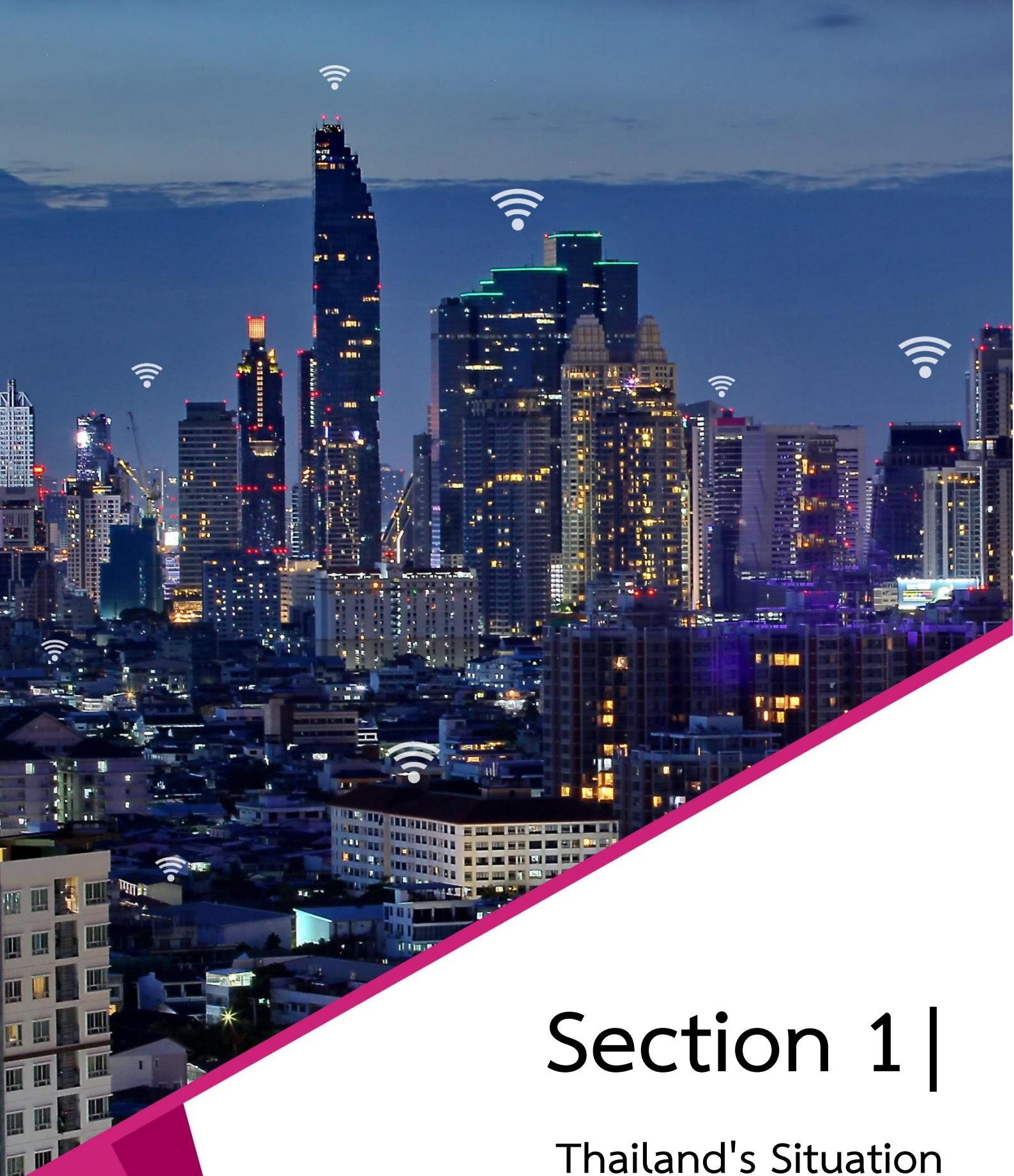
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Section 1 |

Thailand's Situation for Promoting the Adoption of 5G Technology

Section 1 Thailand's Situation for Promoting the Adoption of 5G Technology

1.1 Methodology for the Action Plan for Promoting the Adoption of 5G Technology in Thailand

Thailand is in the process of transforming towards becoming Thailand 4.0 whereby the economic and social developments are driven by digital technologies and innovations. Thus, stimulating the development of innovations that utilize the capabilities of 5G technology is considered one of the mechanisms for promoting the adoption of 5G technology in various sectors, including the economic and social sectors. This also encourages the development of digital technologies and innovations for future application in various industries. Consequently, Thailand will be able to fully utilize the benefits of 5G technology and hence, improve the country's competitiveness in the global market. For this reason, the National 5G Steering Committee initiated the development of the Action Plan for Promoting the Adoption of 5G Technology in Thailand Phase 1 with the objective to define the framework for laying a solid foundation to support the widespread adoption of 5G technology in various sectors. This includes establishing an appropriate mechanism for promoting efficient collaboration and cooperation between the public and private sectors, as well as ensuring the efficient use of resources and that the weaknesses and obstacles in effectively adopting 5G technology in Thailand are resolved. At the same time, the Action Plan for Promotion the Adoption of 5G Technology in Thailand Phase 1 must be aligned with the direction and strategies of development as defined in the national plan and policies as well.

The methodology for the Action Plan for Promoting the Adoption of 5G Technology in Thailand includes the following details:

1. Gap Analysis

- In-depth studies and analysis of current state of development and adoption of 5G technology in Thailand on the following topics.
 - Relevant laws and regulations
 - Demand for the adoption of 5G technology in the 10 key industries that have huge impacts on the economy and society which are agriculture, industrial, logistics, tourism, education, public health, smart city, finance, wholesale and retail, and telecommunication.
 - Investment opportunities for 5G technology in each area
 - Challenges on the demand and supply sides
 - 5G Testbed and Sandbox development status

- **In-depth studies and analysis of desired state for the development of 5G technology** by benchmarking international best practices to analyze and determine development guidelines for spectrum frequency, network deployment, investment and competitiveness enhancement and regulatory measures that fit the context of Thailand, and are in accordance with the national plans and policies.
- **Identified the gap between the desired state and current state** of the development and adoption of 5G technology in Thailand to determine the country's direction of development.

2. Consolidate Information, Opinions and Recommendations from Key Stakeholders

- Conducted in-depth interviews with more than 10 relevant government agencies, private organizations and state enterprises which are in the key industries that have huge impacts on the economy and society including Ministry of Industrial, Ministry of Agriculture and Cooperatives, Ministry of Public Health, Ministry of Transport, Digital Economy Promotion Agency, The Federal of Thai Industries, Charoen Pokphand Group Co., Ltd., Bangkok Dusit Medical Services Co., Ltd., Thailand Post, and Phuket City Development Co., Ltd.
- Conducted 3 focus group meetings that include the participation of experts and representatives from government agencies, state enterprises and private organizations, as well as the representatives from the social, public and local sectors, with a total number of 125 participants from 81 organizations. Also, a public hearing on the Action Plan was held with a total number of 34 participants from 18 organizations.
- Conducted joint discussions with experts from relevant fields.

3. Establish the Action Plan for Promoting the Adoption of 5G Technology in Thailand

- Develop the strategies, goals, indicators, tactics and development guidelines.
- Propose project details and workplans for each pilot project and flagship project.

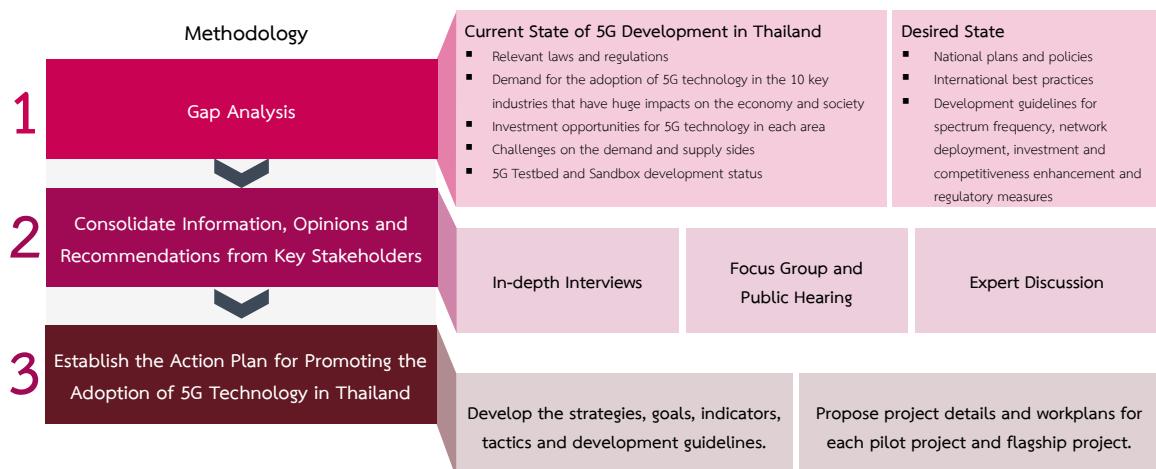


Figure 1-1: Methodology for the Action Plan for Promoting the Adoption of 5G Technology in Thailand

1.2 Overview of 5G Technology

1.2.1 Development of 5G Technology

The development of 5G technology has been discussed since B.E. 2555, and subsequently in B.E. 2558, the International Telecommunication Union (ITU) established the roadmap on the development of International Mobile Telecommunications-2020 (IMT-2020), which refers to the standards of 5G technology. The roadmap for IMT-2020 includes the timeline and work plans for the development of technical performance requirements and specifications for the standards of 5G technology¹. Also, IMT-2020 has defined the potential uses of 5G technology into three key capabilities, as shown in Figure 1-2, namely,

- 1) Enhanced Mobile Broadband (eMBB) which is suitable for handling services that require ultra-high wireless bandwidth, such as downloading high definition videos.
- 2) Massive Machine Type Communications (mMTC) supports services that require robust connection of devices such as Smart City applications.
- 3) Ultra-Reliable and Low Latency Communications (URLLC) which is suitable for handling critical applications requiring high reliability, such as autonomous driving.

Nonetheless, several use cases still require several capabilities of 5G, such as the Virtual Reality services that require both eMBB and URLLC.

¹ Source: Office of The National Broadcasting and Telecommunications Commission (NBTC)

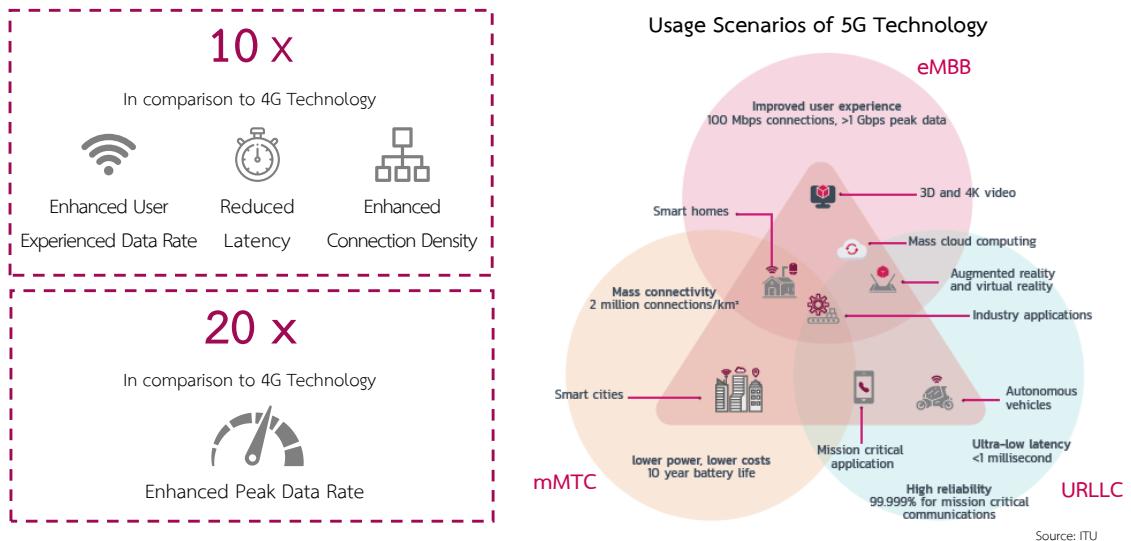


Figure 1-2: Capabilities of 5G Technology

Under the IMT-2020 roadmap, the 3rd Generation Partnership Project (3GPP), the key Standards Development Organizations (SDOs) established by international cooperation, is responsible for developing technical specifications for cellular telecommunications technologies, including the technical specifications for 5G technology as well. The organization has started the 5G standard development since B.E. 2560 in Release 14².

Release 14 reveals the initial study on 5G technology, and subsequently in B.E. 2561, 3GPP published Release 15 which includes both the standards for 5G non-standalone (NSA) network and 5G standalone (SA) network. The key difference between 5G NSA network and 5G SA network is that the 5G NSA network still relies on the Long-Term Evolution (LTE) core network in providing 5G services while the 5G SA network relies solely on the New Radio (NR) core network in providing 5G services³. While the main focus of Release 15 is the standards for Enhanced Mobile Broadband services but it did mention about the development of standards for Ultra-Reliable and Low Latency Communications services and Massive Machine Type Communications services, especially the standards for Internet of Things (IoT) applications. For Release 16 and Release 17, which are expected to be completed by B.E. 2563 and B.E. 2564 respectively, both will emphasize on establishing standards for adopting 5G technology in the vertical industries or all businesses across value chain. Release 16 will set standards for 5G services such as Vehicle-to-everything (V2X) and Industrial IoT, and Release

² Source: Qualcomm

³ Source: Institute of Electrical and Electronics Engineers (IEEE)

17 will set standards for 5G services such as Extended Reality (XR), Multicast Broadcast, NR Positioning and Unmanned Aerial Systems.

Presently, the telecommunication service providers in various countries are still in the initial stage of deploying 5G technology for providing mobile services to the consumers. Nevertheless, the mobile wireless technology evolves on average every ten years before moving to the next generation⁴, as illustrated in Figure 1-3. Therefore, apart from the purpose of utilizing the full capacity of 5G, the promotion of the adoption of 5G technology to be ready in the initial stage will enable Thailand to utilize full benefits of digital technologies and innovations, and finally step into the group of developed countries.

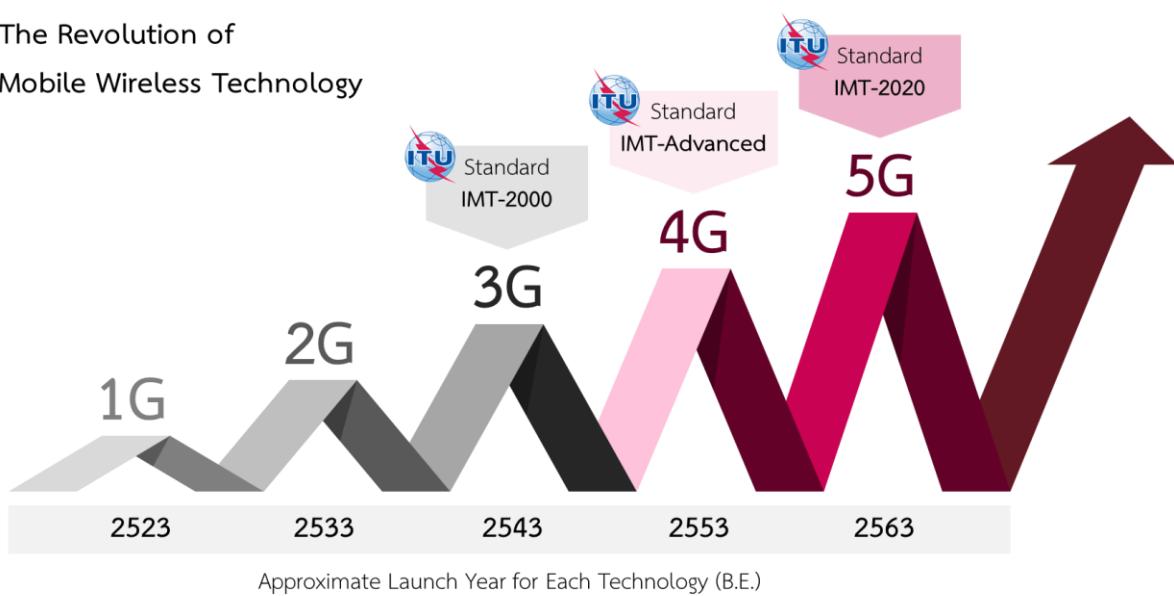


Figure 1-3: The Revolution of Mobile Wireless Technology

1.2.2 Benefits of 5G Technology

5G technology could play a crucial role in transforming the country into Digital Thailand. Nonetheless, 5G technology is not meant to replace the previous technologies, but instead helps to fill in the gaps where the capabilities of 4G technology could not cater to those needs.

Enhanced Mobile Broadband (eMBB) has a distinctive feature in terms of speed, allowing 5G technology to offer peak data rate of 20 Gbps while 4G technology can only offer peak data rate of 1 Gbps, which is 20 times difference. Also, the 5G technology comes with

⁴ Source: International Telecommunication Union (ITU)

enhanced user experienced data rate (100 Mbps) and enhanced area traffic capacity (10 Mbps/m²). Thus, 5G technology can offer wider area coverage, support connections from a large number of devices and support applications that require high data transmission, making it more suitable than the previous technologies in providing services outside the city areas and in crowded areas. Also, as compared to the previous technologies, 5G technology comes with enhanced network energy efficiency, which is considered as an important factor in developing the digital society as it encourages the use of applications over 5G network. Therefore, eMBB focuses on providing a more efficient data transmission over the mobile broadband network and enhancing the user experiences, as well as supports the applications with other technologies such as Augmented Reality (AR), Virtual Reality (VR), 360-degree video streaming and Mobile Cloud Computing.

Ultra-Reliable and low latency Communications (URLLC) for 5G technology could offer network latency for data transmission of as low as 1 millisecond (1 millisecond: 1000 seconds) while 4G technology could offer network latency for data transmission of only 10 milliseconds. This will support the use cases that require high precision, high data rate and high data security and reliability such as telesurgery, remote-controlled machinery and remote-controlled car.

Massive Machine Type Communication (mMTC) has a distinctive feature in terms of enabling connections for a large number of devices, in which 5G technology can support up to 1 million devices per square kilometer, unlike 4G that allows only 100,000 devices to be connected per 1 square kilometer. This will be an essential factor in the development of IoT technology. Also, the IoT devices that are connected over the 5G network will consume less power in transmitting the data and the battery life would last more than 10 years. Thus, 5G technology is essential for supporting the use cases that require high density of IoT devices in the specific areas, such as installing a huge number of IoT sensors for Smart City applications.

Moreover, the total amount of spectrum that the previous technologies can utilize is only 3 GHz, which is insufficient to support the massive amount of data transfer, whereas 5G technology can utilizes up to 30 GHz of spectrum. With the three key capabilities of 5G technology, namely eMBB, URLLC and mMTC, the applications of 5G technology could expand to cover the vertical industries as well as the new industries that may emerge from the applications of 5G technology, while the previous technologies can only cater to the

consumer needs. In addition, regarding the fixed broadband services, there is an ongoing issue on the cost and difficulty of connecting fiber-optic cable to the premises (Last Mile Access) in certain areas, resulting in some groups of people not able to access the fast and reliable internet broadband services despite the demands. In this case, the applications of 5G technology can lower the needs of directly connecting the fiber-optic to each premise and thus, allow a wider group of people to gain access to the fixed broadband services.

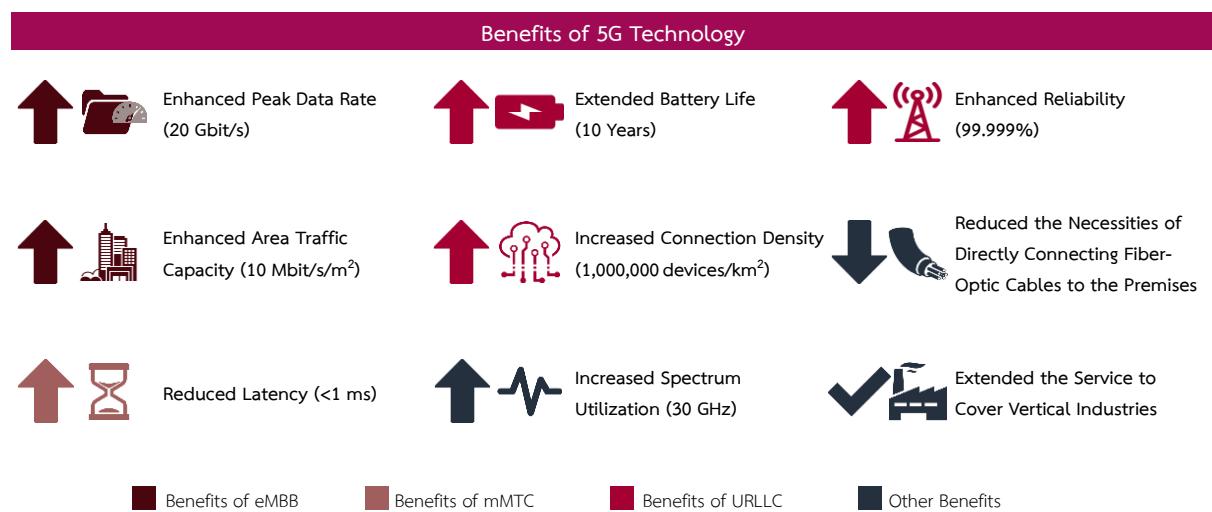


Figure 1-4: Benefits of 5G Technology

1.2.3 Impacts of 5G Technology on the Thai Economy

The adoption of 5G technology in various sectors, especially the vertical industries, is expected to generate great benefits for the Thai economy. Thus, in B.E. 2578, the incremental value that Thailand will gain from the adoption of 5G technology in various sectors would reach up to approximately 2,319,454 - 5,059,798 million Baht or equivalent to 10.12% of Thailand's Gross Domestic Product (GDP)⁵. As a result, the Thai economy is expected to expand significantly, higher than the current average growth, in which the manufacturing businesses will receive the most benefits.

Moreover, the 5G technology can create opportunities for the manufacturing and industrial sectors by at least 700,000 – 1,600,000 million Baht in B.E. 2578, especially in the following sectors: (1 Manufacturing sector : 5G technology can increase efficiency and reduce operating costs from the application of various automation sensors and machines on the 5G network; (2 Agricultural sector: 5G technology can increase the efficiency of Smart Farming applications, such as using the IoT sensors to collect and analyse data on the factors

⁵ Source: Office of The National Broadcasting and Telecommunications Commission (NBTC)

that affect the cultivation of crops (e.g., soil and water); (3) Transportation and Logistics sector: 5G technology can enhance the capability and competitiveness of the transportation and logistics activities, be it the land transportation, water transportation or air transportation; (4) Tourism sector: 5G technology can enhance and offer new travel experiences through AR/ VR technology and 5) Public Health sector: 5G technology can enhance the efficiency and reliability of telehealth system and remote medical treatment services. The enhancement in the accessibility to medical care will benefit the vulnerable groups, such as the elderly and people with physical disabilities, as this will help reduce the burden of travelling to hospitals. Apart from the mentioned use cases, 5G technology can enhance the effectiveness in providing other forms of medical care that could improve the people's quality of life as well. As a result, the medical expenses on the national level could be lowered by 38,000 million Baht each year⁶. The overall economic benefits of 5G technology on the Thai economy are summarized in Figure 1-5.

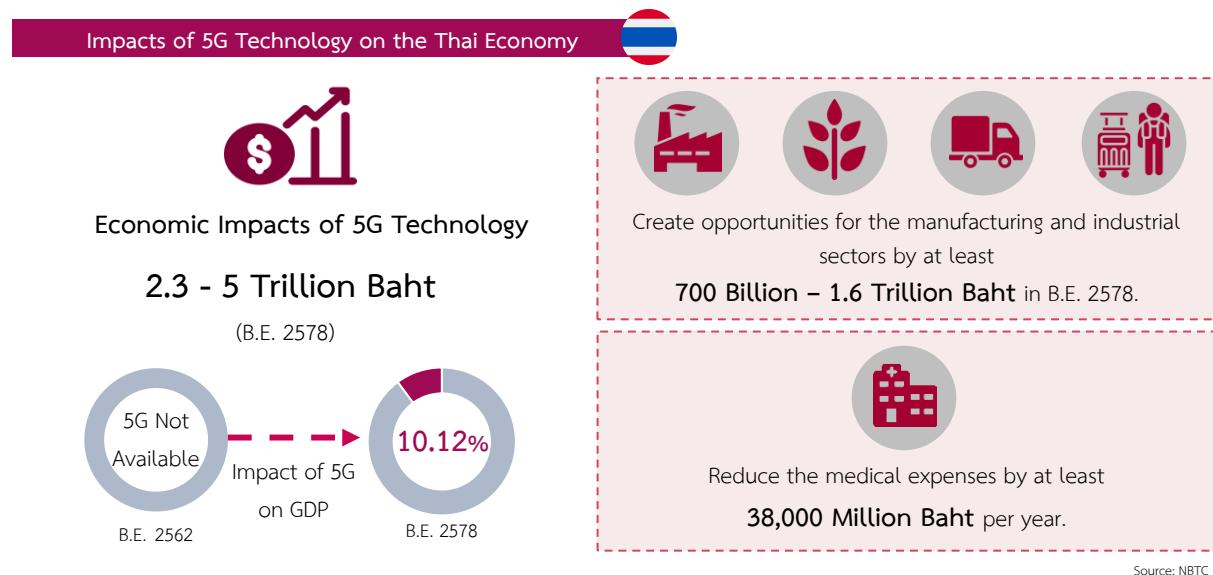


Figure 1-5: Impacts of 5G Technology on the Thai Economy

⁶ Source: Office of The National Broadcasting and Telecommunications Commission (NBTC)

1.3 Thailand's Readiness for the Adoption of 5G Technology compared to the Global context

5G technology is one of the technologies expected to unlock the potential across various sectors. Subsequently, Countries around the world have started to promote and adopt 5G technology in their vertical industries. While Thailand's level of readiness in adopting 5G technology can be analyzed in 6 dimensions as follows.

1.3.1 National Plan

Thailand has national policies and plans that promote the use of digital technology and innovation for the national development, which includes the following policies and plans.

Level-1 plan includes the 20-Year National Strategy which emphasizes on utilizing digital technology for enhancing the country's competitiveness, promoting social cohesion and equity and elevating the national security.

Level-2 plan includes 1) the 12th National Economic and Social Development Plan which comprises of Strategy 2: Creating a just society and reducing inequality, Strategy 3: Strengthening the economy, and underpinning sustainable competitiveness, Strategy 7: Advancing infrastructure and logistics, Strategy 8: Development of science, technology, research, and innovation and Strategy 9: Regional, urban, and economic zone development, 2) National Reform Plans on the aspects of economy, society and legislation and 3) National Security Plan and Policy (B.E. 2562-2565).

Level-3 plan includes 1) Thailand Digital Economy and Society Development Plan (B.E. 2561-2580), in which all the six strategies promote the use of digital technology for enhancing the economic and social development, 2) 5-Year Action Plan for Digital Economy and Society (B.E. 2561 - 2565), which is the first phase action plan under the Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580), 3) Telecommunications Master Plan No. 2 (B.E. 2562-2566), in which all the six strategies promote the utilization of digital technology, and 4) Spectrum Management Master Plan (B.E. 2562) which ensure that the spectrums are managed and allocated efficiently.

All of the aforementioned national policies and plans support the use of digital technology, which indirectly supporting the adoption of 5G technology. Whereas, the leading countries in the telecommunications industry which already deployed 5G technology for

commercial purposes all have plans or policies that directly support the development of 5G technology. For instance, South Korea has the 5G+ Strategy⁷ covering various areas to utilize 5G technology for economic and social development with goals of increasing the production value by 150,000 million US dollars and the export volume by 73,000 million US dollars, and also creating new jobs of 600,000 positions within B.E. 2569. Meanwhile, the United States of America has the 5G Fast Plan⁸ that emphasizes on the utilization of 5G technology in the short run. The plan covers issues such as spectrum allocations, amendments to telecommunications infrastructure policies and the modernization of regulations. At the same time, the United Kingdom has the 5G Strategy for the UK⁹ that emphasizes on promoting trial areas for the application of 5G technology with the aim of extension covering all regions in order to commercially implement the 5G technology nationwide. While Japan has developed the 5G Roadmap Toward 2020¹⁰ policy to help support 5G-related activities, especially 5G Implementation trials. Similarly, China has also set targets for the support on 5G technology in 13th Five-Year Plan¹¹ which focuses on conducting research and development on 5G infrastructure and other relevant technologies. All the above-mentioned plans are illustrated in Figure 1-6.

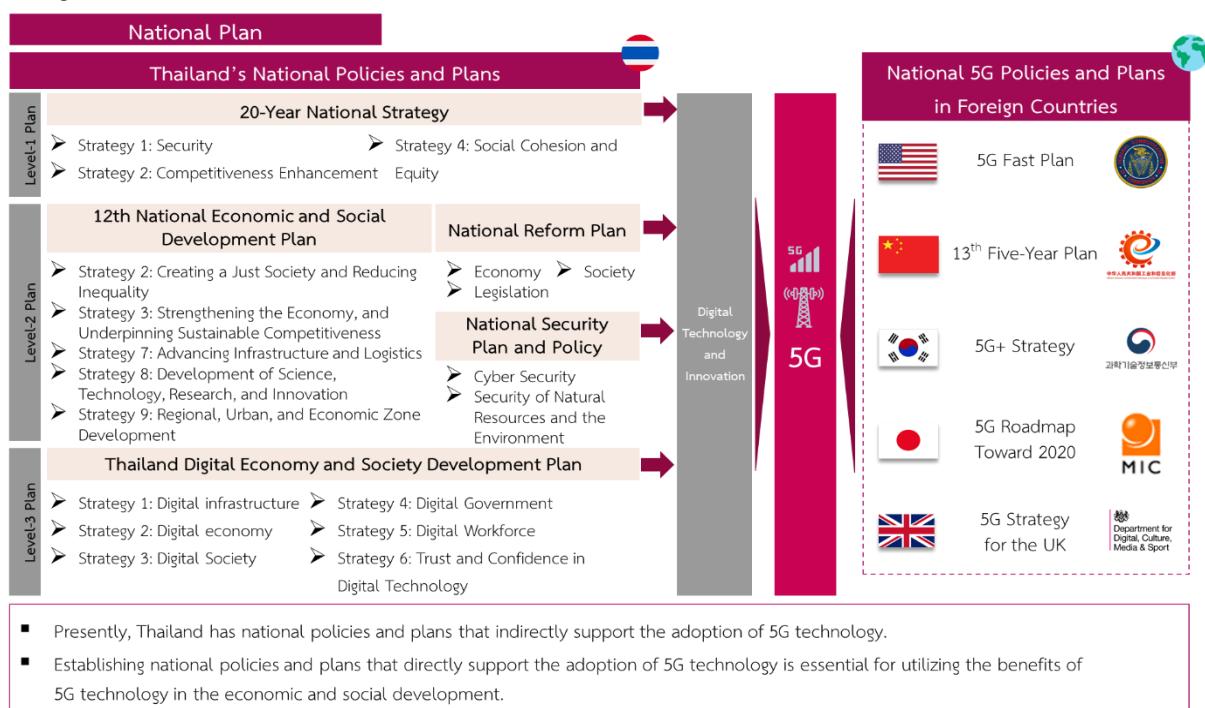


Figure 1-6: Relevant National Policies and Plans for Promoting the Adoption of 5G Technology

⁷ Source: Ministry of Science and ICT (The Republic of Korea)

⁸ Source: Federal Communications Commission (United States)

⁹ Source: Department for Digital, Culture, Media and Sport (United Kingdom)

¹⁰ Source: Ministry of Internal Affairs and Communications (Japan)

¹¹ Source: Central Committee of the Communist Party of China (China)

Therefore, the establishment of national policies and plans that directly support the adoption of 5G technology is essential in order to implement 5G in Thailand.

1.3.2 Laws and Regulations

The advent of 5G technology enables a new service paradigm in several industries. Therefore, laws and regulations need to be amended in accordance with the development of 5G technology and new services that apply 5G Technology, both in the telecommunications sector and other industrial sectors. Currently, Thailand is well-equipped with laws and regulations that allow various sectors to utilize 5G technology to a certain level. However, laws and regulations should be updated in order to facilitate the utilization of 5G technology at a higher level of efficiency and prevalence. Here are the examples of relevant laws and regulations.

Infrastructure Sharing Regulation: Currently, the National Broadcasting and Telecommunications Commission (NBTC) has enacted regulations regarding telecommunications infrastructure sharing for wireless telecommunications networks, announced in the Government Gazette on 29 December B.E. 2562. This regulation emphasizes on sharing telecommunication towers only at the Macro Site level, but not yet covering the Micro / Pole Site level, which is important to the coverage expansion of 5G network. Meanwhile, foreign countries have already revised the regulations related to the extension of telecommunication networks, e.g. the regulations for promoting the infrastructure and telecommuting tower sharing in the United Kingdom which emphasizes on the network coverage in rural areas, the regulations on the use of facilities of public service providers in China that allow telecommunication service providers to install telecommunication equipment in designated public areas, etc.

Hence, Thailand should enact regulations or measures to promote the sharing of telecommunications infrastructure for wireless telecommunications networks covering the Micro / Pole Site in order to expand the good quality of 5G network to all areas nationwide.

The Laws Supporting the Adoption of 5G Technology (5G Use Cases): The change in digital technologies impact on the emerge of several new services. This also applies to 5G technology which is not only used to enhance the efficiency of mobile communication, but will also support a new range of services with a higher level of efficiency such as Autonomous Car, Telehealth, Drone, etc. However, the current laws and regulations in

Thailand do not support some applications of technology. In contrast, many countries with 5G technology deployed have revised laws that hinder the use of 5G technology, for example, the United Kingdom has studied and amended the law in parallel with testing the application of 5G technology on the trial areas. In the EU, there are plans to set technical standards for the utilization of 5G technology for Unmanned Aerial Systems which will be introduced in B.E. 2564¹², while the United States has defined the definition for telehealth and the duty of the underlying doctor, also stated that telehealth service shall be under the same law, prudence or standard of treatment as the face-to-face treatment. Regarding informed consent, a consent must be given by the patient before the doctor can conduct any telehealth service.



Figure 1-7: Example of 5G Use Cases that require the support from law and regulation

The laws and regulations should be revised to facilitate the application of 5G services for Thailand context in order to promote the effective and wide-scale utilization of 5G technology in various industrial sectors. For instance, even though Thailand already has laws regulating Unmanned Aerial Systems regarding the licensing criteria and conditions for control and operation of Unmanned Aerial Vehicle B.E. 2558, it is still unclear and does not fully accommodate the Transportation and Logistics sector. If unmanned aerial vehicles can be applied in this sector, it will unlock the potential and enhance the efficiency of the transportation, especially in remote areas and in urgent situations. In addition, the technical standards of 5G services or Quality of Service should be set in compliance with the international standards to promote good quality of 5G services and build trust in applying 5G technology among 5G technology users.

Cyber Security and Privacy Measure: The application of 5G technology in the form of machine-to-machine communication (M2M) is likely to become more popular. It is direct communication between devices or machines, resulting in automated data creation;

¹² Source: The 3rd Generation Partnership Project (3GPP)

therefore, it is important to improve the rules of cyber security and privacy such as the scope of the use of third-party data to be more updated. Since M2M service providers can usually access to stored personal information, user locations and personally identifiable information. In the United Kingdom, regulations have been amended to cover the protection of personal information towards the data generated by the IoT system¹³ and to create guidelines for storing sensitive information in a unique encryption format in order to build cyber security and trust for users. Hence, Thailand should also improve restrictions on the use of third-party data in the same manner.

Laws and Regulations	
	Current Situation in Thailand
	<ul style="list-style-type: none"> ■ Infrastructure Sharing The current infrastructure sharing regulation only focuses on the sharing of macro sites and towers for wireless telecommunication network. However, the regulation does not cover the micro/pole site level, which are the main elements for 5G network expansion.
	<ul style="list-style-type: none"> ■ Adoption of 5G Use Cases The current laws and regulations in Thailand does not support 5G use cases, e.g. drone and telehealth. Therefore, these laws and regulations should be revised and the relevant fundamental technical standards of 5G use cases shall be defined.
	<ul style="list-style-type: none"> ■ Cyber Security and Privacy Protection Cyber Security and Privacy measures does not support the use of new services that arises from 5G network, e.g. regulations on IoT security control.
Source: Ofcom Policy Document (2018), 3GPP, MIIT Guideline(2019)	
	Published policy on infrastructure and tower sharing to support the rural network expansion.
	The MIIT* encourages the local authorities to support the access to public facilities.
	3GPP has plans to define the technical specifications for the use of drone over 5G network in Release 17 by B.E. 2564.
	The laws and standards for face-to-face medical treatments are applied to Telehealth as well.
	UK's New Data Protection Act 2018 ("DPA 2018") covers the issue on the data transmission between IoT devices.

*MIIT: Ministry of Industry and Information Technology of the Chinese government

Figure 1-8: Relevant Laws and Regulations for 5G Technology

1.3.3 Demand

The demand for 5G technology exists for both the consumer and business sectors, and can be further described as follows:

- Consumer demand for 5G services
 - Mobile Broadband
 - Fixed Internet Broadband
 - Amount of Data Usage on Mobile Broadband
- Business demand for 5G services
 - Internet of Things (IoT)
 - Private/Local Network

¹³ Source: The Office of Communications (United Kingdom)

- 5G Technology Implementation Trend
- 5G Testbed in Thailand

1) Consumer Demand For 5G Services

Currently, it is found that there is an existing demand from the consumer sector due to the fact that the 4G penetration rate and the amount of data usage in Thailand is at the intermediate level, as well as the fixed broadband penetration rate is also at a moderate level. Thus, these factors will positively affect the adoption of 5G technology in the consumer sector.

Mobile Broadband Network: In B.E. 2562, the total number of mobile broadband subscribers in Thailand is 92.5 million in which the mobile broadband penetration rate is around 139% of the total population. In the Base Scenario, it is projected that by B.E. 2570, the number of mobile broadband subscribers using 5G technology will be around 70 million or equivalent to the penetration rate of 73%, as shown in Figure 1-9. However, in the Best Scenario, it is projected that by B.E. 2570, the number of mobile broadband subscribers using 5G technology will be around 77 million or equivalent to the penetration rate of 80%¹⁴, as shown in Figure 1-10.

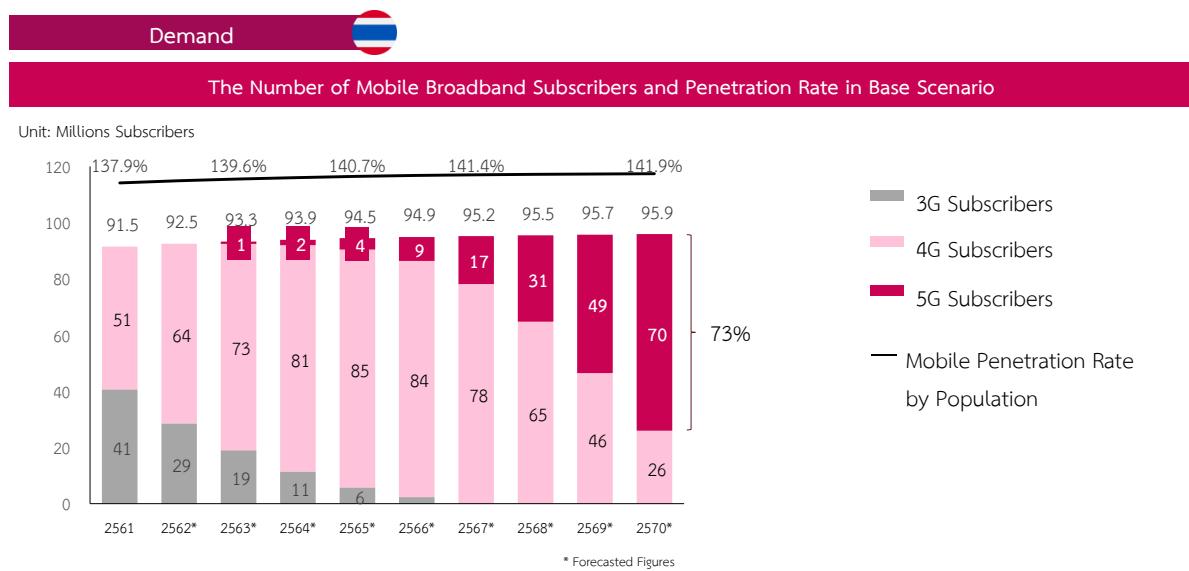


Figure 1-9: The Number of Mobile Broadband Subscribers and Penetration Rate in Base Scenario

¹⁴ Source: TIME Research

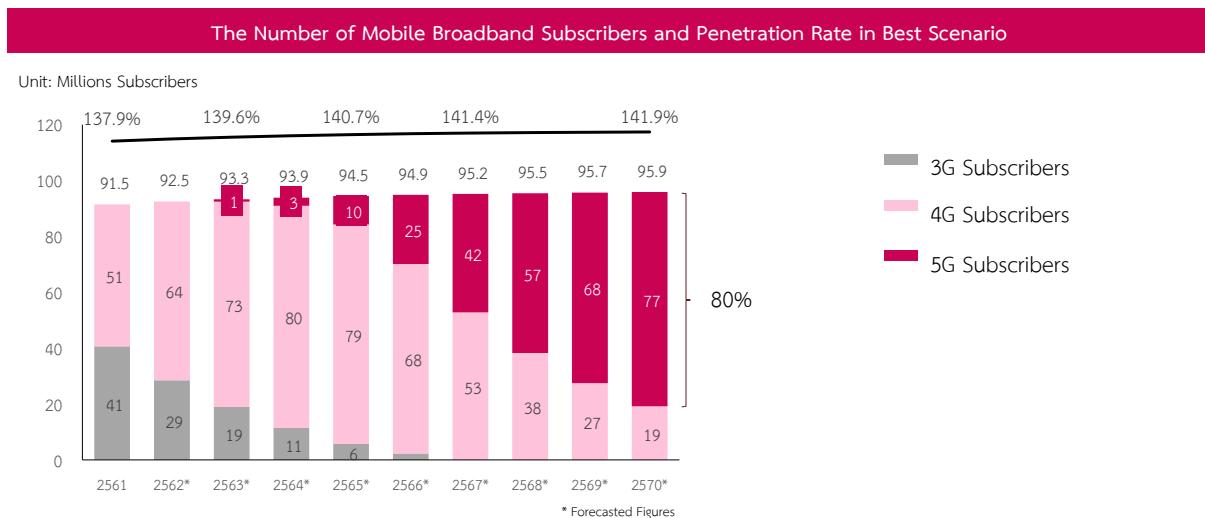


Figure 1-10: The Number of Mobile Broadband Subscribers and Penetration Rate in Best Scenario

At present, users are mainly connected to the mobile broadband network via 4G technology. It is partly due to the 3 major service providers (AIS, TRUE, and DTAC) having expanded their mobile broadband internet network to cover more than 94% of the population. Both the AIS Group and the TRUE Group provide 4G networks that cover 98% of the population. In B.E. 2562, up to 96.9% of Thai population can access mobile broadband with 4G technology, which is close to foreign countries such as South Korea, Japan, Australia, the United States of America and the United Kingdom, with 4G technology penetration rate at 105.2%, 104.4%, 103.8%, 102.9% and 97.9% of total population, respectively. In conclusion, 5G technology will surely enhance the use of mobile broadband network.

Fixed Broadband Internet: In B.E. 2562, the total number of households using fixed broadband services in Thailand is approximately 10.1 million households, representing a medium level of fixed broadband household penetration rate of 47%, as shown in Figure 1-11. The fixed broadband penetration rate tends to increase gradually but slowly. One of the causes is due to the difficulty and high cost of investment on connecting the fiber optic cables to the users' premises (Last Mile Access), resulting in the inaccessibility of fixed broadband services for some group of population. This reflects the demand for the application of 5G technology in the development of fixed broadband services to expand the network coverage and stimulate the penetration rate. It is projected that if there is a policy that promotes the use of 5G technology by B.E. 2570, the number of fixed broadband subscribers will increase to 15 million households, or equivalent to the penetration rate of 70%, as shown in Figure 1-12.

The Global Fixed Broadband Penetration Rate by Households (B.E. 2562)

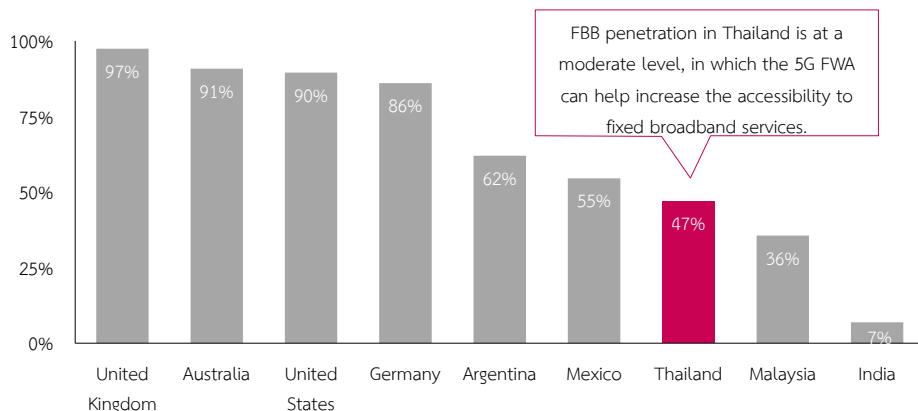


Figure 1-11: The Global Fixed Broadband Penetration Rate by Households (B.E. 2562)

The Number of Fixed Broadband Subscribers and Penetration Rate by Households in Thailand

Unit: Million Households

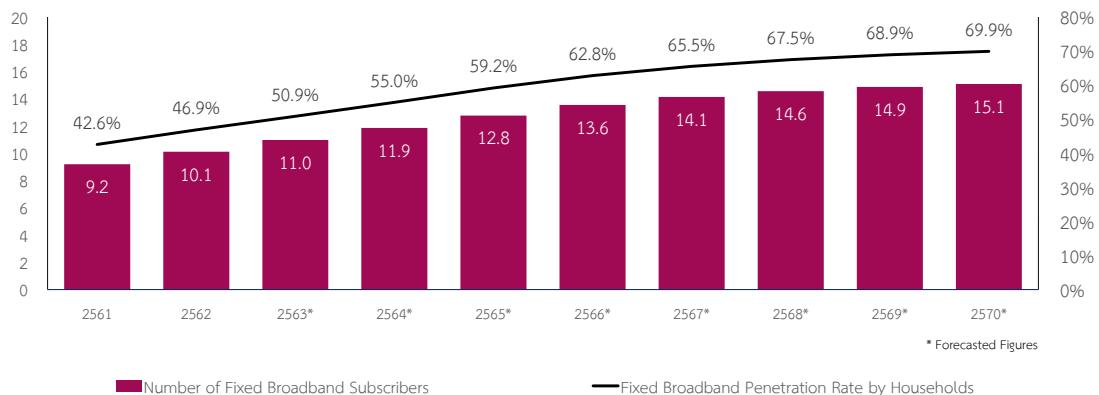


Figure 1-12: The Number of Fixed Broadband Subscribers and Penetration Rate by Households in Thailand

The advent of 5G technology will enhance the Fixed Wireless Access service and will result in the increasing rate of fixed broadband internet access in Thailand. At present, 12 countries around the world¹⁵, namely the United States of America, United Kingdom, Switzerland, Finland, Czech Republic, Romania, Saudi Arabia, South Africa, Qatar, Philippines, Australia and New Zealand as shown in Figure 1-13, have started providing such services to their citizen to expand the coverage for fixed broadband internet and to providing services with higher speed especially in areas that used to have restrictions. So, this issue is one of the factors contributing to the demand for 5G technology.

¹⁵ Source: Ovum

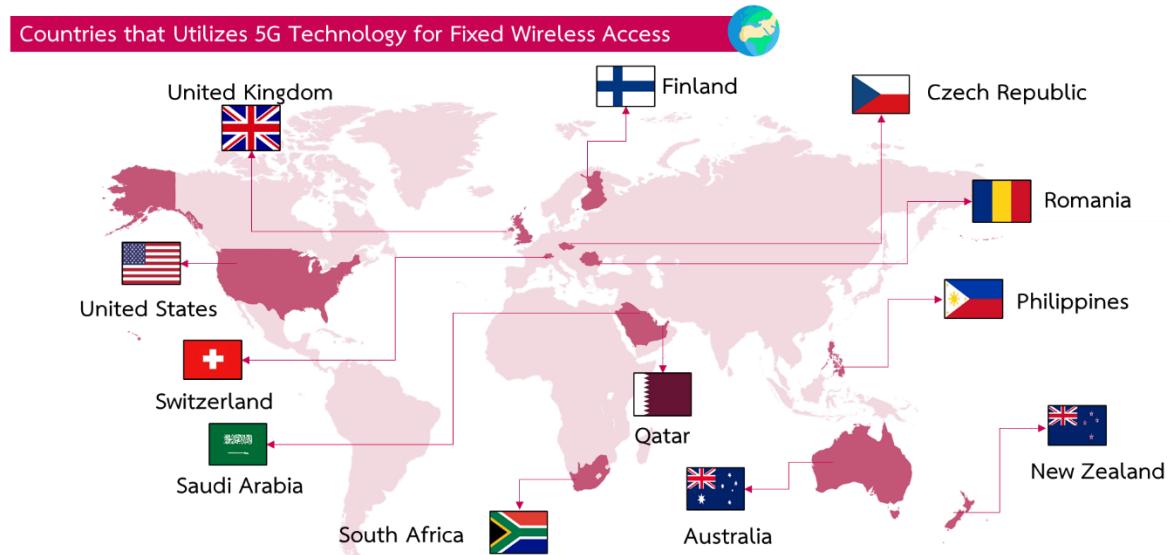


Figure 1-13: Countries that Utilizes 5G Technology for Fixed Wireless Access

Amount of Data Usage on Mobile Broadband: The volume of data usage on the mobile broadband internet network in Thailand is likely to continuously grow due to the change in the behavior of mobile broadband network users around the world. The number of users watching videos via the mobile broadband network has significantly increased. Based on the total data usage on the mobile broadband network, Ericsson estimates that the proportion of video viewing will increase from 59% in B.E. 2561 to 74% in B.E. 2567 as shown in Figure 1-14, resulting in data usage on the mobile broadband network of the world growing at an average compound annual growth rate of 34%¹⁶, as shown in Figure 1-15. One of the reasons is that video contents are becoming more interesting and are being delivered in a higher quality such that watching the videos requires a high volume of data. Therefore, 5G network is necessary for users to be able to view various contents and services that require a lot of data transmission, resulting in gaining better experience from using the services.

¹⁶ Source: Ericsson

The Category of Global Data Usage Through Mobile Broadband

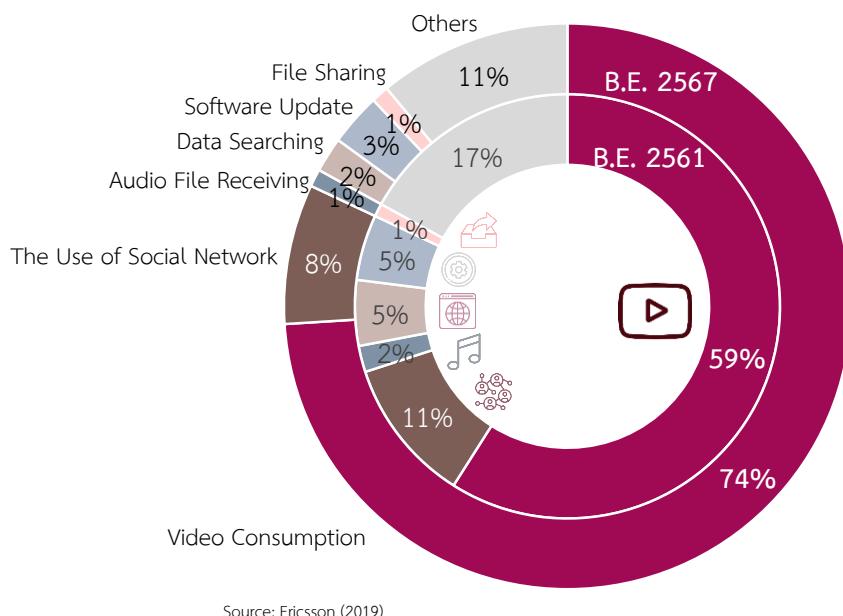


Figure 1-14: The Category of Global Data Usage Through Mobile Broadband

Global Data Usage Through Mobile Broadband

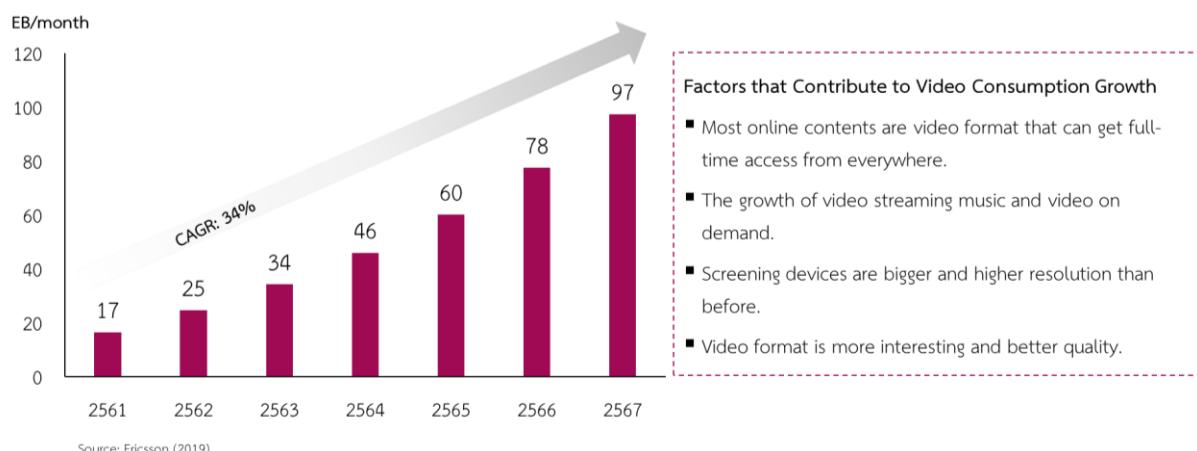


Figure 1-15: Global Data Usage Through Mobile Broadband

In the first quarter of B.E. 2562, Thailand has the data usage on the mobile broadband internet network at approximately 6.7 GB/month/user¹⁷ as shown in Figure 1-16, which is considered moderate when compared to other countries; however, users are expected to have behavioral changes in the future. Referring to Figure 1-17, data usage on the mobile broadband internet in Thailand is likely to considerably grow and in the Base Scenario, data usage on all mobile broadband networks in Thailand will grow up to 35,880 PB/year by

¹⁷ Source: Tefficient

B.E. 2570, in which the data usage through 5G technology will be at 78%. While the data usage on mobile broadband network in the Best Scenario will grow up to 39,184 PB/year, in which the data usage through 5G technology will be 9% higher than the Base Scenario¹⁸.

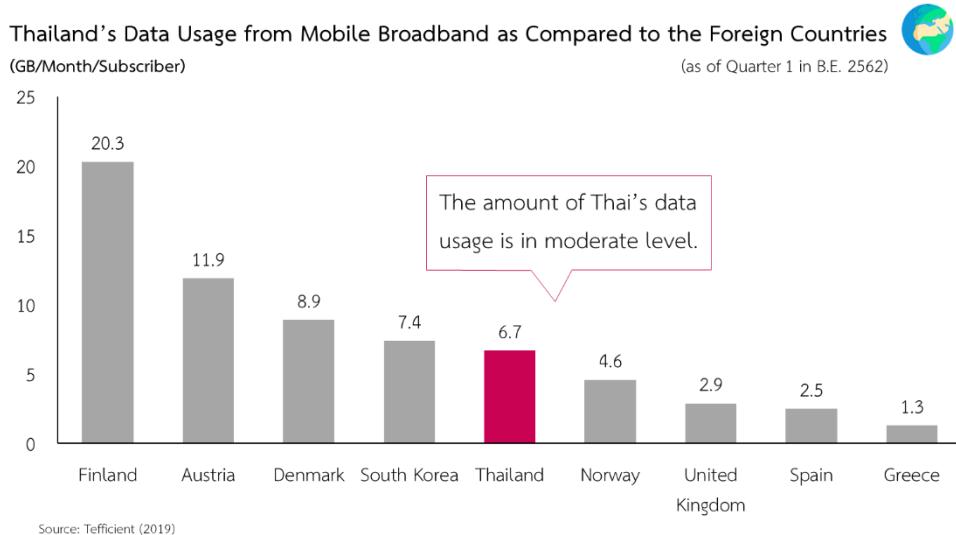


Figure 1-16: Thailand's Data Usage from Mobile Broadband as Compared to the Foreign Countries

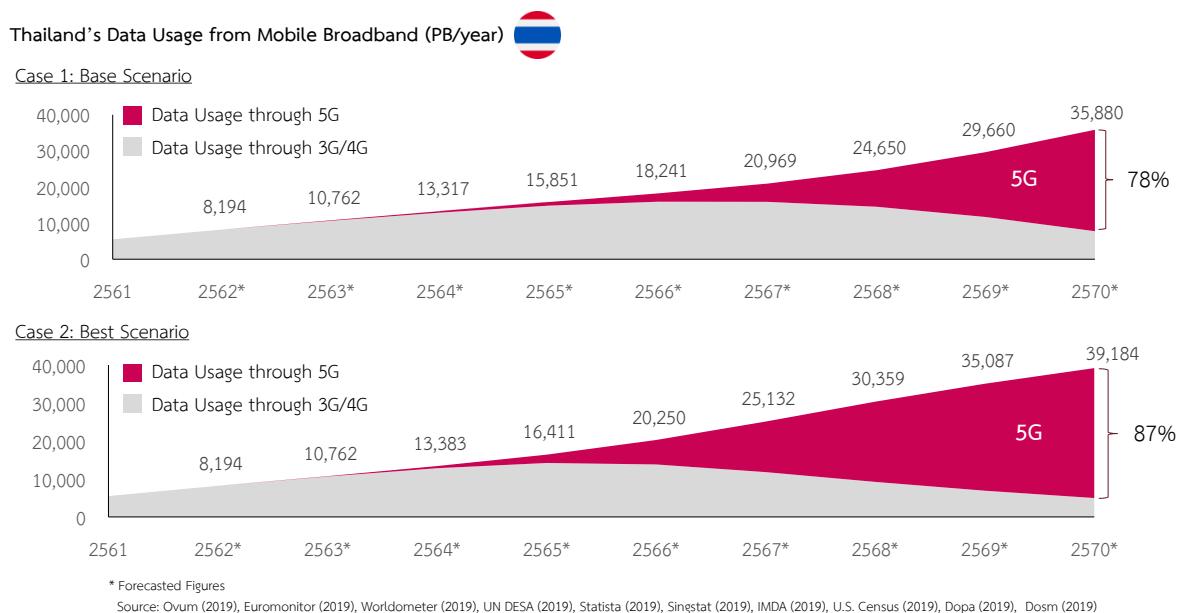


Figure 1-17: Thailand's Data Usage from Mobile Broadband

2) Business Demand for 5G Services

5G technology will play a significant role within the business sector since it can elevate the connection efficiency between devices resulting in the increased capability of data transmissions and lowered latency. This will potentially create huge impacts on the

¹⁸ Source: TIME Research

business/industrial sectors as well as create changes in various business operations. Other than that, 5G technology can support the usage of other relevant technologies as well.

Internet of Things (IoT): One of the technologies that will have an upward usage trend due to the changes in business operations and consumers' behavior, the value of the IoT market in Thailand is projected to increase from 3,709 million Baht in B.E. 2561 to 7,691 million Baht, or equivalent to 2.1 times growth, in B.E. 2565¹⁹ as shown in Figure 1-18. This growth is in line with the global connected devices' growth as most of the growth is primarily driven by the usage of IoT devices both in the consumer sectors (e.g. Smart Home) and organizational sectors (e.g. Connected Machines). For the global market, it is projected that the value of the global IoT market will grow 3.5 times from 151,000 million US dollars in B.E. 2561 to 531,000 million US dollars in B.E. 2565²⁰. It is also expected that the user base of the Low Power Wide Area (LPWA) technology will exponentially grow 7.7 times from a total of 145 million users in B.E. 2561 to 1,111 million users in B.E. 2565²¹, as shown in Figure 1-19.

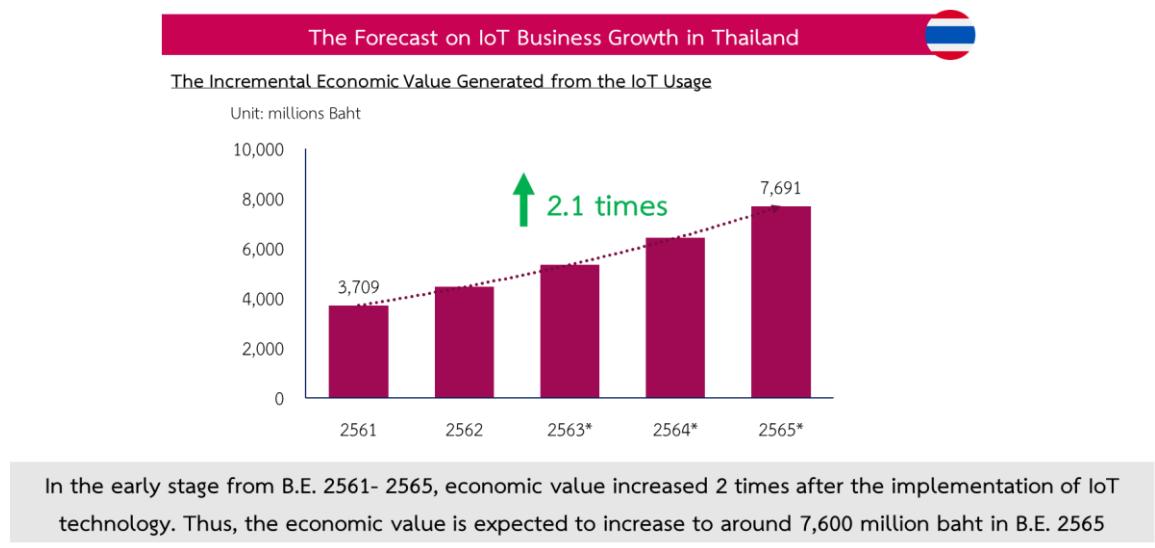


Figure 1-18: Forecast on IoT Business Growth in Thailand

¹⁹ Source: Office of The National Broadcasting and Telecommunications Commission (NBTC)

²⁰ Source: IoT Analytics

²¹ Source: Ovum

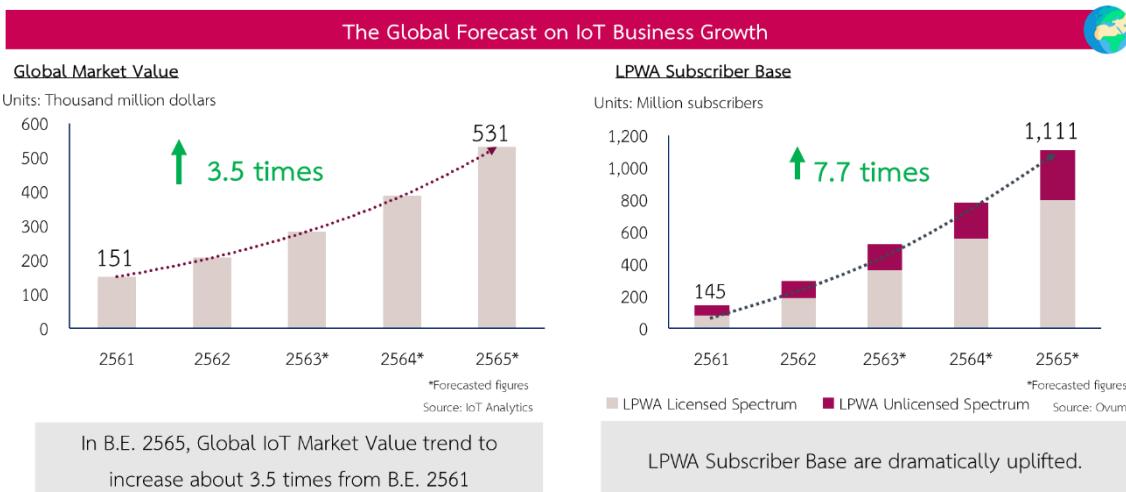


Figure 1-19: The Global Forecast on IoT Business Growth

Private/Local Network: Various vertical industries have shown strong interests in acquiring spectrum for their own business uses. For example, the use of Private/Local Network to provide services in airports, mining activities and at manufacturing plants. There are two approach in industry, the mainstream approach is logical private network based on 5G public network by 5G LAN technology etc. Another approach is dedicated spectrum and licenses for private local networks. Thus, several countries have already allocated a certain amount of spectrum specially for Private/Local Network in the form of spectrum licenses for specific areas or zones as shown in Figure 1-20. For example, in Germany, aside from allocating the 5G spectrum in the 3400 - 3700 MHz band for nationwide deployment, the 3700 - 3800 MHz band has been specifically allocated for Private/Local Network, in which 33 companies in the vertical industries participated in the auction. Similarly, Japan has allocated the 5G spectrum in the 28.2-28.3 GHz band for Private/Local Network and the United Kingdom has allocated the 3800 - 4200 MHz and 24.25-26.5 GHz spectrum bands for Private/Local Network²².

²² Source: Qualcomm and 5G Observatory

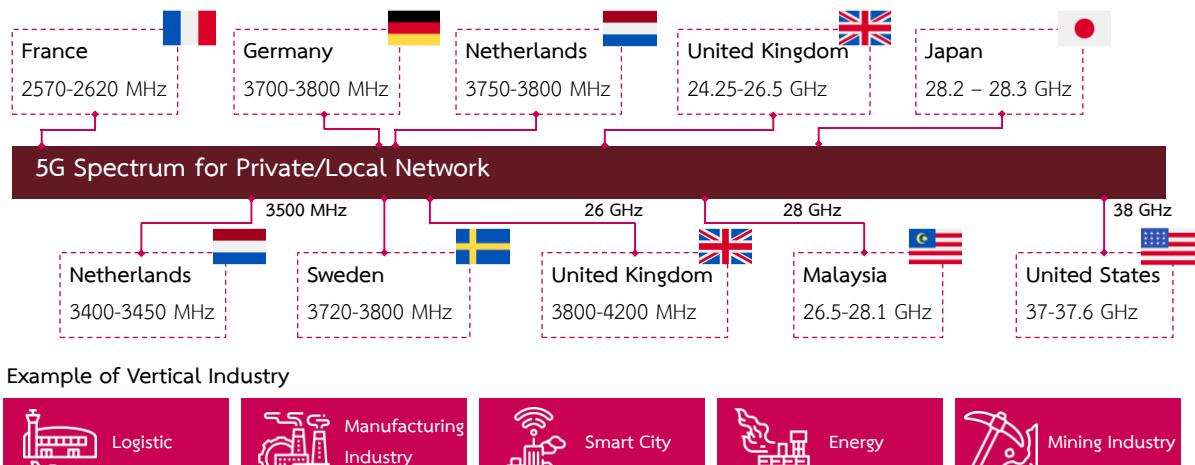


Figure 1-20: 5G Spectrum for Private/Local Network

5G Technology Implementation Trend: 5G technology is not limited only to the consumer sector, but its implementations will cover the business sector far wider than the current 4G technology. Currently, the business sector in Thailand is aware of the application of digital technology. However, the demand for the utilization of 5G technology is unclear since Thailand is still in the initial stage of 5G ecosystem preparation. The major factors affecting the demand for the utilization of 5G technology in the business sector are as follows.

- **5G National Supporting Policies and Strategies:** At present, the government promotes the trial and testing of the utilization of 5G technology in the 5G Testbed area. However, there are still unclear policies and guidelines to support the use of 5G technology in the business sectors, especially small and medium-sized businesses, resulting in them being unprepared for investment. Therefore, plans and policies that directly promote the use of 5G technology are required to be formulated in Thailand in order to provide concrete result from the utilization of 5G technology in economic and social development.
- **5G Technology Literacy:** At the present, most businesses have applied digital technology to their business operation through 3G / 4G network. The business sector is of the opinion that, currently, the 3G / 4G technology is not utilized in full efficiency. The business sector is not yet aware of the importance and potential of the 5G technology. There is also a lack of knowledge and understanding about the differences between 4G and 5G technology. As a result, the business sector is unable

to assess the worth of investment and benefits they will receive from the switch to 5G technology in both the short and long term.

- **Finance:** Applications of 5G technology require businesses to invest in devices that can support 5G networks, most of which must be imported from abroad. As Thailand imports technology from foreign countries rather than investing for research and development of the technology; thus, business operators have to bear the high cost in the short term. Investment in the application of 5G technology is therefore not worthwhile for business operators that have limitations on business scale and capital.

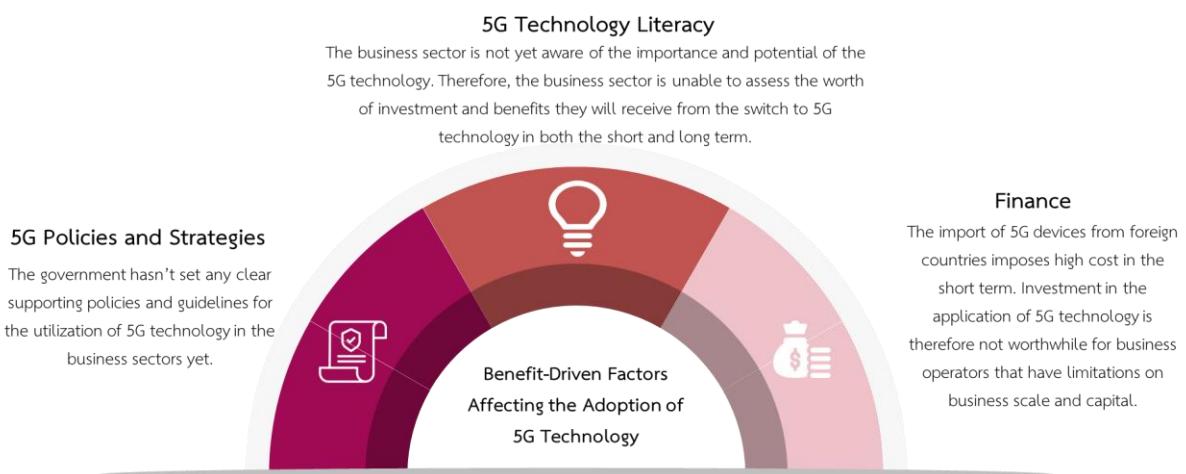


Figure 1-21: Benefit-Driven Factors Affecting the Adoption of 5G Technology

5G Testbed in Thailand: At present, due to the relatively few applications of 5G technology in Thai vertical industries, government agencies such as the Ministry of Digital Economy and Society (MDES) and the Office of The National Broadcasting and Telecommunications Commission (NBTC) have been promoting the collaboration of 5G trials between different sectors in order to encourage research and development activities for 5G technology. The current test centers are located in economic zones and universities. For instance, the NBTC has collaborated with Chulalongkorn University in order to develop an autonomous vehicle prototype while the MDES jointly test and experiment the uses of AR/VR systems for equipment training in factories with Kasetsart University. Other than the first two, there are other 5G trials being conducted in universities around the country such as Chiang Mai University, Prince of Songkhla University, and Khon Kaen University which are testing out

different use cases based on the opportunities, challenges and geographical limitations of each region as shown in Figure 1-22.

In addition, the private sector has also launched pilot projects such as the collaboration between AIS group and Siam Cement Company Limited (Public Company) to test 5G innovations in the industrial sector and the True 5G World of Agriculture Project, which is a collaboration between scholars, researchers, teachers from Khon Kaen University and the private sector, including CP Siam, Kubota and True, who jointly collaborate in the utilization of 5G technology to help develop the agriculture sector.

However, the number of 5G Testbed in Thailand is considered small when compared to other countries. In Spain, 30 trials on 5G use cases have been carried out and 21 trials each for Germany and Italy while the United Kingdom and France carried out 19 trials each. Not only that, most of their trials are mainly focused on the 3.6 GHz frequency band²³ and the distribution of Testbeds are also well-distributed all over their nations. For Instance, Testbeds in the United Kingdom, are distributed to all areas of the country, covering both urban and rural areas. Therefore, the emphasis on making Testbeds well-distributed and cover several industries as well as integrating at the local level are the essential issues that Thailand should consider as a way to develop the country's 5G. In addition, DEPA, cooperate with 5G supplier, is going to build 5G national innovation center to accelerate 5G adoption and incubate Thai 5G ecosystem.

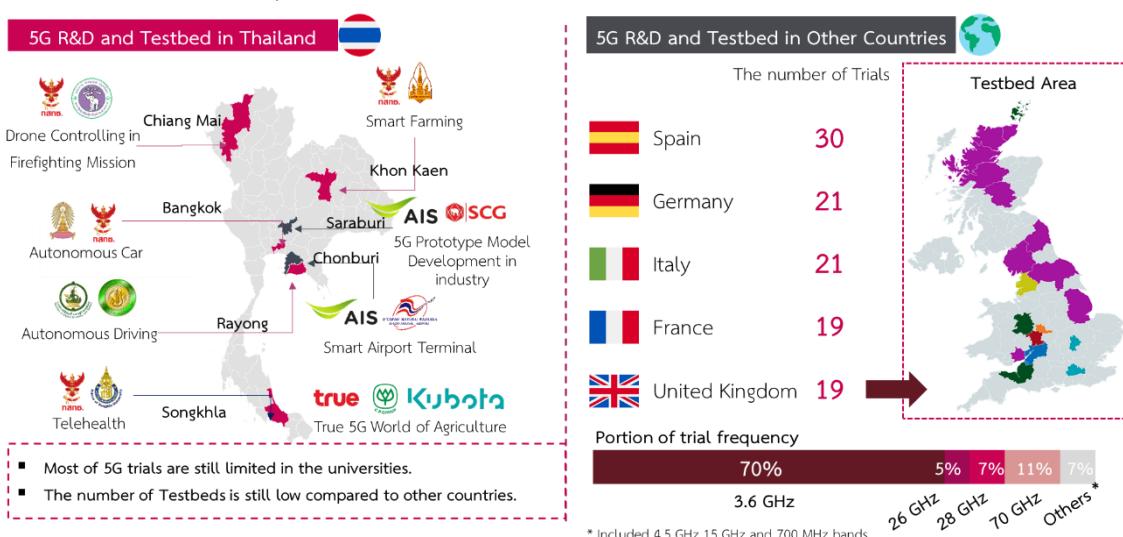


Figure 1-22: Thailand 5G Testbed in Comparison with Foreign Countries

²³ Source: 5G Observatory

1.3.4 Infrastructure

Although Thailand's readiness in term of infrastructure and technology is in a moderate level, however, some issues should be improved including: 1) Insufficient volume of mid-band and high-band spectrum to support the future 5G Use Cases, and 2) Network infrastructure sharing, especially in terms of Small Cell installation costs, in order to achieve maximum investment efficiency.

In B.E. 2562, Thailand has a high level of coverage for mobile broadband internet networks or about 98% of the population²⁴. The current access to mobile broadband in Thailand is mostly through 4G technology, which accounted for 69%, followed by 3G which accounted for 31%, as shown in Figure 1-23. However, the proportion of 3G technology has been declining rapidly over the past several years and is being replaced by a growing proportion of 4G technology as a result of the increase in access to 4G technology for the Thai population. In addition, the launch of the network service on 5G technology will replace the network usage on 4G technology in the near future. This trend will be more concrete from B.E. 2564 onwards. It is predicted that in B.E. 2570, access to mobile broadband Internet of Thai people through 5G technology will be up to 73%²⁵ due to market mechanisms.

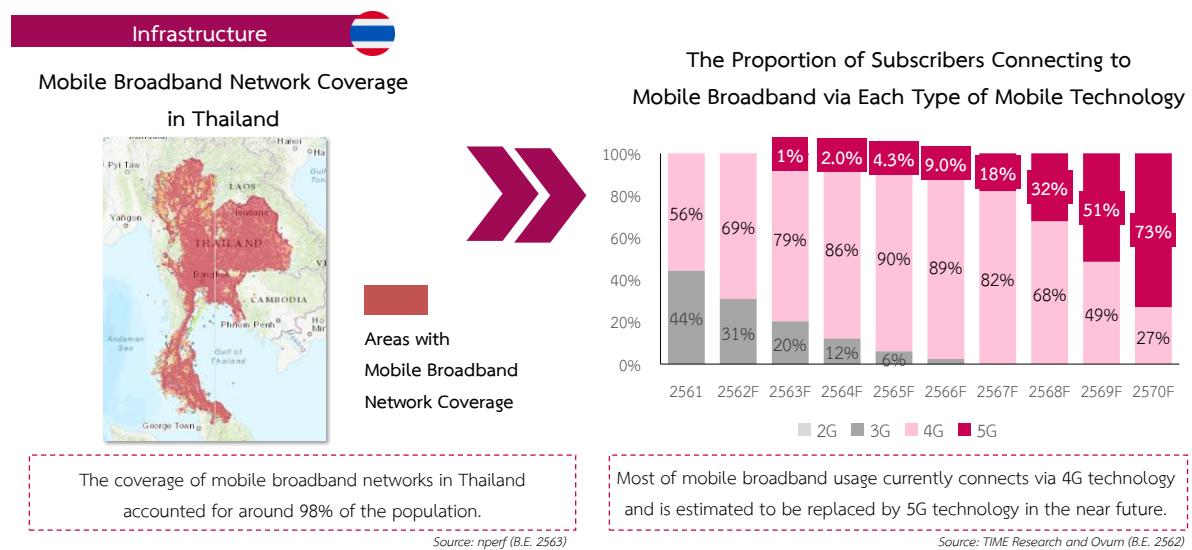


Figure 1-23: The Coverage and Technology Usage of Mobile Broadband Networks in Thailand

²⁴ Source: nPerf

²⁵ Source: TIME Research and OVUM

After the latest spectrum auction on 16 February B.E. 2563, the current mobile telecommunications industry in Thailand has a total volume of 3,220 MHz. Details of the bands and appropriate technology for providing the services are as follows:

Table 1-1: Spectrum Bands for Uses in Telecommunication Services

	Spectrum Band	Spectrum Range	Amount	Suitable Technology
1	700 MHz ²⁶	703-748/758-803 MHz	2x45 MHz	4G and 5G
2	850 MHz	824-839/869-884 MHz	2x15 MHz	3G
3	900 MHz	890-915/935-960 MHz	2x25 MHz	3G
4	1800 MHz	1710-1750/ 1805-1845 MHz	2x40 MHz	4G
5	2100 MHz	1920-1980/ 2110-2170 MHz	2x60 MHz	3G and 4G
6	2300 MHz	2310-2370 MHz	60 MHz	4G
7	2600 MHz	2500-2690 MHz	190 MHz	5G
8	26 GHz	24.30 - 25.10 GHz and 25.20 - 27.00 GHz	2600 MHz	5G
Total			2x185 MHz (FDD) + 2850 MHz (TDD) or 3220 MHz	3G, 4G and 5G

For the provision of services with 5G technology, service providers must possess all spectrums in each band in order to be able to provide efficient services. The specific characteristics and the suitable band size of each band are as follows:

²⁶ The band cannot be promptly recalled as it has to wait for the license expiration under the Order of the Head of National Council for Peace and Order No. 4/2562 as of 11 April B.E. 2562. It is expected to be available for telecommunication services within B.E. 2564.

- 1) **Low Band (Band below 1 GHz)** is the band that supports a wide coverage. Service providers should have low-band spectrum with **a minimum adjacent width of approximately 2x10 MHz²⁷** in order to be able to cover a wide range of services, which includes in-door coverage.
- 2) **Mid Band (Band between 1 - 6 GHz)** is the band that supports the capacity of the network. A service provider must possess mid-band spectrum with **a minimum adjacent width of approximately 80-100 MHz²⁸** in order to ensure optimal 5G services in terms of coverage and service capabilities.
- 3) **High Band (Band higher than 6 GHz)** is the band that is suitable for the use in areas with high usage or high data rate requirements. Huawei has suggested that a service provider must possess high-band spectrum with a minimum adjacent width of approximately 800 MHz in order to be able to provide certain types of services with high traffic or with high data rate requirements. However, the DIGITALEUROPE organization sees that the volume of band can be changed as each region has different data transmission rates and some service providers may not have Network Slicing in place, so there is no need for operators to possess a lot of high band spectrums. The suitable volume of high band spectrum suggested by DIGITALEUROPE ranges from 400 MHz to 1,000 MHz. In addition, GSMA also recommends the allocation of high band spectrum of approximately 1,000 MHz to each service provider.

When considering the appropriate band for the use of 5G services, Thailand has already allocated the band to all telecommunication service providers at the total amount of 2,880 MHz. The Advanced Info Service Public Company Limited or AIS group is the telecommunications service provider that has the greatest number of bands for 5G service, with a volume of 1,330 MHz, which can be separated into 30 MHz of low bands, 100 MHz of mid band and 1,200 MHz of high band, followed by True Corporation Public Company Limited or TRUE with 910 MHz in total, consisting of 20 MHz of low band, 90 MHz of mid band, and 800 MHz of high band. TOT Public Company Limited or TOT has a total band of 400 MHz, all of which are in the high band, and the Total Access Communication Public Company Limited or DTAC who has a total band of 220 MHz, consisting of 20 MHz low band and 200 MHz high

²⁷ Source: DIGITALEUROPE

²⁸ Source: GSMA

band. Lastly, CAT Telecom Public Company Limited or CAT Group has a total of 20 MHz band, all of which are of low band as shown in Figure 1-24.

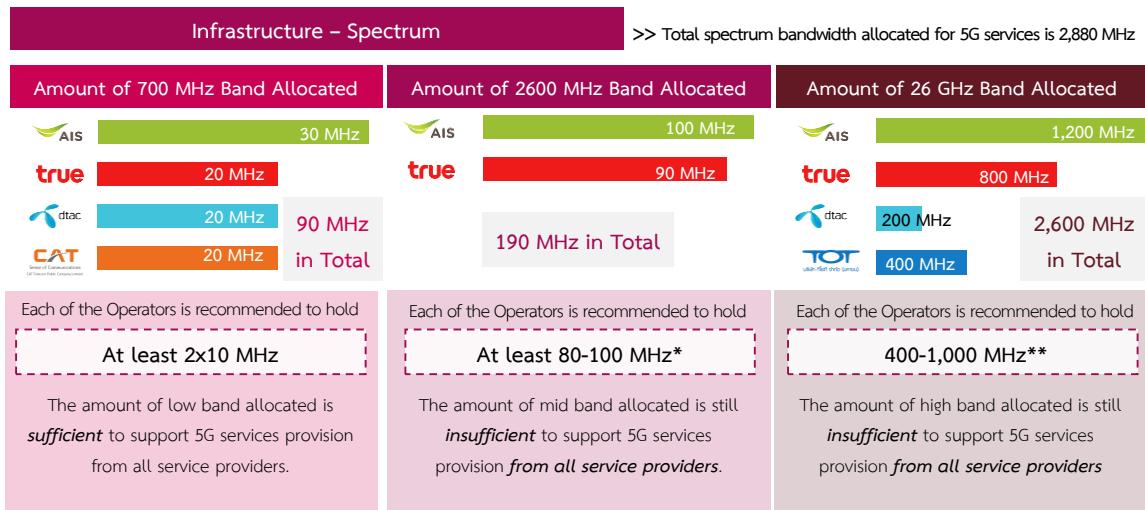


Figure 1-24: 5G Spectrum Allocation in Thailand

Therefore, when comparing the volume of bands in each area that each service provider should have to the volume of bands in each area that is allocated, the following results can be concluded.

- 1) **The volume of low band being auctioned is sufficient for all service providers;** AIS, TRUE, DTAC, CAT and TOT.
- 2) **The mid band and allocation is still insufficient for the 5G service to support all service providers in the future in term of the network capacity and coverage.** Therefore, the regulatory agencies should allocate additional mid band in the future.
- 3) **The high band allocated is not enough to accommodate all service providers.** The regulatory agencies should allocate additional high band so that service providers can occupy adjacent high band of 400 MHz – 1,000 MHz and to be able to provide the most efficient service.

In overall picture, Thailand has allocated bands that are suitable for providing a 5G service in a high volume when compared to other countries. However, there is still a very small volume of the mid band compared to other countries as shown in Figure 1-25, for example, in Japan, there is a total of 600 MHz for all 4 service providers including NTTdocomo, KDDI, SoftBank and Rakuten, in which at least 100 MHz is allocated to each of the service providers. Regarding Rakuten, it has successfully transformed from being a Mobile Virtual

Network Provider (MVNO) into being a Mobile Network Operator (MNO). In China, 460 MHz of mid band has been allocated to all 3 service providers (China Telecom, China Unicom and China Mobile), each of which has the band of at least 100 MHz. In addition, South Korea has allocated 280 MHz of mid band for all 3 service providers (LGU+, KT Corporation and SK Telecom), each of which has been allocated between 80-100 MHz. Meanwhile, Thailand has allocated only 190 MHz of mid band, which is currently allocated to 2 service providers (AIS and TRUE) only.

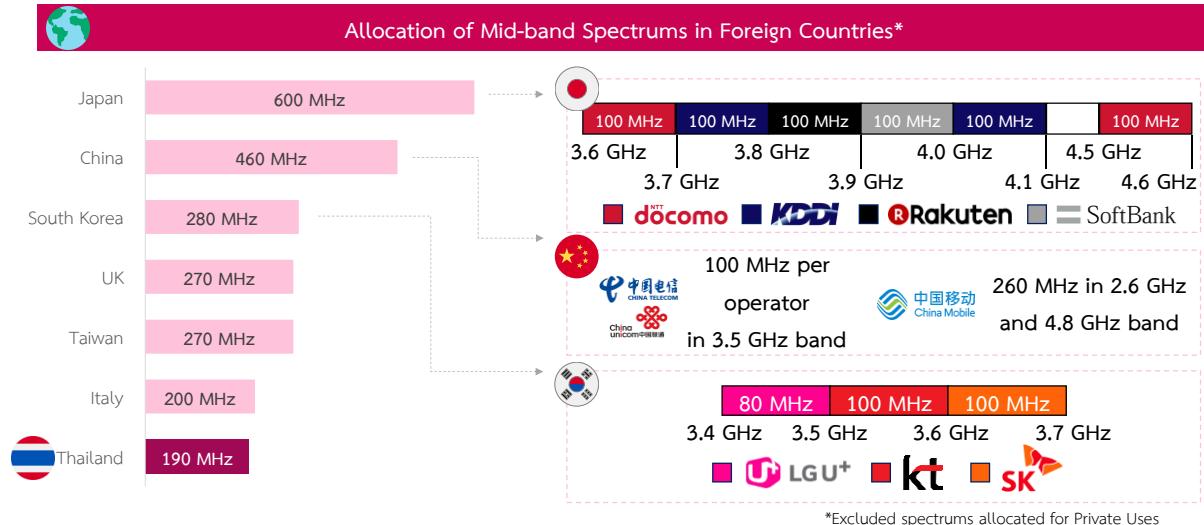


Figure 1-25: Allocation of Mid-band Spectrums in Foreign Countries

In this regard, Thailand has a plan to recall and allocate additional mid and high band. An additional 200 - 300 MHz²⁹ (3.4 - 3.7 GHz) of mid band or 3.5 GHz will be recalled in order to be reallocated for use in 5G services and an additional 2,500 MHz (27 – 29.5 GHz) of high band or 28 GHz will be recalled in order to be reallocated for use in 5G services. Both bands will be recalled, when the contract is expired, for the operation of the domestic communications satellite between Thaicom Public Company Limited and the Ministry of Digital Economy and Society within B.E. 2564 as specified in the guidelines for band recall, guidelines for band return for reallocation and guidelines for improving the use of band (B.E. 2562 - 2566) in the National Broadcasting and Telecommunications Commission's Spectrum Management Master Plan (B.E. 2562). Furthermore, there is also an ongoing issue of Extremely High Frequency (EHF) band which is currently under consideration for its compatibility and feasibility with mobile telecommunications operators. The portion of the band which will be used for 5G services consist of bands between 37 - 43.5 GHz, 45.5 - 50.2 GHz, 50.4 - 52.6 GHz,

²⁹ The volume of 3.4 - 3.7 GHz band to be allocated will depend on the specified Guard Band.

66 - 76 GHz and 81 - 86 GHz. However, the consensus from the World Radio Communication Conference 2019 (WRC 2019) additionally designated that the bands between 37 - 43.5 GHz, 45.5 - 47 GHz, 47.2 - 48.2 GHz and 66-71 GHz are also suitable for telecommunications services³⁰ as shown in Figure 1- 26. In addition, during the World Radio Communication Conference 2023 (WRC-23), more frequency bands will be considered for 5G technology including 470-960 MHz, 3 GHz, 6 GHz, and 10 GHz.

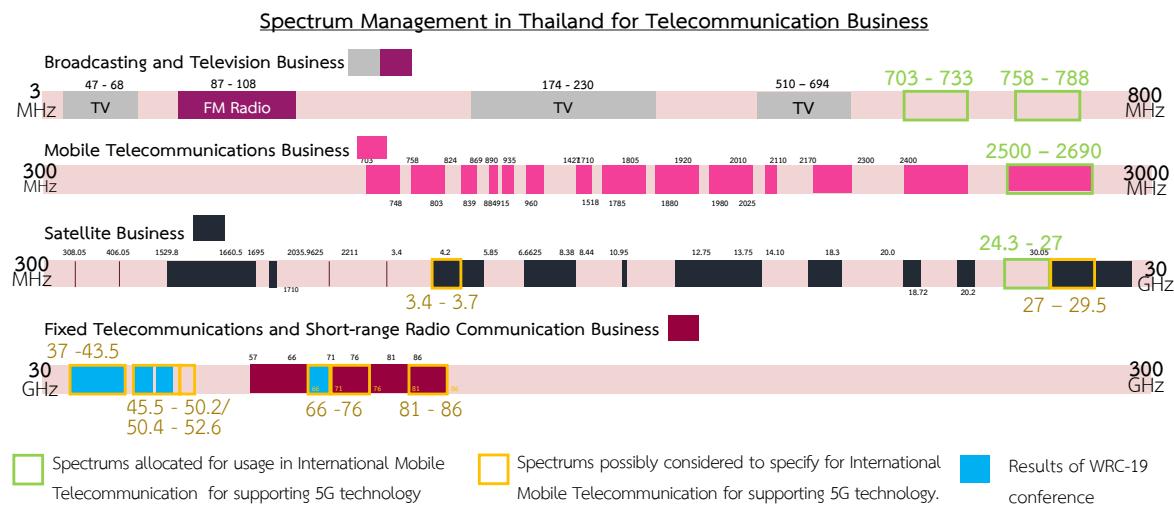


Figure 1-26: Spectrum Management in Thailand for Telecommunication Business

With regards to the network deployment, Small Cells must be deployed on a large scale to ensure nationwide network coverage and guarantee quality services. In general, Small Cells could be installed in all areas that require signal coverage and could be attached to various facilities, be it the utility poles, street light poles, telephone booths, traffic signals, buildings or billboards. However, gaining the access to those facilities remains a key challenge for the network expansion. Therefore, in order to enable efficient rollout of 5G network services, promoting infrastructure sharing between operators or organizations are very much needed. The network infrastructure includes passive infrastructure and active infrastructure, in which Thailand is only focusing on the passive infrastructure sharing as there has only been rules and conditions regarding the allocation and use of IMT spectrums³¹, but not for the active infrastructure sharing, especially for the Micro/Pole Site. Whereas, several foreign countries have already been actively promoting active infrastructure sharing by establishing regulatory frameworks to facilitate the access to existing public facilities, especially the pole sites, for

³⁰ Source: ITU News

³¹ Source: Office of The National Broadcasting and Telecommunications Commission (NBTC)

Small Cells installations, but the types of facilities to be opened for sharing and the designated areas for infrastructure sharing depend on the policies in each country.

For example, within the European Union, the ‘EU Strategy on Connectivity for a European Gigabit Society’³² policy indicates that the 5G network must cover major city areas and main transportation routes by B.E. 2568. In response to the policy, Germany requires the installation of base stations alongside the fiber optic cables along the main road and railroad in Germany³³ and thus, active infrastructures located at the roadsides must be opened for sharing to ensure efficient network deployment.

Meanwhile, Singapore emphasizes on developing broadband networks that can support the uses of mobile broadband and fixed wireless access in high-rise buildings. This is indicated in the ‘Code of Practice for Info-communication Facilities in Buildings’ (COPIF), published by the Infocomm Media Development Authority (IMDA), which has the objective to manage facilities within new buildings. The code of practice also requires the property developers and property owners to open the areas and facilities that are essential for providing quality services to telecommunication service providers, in which they could charge the rental fees. Also, IMDA plans to continuously update the rules and regulation in the COPIF to respond to the changing technologies, and the latest revised version was effective since December B.E. 2562³⁴.

Similarly, Malaysia has specified the use of existing public facilities as part of 5G network expansion so as to reduce the cost burden telecommunication service providers have to face. In order to facilitate the use of public facilities, the government promotes joint integration among government agencies that own those facilities³⁵. Moreover, 5G Strategy for Germany also supports the use of existing facilities, including traffic signals and street light poles, for Small Cells deployment with the objective to reduce the cost of building new poles and provide 5G hotspot services. In addition, the United Kingdom’s National Infrastructure Commission (NIC), which acts as an independent infrastructure advisor for the government, has also established clear guidelines on the cooperation between telecommunication service providers and government agencies that own facilities such as land, buildings, roads, utility poles, etc. This is to ensure nationwide network coverage and improvement in operational efficiency without having to make unnecessary investments.

³² Source: European Commission

³³ Source: The Federal Government of Germany

³⁴ Source: Info-communications Media Development Authority (Singapore)

³⁵ Source: The Malaysian Communications and Multimedia Commission (Malaysia)

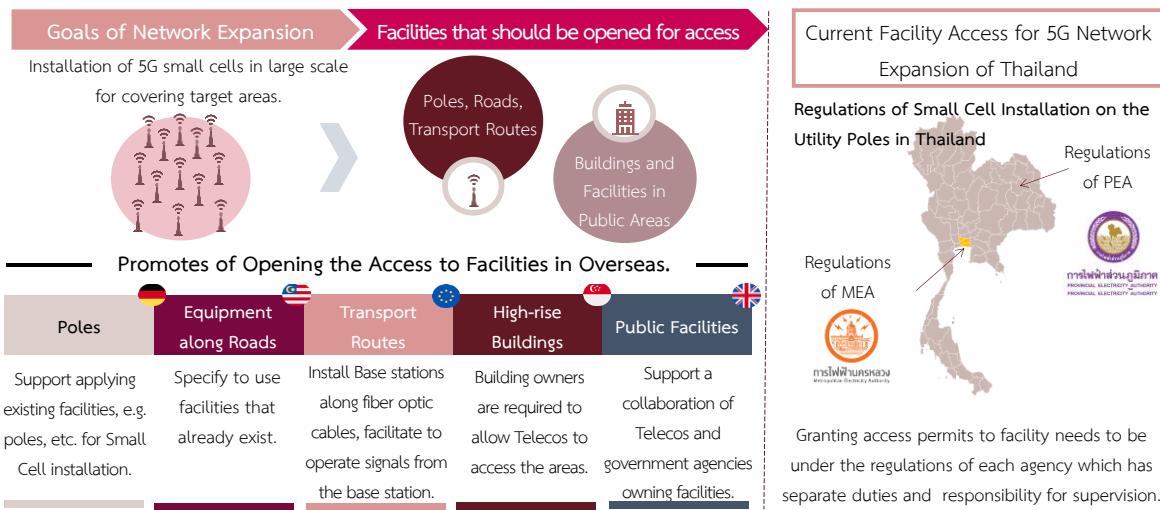


Figure 1-27: Access to Public Facilities for 5G Network Expansion

1.3.5 Digital Human Capital

According to the employment data report in the Information and Communication Technology (ICT)³⁶ industry in B.E. 2561 made by the National Statistical Office, Thailand has a total of 415,623 digital and ICT workers³⁷, which is 8% higher than the previous year. Considering the type of economic activity, it is found that most digital and ICT workers (83%) are in the trade and service sector and 17% of them are in the manufacturing sector. However, 56%³⁸ of the digital and ICT workers in the country do not have a direct digital and ICT education. Over 22% of the digital and ICT workforces do not graduate with information and communication technology qualification in the basic education level³⁹. This reflects the education inconsistencies in the digital and ICT labor markets, while approximately 44%⁴⁰ of them graduated under the digital and ICT fields directly, which is 5% higher than last year, and most of them have a bachelor's degree.

In spite of the overall increasing of digital and ICT workforces in Thailand, when comparing the total workforces in Thailand, the number of digital and ICT workforces only accounted for 1.1% which is insufficient to meet the demand in Thailand as it continues to increase, especially in the Eastern Economic Corridor (EEC) area, which still needs more than 400,000 workforces over the course of B.E. 2562 - 2566⁴¹, in which 180,000 of them are skilled

³⁶ Source: National Statistical Office

³⁷ Digital and ICT workers consist of 260,000 IT and communication technology professionals, 78,000 IT and communications technology technicians, nearly 41,000 software analysts, and 24,000 database and network professions and 13,000 communication technicians.

³⁸ Digital and ICT workers consist of lower secondary education or lower (11%), upper secondary education (11%), vocational certificate/diploma (2%), bachelor's degree (27%) and higher than Bachelor degree (4%).

³⁹ Source: ITU News

⁴⁰ Digital and ICT graduates consist of 2% of graduates from upper secondary education, 8% of graduates from diploma / vocational certificate, 27% of graduates from Bachelor degree 27% and 5% of graduates from higher education than a bachelor degree.

⁴¹ Source: The Committee of Eastern Economic Corridor

labor and professional in digital, comprising more than 100,000 of digital workforces in the electronics industry, over 50,000 vacancies in the smart electronics industry, and 31,000 vacancies in the robotic industry, as shown in Figure 1-28.

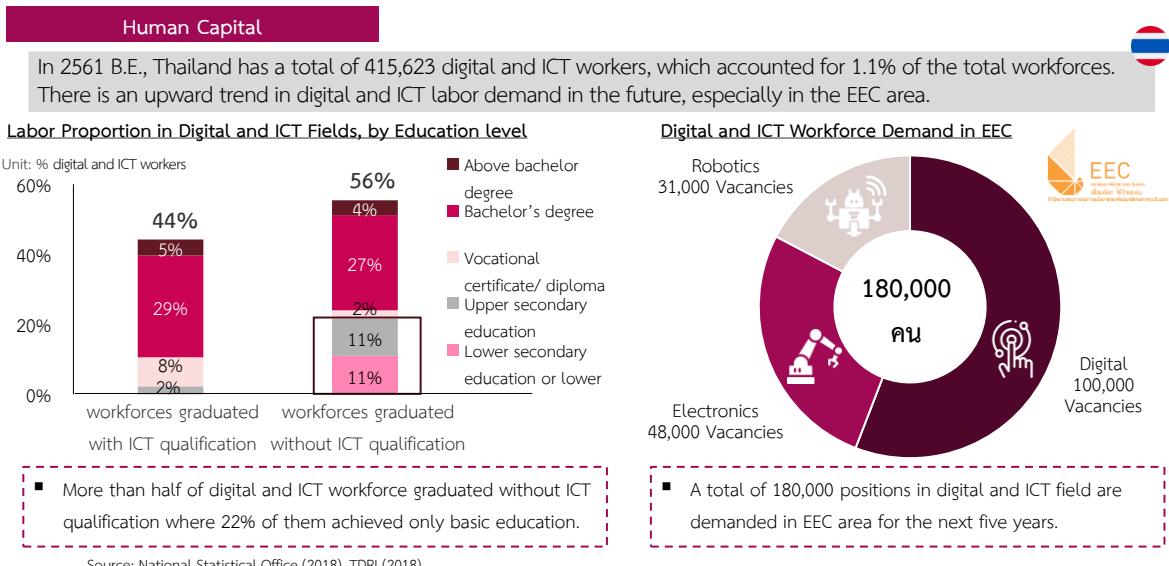


Figure 1-28: Digital Human Capital in Thailand

In addition, the ranking of the digital competitiveness rated by International Institute for Management Development (IMD), which is an assessment that reflects the organization's potential in using digital devices and technology to improve business outcomes, reveals that from B.E. 2560 to 2562, organizations in Thailand have continuously increased their potential due to the average annual growth rate of 3%, in the B.E. 2562 with 68.4 score⁴² out of 100 scores in total, or ranked No. 40, which is one rank higher than in B.E. 2561 (No. 39). When analyzing from the sub-indicators, it is found that the while the nation's score on future readiness decreases, the score on technology, which is a measure of the overall environment that affects the development of digital technology, and knowledge, which is a measure of knowledge and understanding of technology, including the ability to produce technology, has increased. However, the results of the evaluation of the ability to use digital devices and technology within the organizations in Thailand are still lower than the world average (74.8 scores) by 9%.

In this regard, if considering the details of the knowledge assessment, which is an indicator related to the skills of digital and ICT workforces, it is found that Thailand has a higher score of 58.4 or ranked No. 43 out of 63 countries, but is still below the global average of 67.1

⁴² Source: The Institute for Management Development (IMD)

by 15% as shown in Figure 1-29. One of the main factors is that Thai workforces still lack digital technology skills. Moreover, the quality of training and education in Thailand is below average, such as the Program for International Student Assessment and the assessment of student-teacher ratio, etc. In other words, the level of knowledge and skills in digital and ICT aspect of Thai workforces is still at a low level.

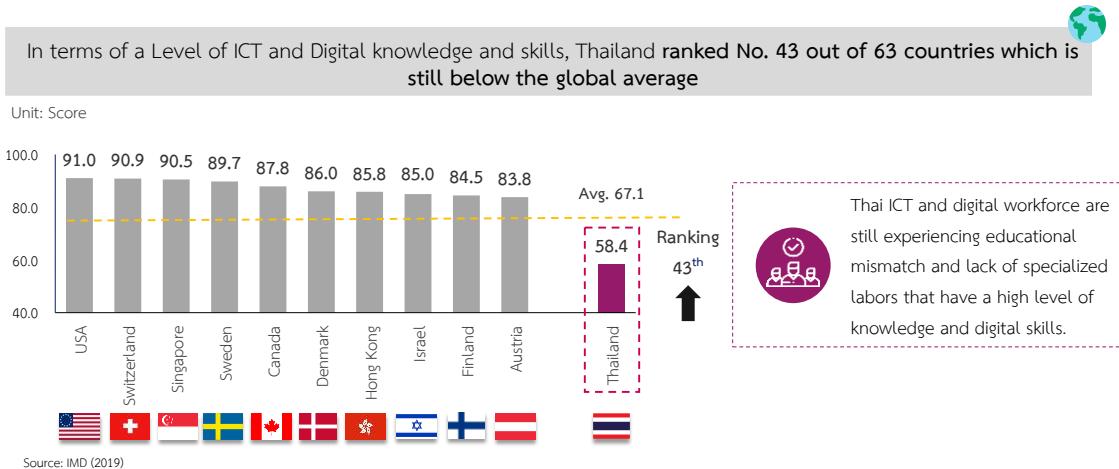


Figure 1-29: Level of Knowledge and Skills of the Global Digital and ICT Workforces

The results of the study reflect the inconsistency between digital and ICT workforces in Thailand and its education system. In addition, the inconsistency between the qualifications of ICT workforces and the changing demand for workforces due to technological advancement has caused Thailand to face a shortage of high-quality digital and ICT workforces which will then affect the usage efficiency of 5G technology, resulting in a slow growth of high-tech industries in Thailand. Thus, developing personnel's knowledge and skills in digital technology will accelerate the production and induce a wide utilization of 5G technology as well as attracting more foreign investors.

1.3.6 Innovation Landscape

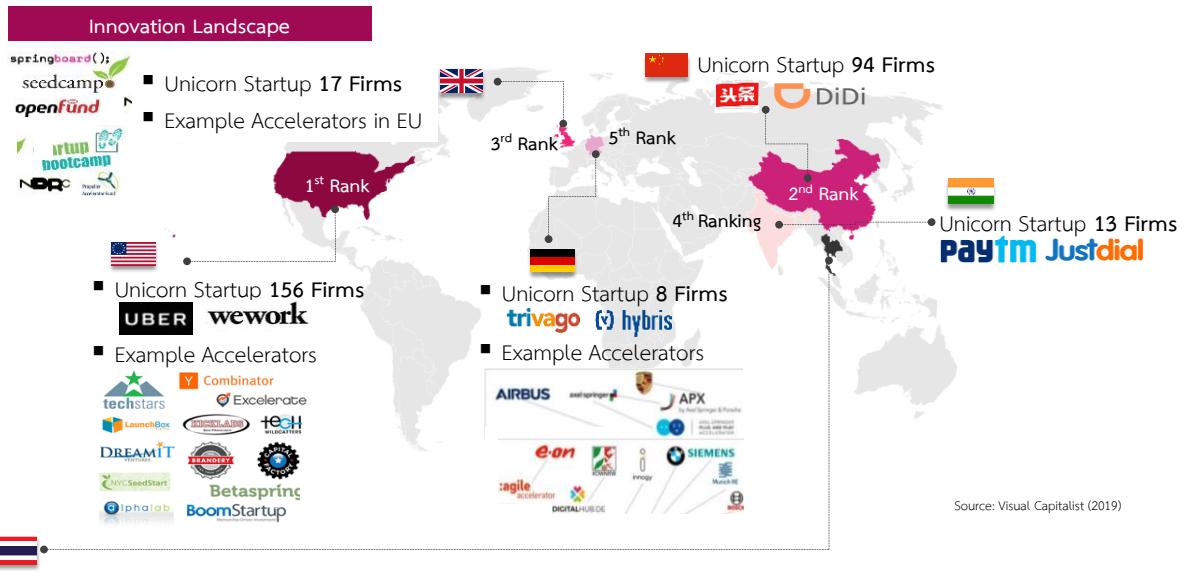
At present, most Thai startups are clustered at the same level, not yet turning unicorn level or the company's values over 1,000,000,000 US dollars. Developing a unicorn startup depends on a variety of factors, one of which includes having a well-developed innovation ecosystem, whereby this factor is still the big challenge since Thailand's innovation ecosystem is still in the initial stage of development. Currently, there are several government agencies in Thailand that are responsible for startups support such as the Digital Economy Promotion Agency, National Science and Technology Development Agency, National Innovation Agency (Public Organization), Electronic Transactions Development Agency, Digital Government Development Agency (Public Organization) and the Office of the Board of

Investment. Also, there are private investors that act as Angel Investors and Venture Capitalists both from Thailand and abroad such as AddVentures by SCG under Thai Cement Public Company Limited, Digital Ventures Company Limited, SOSV Company and Verizon Ventures. Furthermore, there are organizations that are under the leadership of Thailand's leading company such as AIS Startup, True Incube, Bangkok Bank Innohub, and the DEPA Accelerator x Techsauce Project which act as incubators and accelerators for startups. However, most organizations mentioned above only offer preliminary funding and knowledge support, thereby the impacts are not enough apparently to make Thai startups reach Unicorn-level or the company's values over 1,000,000,000 US dollars.

Referring to Figure 1-30, there were a total of 326 unicorn startups⁴³ around the world in B.E. 2562. Considering the case study in the top 5 countries with the most number of unicorn startups, including 1) the United States of America with 156 unicorn startups, 2) China with 94 unicorn startups, 3) the United Kingdom with 17 unicorn startups, 4) India with 13 unicorn startups, and 5) Germany with 8 unicorn startups, it is found that one of the factors that cause these countries to develop a great number of startups, especially reaching the unicorn level, is the integration of all sectors to jointly develop an ecosystem that is ready to create new innovations. In addition, they also have a large number of Incubators and Accelerators, which are another key factor in enhancing the potential of startups.

Therefore, Thailand should also push forward for mutual work integration between government agencies, private sectors, educational institutions and public sectors, to create an ecosystem that accommodates the emergence of new innovations, enhance the potential of Thai startups, create opportunities for business expansion and increase international competitiveness. These consequences make integration be one of the main factors that enable the efficient and widespread utilization of 5G technology.

⁴³ Source: Visual Capitalist



12 Government agencies supporting Startups	There are still few sponsors for initiating new Startups.	Thailand has no Unicorn Startups. (Company value > 1 billion USD)
	Available Startups received main financial support from the private section (VC & Angel Investor). However, there is a few number of Incubators/Accelerator.	

Figure 1-30: Innovation Landscape

Considering the context of digital technology and innovation, it is found that Thailand has a large number of privileges in digital technology and innovation covering the development of infrastructure, human capability, research and development, application of digital technology and innovation, and startups incubation in digital technology and innovation, both with and without funding support. There are 2 main responsible agencies as follow:

- The Digital Economy Promotion Agency (DEPA) is an organization that is responsible for promoting and supporting investment or business operation specific to the digital industry or innovation. At present, the agency has measures to help or subsidize the development of infrastructure for industrial and digital innovation development (DEPA Digital Infrastructure Fund for Private Investment), measures to help or subsidize the application of digital technology and innovation for the business sector (DEPA Digital Transformation Fund) to promote the application of technology and digital innovations in business or industries in the area of product development, production processes, services, and marketing for capability enhancement

in term of increased efficiency / productivity or added value of the products. In addition, there is a measure to develop the potential of digital workforces emphasizing on building the potential of industrial and digital innovation workforces, which can be divided into 2 levels: the basic usage level and management level. Moreover, there is also a measure to research and develop digital technology and innovation (Digital R&D and Innovation Fund). Furthermore, the Digital Economy Promotion Agency has collaborated with private organizations, for instance, the collaboration with Techsauce Company Limited or Techsauce, in order to establish the DEPA accelerator x Techsauce project to elevate the potential of Thai startups into the international level through training sessions with foreign experts.

- The National Innovation Agency (NIA) is an organization to provide financial support under the Open Innovation Program to encourage the creation of innovation, creating values throughout the supply chain of the targeted industry (S-Curve). Also, the Youth Startup Fund is established to support young generations starting startups through incubation, practical experiences, and creative creation. Moreover, the National Innovation Agency has attached importance to enhancing the innovation potential of entrepreneurs and general personnel by organizing activities and training courses such as the Managing Innovation Development Credit or "MIND CREDIT" to provides personnel expert consulting services, leading to further innovation development.

In addition to the above-mentioned key agencies, there are also other supporting agencies such as the National Science and Technology Development Agency, which provides space and equipment support for research and development activities and the Office of the Board of Investment that focuses on tax support for investors. It can be said that Thailand has many digital technology and innovation support that can indirectly promote the utilization of 5G technology. However, Thailand has not had a clear budget allocation, having the direct purpose of encouraging investment and utilization of 5G technology.

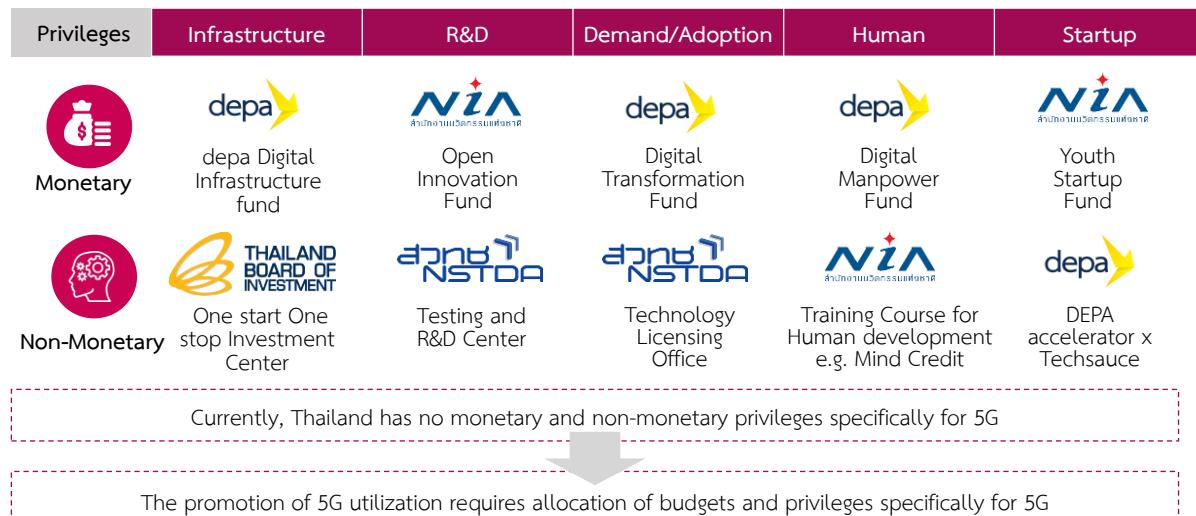


Figure 1-31: Examples of Privileges for Digital Technology and Innovation in Thailand

Taking into consideration of the leading countries in 5G technology, it is found that these countries have set specific policies to promote 5G. Therefore, there are clear frameworks and budget allocations for 5G to encourage all sectors to utilize 5G technology concretely. This promotion covers all factors contributing to the development of a suitable 5G ecosystem, for instance, the United Kingdom has created the "5G Strategy for UK"⁴⁴ policy which involves amendments of laws and regulations such as setting the rules for the installation of Small Cells to support the application of 5G technology in various areas, etc., and establishment of the UK 5G Innovation Network organization. This is to promote cooperation in the development and distribution of research data in all sectors and drive the adoption of 5G technology as well as expand their commercial applications. Other than that, the United Kingdom also provides funding to network service providers to expand the 5G infrastructure and establish the 5G Testbeds and Trials Program (5GTT Program) to support fund research and trials for 5G technology implementation while pushing for the provision of network services in rural areas. Moreover, it also promotes human resources development in order to prepare for the transition to the 5G technology era through the 5G Testbed Accelerator Programme.

Germany has established the "5G Strategy for Germany"⁴⁵ policy along with the allocation of 5G Initiative Fund to develop 5G networks and services in the focused areas and industries by determining criteria that promote the expansion of 5G network coverage to the targeted area such as the installation of base stations along the fiber lines, main roads and

⁴⁴ Source: Department for Culture Media and Sport (United Kingdom)

⁴⁵ Source: The Federal Government (Germany)

railroad as well as facilitating signal connection from the base stations, in order to comply with the EU Strategy on Connectivity for a European Gigabit Society policy where the European Union has stipulated that the 5G network has to cover main public transport routes and major cities. Furthermore, Germany has established the 5G Dialogue Forum which is the integration of network service providers, entrepreneurs in the vertical industry and other agencies to drive the utilization of 5G technology, as well as facilitating researches and development by establishing a nationwide research and development center (5G Research Center) so that all sectors can access various resources and services.

Meanwhile in Asia, South Korea has enacted a policy called "5G + Strategy"⁴⁶. Under this policy, the South Korean government has revised regulations regarding cyber security to ensure the confidence of all sectors in the implementation of 5G technology and to support the utilization of 5G technology in various forms such as providing a tax credit to 5G infrastructure investors in order to reduce their investment burdens and attract more private investment and funding for 5G service developers under the 5G Convergence Service program. In addition, the South Korean government attaches importance to the development of 5G-related skills of media workforces. Therefore, the Nurture Talent Program and the 5G Immersive Content Lab are established to promote and develop startups in content creation knowledge. The mentioned activities that promote the utilization of 5G technology under the policy framework of South Korea are driven by the 5G + Strategy Committee, which is the collaboration of various sectors.

In Singapore, the government has established the 5G Mobile Networks and Services⁴⁷ policy with the Info-communications Media Development Authority (IMDA), which is a government agency appointed to oversee the country's information technology system, as the main responsible agency. IMDA's duty also involves pushing the 5G technology forward, allocating budgets for the development of the ecosystem for 5G, promoting research and development of 5G technology innovations and organizing test centers in 6 target industries. In addition, it also revised the TechSkills Accelerator (TeSA) curriculum so as to develop the skills of workforces to meet the needs of the utilization of 5G technology in various sectors. Moreover, the Singapore government has set the criteria for the use of spectrum bands. The

⁴⁶ Source: Ministry of Science and ICT (The Republic of Korea)

⁴⁷ Source: Info-communications Media Development Authority (Singapore)

licensees must provide wholesale band services to other telecommunication service providers, especially the mobile virtual network operators with the aim of providing a comprehensive nationwide network to support a wide variety of applications of 5G technology.

Therefore, Thailand needs to enact policies and plans as well as allocate budgets that directly promote the utilization of 5G technology in order for 5G technology to contribute towards economic and social development with concrete outcomes.

National Plan	Regulation	Infrastructure	Demand	Innovation	Human	5G Working Group
 In present, Thailand has not yet allocated a budget as well as introduced a policy for promoting the utilization of 5G technology clearly						
 UK	5G Strategy for UK	The installation of Small cell Rules	Digital Infrastructure Fund: £500m	5GTT: £200m	5G Testbed Accelerator Programme	
 Germany	5G Strategy for Germany	Base station Installation along Transport Routes	5G Initiative Fund: \$88m for 5G Network and Services		5G Research Centre	5G Dialog Forum
 South Korea	5G+ Strategy	Revise Cyber Security Regulation	Tax Credit 2-3% of 5G Network Investment	5G Convergence Service: \$86.3 Billion	5G Immersive Content Lab: \$26 Million	5G+ Strategy Committee
 Singapore	Policy for G Mobile Networks and Service	Identify Criteria in MVNO Services	Develop 5G Infrastructure Nationwide	Support 5G Funding for Targeted Industries: \$40m	Support 5G Funding for Targeted Industries: \$40m	

Figure 1-32: 5G Policies and Budget Allocation in Foreign Countries

1.4 Challenges and Key Development Issues for 5G Technology Adoption

1.4.1 Challenges for 5G Technology Adoption

Although 5G technology can be applied to both the consumer and business sectors to enhance capabilities, create added value to various industries and improve the quality of life for the population in many aspects, the technology is undeniably very new, which inevitably comes with challenges and obstacles in terms of both the demand and supply side that Thailand has to overcome in order to successfully implement the technology. The challenges and obstacles include:

1) Awareness of 5G technology Importance

As 5G technology is largely different from its predecessor, it is crucial that the awareness in technology difference and benefits are carefully raised. There is no doubt that this challenge is an essential factor that would eventually affects the demand in 5G technology, especially within the business sector. After analyzing the current situation in Thailand, it is found that:

- Only a minor portion of consumer and business sectors are currently aware of the potential and benefits that 5G technology has to offer. Mid-band shall provide capacity layer for 5G to ensure enhanced user experience and ITU has recommended criteria for 5G service as 100 Mbps in urban. Long-term guidance is needed to lead national user experience standard.
- Supports for tests and trials for 5G technology implementation in vertical industries are still limited, which affect the confidence and trust entrepreneurs has towards the technology's efficiency.
- A work integration in all relevant sectors related to 5G technology applications in Thailand is still at a low level as can be seen from the limited number of collaboration projects that aim to push 5G technology forward. The inter-sector integration acts as an important factor in driving the utilization of 5G technology, since 5G applications can be realized sooner if all of the relevant sectors are aware of its importance and willingly collaborate together.

2) The cost of 5G technology and services

The implementation of 5G technology and services imposes substantial costs, which will ultimately affect users' demand and investment value of the relevant stakeholders. The issues can be summarized as follows:

- Thailand is a country that heavily relies on technology imports from foreign countries rather than investing in the research and development of the technology. This imposes cost burdens to both users and service providers as they have to import equipment related to 5G technology.
- Users also have to take into consideration other variable costs such as maintenance costs, some of which needs to be shipped to its origin country for repair services as Thailand is relatively limited in terms of digital workforces' capabilities.
- As the spectrum band that is the prominent feature of 5G technology in terms of speed, data transfer and faster response is the high band, which can only transmit its signal in short distance area. Therefore, network service providers need to install more antennas and base stations in order to have sufficient network coverage.

- The utilization trend for 5G technology in vertical industries tends to be realized by large enterprises as they have abundant resources for 5G technology implementation. Meanwhile, small and medium enterprises still lack in terms of knowledge and financial capabilities for 5G implementation.

3) Laws and Regulations

At present, Thailand is compelled to make amendments to their laws and regulations in order to encourage investment in infrastructure and implementation of 5G technology in vertical industries. Therefore, at the very least, the following laws and regulations need to be reconsidered:

- Laws and regulations related to 5G network equipment imports and installations as well as 5G customer premises equipment imports.
- Laws regarding spectrum sharing, spectrum leasing and spectrum trading
- Regulations for in-band migrations.
- Regulations related to the expansion of 5G network, e. g. Small Cell installation approval procedure.
- Laws and regulations that support the implementation of 5G use cases such as Telehealth, Vehicle-to-everything (V2X) and Drone.

4) 5G Technology Infrastructure

The challenges that involve 5G technology infrastructure include allocating sufficient spectrum band for 5G services and the preparation of 5G network for high efficient service offerings with coverage in various regions within the country.

The issues can be summarized as follow:

- The amount of allocated spectrum band for 5G services is still insufficient, when taking into consideration the current number of all operators.
- Facilities access and infrastructure sharing in Thailand still lack incentives that will attract sharing between telecommunications operators.
- Those who live in rural areas still face obstacles in gaining quality internet broadband access, which hinder them from accessing efficient and quality public services.

5) Knowledge in Development and Application of Digital and 5G Technology

The issues regarding the personnel in the digital and ICT field are another important challenge towards the implementation of 5G technology where Thailand needs to put their development efforts in, so as to fully utilize 5G technology. The challenge includes:

- The amount of digital and ICT workforces with adequate skills and knowledge in 5G technology development and implementation is not enough to address the labor market demand.
- The inconsistencies between the education/qualification of digital and ICT workforces and the changes in labor demand.

1.4.2 Summary of Key Development Issues

In order to ensure that digital and 5G technology are able to optimally induce drive in both the economy and society with the highest efficiency and output, ultimately achieving the expected economic value, Thailand has to reform and support developments according to the five challenges mentioned above, where the work integration in all relevant sectors is imperative as shown in Figure 1-33. This involves the government, private, educational and public organizations in order to jointly develop the ecosystem such that it is prepared for the utilization of 5G technology. The key development issues that need to be addressed are as follows:

- **Raising 5G awareness and knowledge creation in all sectors** so as to ensure awareness in sectors including the government, private and public sector of benefits from 5G technology as well as create concrete knowledge for 5G implementation.
- **5G use cases implementation** in vertical industries is paramount. This is to set clear examples on how services operate under 5G network which can show the potential of 5G technology. However, investment costs in 5G technology is relatively high, therefore, 5G implementation needs to present a clear impact, bear reasonable costs, have an efficient investment manner and create results in both quantitative and qualitative benefits in order to build trust and confidence for investors, which will eventually lead to a widespread implementation in economic and social aspects.

- **Research and trials** on leveraging 5G technology to create new services that are suitable and addressable to the country's changing context as well as reducing the country's reliance on technology imports.
- **5G network expansion** is needed to support high quality 5G services provisions as well as extending coverage in various regions, including economic zones and rural areas.
- **Laws and regulations amendments** should be made to accommodate the adoption of new services and facilitate network providers in their network expansion process as well as encourage investment and implementation of 5G technology in vertical industries.
- **5G digital workforce development** is a crucial process to help enhance the capabilities of Thailand's digital workforces, which should be focused on meeting the labor market demand.

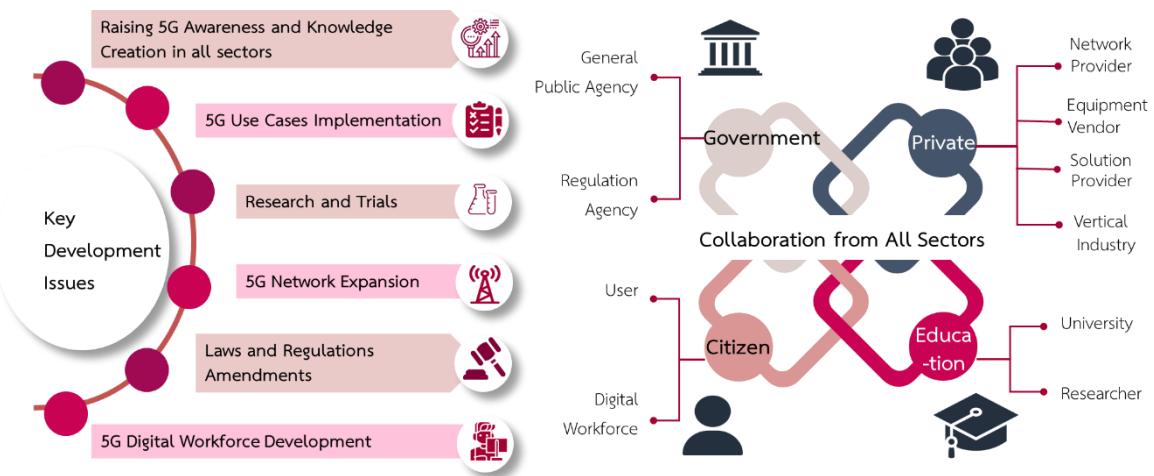
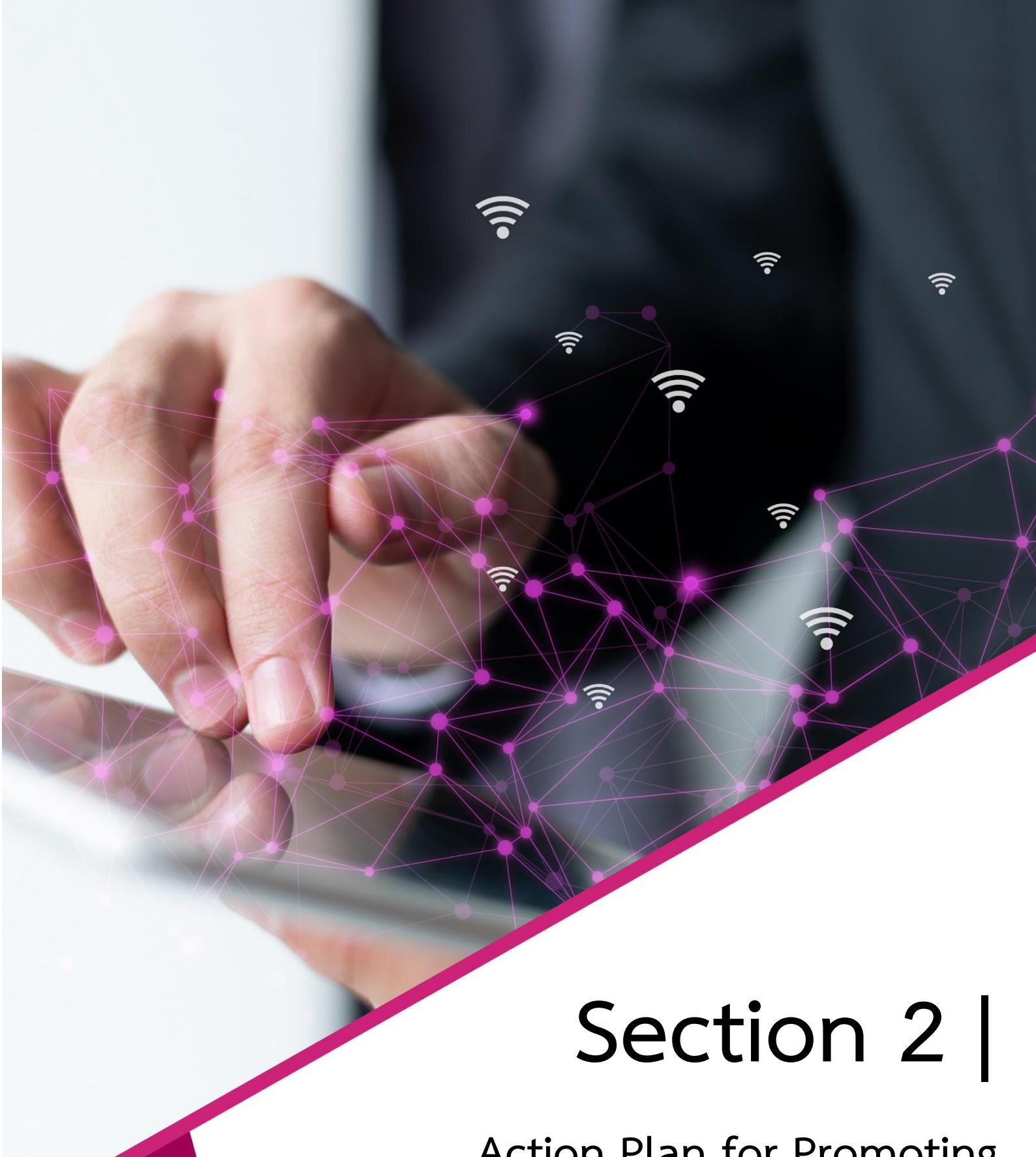


Figure 1-33: Key Development Issues for Promoting the Adoption of 5G Technology



Section 2 |

Action Plan for Promoting the Adoption of 5G Technology in Thailand Phase 1

Section 2 Action Plan for Promoting the Adoption of 5G Technology in Thailand Phase 1

2.1 Vision

Thailand can fully utilize the capabilities of 5G technology for the continual and sustainable development of the economy and society.

2.2 Goals

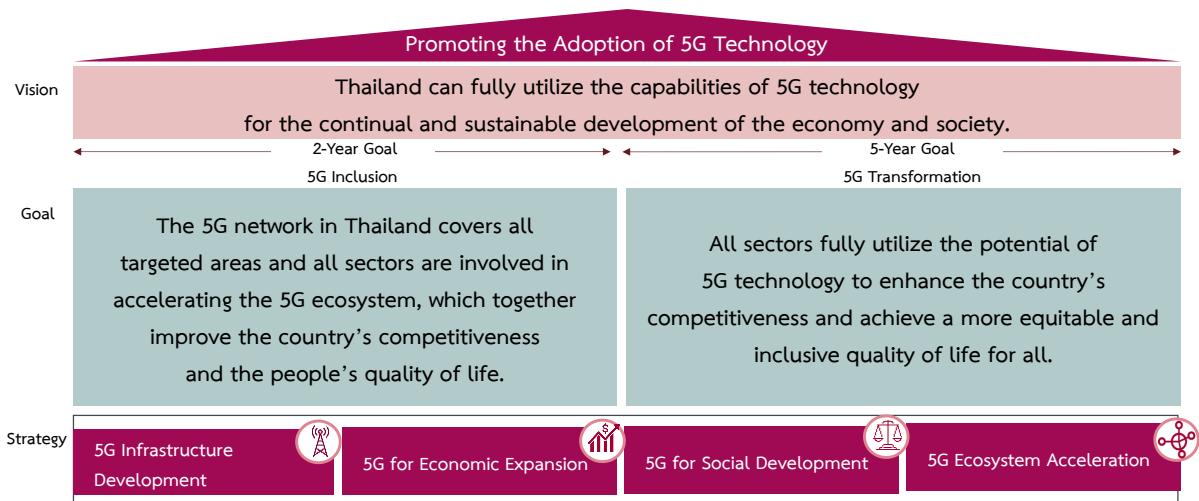


Figure 2-1: Goals of the Action Plan for Promoting the Adoption of 5G Technology in Thailand

The Action Plan for Promoting the Adoption of 5G Technology in Thailand separates the development goals into 2 phases, 2-year goal and 5-year goal, which are in line with Phase 2 (Digital Thailand I: Inclusion) and Phase 3 (Digital Thailand II: Full Transformation) of Thailand Digital Landscape as defined in Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580).

➤ 2-Year Goal (B.E. 2564 – 2565) - 5G Inclusion

The 5G network in Thailand covers all targeted areas and all sectors are involved in accelerating the 5G ecosystem, which together improve the country's competitiveness and the people's quality of life.

➤ 5-Year Goal (B.E. 2566 – 2570) - 5G Transformation

All sectors fully utilize the potential of 5G technology to enhance the country's competitiveness and achieve a more equitable and inclusive quality of life for all.

The Action Plan for Promoting the Adoption of 5G Technology in Thailand includes the indicators for the overall goals⁴⁸, which are in accordance with Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580)⁴⁹ and reflect the goal at the end of B.E. 2570 as described in the Action Plan for Promoting the Adoption of 5G Technology in Thailand, as follows.

- 1) The 5G network covers with average DL speed at least 50 Mbps everywhere and 100 Mbps in Urban area and cover:
 - 98% of the population.
 - the entire areas of all zones declared as the Special Economic Promotional Zones within the Eastern Economic Corridor (EEC)⁵⁰.
 - all residents in the Smart Cities⁵¹.
- 2) The adoption of 5G technology in the vertical industries increases the Gross Domestic Product (GDP) by at least 6.6%.
- 3) The number of enterprises utilizing 5G technology for their business operations must include at least 10,000 small and medium-sized enterprises (SMEs), which is equivalent to 2.2% of SMEs.⁵²
- 4) At least 700,000 people are able to receive remote medical diagnostic and consultation from the experts through leveraging the capabilities of 5G technology.
- 5) At least 700,000 students in the basic educational level are able to access digital education services that leverage the capabilities of 5G technology.
- 6) Every Smart City must adopt at least 6 5G use cases per city.
- 7) At least 70% of the digital workforces are equipped with the appropriate 5G-related skills that cater to the industrial needs.
- 8) 5G mobile adoption rate covers at least 80% of the population.

⁴⁸ Details of indicators explanation are in Appendix A: Explanation of the Indicators.

⁴⁹ Details of indicators' alignment are mentioned in Section 2.5: Strategies and Indicators for Promoting the Adoption of 5G Technology in Thailand.

⁵⁰ Includes all areas declared as the Special Economic Promotional Zones within EEC at the end of B.E. 2570.

⁵¹ Includes all cities declared as Smart City at the end of B.E. 2565.

⁵² Percentage of SMEs is calculated from the data of Office of Small and Medium Enterprise Promotion (OSMEP) which, in B.E. 2563, Thailand has 460,002 SMEs excluding micro-sized enterprises.

2.3 Thailand's 5G Technology Adoption Landscape

The Action Plan on Promoting the Adoption of 5G Technology in Thailand set the direction of development in accordance with Thailand digital landscape as defined in Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580). For this reason, the development goals for promoting the adoption of 5G technology in Thailand are divided into 2 phases. The 2-year phase (5G Inclusion) covers the development in B.E. 2564 to B.E. 2565, which is in line with Phase 2 (Digital Thailand I: Inclusion) of Thailand Digital Landscape that ends in B.E. 2565. The 5-year phase (5G Transformation) covers the development in B.E. 2566 to B.E. 2570, which is in line with Phase 3 (Digital Thailand II: Full Transformation) of Thailand Digital Landscape that ends in B.E. 2570. Nonetheless, several organizations have already started working on issues regarding the development of 5G technology in Thailand, simultaneously with the development of the Action Plan on Promoting the Adoption of 5G Technology in Thailand. Therefore, the 5G technology adoption landscape is divided into 3 phases as follows.

➤ **Initiation Phase (B.E. 2563)**

Thailand is aware of the capabilities of 5G technology and establish appropriate guidelines to support and drive the adoption of 5G technology.

➤ **2-Year Phase (B.E. 2564 - 2565) - 5G Inclusion**

In year 1-2, the 5G technology is accessible by all sectors in Thailand and the capabilities of 5G technology are widely utilized in the targeted areas.

➤ **5-Year Phase (B.E. 2566 - 2570) - 5G Transformation**

In year 3-7, Thailand can fully utilize the capabilities of 5G technology to drive a more equitable and inclusive development of the economy and society.

The direction of development in each phase is further categorized into 4 dimensions, including the infrastructure development, economic development, social development and ecosystem development. The following table, Table 2-1, describe the overview of the direction of development in each dimension in accordance with each phase of development.

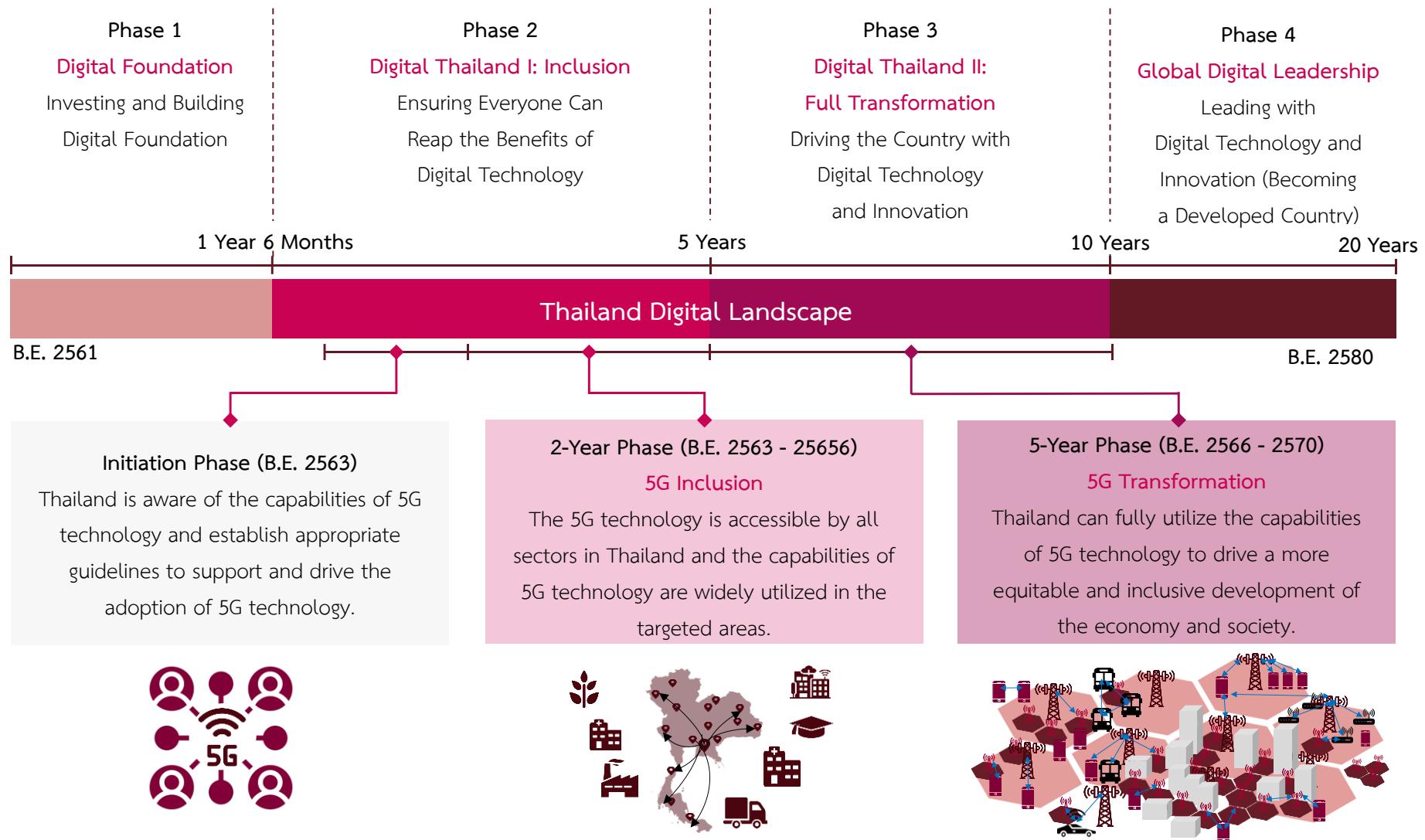


Figure 2-2: Thailand's 5G Technology Adoption Landscape

Table 2-1: Overview of the Direction of Development in the 4 Dimensions in Accordance with Each Phase of Development

	Initiation Phase (B.E. 2563)	2-Year Phase - 5G Inclusion (B.E. 2564 - 2565)	5-Year Phase - 5G Transformation (B.E. 2566 - 2570)
Infrastructure Development Landscape	Thailand is well-prepared for the expansion of 5G network coverage over the targeted key strategic zones.	Thailand has the 5G network that can support the adoption of 5G use cases in the targeted key strategic zones, namely EEC, Smart City Tambon Health Promoting Hospitals and Community ICT Learning Centers/Digital Community Centers.	Thailand has the 5G network that covers at least 98 percent of the population and the network is able to support the widespread adoption of 5G technologies in all sectors.
Economic Development Landscape	Thailand is aware of the benefits and potentials that 5G technology could offer in increasing the business capabilities.	Thailand utilizes 5G technology in the targeted key industries for improving the business competitiveness.	Thailand is able to transform into a technology and innovation-driven economy through the utilization of 5G technology.
Social Development Landscape	Thailand has concrete guidelines on the application of 5G technology for enhancing the quality and accessibilities of public services.	Thailand utilizes 5G technology for enhancing the people's quality of life and reducing disparities in accessing public services.	The whole population has equitable and inclusive access to quality public services through the adoption of 5G technology.
Ecosystem Development Landscape	Thailand realizes the importance of the collaboration and cooperation between all sectors to strengthen the 5G ecosystem for supporting the adoption of 5G technology.	All sectors in Thailand are engaged in strengthening the 5G ecosystem for accelerating the adoption of 5G technology.	All sectors in Thailand can fully utilize the benefits of 5G technology due to the well-established 5G ecosystem and network.

2.3.1 Infrastructure Development Landscape

Initiation Phase (B.E. 2563)

Thailand is well-prepared for the expansion of 5G network coverage over the targeted key strategic zones.

2-Year Phase (B.E. 2564 - 2565)

Thailand has the 5G network that can support the adoption of 5G use cases in various industries, making 5G network readily available throughout the key strategic zones and support the usage scenarios that require Enhanced Mobile Broadband (eMBB), Massive Machine Type Communications (mMTC) and Ultra-reliable and Low Latency Communications (URLLC). Thus, by the end of B.E. 2565, the 5G network must cover at least the following areas.

1) 50% of the defined Special Economic Promotional Zones within the Eastern Economic Corridor (EEC)⁵³ in all three provinces.

2) 50% of the residents in each Smart City⁵⁴

Additionally, in order to utilize 5G technology for enhancing public services, with the aim to improve the people's quality of life and reduce social inequalities, the 5G network must cover at least the following locations in the rural areas.

3) 500 Tambon Health Promoting Hospitals (THPHs)

4) 100 Community ICT Learning Centers/Digital Community Centers

5-Year Phase (B.E. 2566-2570)

Thailand expands the 5G network to cover majority of the area in the country. Also, Thailand shall be equipped with high-performance telecommunications infrastructures that cater to the needs of all sectors in utilizing 5G technology, leading Thailand into having a continual and sustainable development of digital technologies and innovations. Thus, by the end of B.E. 2570, the 5G network, with average DL speed at least 50 Mbps everywhere and 100 Mbps in Urban area, must cover at least the following areas.

1) 98% of the total population in the country, in order to efficiently drive the development in economic and social sectors.

⁵³ Includes all areas declared as the Special Economic Promotional Zones within EEC at the end of B.E. 2562.

⁵⁴ The target of 50% of the residents in each Smart City is aligned with the obligation of NBTC spectrum auction, which the 2-Year Phase is expected to cover approximately 30% of all cities declared as Smart City at the end of B.E. 2562.

2) Entire areas of the Special Economic Promotional Zones within the Eastern Economic Corridor (EEC)⁵⁵, in order to support the adoption of modern digital technologies in various vertical industries to improve the efficiency in providing products and services.

3) All residents in the Smart Cities⁵⁶, in order to fully utilize the benefits of 5G technology in the Smart City.

4) Entire areas of the Special Economic Zones (SEZs), in order to support the economic activities within the SEZs. Since SEZs are located at the border areas, including Tak Sa Kaeo, Trat, Songkhla, Mukdahan, Nong Khai, Kanchanaburi, Chiang Rai, Nakhon Phanom and Narathiwat, which are the gateways to neighboring ASEAN countries, there are regular ongoing trades and investments occurring at those zones. In addition, the SEZs are connected to several key transportation routes. Hence, the SEZs are another key strategic zone that helps link the local economy to international markets.

5) 7,800 Tambon Health Promoting Hospitals (THPHs), in order to facilitate all groups of people in accessing to quality health services, especially through the THPHs.

6) 1,800 Community ICT Learning Centers/Digital Community Centers, in order to facilitate all groups of people in accessing to public services, especially at the Community ICT Learning Centers/Digital Community Centers. In addition, people in all areas shall be well equipped with digital knowledge, especially on the 5G technology, and utilize those knowledges for their career development or to improve their quality of life.

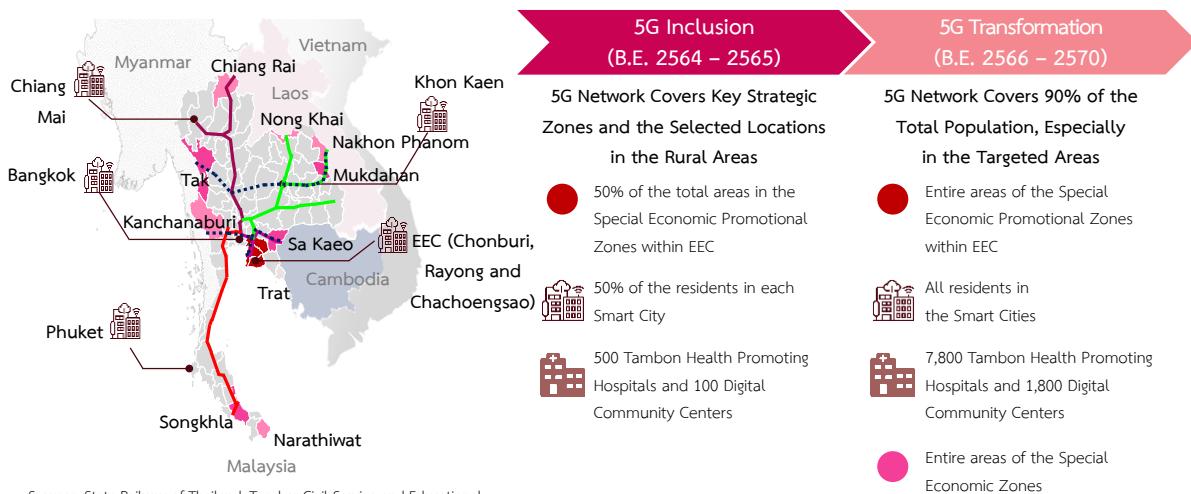


Figure 2-3: Infrastructure Development Landscape

⁵⁵ Includes all zones declared as the Special Economic Promotional Zones within the EEC by the end of B.E. 2570.

⁵⁶ Includes all cities declared as Smart City at the end of B.E. 2565.

2.3.2 Economic Development Landscape

Initiation Phase (B.E. 2563)

Thailand is aware of the benefits and potentials that 5G technology could offer in terms of the increase in productivity for the manufacturing sector and the increase in service quality for the service sector.

2-Year Phase (B.E. 2564 - 2565)

The private sector in the key industries that drive the economic development in Thailand utilizes 5G technology for improving their business operations in terms of efficiency and productivity, leading to incremental value creation which enhances the business competitiveness. The adoption of 5G use cases in this phase focuses on the industries that are located within the key strategic zones. Thus, for the 2-year phase, the emphasis is on the following 6 key industries⁵⁷.

- **Industrial Sector** utilizes 5G technology together with other types of technologies, such as Robotic Technology and Industrial Internet of Things (IIoT), to develop low-latency automation systems for uses in the smart factories which resulted in efficiency enhancement in the production process.
- **Transportation and Logistics Sector** utilizes 5G technology in Vehicle-to-everything (V2X) to improve efficiency and capacity in land, water and air transportations.
- **Agricultural Sector** utilizes 5G technology for collecting and analyzing data to help improve efficiency in farming and supply chain management, leading to the increase in income for the farmers.
- **Tourism Sector** utilizes 5G technology in tourist attraction, tourist journey and tourism services in order to enhance the experiences and create lasting impacts for the tourists.
- **Financial Sector** utilizes 5G technology for providing access to quality digital financial services across various channels and for providing a more secure and reliable digital financial services.
- **Wholesale and Retail Sector** utilizes 5G technology for enhancing the system capabilities, covering issues regarding e-commerce.

⁵⁷ The six key industries are the industries that contribute the most to Thailand's gross domestic product (GDP) in B.E. 2561 and are in line with the S-Curve targeted industries, namely 1) Next-Generation Automotive, 2) Intelligent Electronics, 3) High-Value and Medical Tourism, 4) Advanced Agricultural and Biotechnology, 5) Automation and Robotics, 6) Aviation and Logistics and 7) Digital.

5-Year Phase (B.E. 2566 - 2570)

Various industries in Thailand can fully utilize the capabilities of 5G technology together with modern technologies and innovations, as described in Figure 2-4. As a result, Thailand is able to transform into Thailand 4.0 whereby the economy development is driven by technology and innovation (Value-based Economy). With 5G technology supporting the applications of modern technology and innovation in various industries, the Thai economy will grow substantially both in terms of the economic value and Thailand's competitiveness in the global market.

Industrial Sector	Agricultural Sector	Transportation and Logistic Sector
		
<p>Thailand comprises of innovation driven enterprises (IDE) that are able to utilize 5G technology within the Connected and Automated Smart Factory to develop various automated processes including machine controlling and plant monitoring through intelligent automation systems.</p>	<p>Agriculture sector in Thailand makes use of 5G technology in Precision farming and Supply Chain Management to improve quality and quantity of agricultural products, leading to an increasing in competitive advantage in global market.</p>	<p>The efficiency of land, water and air transportation in Thailand has been improved from the use of Intelligent Transport System (ITS) and Vehicle-to-everything (V2X), supporting a wide variety of services in transportation and logistic sector.</p>
Tourism Sector	Financial Sector	Wholesale and Retail Sctor
		
<p>Tourism sector in Thailand is able to enhance tourist attraction, tourist journey and tourism ecosystem through various 5G applications in order to differentiate and create uniqueness in tourist attractions along with building the tourist's confidence in safety and improving the quality of services.</p>	<p>Thailand develops a wide range of digital financial services and the people have confidence in the online transaction systems which uses 5G network to offer fast, secure and reliable services, resulting in online transactions becoming a part of business operations and people's everyday life.</p>	<p>Thailand utilizes 5G technology together with various types of modern digital technologies to cater to the consumers' needs in buying and selling products and services through the secure and high-quality online platforms.</p>

Figure 2-4: Economic Development Landscape within the 5-Year Phase (B.E. 2566 - 2570)

2.3.3 Social Development Landscape

Initiation Phase (B.E. 2563)

Thailand has concrete guidelines on the application of 5G technology for enhancing the quality of public services and improving the accessibilities to public services.

2-Year Phase (B.E. 2564 - 2565)

Thailand utilizes 5G technology for enhancing the people's quality of life and reducing disparities in accessing public services, especially in the areas with 5G network coverage. Within the 2 years period, the emphasis is on the followings key sectors that have great impacts on the social development.

- **Public Health Sector** utilizes 5G technology for enhancing the efficiency and quality of medical services by using the capabilities of 5G technology for enhancing telehealth services to enable the population in the rural areas to have access to medical consultation from the experts.
- **Education Sector** utilizes 5G technology together with AR/VR technology for enhancing the learning experiences and the accessibilities to quality education.
- **Smart City Sector** utilizes 5G technology for enhancing the efficiency and quality of public services, especially in public services that improve public safety and the people's quality of life.

5-Year Phase (B.E. 2566 - 2570)

The whole population has equitable and inclusive access to quality public services through the adoption of 5G technology, especially in the public health sector, education sector and Smart City sector, as shown in Figure 2-5. Also, in order to enhance the quality of life in all areas, the local community and organizations must be engaged in driving the local development through the adoption of 5G technology.



Figure 2-5: Social Development Landscape within the 5-Year Phase (B.E. 2566-2570)

2.3.4 Ecosystem Development Landscape

Initiation Phase (B.E. 2563)

Thailand realizes the importance of the collaboration and cooperation between all sectors to strengthen the 5G ecosystem for supporting the adoption of 5G technology.

2-Year Phase (B.E. 2564 - 2565)

All sectors in Thailand are engaged in strengthening the 5G ecosystem, especially on the issues regarding the research and development of 5G technology and services, the availability of 5G equipment and devices, the investment from the private sector, the support from the government, the law, regulations and government procedures that facilitate the adoption of 5G technology, the confidence in utilizing digital technologies, the digital human capital, the accurate understanding of 5G technology, the awareness on the importance of 5G technology in all sectors, the market for 5G services and the 5G network and service security. In addition, the platform for promoting the collaboration and cooperation between all sectors is established to enable the rapid and efficient development of 5G ecosystem.

5-Year Phase (B.E. 2566-2570)

All sectors in Thailand can fully utilize the benefits of 5G technology, both in the economic and social sectors, due to the well-established 5G ecosystem and network.

2.4 Alignment with National Plans and Strategies

The Action Plan on Promoting the Adoption of 5G Technology in Thailand is aligned with the country's policies and plans, namely the 20-Year National Strategy, National Reform Plans, the Twelfth National Economic and Social Development Plan, National Security Plan and Policy (B.E. 2562 - 2565), Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580) and the 5-Year Action Plan for Digital Economy and Society (B.E. 2561 – 2565) where the details on their alignments and compliances with other strategies and plans are shown in Figure 2-6.

Additionally, The Action Plan on Promoting the Adoption of 5G Technology in Thailand is also in compliance with other policies, plans, laws, and regulations which include the Master Plans Under the National Strategy, Telecommunications Master Plan No. 2 (B.E. 2562 - 2566), Spectrum Management Master Plan B.E. 2562, Organization to Assign Frequency Waves and to Regulate the Radio Broadcasting, Radio Television and Telecommunications Services Act (No.3) B.E. 2562, and Development of Digitality for Economy and Society Act B.E. 2560, where all of which can be classified based on their respective plan levels as follows:

Linkages between the Action plan for Promoting the Adoption of 5G Technology in Thailand and Relevant Nation Plans and Policies

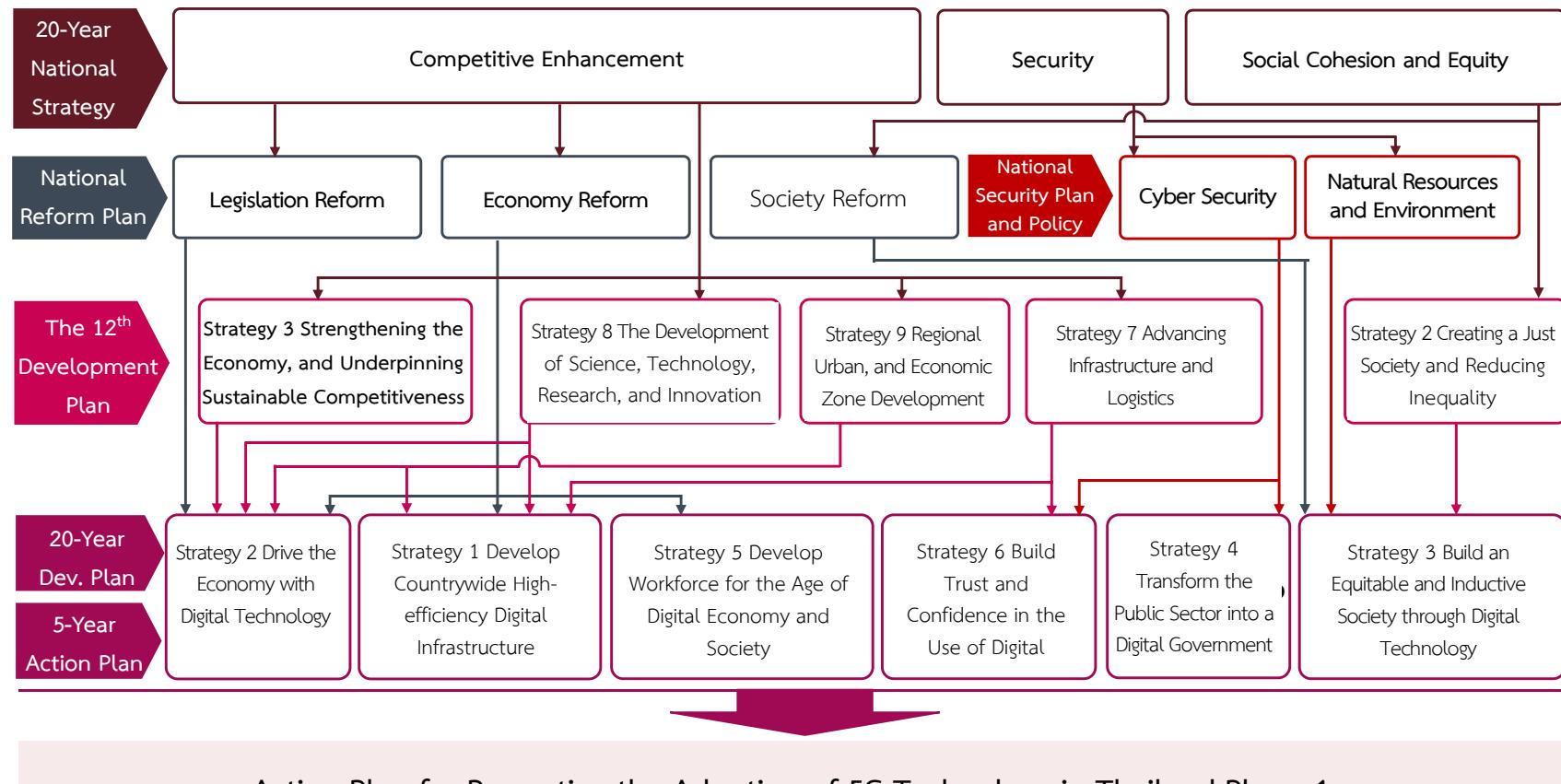


Figure 2-6: Linkages between the Action Plan for Promoting the Adoption of 5G Technology in Thailand and Relevant National Plans and Policies

1) Level-1 plan refers to the 20-Year National Strategy, which is a strategic plan with a vision for Thailand to become a developed country with security, prosperity and sustainability in accordance with the principles of the Sufficiency Economy Philosophy. The ultimate goals for the National Strategy include having “A Secure Nation, Contented People, Continued Economic Growth, An Equal Society, and Sustainable Natural Resources”. Thus, the six strategies under the 20-year National Strategy consists of 1) National Strategy on Security, 2) National Strategy on Competitiveness Enhancement, 3) National Strategy on Developing and Strengthening Human Capital, 4) National Strategy on Social Cohesion and Equity, 5) National Strategy on Eco-Friendly Development and Growth and 6) National Strategy on Public Sector Rebalancing and Development. Regarding the Action Plan on Promoting the Adoption of 5G Technology in Thailand, the direction of development is in line with the National Strategy on Competitiveness Enhancement which emphasizes on developing economic mechanisms to create higher added value of the agricultural, industrial and services sectors, with the employment of technology and innovation to enhance the country’s competitiveness. It is also in line with the National Strategy on Social Cohesion and Equity which is committed to ensuring equitable and inclusive access to quality public services and welfare practices, as well as the National Strategy on Security which focuses on preventing and addressing existing and future security related issues.

2) Level-2 plan refers to the national plans that provide the guideline and framework for the national development which support the implementation of the 20-Year National Strategy. The Level-2 plans include the followings.

- **Master Plans Under the National Strategy** corresponds to the key development guidelines as defined in the 20-Year National Strategy. Regarding the Action Plan on Promoting the Adoption of 5G Technology in Thailand, the four dimensions of development defined, namely the dimensions on infrastructure, economic, social and ecosystem, are in line with 20 master plans from a total of 23 master plans. The 20 master plans include the plans on Security, Foreign Affairs, Agriculture, Industries and Services for the Future, Tourism, Smart City and Space, Infrastructure Logistics and Digital System, Smart Entrepreneurs and SMEs, Special Economic Zone, Human Capability for All Age of Life, Learning Development, Thai People Well-Being Enhancement, Social Empowerment, Local Economy Development, Equity and Social Protection, Eco-friendly Growth, Integrated Water Management, Public Administration for the People, Laws and Justice Procedures

and Research and Innovation, as summarized in Table 1-1. The remaining 3 master plans not addressed include the plans on Value and Culture Adjustment, Sport Capability Improvement and Anti-corruption and Misconduct.

Table 2-2: Action Plan Alignment with the 20 Master Plans Under the National Strategy

	Infrastructure Dimension	Economic Dimension	Social Dimension	Ecosystem Dimension
Security			✓	✓
Foreign Affairs				✓
Agriculture		✓		
Industries and Services for the Future		✓	✓	
Tourism		✓		
Smart City and Space	✓		✓	
Infrastructure, Logistics and Digital System	✓	✓		
Smart Entrepreneurs and SMEs		✓	✓	✓
Special Economic Zone	✓	✓		
Human Capability for All Age of Life		✓	✓	✓
Learning Development			✓	✓
Thai People Well-Being Enhancement			✓	
Social Empowerment			✓	
Local Economy Development		✓		
Equity and Social Protection	✓		✓	
Eco-friendly Growth		✓	✓	
Integrated Water Management		✓	✓	
Public Administration for the People	✓		✓	✓
Laws and Justice Procedures	✓	✓	✓	✓
Research and Innovation	✓	✓	✓	✓

- **The Twelfth National Economic and Social Development Plan** is a 5-Year (B.E. 2560 - 2564) strategic plan that sets out the direction of Thailand's economic development into becoming a country with innovation-driven economy. The development strategies cover the following 10 issues.
 - 1) Strategy for Strengthening and Realizing the Potential of Human Capital
 - 2) Strategy for Creating a Just Society and Reducing Inequality
 - 3) Strategy for Strengthening the Economy, and Underpinning Sustainable Competitiveness
 - 4) Strategy for Environmentally-Friendly Growth for Sustainable Development
 - 5) Strategy for Reinforcing National Security for the Country's Progress towards Prosperity and Sustainability
 - 6) Strategy for Public Administration, Corruption Prevention, and Good Governance in Thai Society
 - 7) Strategy for Advancing Infrastructure and Logistics
 - 8) Strategy for the Development of Science, Technology, Research, and Innovation
 - 9) Strategy for Regional, Urban, and Economic Zone Development
 - 10) Strategy for International Cooperation for Development

Regarding the Action Plan on Promoting the Adoption of 5G Technology in Thailand, the direction of development is in line with the following strategies; Strategy 2: Creating a Just Society and Reducing Inequality; Strategy 3: Strengthening the Economy, and Underpinning Sustainable Competitiveness, which emphasizes on enhancing and developing the competitiveness in manufacturing and service sectors and allowing Thai economy to grow with full potential and stability; Strategy 7: Advancing Infrastructure and Logistics, which emphasizes on the development of infrastructure and facilities, including the development of digital infrastructure to promote the development of the digital economy; Strategy 8: Development of Science, Technology, Research, and Innovation, which emphasizes on the enhancement of application of science, technology and innovation to raise the level of competitiveness in manufacturing and service sectors, including the quality of life of people; Strategy 9: Regional, Urban, and Economic Zone Development which emphasizes on the development of the geosocial potential of each locality to enhance the strength

of each region and province to reinforce the foundations of the key manufacturing and services, as well as developing the urban areas to become livable cities and have the potential to support various businesses.

- **The National Reform Plans** covers the major reforms in the social, economic, and environmental dimensions which benefits the public sector, community and locality, and business sectors as well as the government sector to prepare Thailand into becoming a developed country with security, prosperity and sustainability. The reform plans cover 11 key areas: namely, Politics, State Administration, Legislation, the Judicial Process, Energy, the Economy, National Resources and the Environment, Public Health, Mass Media and Information Technology, Society and Anti-Corruption and Misconduct. The issues in relation to the promotion of 5G technologies are under the plan's guideline, namely the economy reform guideline, which emphasizes on building new industrial foundations including the digital industry so as to raise the potential of personnel, entrepreneurs and the country's overall industry; the society reform guideline, under the topic of creating inclusive opportunities for every community of the populace, and the legislation reform guideline, where amendments on laws that are obsolete or inconsistent to the current context of the society are addressed.
- **National Security Plan and Policy (B.E. 2562 - 2565)** is a national plan which concerns the national security in many different dimensions. The issues related to 5G technology revolve around preventing and solving cyber security issues which emphasizes on the capability development of all sectors to prevent and solve cyber security problems, including preparation to support the digital society, as well as developing knowledge and raising awareness of possible cyber threats. The other issue related to the promotion of 5G technology adoption is under the security of natural resources and the environment, aiming to prevent communities through sustainable natural resource and environmental management.

3) **Level-3 plan** refers to plans and policies that aim to support the implementation of Level 1 and Level 2 plans or plans in accordance with the laws or obligations or international conventions. The plans, policies, laws and regulations related to the deployment of 5G technology in Thailand are as follows:

- **Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580)** is considered as the main master plan for the development of digital economy and society in Thailand with the effective duration of 20 years (B.E. 2561-2580) by utilizing digital technology at its full potential to drive the economy and society in Thailand. This includes the use of digital innovations to add value to the economic and social systems as well as ensuring Thailand's prosperity and sustainability in the long run. The issues related to the promotion of 5G technology adoption are under Strategy 1: Develop countrywide high-efficiency digital infrastructure, which aims to develop a modern digital infrastructure where all citizens can equally access; Strategy 2: Drive the economy with digital technology, that focuses on promoting digital technology utilization in the business sector to reduce the costs of manufacturing goods and services; Strategy 3: Build an equitable and inclusive society through digital technology, aiming to improve the populace's quality of life while enabling all groups of the populace to gain equal access to government services; Strategy 4: Transform the public sector into a digital government, which aims to increase the efficiency of government services through digital technology; Strategy 5: Develop workforce for the age of digital economy and society, which focuses on developing workforces' creativity and their adoption in digital technology and Strategy 6: Build trust and confidence in the use of digital technology, aiming to build confidence in terms of the standards, privacy, and cyber security of digital technology.
- **5-Year Action Plan for Digital Economy and Society (B.E. 2561 - 2565)** is the first phase action plan under the Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580). The issues related to the promotion of 5G technology are under the plan's strategic development goals, including 1) the goal to drive the economy through the increase in average household income, distribution of income and economic prosperity in the region by relying on applications of digital technology in economic activities, 2) the goal to create a

quality society, focusing on improving the quality of life and providing access opportunities to public services through digital technology, 3) the goal on government's digital transformation, focusing on providing public or government services efficiently through digital technology, 4) the goal to develop digital infrastructure to support changes, emphasizing on the expansion of high-speed internet coverage in all areas, 5) the goal to build trust, focusing on eliminating cyber threats as well as building trust for business and public sector in the digital age, and 6) the goal to develop digital manpower, focusing on developing digital skills for various professions in order to increase labor productivity and raising awareness for the creative use of digital technology.

- **Telecommunications Master Plan No. 2 B.E. 2562 - 2566** is a master plan that sets out the regulation direction of telecommunications operators for the Office of the National Broadcasting and Telecommunications Commission (NBTC) with an effective duration of 5 years to support the rapid shift of digital ecosystem where 5G and IoT technology are expected to play an important role in the near future. The plan focuses on having a sufficient allocation of telecommunications resources; giving a comprehensive infrastructure support; promoting the effectiveness of market mechanisms; laying foundations for effective governance and strengthening consumers for the advancement to digital society in order to ensure a sustainable economic development. The issues related to the promotion of 5G technology adoption are under Strategy 1: Developing and promoting free and fair competition, focusing on the development of high-speed broadband networks that cover all areas and promote innovation as well as promoting access and utilization of telecommunications infrastructure to their full extent of benefits; Strategy 2: Telecommunications business licensing and regulation, which focuses on increasing the efficiency of licensing and regulation of business operations, including the adoption of digital technology to accommodate the operations; Strategy 3: Efficient utilization of telecommunication resources, aiming to manage spectrum frequencies and telecommunication numbering in an efficient, transparent and fair manner for public interest, security and communication in case of disasters and emergencies. Strategy 4: Providing universal basic telecommunications services and social services, which aims to inclusively provide basic telecommunication services in

terms of both spatial and social dimensions as well as develop broadband network in rural areas in order to improve education, public health, public services and information access opportunities; Strategy 5: Protecting consumer in telecommunications and services for social and public benefits, emphasizing on the promotion of the populace's awareness and capabilities to keep pace with digital technology as well as the regulation of quality telecommunications services provision at a reasonable price, and Strategy 6: Supporting the driving of digital development for economy and society, aiming to induce cooperation to drive digital policies through research and development activities that create value for the telecommunications industry.

- **Spectrum Management Master Plan (B.E. 2562)** is a master plan that sets out the criteria for the allocation and regulation of efficient spectrum management to sufficiently meet the demand, keep pace with the dynamic changes of technology and comply with international standards. The master plan has specified frequency bands to support 5G technology which include 3.4 - 3.7 GHz, 24.25 - 27.5 GHz and 27.5 - 29.5 GHz.

In addition, there are other important laws and regulations concerning the deployment of 5G technology in Thailand which consist of:

- **Organization to Assign Radio Frequency and to Regulate the Broadcasting and Telecommunications Services Act (No. 3) B.E. 2562** is an act related to the regulation of business operations and the licensing of frequencies uses in the best interest of the populace, state security and public benefits. This act is related to the implementation of 5G technology in term of frequency band; namely, this act fosters the use of spectrum that is permitted in accordance with the Spectrum Management Master Plan's specified frequency bands as mentioned above. The act contain clauses related to the Action Plan on Promoting the Adoption of 5G Technology in Thailand in the third chapter, namely Radio Frequency Licensing, Section 41: The licensing of spectrum for business operation shall be in accordance with the Spectrum Management Master Plan; Section 42: Spectrum band licensing shall be conducted only through bidding process; Section 43: The licensee is permitted to carry out radio broadcasting, television broadcasting or

telecommunications business, and Section 44: The use of spectrum band shall be suspended if it causes interference to the existing licensed spectrum.

- **Digital Development for Economy and Society Act B.E. 2560** is an act related to the promotion and development of the digital economy for the overall benefit of the economy and society of the country. The category related to the Action Plan for Promoting the Adoption of 5G Technology in Thailand is the Digital Development Fund for Economy and Society category, which aims to promote, support and assist various digital developments. The issues related to the promotion of 5G technology adoption are under Section 26 which involves spending funds to support the digital development of economy and society. The fund's objective is to promote, support, or assist the public or private sector in implementing digital development for the economy and society, as well as to subsidize research and development activities on matters related to digital development of economy and society.

2.5 Strategies and Indicators for Promoting the Adoption of 5G Technology in Thailand

In achieving the vision and goals of promoting the adoption of 5G technology in Thailand, the four strategies, which complement each other, have been established. The four strategies are in accordance with the direction of development as defined in section 2.3: Thailand's 5G Technology Adoption Landscape. Thus, the details of each strategy are as follows.

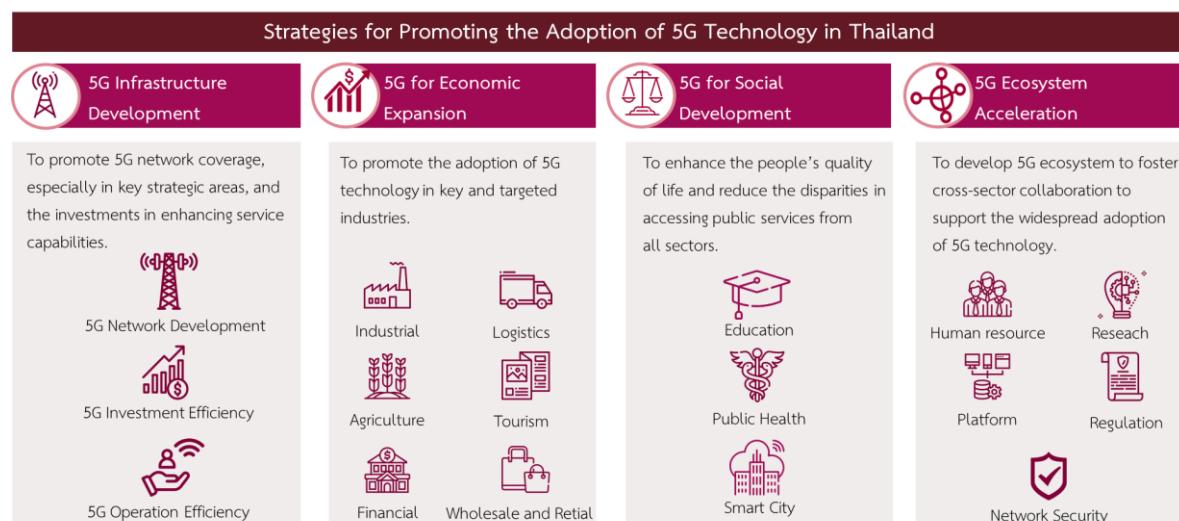


Figure 2-7: Strategies for Promoting the Adoption of 5G Technology

- **Strategy 1: 5G Infrastructure Development** - To promote 5G network coverage, especially in key strategic areas, and the investments in enhancing service capabilities, focusing on the efficiency development in 3 key areas, namely 1) Network and Spectrum Holding Efficiency, 2) Investment Efficiency and 3) Operational Efficiency.
- **Strategy 2: 5G for Economic Expansion** - To promote the adoption of 5G technology in businesses at all levels within the key and targeted industries, focusing on Industrial sector, Agricultural sector, Transportation and Logistics sector, Financial sector, Tourism sector and Wholesale and Retail sector in the initial stage.
- **Strategy 3: 5G for Social Development** - To promote the adoption of 5G technology for enhancing the people's quality of life and reducing disparities in accessing public services from all sectors, focusing on Education sector, Public Health sector and Smart City sector.
- **Strategy 4: 5G Ecosystem Acceleration** - To support the development of 5G ecosystem and foster cross-sector collaboration to support the widespread adoption of 5G technology, focusing on human resource development, platform development, research development, regulation development and in ensuring network security.

Regarding the four strategies defined in the Action Plan for Promoting the Adoption of 5G Technology in Thailand Phase 1, the development guidelines specified in each strategy emphasizes on achieving the goal of the 5G Inclusion phase. Nonetheless, the development would continue throughout the 5G Transformation phase. The indicators for each strategy under the Action Plan are adapted from the indicators in the six strategies under Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580) and the indicators in the 5-Year Action Plan for Digital Economy and Society (B.E. 2561 - 2565), as well as new indicators have been established to drive the adoption of 5G technology in the 2-year phase and 5-year phase. The alignment between the indicators for the 2-year phase and 5-year phase under each strategy and the indicators from the above-mentioned policy and plans are shown in Figure 2-8, Figure 2-9, Figure 2-10 and Figure 2-11.

Thailand Digital
Economy and Society
Development Plan
(B.E. 2561 - 2580)

5-Year Action Plan for
Digital Economy and
Society (B.E. 2561 - 2565)

2-Year Action Plan for
Promoting the Adoption
of 5G Technology in
Thailand
(B.E. 2564-2565)

2-Year Indicators of Strategy 1 & 2 and their Alignment with Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580)

Strategy 1	Strategy 2
<p align="center">Develop countrywide high-efficiency digital infrastructure</p> <p>1) Broadband Internet network will reach every village. - 90% of users in municipalities of every province and economic zone can access broadband service at a speed no less than 100 Mbps. - 95% of schools, Tambon (sub-district) health promotion hospitals, local administration organizations and digital community centers.</p> <p>2) Mobile broadband services will be accessible and available to the public, covering all villages, communities and tourism sites.</p>	<p align="center">Drive the economy with digital technology</p> <p>1) Competitiveness of Thai businesses will be increased by using digital technology. 2) Thailand will be placed in the top 30 of the Global Competitiveness Index in terms of technological readiness and innovation.</p>
<p>Thailand's ranking for the Technological Infrastructure sub-factor in the IMD World Competitiveness Index is ranked above 35th</p>	<p>500,000 Small and medium-sized enterprises (SMEs) adopt digital technology.</p>
<p align="center">Strategy 1: 5G Infrastructure Development</p> <p>1. 5G network coverage over the key strategic areas with average DL speed at least 50 Mbps everywhere and 100 Mbps in Urban area: - Covering 50% of defined areas in the Special Economic Promotional Zones within EEC*. - Covering 50% of the residents in each Smart City**. - Covering at least 500 Tambon Health Promoting Hospitals and 100 Community ICT Learning Centers/Digital Community Centers.</p> <p>2. Thailand's ranking for the Technological Infrastructure sub-factor in the Institute for Management Development (IMD) World Competitiveness Index improved by at least 3 rankings.</p> <p>3. The amount of spectrum allocated in all bands is enough to serve all 5G mobile service providers and is in line with the market conditions and competitive situation.</p> <p>4. The mobile service providers are able to refarm the existing spectrum for providing 5G network services.</p>	<p align="center">Strategy 2: 5G for Economic Expansion</p> <p>1. Thailand's ranking for the Overall Productivity (PPP) sub-factor in the Institute for Management Development (IMD) World Competitiveness Index improved by at least 3 rankings.</p> <p>2. The number of enterprises utilizing 5G technology for their business operations must include at least 2,000 SMEs, which is equivalent to 0.4% of SMEs***</p> <p>3. Thailand's ranking for the Use of Digital Tools and Technologies sub-factor in the IMD World Competitiveness Index improved by at least 3 rankings.</p>

Note: *Special Economic Promotional Zones as declared by B.E. 2562

** The target of 50% of the residents in each Smart City is aligned with the obligation of NBTC spectrum auction, which the 2-Year Phase is expected to cover approximately 30% of all cities declared as Smart City at the end of B.E. 2562.

***Percentage of SMEs is calculated from the data of Office of Small and Medium Enterprise Promotion (OSMEP) which, in B.E. 2563, Thailand has 460,002 SMEs excluding micro-sized enterprises.

Figure 2-8: 2-Year Indicators of Strategy 1 & 2 and their Alignment with Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580)

2-Year Indicators of Strategy 3 & 4 and their Alignment with National Digital Economy and Society Development Plan (B.E. 2561 - 2580)				
Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580)	Strategy 3 Build an equitable and inclusive society through digital technology	Strategy 4 Transform the public sector into a digital government	Strategy 5 Develop workforce for the age of digital economy and society	Strategy 6 Build trust and confidence in the use of digital technology
5-Year Action Plan for Digital Economy and Society (B.E. 2561 - 2565)	1) People of all groups will be able to access and utilize digital technology. 2) All Thais will become digitally literate. 3) People can access education, healthcare, and essential public services by digital means.	1) Government services will meet the demands of people and businesses with respect to convenience, speed and accuracy. 2) People will be able to access public sector information conveniently.	1) Digital professionals will be developed in both quantity and quality 2) Digital technology development will generate new jobs. 3) Workforce in all sectors will have digital know-how and skills.	1) People and businesses will have complete trust and confidence in online transactions. 2) Digital rules, laws and regulations will be updated. 3) Internationally accepted data standards.
2-Year Action Plan for Promoting the Adoption of 5G Technology in Thailand (B.E. 2564-2565)	77 Smart Cities.	The score of E-Government Development Index increases by 25%.	- 75% of population possess digital skills. - Develop digital workforce.	Cyber risks ranking is below 10 th
Strategy 3: 5G 5G for Social Development		Strategy 4: 5G Ecosystem Acceleration		
<p>1. Thailand's ranking for the Education sub-factor in the Institute for Management Development (IMD) World Competitiveness Index improved by at least 8 rankings.</p> <p>2. At least 4 5G use cases regarding the health technologies that are used for providing medical services, enhancing consumer protection or for commercial purposes must be developed.</p> <p>3. Every Smart City* must adopt at least 1 5G use case that promote public safety and/or enhance the public wellbeing per city.</p> <p>4. At least 300,000 students in the basic educational level are able to access digital education services that leverage 5G technology.</p> <p>5. At least 300,000 people are able to receive remote medical diagnostic and consultation from the experts through leveraging the capabilities of 5G technology.</p>		<p>1. Thailand's ranking for the Knowledge sub-factor in the Institute for Management Development (IMD) World Digital Competitiveness Rankings improved by at least 3 rankings.</p> <p>2. At least 20% of the digital workforces are equipped with the appropriate 5G-related skills that cater to the industrial needs.</p> <p>3. The public sector, private sector, educational sector and the general public are engaged through the central platform to jointly develop a conducive 5G ecosystem that facilitate adoption of 5G technology.</p> <p>4. At least 30% of the total 5G use cases being developed are commercialized.</p> <p>5. At least 2 measures that promote the development of 5G ecosystem are issued.</p> <p>6. 5G mobile adoption rate covers at least 5% of the population</p> <p>7. The technical standards of at least 10 5G use cases that support the economic and social development are issued.</p>		

Note: * All cities declared as the Smart City by the end of B.E. 2562

Figure 2-9: 2-Year Indicators of Strategy 3 & 4 and their Alignment with National Digital Economy and Society Development Plan (B.E. 2561 - 2580)

5-Year Indicators of Strategy 1 & 2 and their Alignment with Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580)

Strategy 1	Strategy 2
<p>Develop countrywide high-efficiency digital infrastructure</p> <p>1) Broadband Internet network will reach every village. - 90% of users in municipalities of every province and economic zone can access broadband service at a speed no less than 100 Mbps. - 95% of schools, Tambon (sub-district) health promotion hospitals, local administration organizations and digital community centers.</p> <p>2) Mobile broadband services will be accessible and available to the public, covering all villages, communities and tourism sites.</p>	<p>Drive the economy with digital technology</p> <p>1) Competitiveness of Thai businesses will be increased by using digital technology. 2) Thailand will be placed in the top 30 of the Global Competitiveness Index in terms of technological readiness and innovation.</p>
<p>Strategy 1: 5G Infrastructure Development</p> <p>1. The 5G network covers at least 98% of the population within B.E. 2570. 2. 5G network coverage over the targeted areas with average DL speed at least 50 Mbps everywhere and 100 Mbps in Urban area: - Covering the entire areas of defined zones declared as the Special Economic Promotional Zones within the EEC*. - Covering all residents in the Smart Cities**. - Covering at least 7,800 Tambon Health Promoting Hospitals and 1,800 Community ICT Learning Centers/Digital Community Centers.</p> <p>3. Thailand's ranking for the Technological Infrastructure sub-factor in the Institute for Management Development (IMD) World Competitiveness Index improved by at least 8 rankings.</p> <p>4. The amount of spectrum allocated in all bands is enough to serve all 5G mobile service providers and is in line with the market conditions and competitive situation.</p> <p>5. The sharing of public facilities, such as utility poles and street light poles, is not less than 10,000 poles.</p>	<p>Strategy 2: 5G for Economic Expansion</p> <p>1. Thailand's ranking for the Overall Productivity (PPP) sub-factor in the Institute for Management Development (IMD) World Competitiveness Index improved by at least 8 rankings. 2. The adoption of 5G technology in the vertical industries increases the Gross Domestic Product (GDP) by at least 6.6% 3. The number of enterprises utilizing digital technology for their business operations must include at least 10,000 SMEs, which is equivalent to 2.2% of SMEs.*** 4. Thailand's ranking for the Use of Digital Tools and Technologies sub-factor in the IMD World Competitiveness Index improved by at least 8 rankings.</p>

Note: *Special Economic Promotional Zones as declared by B.E. 2570

** All cities declared as the Smart City by B.E. 2565

***Percentage of SMEs is calculated from the data of Office of Small and Medium Enterprise Promotion (OSMEP) which, in B.E. 2563, Thailand has 460,002 SMEs excluding micro-sized enterprises.

Figure 2-10: 5-Year Indicators of Strategy 1 & 2 and their Alignment with Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580)

Thailand Digital
Economy and Society
Development Plan
(B.E. 2561 - 2580)

5-Year Action Plan for
Promoting the Adoption
of 5G Technology in
Thailand
(B.E. 2566-2570)

5-Year Indicators of Strategy 3 & 4 and their Alignment with National Digital Economy and Society Development Plan (B.E. 2561 - 2580)

Strategy 3 Build an equitable and inclusive society through digital technology	Strategy 4 Transform the public sector into a digital government	Strategy 5 Develop workforce for the age of digital economy and society	Strategy 6 Build trust and confidence in the use of digital technology
<ul style="list-style-type: none"> 1) People of all groups will be able to access and utilize digital technology. 2) All Thais will become digitally literate. 3) People can access education, healthcare, and essential public services by digital means. 	<ul style="list-style-type: none"> 1) Government services will meet the demands of people and businesses with respect to convenience, speed and accuracy. 2) People will be able to access public sector information conveniently. 	<ul style="list-style-type: none"> 1) Digital professionals will be developed in both quantity and quality 2) Digital technology development will generate new jobs. 3) Workforce in all sectors will have digital know-how and skills. 	<ul style="list-style-type: none"> 1) People and businesses will have complete trust and confidence in online transactions. 2) Digital rules, laws and regulations will be updated. 3) Internationally accepted data standards.
Strategy 3: 5G 5G for Social Development		Strategy 4: 5G Ecosystem Acceleration	
<ul style="list-style-type: none"> 1. Thailand's ranking for the Education sub-factor in the the Institute for Management Development (IMD) World Competitiveness Index improved by at least 12 rankings. 2. At least 14 5G use cases regarding the health technologies that are used for providing medical services, enhancing consumer protection or for commercial purposes must be developed. 3. Every Smart City* must adopt at least 6 5G use case that promote public safety and/or the enhance the public wellbeing per city 4. At least 700,000 students in the basic educational level are able to access digital education services that leverage 5G technology 5. At least 800,000 people in all areas are able to receive remote medical diagnostic and consultation from the experts through leveraging the capabilities of 5G technology. 6. Thailand's ranking for E-Government Development Index improved by at least 10 rankings by B.E. 2570. 		<ul style="list-style-type: none"> 1. Thailand's ranking for the Knowledge sub-factor in the the Institute for Management Development (IMD) World Digital Competitiveness Rankings improved by at least 3 rankings. 2. At least 20% of the digital workforces are equipped with the appropriate 5G-related skills that cater to the industrial needs. 3. The public sector, private sector, educational sector and the general public are engaged through the central platform to jointly develop a conducive 5G ecosystem that facilitate adoption of 5G technology. 4. At least 30% of the total 5G use cases being developed are commercialized. 5. At least 2 measures that promote the development of 5G ecosystem are issued. 6. 5G mobile adoption rate covers at least 5% of the population 7. The technical standards of at least 10 5G use cases that support the economic and social development are issued. 	

Note: * All cities declared as the Smart City by the end of B.E. 2565

Figure 2-11: 5-Year Indicators of Strategy 3 & 4 and their Alignment with Thailand Digital Economy and Society Development Plan (B.E. 2561 - 2580)

2.5.1 Strategy 1: 5G Infrastructure Development

To promote 5G network coverage, especially in key strategic areas, and the investments in enhancing service capabilities, focusing on the efficiency development in 3 key areas, namely 1) Network and Spectrum Holding Efficiency, 2) Investment Efficiency and 3) Operational Efficiency.

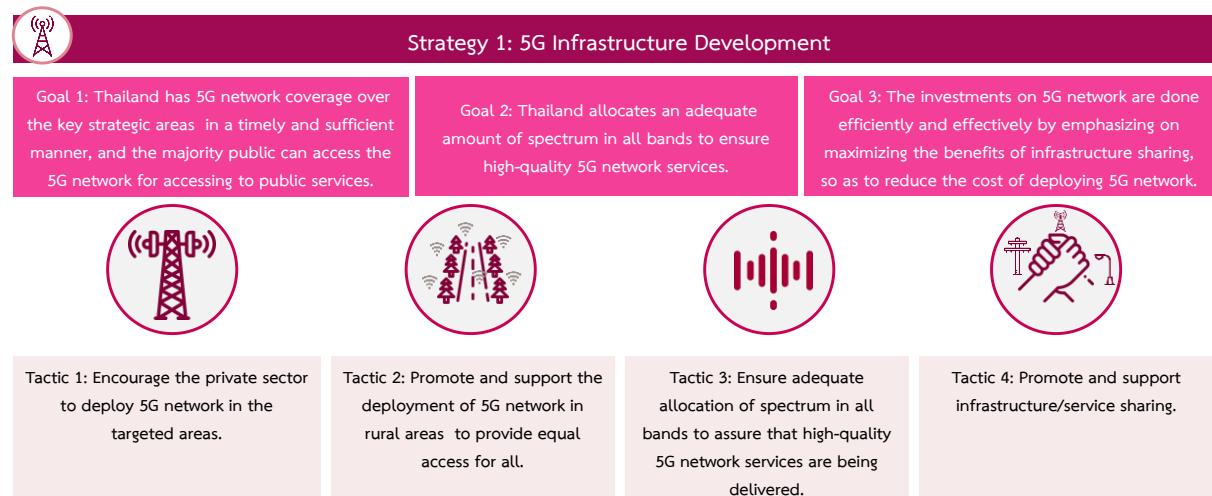


Figure 2-12: Strategy 1 5G Infrastructure Development

Goals

- Thailand has 5G network coverage over the targeted areas⁵⁸ in a timely and sufficient manner, and the majority public is able to access the 5G network for accessing to public services.

Indicators

- The 5G network covers at least 98% of the population within B.E. 2570.
- 5G network coverage over the key strategic areas with average DL speed at least 50 Mbps everywhere and 100 Mbps in Urban area:
 - Covering 50% of the defined Special Economic Promotional Zones within the Eastern Economic Corridor (EEC)⁵⁹ by B.E. 2565 and the entire areas of all zones declared as the Special Economic Promotional Zones within the EEC⁶⁰ by B.E. 2570

⁵⁸ Targeted area refers to the area that needs to install the 5G technology network in the first phase for economic and social benefits.

⁵⁹ Special Economic Promotional Zones in the EEC as declared by B.E. 2562.

⁶⁰ Special Economic Promotional Zones in the EEC as declared by B.E. 2570.

- Covering 50% of the residents in each Smart City⁶¹ by B.E. 2565 and all residents in the Smart Cities⁶² by B.E. 2570
 - 5G network coverage at public facilities with average DL speed at least 50 Mbps everywhere and 100 Mbps in Urban area
 - Covering at least 500 Tambon Health Promoting Hospitals and 100 Community ICT Learning Centers/Digital Community Centers by B.E. 2565 and at least 7,800 Tambon Health Promoting Hospitals and 1,800 Community ICT Learning Centers/Digital Community Centers by B.E. 2570.
 - Thailand's ranking for the Technological Infrastructure sub-factor in the Institute for Management Development (IMD) World Competitiveness Index improved by at least 3 rankings by B.E. 2565 and improved by at least 8 rankings by B.E. 2570⁶³.
2. Thailand allocates an adequate amount of spectrum in all bands to ensure high-quality 5G network services.

Indicators

- The amount of spectrum allocated in all bands is enough to serve all 5G telecommunication service providers and is in line with the market conditions and competitive situation.
 - The telecommunication service providers are able to reform the existing spectrum for providing 5G network services.
3. The investments on 5G network are done efficiently and effectively by emphasizing on maximizing the benefits of infrastructure sharing, so as to reduce the cost of deploying 5G network.

Indicators

- The infrastructure sharing rate increased.
 - The sharing of public facilities, such as utility poles and street light poles, is not less than 2,000 poles by B.E. 2565 and not less than 10,000 poles by B.E. 2570.
 - Tower Tenancy Ratio⁶⁴ equals to or higher than 1.5 by B.E. 2570⁶⁵.

⁶¹ The target of 50% of the residents in each Smart City is aligned with the obligation of NBTC spectrum auction, which the 2-Year Phase is expected to cover approximately 30% of all cities declared as Smart City at the end of B.E. 2562.

⁶² All cities declared as the Smart City by B.E. 2565.

⁶³ In B.E. 2562, Thailand was ranked 38th for Technological Infrastructure sub-factor in the IMD World Competitiveness Index.

⁶⁴ According to GSMA, the tower tenancy ratios are expressed as a fraction of total number of operators sharing towers/total number of sites present in which the ratio of 1.5 is recommended by the GSMA.

⁶⁵ In B.E. 2565, Thailand's Tower Tenancy Ratio is at 1.1.

Tactics

Tactic 1: Encourage the private sector to deploy 5G network in the targeted areas.

- **Approach 1:** Set the targeted areas for network deployment and targeted industries in order to boost investing confidence and increase investment opportunities among the investors by integrating the work from all relevant sectors.
- **Approach 2:** Determine the technical requirements of the 5G network in each targeted area and each targeted industry based on the quality of services of each 5G use case⁶⁶ to enable the telecommunication service providers to plan network designs to meet the need of the targeted areas and target industries.
- **Approach 3:** Stimulate the revision of regulations, rules, and conditions to facilitate 5G network deployment in the targeted areas and targeted industries as mutually agreed by the relevant sectors, as well as issue incentive measures such as tax incentive measures, fee reduction measures, and utility cost subsidies.
- **Approach 4:** Make appropriate amendments to the laws and regulations that obstruct the deployment of fibre optics cable, so as to ensure high-quality 5G services.

Tactic 2: Promote and support the deployment of 5G network in rural areas⁶⁷ to provide equal access for all.

- **Approach 1:** Promote collaboration among telecommunication service providers to invest in the 5G network and share the resources among themselves in order to reduce redundant investments.
- **Approach 2:** Promote cooperation with local organizations to deploy 5G network and develop 5G-based public services in local areas.

⁶⁶ The examples of key technical requirements for 5G use cases are in Appendix B Examples of Key Technical Requirements for 5G Use Cases.

⁶⁷ Rural area refers to zone C according to the definition of the Office of the National Broadcasting and Telecommunications Commission, which is defined as "areas without commercial potential and without services" that is the areas where basic telecommunications services are not yet available and it is expected that the said area will not have the potential and opportunity to be developed into a commercial area that can be serviced under current market conditions and environmental factors.

- **Approach 3:** Issue regulations, rules, and conditions to support 5G network rollout in rural areas.

Tactic 3: Ensure adequate allocation of spectrum in all bands to assure that high-quality 5G network services are being delivered.

- **Approach 1:** Promote the study, test and trial on the appropriate spectrum allocation tools for the maximum benefit and adequate allocation of spectrum to assure high-quality 5G network services are being delivered.
- **Approach 2:** Revise regulations and set guidelines to ensure adequate allocation of spectrum for delivering high-quality 5G network services.

Tactic 4: Promote and support infrastructure/service sharing.

- **Approach 1:** Promote the collaboration among relevant stakeholders to revise the regulations, the procedures, and the conditions for facilitating telecommunication service providers to access facilities for Small Cell deployment.
- **Approach 2:** Promote the provision of 5G network services that are suitable for creating new innovations to encourage the adoption of 5G technology and reduce monopolies in the market.

2.5.2 Strategy 2: 5G for Economic Expansion

To promote the adoption of 5G technology in businesses at all levels within the key and targeted industries, focusing on Industrial sector, Agricultural sector, Transportation and Logistics sector, Financial sector, Tourism sector and Wholesale and Retail sector in the initial stage.



Figure 2-13: Strategy 2 5G for Economic Expansion

Goals

1. Thailand can utilize 5G technology to improve the productivity of economic activities, leading to the generation of incremental value for the economy.

Indicators

- Thailand's ranking for the Overall Productivity (PPP) sub-factor under Business Efficiency Index in the Institute for Management Development (IMD) World Competitiveness Index improved by at least 3 rankings by B.E. 2565 and improved by at least 8 rankings by B.E. 2570⁶⁸.
- The adoption of 5G technology in the vertical industries increases the Gross Domestic Product (GDP) by at least 6.6% within B.E. 2570.

 2. The private sector adopts 5G technology to improve their operational efficiency, and hence enhances the country's competitiveness in the global market

Indicators

- The number of enterprises utilizing 5G technology for their business operations must include at least 2,000 small and medium-sized enterprises (SMEs), which is equivalent to 0.4% of SMEs by B.E. 2565 and at least 10,000 SMEs, which is equivalent to 2.2% of SMEs by B.E. 2570.⁶⁹
- Thailand's ranking for the Use of Digital Tools and Technologies sub-factor in the Institute for Management Development (IMD) World Competitiveness Index improved by at least 3 rankings in B.E. 2565 and improved by at least 8 rankings by B.E. 2570⁷⁰.

Tactics

Tactic 1: Encourage the manufacturing businesses, especially the SMEs, to adopt 5G technology for improving their productivity.

- **Approach 1:** Promote the adoption of 5G use cases in the manufacturing businesses to strengthen the core competencies of the key and targeted industries, especially within the key strategic areas such as the Eastern Economic Corridor (EEC).

⁶⁸ In B.E. 2562, Thailand was ranked 54th for Overall Productivity (PPP) sub-factor in the IMD World Competitiveness Index.

⁶⁹ Percentage of SMEs is calculated from the data of Office of Small and Medium Enterprise Promotion (OSMEP) which, in B.E. 2563, Thailand has 460,002 SMEs excluding micro-sized enterprises.

⁷⁰ In B.E. 2562, Thailand was ranked 40th for Use of Digital Tools and Technologies sub-factor in the IMD World Competitiveness Index.

- **Approach 2:** Encourage the agricultural sector to leverage the capabilities of 5G in combination with other agricultural-related technologies to enable smart farming such as the use of Internet of Things (IoT) for smart farming.

Tactic 2: Encourage the businesses in the service sector, especially SMEs, to adopt 5G technology for offering value-added services.

- **Approach 1:** Promote the adoption of 5G technology in the logistics sector to improve the efficiency and the quality of services.
- **Approach 2:** Support the adoption of 5G technology in combination with other technologies to enhance immersive experiences of the tourists.
- **Approach 3:** Make appropriate amendments to the laws and regulations related to the utilization of 5G technology in the service sector.
- **Approach 4:** Promote the development of 5G use cases that are secure and reliable for the financial sector.

2.5.3 Strategy 3: 5G for Social Development

To promote the adoption of 5G technology for enhancing the people's quality of life and reducing disparities in accessing public services from all sectors, focusing on Education sector, Public Health sector and Smart City sector in the initial stage.



Figure 2-14: Strategy 3 5G for Social Development

Goals

1. The public sectors leverage the capabilities of 5G technology to enhance the quality and efficiency of public services.

Indicators

- Thailand's ranking for the Education sub-factor in the Institute for Management Development (IMD) World Competitiveness Index improved by at least 8 rankings by B.E. 2565 and improved by at least 12 rankings by B.E. 2570⁷¹.
- At least 4 5G use cases regarding the health technologies that are used for providing medical services, enhancing consumer protection or for commercial purposes must be developed by B.E. 2565 and at least 14 5G use cases by B.E. 2570.
- Every Smart City⁷² must adopt at least 1 5G use case that promote public safety and/or the enhance the public wellbeing per city by B.E. 2565 and at least 6 5G use cases per city by B.E. 2570.
- Thailand's ranking for E-Government Development Index improved by at least 10 rankings by B.E. 2570⁷³.

2. The population in all areas, especially those residing in the rural areas, are able to access quality public services through leveraging the capabilities of 5G technology.

Indicators

- At least 300,000 students in the basic educational level are able to access digital education services that leverage the capabilities of 5G technology to enhance the learning experience by B.E. 2565 and at least 700,000 students in the basic educational level by B.E. 2570.
- At least 300,000 people are able to receive remote medical diagnostic and consultation from the experts through leveraging the capabilities of 5G technology by B.E. 2565 and at least 700,000 people by B.E. 2570.

⁷¹ In B.E. 2562, Thailand was ranked 56th for the Education sub-factor in the IMD World Competitiveness Index.

⁷² Includes all cities declared as the Smart City by the end of B.E. 2562 and by the end of B.E. 2565.

⁷³ In B.E. 2560, Thailand was ranked 73rd for E-Government Development Index.

Tactics

Tactic 1: Promote the enhancement of efficiency for providing medical services and reduce the disparities in accessing to quality healthcare.

- **Approach 1:** Make appropriate amendment to the laws and regulations that hinder the adoption of 5G technology in medical services.
- **Approach 2:** Promote the adoption of IoT devices for improving the efficiency of medical services and hospital systems.
- **Approach 3:** Leverage the eMBB capabilities of 5G technology to reduce the disparities in accessing to quality healthcare.

Tactic 2: Promote the development of 5G use cases that enhance public safety and public wellbeing, making the Smart City pleasant to live for all groups of people.

- **Approach 1:** Promote the collaboration between the relevant government agencies to facilitate the development of public services that enhance public safety and the well-being of the people in Smart Cities.
- **Approach 2:** Promote the adoption of 5G technology for public safety enhancement, in terms of life safety and property security, in Smart Cities.
- **Approach 3:** Promote the adoption of 5G technology to manage the environmental issues in Smart Cities efficiently.

Tactic 3: Enhance the quality of the education system and improve the accessibility to quality education.

- **Approach 1:** Promote the education sector to adopt 5G technology to enable all groups of people to have equal access to quality education.
- **Approach 2:** Promote the adoption of 5G technology in the education sector to enhance the quality of teaching and learning processes, focusing on providing exposure to real-world experiences.

2.5.4 Strategy 4: 5G Ecosystem Acceleration

To support the development of 5G ecosystem and foster cross-sector collaboration to support the widespread adoption of 5G technology, focusing on human resource development, platform development, research development, regulation development and in ensuring network security.

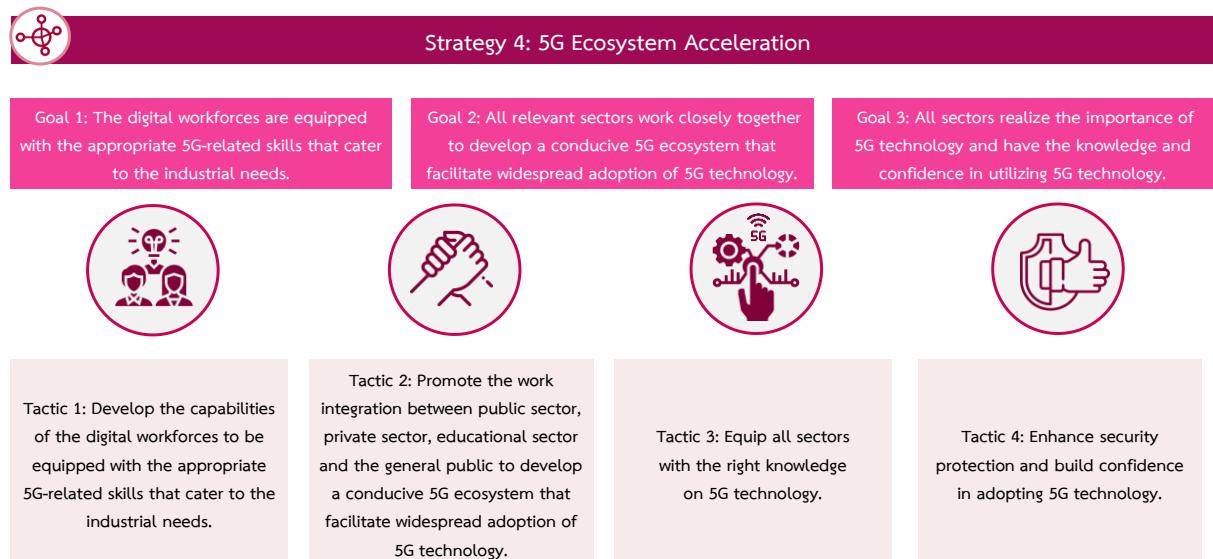


Figure 2-15: Strategy 4 5G Ecosystem Acceleration

Goals

1. The digital workforces are equipped with the appropriate 5G-related skills that cater to the industrial needs.

Indicators

- Thailand's ranking for the Knowledge sub-factor in the Institute for Management Development (IMD) World Digital Competitiveness Ranking improved by at least 3 rankings by B.E. 2565 and improved by at least 8 rankings by B.E. 2570⁷⁴.
 - At least 20% of the digital workforces are equipped with the appropriate 5G-related skills that cater to the industrial needs by B.E. 2565 and at least 70% of the digital workforces by B.E. 2570.
2. All relevant sectors work closely together to develop a conducive 5G ecosystem that facilitates widespread adoption of 5G technology.

⁷⁴ In B.E. 2562, Thailand was ranked 43rd for Knowledge factor in IMD World Digital Competitiveness Ranking.

Indicators

- The public sector, private sector, educational sector and the general public are engaged through the central platform to jointly develop a conducive 5G ecosystem that facilitate widespread adoption of 5G technology.
 - At least 30% of the total 5G use cases being developed are commercialized by B.E. 2565 and at least 50% of the total 5G use cases by B.E. 2570.
 - At least 2 measures that promote the development of 5G ecosystem are issued by B.E. 2565 and at least 7 measures by B.E. 2570.
3. All sectors realize the importance of 5G technology and have the knowledge and confidence in utilizing 5G technology.

Indicators

- 5G mobile adoption rate covers at least 5% of the population by B.E. 2565 and covers at least 80% of the population by B.E. 2570.
- The technical standards of at least 10 5G use cases that support the economic and social development are issued by B.E. 2565 and the technical standards of at least 100 5G use cases are issued by B.E. 2570.

Tactics

Tactic 1: Develop the capabilities of the digital workforces to be equipped with the appropriate 5G-related skills that cater to the industrial needs.

- **Approach:** Enhance the digital workforces with knowledge, skills and expertise that correspond to the needs of the industrial sectors in utilizing the benefits of 5G technology.

Tactic 2: Promote the work integration between public sector, private sector, educational sector and the general public to develop a conducive 5G ecosystem that facilitates widespread adoption of 5G technology.

- **Approach 1:** Promote the establishment of networking groups and enhance the cooperation between all sectors, as well as promote the accessibility of SMEs to resources that support the business development.

- **Approach 2:** Promote the collaboration across all sectors to develop innovations that utilize the capabilities of 5G technology and ensure that the 5G innovations are able to be commercialized.
- **Approach 3:** Develop the mechanisms and incentives for engaging all relevant parties, such as researchers, equipment vendors, 5G service providers and data center providers, in strengthening the ecosystem to support the wide adoption of 5G technologies across various sectors.

Tactic 3: Equip all sectors with the right knowledge on 5G technology.

- **Approach:** Raise awareness on the benefits of adopting 5G technology in each sector and to all individuals.

Tactic 4: Enhance security protection and build confidence in adopting 5G technology.

- **Approach 1:** Enhance cyber security protection to ensure a secure and reliable use of 5G technology.
- **Approach 2:** Build confidence in the utilization of 5G technology in all sectors by setting out standards / regulatory measures to support the economic and social development through the utilization of 5G technology.

2.6 Project Work Plans

The National 5G Steering Committee proposed 31 pilot projects, covering all four strategies, to drive the implementation of the Action Plan for Promoting the Adoption of 5G Technology in Thailand and the development of Thailand's 5G Technology Adoption Landscape. The number of pilot projects in each strategy is concluded as follows.

- Strategy 1: 5G Infrastructure Development comprises of 1 pilot project.
- Strategy 2: 5G for Economic Expansion comprises of 11 pilot projects.
- Strategy 3: 5G for Social Development comprises of 10 pilot projects.
- Strategy 4: 5G Ecosystem Acceleration comprises of 9 pilot projects.

The details of each pilot projects are as follows.

2.6.1 Project Work Plans for Strategy 1: 5G Infrastructure Development

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
1) 5G Network in Rural Area	***	<p>1) Promote the collaboration with stakeholders to boost the investment in Radio Access Network Infrastructure for 5G network deployment in Zone C area or non-commercial areas to align with the Net Pracharat Project.</p> <p>2) Arrange joint meetings with stakeholders to determine measures for sharing infrastructure permissions, for instance, telecommunication service providers make a mutual agreement to allocate for investment in 5G technology (RAN Infrastructure investment in Zone C⁷⁵ and then the telecommunication service provider has to provider 5G roaming service for other</p>	<p>1) To deploy 5G network in rural areas and enhance the quality of broadband internet service in rural areas.</p> <p>2) To promote a cost saving for telecommunication service providers, encourage network sharing, as well as avoid overlapping 5G network deployment.</p> <p>3) To support a collaboration with local organizations for 5G network rollout and adoption of 5G technology for public services.</p>	Main Organization CAT/TOT Supporting Organizations OPSMDES

⁷⁵ Rural area refers to zone C according to the definition of the Office of the National Broadcasting and Telecommunications Commission, which is defined as "areas without commercial potential and without services" that is the areas where basic telecommunications services are not yet available and it is expected that the said area will not have the potential and opportunity to be developed into a commercial area that can be serviced under current market conditions and environmental factors.

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>telecommunication service providers who are not responsible for that area.</p> <p>3) Provide and install telecommunication equipment throughout the target areas.</p> <p>4) Build the local engagement in order to come up with a real demand on public services and supporting the development of public services that utilize 5G technology such as Medical service, and Educational services, etc.</p>		

2.6.2 Project Work Plans for Strategy 2: 5G for Economic Expansion

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
1) 5G Precision Farming Trials	***	<p>1) Designate areas to test out 5G precision farming, focusing on open fields in the initial stage, and cooperate with small and mid-sized farmers or local agricultural cooperatives in deploying 5G-compatible IoT devices to support large data transfer.</p> <p>2) Extend the outcome of Agritech and Innovation Center (AIC) by encouraging knowledge sharing on the applications of 5G-compatible IoT devices in enhancing farm management and promoting the adoption of digital technologies to improve the productivity and efficiency of farming, as well as identify the obstacles in using digital technologies over 5G networks for agricultural use cases.</p> <p>3) Summarize the key results, especially on the incremental revenues, the cost reduction, and the increase in productivity, and identify both positive</p>	<p>1) To promote the adoption of 5G technology and IoT devices that complement with the farmer's know-how.</p> <p>2) To identify factors that impact the growth of each type of crop and analyze the collected data to precisely cater to the needs of each type of crops.</p> <p>3) To examine the benefits of 5G precision farming, such as the incremental revenue, cost reduction, and the increase in productivity.</p>	Main Organization OPSMOAC Supporting Organizations ONDE/DOA

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		and negative factors that impact the growth of each type of crops.		
2) 5G Automated Manufacturing Factory	***	<p>1) Establish 5G smart factories, initially, at the Industry Transformation Center (ITC).</p> <p>2) Develop machineries, equipment or technologies that rely on low-latency and huge connectivity between devices e.g.</p> <ul style="list-style-type: none"> ■ Automation System, such as Automated Guided Vehicle (AGV), Condition Based Maintenance ■ Remote Control Machinery, such as Remote-controlled Factory Robots <p>3) Promote the use of the developed machineries, equipment or technologies on the 5G network within the smart factory to assess the true cost, benefits and values of those 5G use cases.</p> <p>4) Enhance the competencies of local industrial firms, especially the small and medium-sized</p>	<p>1) To provide knowledge to the local firms, especially for small and medium-sized enterprises (SME), on the benefits of utilizing 5G technology in the industrial sector, and promote knowledge sharing between firms.</p> <p>2) To encourage industrial firms to adopt 5G use cases in their factories.</p> <p>3) To facilitate industrial firms in adopting the suitable 5G use cases for their factories.</p> <p>4) To ensure a reliable network for effective application with networks in industrial enterprises.</p>	Main Organization DIP Supporting Organization ONDE/ EECO/ FTI/ M-Industry

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		enterprises (SME), by supporting knowledge exchange, conducting workshops and providing consultation on adopting 5G technology for process improvement and efficient management.	5) To examine the costs, benefits, and values of 5G applications.	
3) 5G Smart Airport	***	<p>1) Support the adoption of 5G technology for enhancing airport automation at least in the following services: self-check-in system, baggage tracking system and biometric authentication system. The focus could be on enhancing the automation systems within the international airports, in which close collaboration with the relevant government agencies and airlines are much needed.</p> <p>2) Research and conduct trials on other 5G use cases that enhance airport services, such as developing interactive tools that offer personalized information to passengers.</p>	<p>1) To enhance operational efficiency and service quality at the airports.</p> <p>2) To improve the congestion issues within the airports by adopting 5G technology for enhancing airport automation systems.</p>	Main Organization AOT Supporting Organization DOA/ IB/ Customs/ DDC/ BAR

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		3) Encourage the adoption of other 5G use cases within the airport.		
4) 5G Augmented Tourist Attraction	***	<p>1) Develop mobile AR/VR platform that offer tourists the immersive experience at respective tourist attractions.</p> <p>2) Develop AR/VR contents for the selected tourist attractions through collaboration with key stakeholders, such as the locals and the Ministry of Culture.</p> <p>3) Make guidelines of appropriate preparations at the selected tourist attractions, such as the 5G network and devices that can use on AR/VR platform with 5G technology, providing in case tourists do not have AR/VR compatible devices.</p> <p>4) Integrate the AR/VR platform with social media applications for the tourists to share their experiences, which would help to publicize the AR/VR service in the online world. Nonetheless,</p>	<p>1) To enhance the experiences and impressions tourists receive at the tourist attractions.</p> <p>2) To enhance the competitiveness and value of Thailand's tourism sector.</p>	Main Organization OPSMOTS Supporting Organization TAT/ OPSMOC/ OPSMNRE

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		offline marketing must be done as well to promote the AR/VR services to the wide public.		
5) 5G Smart Greenhouse	**	<p>1) Establish 5G smart greenhouse within the Agritech and Innovation Center (AIC) focusing on conducting trials in enclosed area and yielding high-value crops such as tomato, strawberry, and melon.</p> <p>2) Implement 5G use cases that solve pressing issues or common issues in producing each type of crops in the greenhouse, especially the use cases that are developed by local digital startup, which are in the project of AIC.</p> <p>3) Install computers and software for processing data received by IoT devices within the smart greenhouse and present the analyzed information to the public.</p>	<p>1) To enhance the applications of IoT technology by utilizing 5G technology to improve efficiency in agricultural activities and reduce production cost.</p> <p>2) To identify factors that impact the production of each type of crop grown in the greenhouse and analyze the collected data to precisely cater to the needs of each type of crops.</p> <p>3) To examine the benefits of 5G smart greenhouse, such as the incremental revenue, cost reduction, and the increase in productivity.</p> <p>4) To promote knowledge sharing from the digital startups in the agricultural sector and promote the</p>	Main Organization OPSMOAC Supporting Organization DOA/ ONDE

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		4) Conduct knowledge sharing workshop between digital startups and farmers.	application of digital technologies in agricultural activities.	
6) 5G Remote Support for Machine Maintenance	**	<p>1) Develop platform and 5G-compatible devices by defining parameters and various connectors that support high definition live video streaming and support the use of AR technology. For example, headset display provides detailed guidance from experts back to the technicians.</p> <p>2) Select a few small and medium-sized enterprises (SME) in industrial business districts that have the potential to adopt digital technologies for the maintenance of industrial machineries, and work with them to use 5G Remote Support for Machine Maintenance in real case scenarios.</p> <p>3) Promote the use of 5G Remote Support for Machine Maintenance in other industrial firms.</p>	<p>1) To reduce transportation costs of repairing industrial machineries.</p> <p>2) To reduce the time spent with machine maintenance and opportunity loss that may occur during the machine downtime.</p> <p>3) To enhance the capabilities of on-site technicians to be able to repair the machineries safely and accurately with the guidance of off-site experts through digital tools.</p>	Main Organization DIW Supporting Organization ONDE/EECO/ FTI/

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		4) Provide monitoring and evaluation progress report to the performance of 5G technology usage.		
7) 5G Smart Monitoring for Industrial Sector	**	<p>1) Provide a monitoring system and report water quality and air quality of industrial enterprises through the website.</p> <p>2) Install IoT sensors that are compatible with 5G technology at the appropriate locations within industrial enterprises to measure water and air environment in order to be uploaded in the automatic storage.</p> <p>3) Improve and develop the dashboard for reporting executives and authorities of the Ministry of Industry.</p>	<p>1) To support the development of IoT devices that are compatible with 5G technology for measuring the environmental factors in the manufacturing industry.</p> <p>2) To promote the sharing of environmental data for setting common practices within the industry.</p> <p>3) To reduce the pollution issues within industrial enterprises to ensure environmental sustainability.</p>	Main Organization M-Industry Supporting Organization DIW / OPSMHESI
8) 5G V2X and Drone Development	**	1) Research and analyze the benefits and possibilities of adopting 5G technology in vehicle-to-everything (V2X) communications and drones	1) To develop appropriate plans in promoting the adoption of V2X	Main Organization OPSMOT

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>as well as the suitability with the demand and supply of the relevant industries.</p> <p>2) Review the national laws regarding the use of V2X communications and drones within Thailand and in foreign countries to make appropriate amendments to the national law in order to facilitate the adoption of those technologies.</p> <p>3) Designate the suitable trials areas to test out V2X communications and drone over 5G network for uses in the relevant industries.</p> <p>4) Develop a detailed plan outlining actions needed to facilitate the adoption of V2X communications and drone over 5G network in the relevant industries.</p> <p>5) Trial V2X communications and drones over 5G network.</p>	<p>communications and drones within the relevant industries.</p> <p>2) To make appropriate amendments to the national laws and regulations as needed to facilitate the adoption of V2X communications and drones on 5G network.</p> <p>3) To reduce the existing problems within the transportation and logistics industry and improve the operational efficiency, especially on the accessibility to hard-to-reach areas or during emergencies.</p> <p>4) To initiate trials of V2X communications and drones for real-life use cases in various industries.</p>	<p>Supporting Organization</p> <p>OPSMDES/OTP/DLT/CAAT/OIE/DEPA/TISI/EECO</p>

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
9) 5G Smart Port	**	<p>1) Develop port management services, such as remote ship-to-shore container cranes and Enhance video surveillance with 5G & AI to help intelligent sort containers, and automated warehouse services, such as automated container handling and automated guided vehicle. The focus could be on developing services that utilize 5G capabilities, namely the low latency and high data transfer rate, and help improves the operational efficiency at the selected ports. In the initial stage, the trials could be conducted at the port within EEC.</p> <p>2) Support the use of Port Community System (PCS) and enhance the system efficiency by adopting 5G technology.</p> <p>3) Follow up on the adoption of 5G use cases in the selected ports and summarize key results,</p>	<p>1) To encourage logistics firms to adopt 5G use cases in their business operations.</p> <p>2) To utilize 5G technology for enhancing the efficiency of port management services</p> <p>3) To enhance the operational efficiency, develop value-added activities for the logistics sector using 5G technology and accelerate Thailand's export volume.</p> <p>4) To promote the ports in Thailand into becoming the logistics and distribution hub of the region.</p>	Main Organization PAT Supporting Organization ONDE/ OPSMOT / EECO

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		especially the cost and benefits of those use cases.		
10) 5G Intelligent Traffic System	**	<p>1) Install intelligent traffic light control systems that utilize 5G capabilities at the selected trial areas, especially within the key strategic zones such as the EEC area.</p> <p>2) Promote data integration between the intelligent traffic light control systems installed across the key strategic zones to analyse key development areas in providing a more efficient real-time traffic management.</p>	<p>1) To improve the traffic congestion issues by utilizing 5G capabilities.</p> <p>2) To improve the efficiency of road traffic management and control.</p>	Main Organization Department of Highways (DOH)/ Department of Rural Roads (DRR) and Department of Local Administration (DLA) Supporting Organization

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
				OTP/MOT/ DEPA
11) 5G Financial Service Inclusion	**	<p>1) Research and analyze the benefits and possibilities of adopting 5G technology in financial services in combination with other digital technologies such as Internet of Things (IoT), Augmented Reality (AR), Virtual Reality (VR), Mixed Reality (MR). For example, Biometric Authentication, Remote Financial Advisers and Virtual Banking.</p> <p>2) Collaborate with all relevant sectors to make appropriate preparations for conducting trials on the 5G use cases for financial services.</p> <p>3) Conduct trials for various types of financial services or transactions and for uses on multiple devices or platforms.</p>	<p>1) To enhance efficiency in financial services and to provide a more secure and reliable digital financial services.</p> <p>2) To provide access to quality digital financial services across various channels.</p> <p>3) To make appropriate amendments to the rules and regulations to support the emerging 5G use cases in the financial sector.</p>	Main Organization BOT Supporting Organization TBA / OPSMDES

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		4) Define clear rules and regulations on providing secure digital financial services to support the widespread adoption of digital financial services in the future.		

2.6.3 Project Work Plans for Strategy 3: 5G for Social Development

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
1) 5G Telehealth	***	<p>1) Revise laws and regulations that impede the effective implementation of Telehealth, with clear obligations, financial systems, dispensing systems, and other relevant systems.</p> <p>2) Develop a platform that supports a connection between physicians and non-urgent patients to reduce the need for face-to-face treatment. The platform could support a connection between medical specialists, particularly for non-communicable diseases (NCDs), and physicians in Subdistrict Health Promoting Hospital (PHC) as well as Community Hospital. Consequently, the physicians can get advice for treatment instructions and the patients who live outside of the suburbs can get proper care from medical specialists and remote medical treatment services.</p>	<p>1) To reduce the disparities in accessing quality healthcare for people in all rural areas and to provide healthcare in remote areas.</p> <p>2) To increase the efficiency of medical services, by adopting 5G technology, for patients in all areas and all ages</p> <p>3) To make appropriate amendments to laws and regulations as needed to facilitate telehealth services.</p>	Main Organization OPSMOPH Supporting Organizations OPSMDES / DGA/ TMC

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>3) Develop telehealth applications covering the appointment system for medical consultation, dispensing system, data storage system for patients with continuity of care, and big data analytics system for disease screening and appropriate medical treatment guidelines.</p> <p>4) Make guidelines for the preparation of equipment and tools crucial to telemedicine accessibility for hospitals, with a shortage of medical equipment particularly 5G devices, as well as promote the utilization of Net Pracharat network for high-quality connectivity in remote areas, in addition to the Telehealth project, in which the NBTC and the Ministry of Public Health have jointly implemented.</p>		
2) 5G Real-Time Surveillance	***	<p>1) Verify coverage, quality, as well as the usage of the existing CCTV system, for new installation planning or for replacing with smart CCTV connected to 5G network.</p>	<p>1) To enhance the efficiency of public safety as well as life and property safety of people and tourists.</p>	<p>Main Organization DEPA</p>

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>2) Develop a real-time analytics system combined with Artificial Intelligence (AI) to analyze the data recorded by smart CCTV and to apply for catering to the needs of each Smart City such as motion detection, heat detection, license plate recognition, face detection, fire surveillance, or critical incident surveillance.</p> <p>3) Connect recording system and data analytics system of CCTV with City Data Platform to facilitate the relevant organizations to work immediately and to promote the data integration with other relevant organizations for the utilization of CCTV data at the national level.</p>	<p>2) To promote data integration from CCTV in each area to utilize the data for national development.</p>	Supporting Organizations OPSMDES / OPSMOI / AIAT / City Development Co., Ltd
3) 5G Virtual Classroom	***	<p>1) Develop an online learning platform in which teachers and students can interact with one another and/or learners can access course materials anytime.</p>	<p>1) To promote the equal opportunity for accessing high-quality education, especially students in the level of basic education in all areas throughout Thailand.</p>	Main Organization OPSMOE

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>2) Develop two online courses and create an online test to evaluate the comprehension level of students/teachers attending the courses.</p> <ul style="list-style-type: none"> ■ 1st Course for students: develop online courses, requiring subject matter experts to teach such as a third language lesson and a difficult lesson, to enable students to access/review the additional lessons for concerned issues anytime to promote equal educational opportunities. These would be the advantage of expanding lesson coverage in the long term. ■ 2nd Course for teachers: develop online courses, for improving teachers' quality and efficiency of teaching, to allow teachers to have a continual learning such as online monthly training which teachers do not need to waste traveling time. 	<p>2) To promote the development of quality and efficiency of teaching in all areas.</p> <p>3) To promote the accessibility of video content with a large amount of data transmission through 5G technology.</p>	Supporting Organizations OPSMDES/ ONDE/ CAT

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		3) Make preparation guidelines of necessary equipment and tools for the virtual classroom and distribute to schools that lack of mentioned educational equipment particularly 5G devices, as well as support the utilization of Net Pracharat network in rural areas.		
4) 5G Smart Hospital	**	<p>1) Select HealthTech entrepreneurs who are interested in 5G technology deployment for solving registered hospitals' problems or enhancing the quality and efficiency of services in the hospitals. 5G-enabled health services can be formed in the following technologies:</p> <ul style="list-style-type: none"> ■ Massive machine type communications (mMTC) services such as Internet of things (IoT) devices for improving the efficiency of equipment and tools management or for observing patients' health. 	<p>1) To promote the development of technologies and innovations for public health services</p> <p>2) To improve the efficiency of general and medical operations in the hospitals through 5G technology.</p>	<p>Main Organizations OPSMDES</p> <p>Supporting Organizations OPSMOPH / NSTDA</p>

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<ul style="list-style-type: none"> ■ Enhanced Mobile Broadband (eMBB) services such as AI technology for analyzing big data to screen patients' health and Multi-access Edge Computing (MEC) based private 5G network to guarantee data security and service performance in hospital ■ Ultra-reliable and Low Latency Communications (URLLC) such as Tele-ultrasound device, robotic nurse, and telesurgery. <p>2) Apply the technologies to test in the participated hospitals</p> <p>3) Monitor the performance and the outcome, compared with the cost, to evaluate the return of the medical services and consider whether this service is worth or not, by disclosing information on a publicly accessible platform.</p>		

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
5) 5G Ambulance	**	<p>1) Develop technologies and equipment installed in the ambulance to enable paramedics to remotely consult about patient's symptoms with medical specialists at the hospital through communication system of video, photo, and voice with high quality and low latency. This can facilitate the destination hospital with the data of patient's symptoms in order to prepare for medical equipment and place.</p> <p>2) Apply technology to test with pilot hospitals that have to support a lot of emergency cases.</p>	<p>1) To utilize 5G technology for improving quality and efficiency of emergency care.</p>	Main Organizations DMS Supporting Organizations OPSMDES / NIEMS / NSTDA
6) 5G Remote Monitoring for Elderly Care & People with Special Needs	**	<p>1) Develop a notification system, by applying a highly efficient 5G network, to immediately notify medical staff about an emergency situation such as an abnormal change in health of elderly or people with physical disabilities.</p> <p>2) Provide Internet of Medical Things (IoMT), which are wearable devices, for elderly and people with special</p>	<p>1) To monitor the health condition of the elderly and people with special needs immediately by leveraging the capabilities of 5G, which are fast and highly accurate.</p> <p>2) Elderly and people with special needs receive medical care continuously and efficiently.</p>	Main Organizations OPSMOPH

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>needs who get primary care and need for constant health monitoring.</p> <p>3) Develop an IoMT-based health monitoring system, for elderly and people with special needs, for recording patient's health data, transferring data to medical staff, and requesting for help by users in emergency.</p> <p>4) Analyze recorded health data, particularly medical value that each person has different medical characteristics based on types of disease, from IoMT device by using AI technology to apply the result of analysis for patient care.</p>	<p>3) To proactively cure, which would be beneficial for the complications detection at the initial phase and can prevent severe symptoms.</p>	<p>Supporting Organizations OPSMDES / TMC / DMS</p>
7) 5G Disaster Sentinel System	**	<p>1) Collect environmental data into a central platform to analyze and predict any environmental changes, especially flooding, as well as to provide early warnings.</p>	<p>1) To utilize environmental data, for disaster predictions in advance which allow the early warnings, in order to minimize property damage and the loss of lives.</p>	<p>Main Organizations DDPM</p>

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>2) Apply IoT devices, connecting with 5G networks, to collect complicated data and transfer data to central platform.</p> <p>3) Connect the data to City Data Platform.</p>	2) To utilize IoT devices for accurate and efficient data collection.	Supporting Organizations OPSMDES / Thai IoT
8) 5G Environmental Monitoring	**	<p>1) Connect data collection system of IoT device, which is for environmental monitoring, to City Data Platform.</p> <p>2) Install IoT device for water and air quality monitoring across Smart City to record data of water, air condition as well as pollution.</p> <p>3) Analyze data collected from IoT devices for environmental management in Smart City.</p>	1) To increase the efficiency of the data collection process about climate change from water and air, which can be used for further environmental management.	Main Organizations TMD Supporting Organizations OPSMNRE/ Thai IoT/ City Development Co., Ltd
9) Vocational Skill Enhancement with 5G	**	1) Design curriculum, by providing digital content as Virtual Reality (VR) or Mixed Reality (MR), for vocational education, such as electrical engineering program, machine shop mechanics program, and	1) To enhance the quality of vocational education, focusing on practical learning, through adopting 5G technology.	Main Organizations VEC

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>automotive mechanic program, etc. Students can practice essential skills through VR-based learning without incurring the risks of working with real-world equipment.</p> <p>2) Provide VR technology and/or MR technology for Vocational Education and Training Career Center (TVET) in all regions in order to enhance educational quality by adopting digital technology.</p>	<p>2) To create and develop workforces with the appropriate skills that cater to the industrial needs.</p> <p>3) To reduce the shortage of equipment and materials for practical training.</p> <p>4) To reduce risk and prevent accidents from working with real-world equipment/environment.</p>	<p>Supporting Organizations DEPA / OPSMHESI</p>
10) 5G Government e-Service Kiosk	**	<p>1) Study on and prioritize necessary government services for people in order to develop those government services to e-government services.</p> <p>2) Deploy 5G network for supporting data transmission from e-government services such as high-quality video, interactive content, etc.</p> <p>3) Set up Kiosk, developed to efficiently provide e-government services and located at Digital</p>	<p>1) To improve the accessibility of people for government services with quality and speed.</p> <p>2) To develop e-government services meeting the demand of users.</p>	<p>Main Organizations DGA</p> <p>Supporting Organizations</p>

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		Community Center in the initial phase as an interface of e-government services.		CAT / TOT / OPS MDES

2.6.4 Project Work Plans for Strategy 4: 5G Ecosystem Acceleration

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
1) 5G Accelerator Program	***	<p>1) Establish cooperative networks to drive the commercial 5G services through cross-section collaboration such as government agencies, universities, telecommunication service providers, entrepreneurs in various industries, other private agencies, etc.</p> <p>2) Develop a platform that supports desktop version and mobile version, allowing user to be able to easily access for 5G related information as well as integrating all data related to the 5G utilization for exchanging data between stakeholders regarding 5G</p>	<p>1) To create cooperative networks between government agencies, private agencies, universities, and entrepreneurs in targeted industries, for mutually driving 5G services as concrete forms.</p> <p>2) To facilitate the 5G service development for all sectors through data integration on the one-stop service platform.</p>	Main Organization DEPA Supporting Organizations ONDE/ M-Industry/ OPSMOPH/ OPSMOT/

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>topics such as 5G Use cases, 5G Testbeds, 5G utilization, etc. and provide advices to entrepreneurs, who are interested to develop and adopt 5G technology as well as to produce 5G-compatible services for commercial distribution, in all aspects including legal, financial, and personnel, etc.</p> <p>3) Facilitate business matching for small and medium-sized enterprises such as, business matching between telecommunication service providers, which are digital service enable/ digital service creator, and entrepreneurs, between researchers and 5G service providers and distributors/entrepreneurs in the vertical industries, and between 5G service providers and distributors and entrepreneurs in the vertical industries, etc. and facilitate the place either a testbed or a sandbox that both business partners do not have the place for trials.</p>	<p>3) To encourage the 5G use cases to be available commercially.</p> <p>4) To strengthen provide opportunities to access the market for Small and Medium-sized Enterprises.</p>	OPSMOAC/ DCT

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		4) Provide monitoring and evaluation progress reports toward the acceleration of 5G utilization.		
2) 5G Awareness	***	<p>1) Produce online learning media to enhance knowledge for all sectors including public sector, private sector and the general public to raise awareness on the potentials and benefits of adopting 5G technology and other relevant topics such as the difference between the former technology and 5G technology, the importance of 5G technology on economy and society, the development of 5G-enabled services, the adoption of 5G technology in vertical industries, adaptation of personnel and agencies in the 5G era, and the issues related to Cybersecurity and privacy.</p> <p>2) Create public relations via media, such as videos on social media, for applying 5G technology in government agencies, private sectors and the general public.</p>	<p>1) To raise awareness on 5G-compatible services, which generate incremental value for the economy and improve the quality of life, to government agencies, private sector, and the general public.</p> <p>2) To boost motivation for developing 5G-enabled services and stimulate demand for the adoption of 5G technology.</p>	<p>Main Organization ONDE</p> <p>Supporting Organizations DEPA/ OPSMDES</p>

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
3) Upskills Digital Workforce for 5G Technology	***	<p>1) Develop courses for enhancing digital capabilities and upgrading the skills of digital workforces in both the public sector and the private sector which consists of 3 main courses as follows:</p> <ul style="list-style-type: none"> ■ The 1st course: Digital capability development for the adoption of 5G technology which the course includes the 5G relevant topics such as the foundation of 5G network, 5G infrastructures, and digital technology deployment on the 5G network consisting of adoption of IoT, Artificial intelligence, automation, and other on-demand technologies for industry sections. ■ The 2nd course: Upgrading digital skills for creating and developing digital technology which is compatible with 5G technology. ■ The 3rd course: Enhancing specialized digital skills for technicians in the 	<p>1) To develop capabilities of digital workforces/technicians to acquire knowledge and specialized skills which are beneficial to the development, implementation, and maintenance of 5G-related products and services for increasing operational efficiency and value to industries.</p> <p>2) To reach the demand on digital workforce both quantitative and qualitative.</p>	Main Organization DEPA Supporting Organizations OPSMHESI/ M-Industry/ TPQI/DSD

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>telecommunication industry or the relevant industries to improve Operation and Maintenance skills related to 5G technology.</p> <p>2) Create training and examinations for the digital workforce within each course.</p> <p>3) Disseminate the available courses on a publicly accessible platform for Lifelong Learning.</p>		
4) Thailand 5G Incubator	**	<p>1) Create specialized innovation networks across all R&D-related sectors such as government agencies, universities, SMEs, telecommunication service providers, telecommunications equipment vendors, digital service providers, and other private sectors.</p> <p>2) Research and develop 5Genabled services in the targeted industries.</p> <p>3) Integrate and share knowledge as well as transfer the results from research and development within the innovation network to be guidelines for further</p>	<p>1) Jointly Establish Open Platform to Unite Industry Partners, Accelerate Thailand 5G Ecosystem</p> <p>2) Incubation and commercial use of 5G 2B and 2 C use cases, application of 5G, cloud, and AI technologies in industries, introduction of ecosystem partners, help industry ICT transformation, and ICT talent cultivation.</p>	Main Organization OPSMHESI Supporting Organizations OPSMDES/ DEPA/ NIA / Universities/

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>development for other researchers and other sectors.</p> <p>4) Create areas that are conducive to research, develop and examine 5G-enabled services within the participating university areas.</p> <p>5) Specify supportive measures of research and development funding for encouraging 5G innovation from 5G technology.</p> <p>6) Build 5G test environment, enable E2E service integration, optimize performance, explore new services</p>		Telecommunications equipment providers/ Telecommunication service providers
5) 5G Economic & Social Impact Assessment	**	<p>1) Review and analyze information about 5G utilization in each major industry in Thailand.</p> <p>2) Evaluate the economic and social impacts of the 5G utilization in each major industry in Thailand.</p> <p>3) Analyze factors and threats affecting the adoption of 5G technology in each major industry in Thailand.</p>	<p>1) To evaluate the economic and social impacts of the 5G utilization in each industry.</p> <p>2) To develop guidelines for promoting the adoption of 5G technology in industries.</p>	Main Organization ONDE

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		4) Develop guidelines for promoting the adoption of 5G technology in each major industry in Thailand.		Supporting Organizations DEPA
6) Incentive for 5G Data Center Expansion	**	<p>1) Establish incentive measures to motivate the investments for data distribution to testbed areas, comprising of the whole supply chain including Cloud computing, and Edge computing. For example, the incentive measures include land tax deduction/exemption, corporate income tax deduction/exemption, and funding for data center service providers.</p> <p>2) Set criteria and guidelines for the consideration of privilege benefits.</p> <p>3) Publicize the incentive measures for data center investment.</p>	<p>1) To support the distribution of data center services to testbed areas both economic and social areas through providing incentives.</p> <p>2) To develop the ecosystem that supports the upcoming 5G investment and the widespread utilization of 5G technology.</p> <p>3) To improve the efficiency of 5G technology utilization.</p>	Main Organization DEPA Supporting Organizations ONDE / BOI

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
7) Cyber and Network Security Sandbox	**	<p>1) Design regulatory sandbox for cyber security testing which includes security of 5G adoption in industries.</p> <p>2) Implement the regulatory sandbox to examine the efficiency of cyber security system of Critical Information Infrastructure (CII).</p> <p>3) Develop cyber simulation systems for training workforces, regarding cyber security.</p>	<p>1) To introduce sandboxes for examining the regulations of cyber and network security, as well as inspecting vulnerability detection system, and penetration testing, for Critical Information Infrastructure (CII) organization.</p> <p>2) To establish efficient guidelines and strategies for regulating the digital infrastructure efficiently.</p> <p>3) To develop the cyber security workforce gaining more knowledge and understanding of cyber threats.</p>	Main Organization NCSA Supporting Organizations NSC/ ETDA/ TCSD
8) 5G IoT Monitoring & Market Potential Assessment	**	1) Study and analyze the IoT market conditions, competitions, and trends of IoT deployment for domestic.	1) To support the adoption of 5G-compatible IoT devices for developing economy and society efficiently.	Main Organization ONDE

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		<p>2) Evaluate the potential of adopting 5G-compatible IoT devices for developing economy and society.</p> <p>3) Establish guidelines for supporting the adoption of 5G-compatible IoT devices, as well as guidelines for developing an ecosystem in Thailand, in order to be prepared for the deployment of Massive IoT.</p> <p>4) Consider the necessary of definitions and regulation identification of IoT devices, along with the needs of improvement of guidelines/ obligations that assist the develop the ecosystem to be prepared for the deployment of Massive IoT.</p>	<p>2) To develop the domestic ecosystem to be prepared for the deployment of Massive IoT on the 5G network.</p>	<p>Supporting Organizations DEPA</p>
9) 5G Equipment Tax Incentive & Exemption	**	<p>1) Specify tax incentive measures for 5G-compatible devices such as Integrated Circuits, IoT devices, and Microelectronics, etc.</p> <p>2) Set criteria and guidelines for the consideration of tax incentive and exemption.</p>	<p>1) To motivate Thai entrepreneurs to produce 5G-compatible smart electronics which the qualifications are suitable to the suitable qualification for deployment in Thailand context.</p>	<p>Main Organization BOI</p>

***High Priority **Intermediate Priority *Low Priority

Project	Priority Level	Project Implementation Approaches	Objectives	Organization in Charge
		3) Publicize the tax incentives measures to the public and agencies in all sections.	2) To produce equipment that corresponds to the demand for 5G adoption of industry sections. 3) To reduce dependence on the import of smart electronic devices from overseas, and to raise the competitiveness of Thai entrepreneurs in the international market.	Supporting Organizations OPSMHESI/ DEPA

2.7 Flagship Projects

Out of the 31 pilot projects that correspond to the four strategies identified in the Action Plan for Promoting the Adoption of 5G Technology in Thailand, the Office of the National Digital Economy and Society Commission (ONDE) , Ministry of Digital Economy and Society, classified the pilot projects based on their priority level to identify flagship projects⁷⁶ that should be the key focus in the initial stage. Thus, the following criteria are used to determine the priority level.

1. Urgency: Assessing the projects that should be addressed in the initial stage, based on Thailand's context, to support the adoption of 5G technology.
2. Impact: Assessing the economic and social impacts, in terms of qualitative and quantitative impacts, that each project could create.

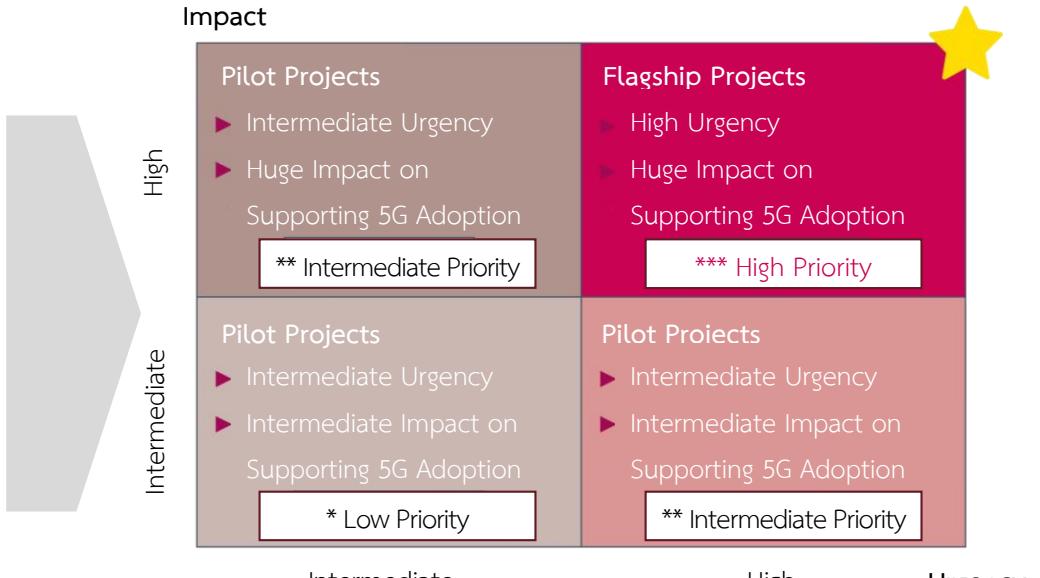
Subsequently, the priority of each pilot projects is classified into three levels, namely 1) *** High Priority (Flagship Project), 2) ** Intermediate Priority and 3) * Low Priority, as shown in Figure 2-16. Hence, after applying the above-mentioned criteria, there is a total of 11 flagship projects and the number of flagship projects in each strategy is concluded as follows.

1. Strategy 1: 5G Infrastructure Development comprises of 1 flagship project.
2. Strategy 2: 5G for Economic Expansion comprises of 4 flagship projects.
3. Strategy 3: 5G for Social Development comprises of 3 flagship projects.
4. Strategy 4: 5G for Ecosystem Acceleration comprises of 3 flagship projects.

⁷⁶ The priority of each project could be adjusted as appropriate.

Projects Under Each Strategy	31 Pilot Projects	11 Flagship Projects
5G Infrastructure Development	1 Projects	1 Project
5G for Economic Expansion	11 Projects	4 Projects
5G for Social Development	10 Projects	3 Projects
5G Ecosystem Acceleration	9 Projects	3 Projects

Criteria for Flagship Projects Selection



The criteria on urgency and impact are used to identify flagship projects that would help lay a solid foundation for 5G technology in the initial phase to support the widespread adoption of 5G technology in the future.

Figure 2-16: Criteria for Flagship Projects Selection

Strategy		Flagship Projects for Promoting the Adoption of 5G Technology	Outcomes
	5G Infrastructure Development	1. 5G Network in Rural Area	5G network coverage reaches the rural areas.
	5G for Economic Expansion	1. 5G Precision Farming Trials 2. 5G Automated Manufacturing Factory 3. 5G Smart Airport 4. 5G Augmented Tourist Attraction	5G use cases for each targeted industries are tested out in the real environment to stimulate the demand for 5G adoption.
	5G for Social Development	1. 5G Telehealth 2. 5G Real-Time Surveillance 3. 5G Virtual Classroom	The public sector utilizes 5G for enhancing the people's quality of life and reducing disparities in accessing public services.
	5G Ecosystem Acceleration	1. Upskills Digital Workforce for 5G Technology 2. 5G Accelerator Program 3. 5G Awareness	All sectors realizes the benefits of 5G, and cross-sector collaboration is formed to accelerate the 5G ecosystem.

Figure 2-17: Flagship Projects for Promoting the Adoption of 5G Technology

Each flagship project has different objectives, resulting in different urgency and impacts, as well as different implementation timeline and budget needed to implement each flagship project. The details of each flagship project are as follows

Strategy 1: 5G Infrastructure Development									
Project	KPI	Annual KPI Target			Total Budget (M Baht)	Annual Budget (Million Baht)			Organization in Charge (Main/ Supporting)
		B.E. 2564	B.E. 2565	B.E. 2566		B.E. 2564	B.E. 2565	B.E. 2566	
1) 5G Network in Rural Area	Number of Internet Broadband Service Points Accessible by the Public	Not less than 200 Tambon Health Promoting Hospitals and 40 Community ICT Learning Centers/Digital Community Centers	Not less than 300 Tambon Health Promoting Hospitals and 60 Community ICT Learning Centers/Digital Community Centers	Not less than 500 Tambon Health Promoting Hospitals and 100 Community ICT Learning Centers/Digital Community Centers	1,800.00	360.00	540.00	900.00	CAT TOT / OPSMDES OPSMOE

Remarks: The budget and KPI target for each flagship project could be adjusted as appropriate.

Strategy 2: 5G for Economic Expansion

Project	KPI	Annual KPI Target			Total Budget (M Baht)	Annual Budget (Million Baht)			Organization in Charge (Main/Supporting)
		B.E. 2564	B.E. 2565	B.E. 2566		B.E. 2564	B.E. 2565	B.E. 2566	
1) 5G Precision Farming Trials	Extensive Studies on Each Plant Species Covering the Factors That Affect the Cost and Productivity of Growing the Crops	Not less than 1 Species	Not less than 1 Species	Not less than 1 Species	60.00	20.00	20.00	20.00	OPSMOAC / ONDE DOA
	Number of Projects in the Pilot Areas	5 Projects	5 Projects	5 Projects					

Strategy 2: 5G for Economic Expansion									
Project	KPI	Annual KPI Target			Total Budget (M Baht)	Annual Budget (Million Baht)			Organization in Charge (Main/ Supporting)
		B.E. 2564	B.E. 2565	B.E. 2566		B.E. 2564	B.E. 2565	B.E. 2566	
2) 5G Automated Manufacturing Factory	Number of Factories Within the Information and Communication Technology Center	10 Smart Factories	10 Smart Factories	10 Smart Factories	240.00	80.00	80.00	80.00	DIP / ONDE EECO FTI M-Industry
	Number of SMEs Participated in the Programs	Not less than 500 SMEs participating in Automation System Development	Not less than 500 SMEs participating in Automation System Development	Not less than 500 SMEs participating in Automation System Development					

Remarks: The budget and KPI target for each flagship project could be adjusted as appropriate.

Strategy 2: 5G for Economic Expansion

Project	KPI	Annual KPI Target			Total Budget (M Baht)	Annual Budget (Million Baht)			Organization in Charge (Main/Supporting)
		B.E. 2564	B.E. 2565	B.E. 2566		B.E. 2564	B.E. 2565	B.E. 2566	
		participating in Remote Control Machinery Development	participating in Remote Control Machinery Development	participating in Remote Control Machinery Development					
3) 5G Smart Airport	Number of 5G Smart Airports	Not less than 1 Airport	Not less than 1 Airport	Not less than 1 Airport	195.00	65.00	65.00	65.00	AOT / DOA IB Customs DDC BAR
	Number of 5G Use Cases in Airport	Not less than 4 Services	Not less than 4 Services	Not less than 4 Services					

Remarks: The budget and KPI target for each flagship project could be adjusted as appropriate.

Strategy 2: 5G for Economic Expansion									
Project	KPI	Annual KPI Target			Total Budget (M Baht)	Annual Budget (Million Baht)			Organization in Charge (Main/ Supporting)
		B.E. 2564	B.E. 2565	B.E. 2566		B.E. 2564	B.E. 2565	B.E. 2566	
4) 5G Augmented Tourist Attraction	Number of Tourist Sites That Uses the AR Platform	10 Sites	20 Sites	20 Sites	120.00	30.00	45.00	45.00	OPSMOTS / TAT OPSMOC OPSMNRE
	User Experience Satisfaction Level Regarding the AR Platform	-	Satisfaction level not less than 80%	Satisfaction level not less than 80%					

Remarks: The budget and KPI target for each flagship project could be adjusted as appropriate.

Strategy 3: 5G for Social Development

Project	KPI	Annual KPI Target			Total Budget (M Baht)	Annual Budget (Million Baht)			Organization in Charge (Main/Supporting)
		B.E. 2564	B.E. 2565	B.E. 2566		B.E. 2564	B.E. 2565	B.E. 2566	
1) 5G Telehealth	Number of Participating Hospitals	Not less than 15 Tambon Health Promoting Hospitals	Not less than 15 Tambon Health Promoting Hospitals	Not less than 15 Tambon Health Promoting Hospitals	450.00	150.00	150.00	150.00	OPSMOPH / OPSMDES DGA TMC

Remarks: The budget and KPI target for each flagship project could be adjusted as appropriate.

Strategy 3: 5G for Social Development									
Project	KPI	Annual KPI Target			Total Budget (M Baht)	Annual Budget (Million Baht)			Organization in Charge (Main/ Supporting)
		B.E. 2564	B.E. 2565	B.E. 2566		B.E. 2564	B.E. 2565	B.E. 2566	
2) 5G Real-Time Surveillance	Number of Cities That Have Developed Real-Time Automated Data Analysis Systems for Smart Surveillance Cameras	Not less than 25 Smart Cities	Not less than 25 Smart Cities	Not less than 25 Smart Cities	80.00	26.00	26.00	28.00	DEPA / OPSMDES OPSMOI AIAT Smart City Development Companies
3) 5G Virtual Classroom	Number of 5G Contents for Students	Not less than 2 courses for each grade	Not less than 3 courses for each grade	Not less than 5 courses for each grade	150.00	60.00	45.00	45.00	OPSMOE / OPSMDES ONDE CAT
	Number of 5G Contents for Teachers	Not less than 4 courses	Not less than 4 courses	Not less than 4 courses					

Remarks: The budget and KPI target for each flagship project could be adjusted as appropriate.

Strategy 4: 5G Ecosystem Acceleration

Project	KPI	Annual KPI Target			Total Budget (M Baht)	Annual Budget (Million Baht)			Organization in Charge (Main/Supporting)
		B.E. 2564	B.E. 2565	B.E. 2566		B.E. 2564	B.E. 2565	B.E. 2566	
1) 5G Accelerator Program	Platform Establishment	Platform Established	-	-	80.00	50.00	15.00	15.00	DEPA / ONDE M-Industry OPSMOPH OPSMOT OPSMOAC DCT
	5G related collaborations or services that can be commercialized	-	5 Collaborations or Services	5 Collaborations or Services					
2) 5G Awareness	5G Adoption Rate	2.5% of the population	5% of the population	-	60.00	30.00	30.00	-	ONDE / DEPA OPSMDES

Remarks: The budget and KPI target for each flagship project could be adjusted as appropriate.

Strategy 4: 5G Ecosystem Acceleration									
Project	KPI	Annual KPI Target			Total Budget (M Baht)	Annual Budget (Million Baht)			Organization in Charge (Main/ Supporting)
		B.E. 2564	B.E. 2565	B.E. 2566		B.E. 2564	B.E. 2565	B.E. 2566	
3) Upskills Digital Workforce for 5G Technology	Number of Digital Workforce with Knowledge on 5G Technology	Not less than 2,000 individuals	Not less than 2,000 individuals	Not less than 2,000 individuals	450.00	150.00	150.00	150.00	DEPA / OPSMHESI M-Industry TPQI DSD
	Number of Digital Workforce That Are Knowledgeable in Creating and Developing Digital Technologies by Leveraging 5G Technology	Not less than 1,000 individuals	Not less than 1,000 individuals	Not less than 1,000 individuals					

Remarks: The budget and KPI target for each flagship project could be adjusted as appropriate.

Strategy 4: 5G Ecosystem Acceleration

Project	KPI	Annual KPI Target			Total Budget (M Baht)	Annual Budget (Million Baht)			Organization in Charge (Main/Supporting)
		B.E. 2564	B.E. 2565	B.E. 2566		B.E. 2564	B.E. 2565	B.E. 2566	
	Number of Technicians with Operational and Maintenance Skills Relevant to 5G Technology	Not less than 200 individuals	Not less than 300 individuals	Not less than 500 individuals					

Remarks: The budget and KPI target for each flagship project could be adjusted as appropriate.

2.8 Project Implementation Timeline

Project implementation timeline is in line with Thailand's 5G Technology Adoption Landscape. The project work plans in each strategy, described in section 2.6, will start in 2-Year Phase (B.E. 2564 – 2565) and some projects will extend the operations to 5-Year Phase (B.E. 2566 – 2570) to achieve the goal of the action plan for promoting the adoption of 5G technology in Thailand phase 1. The following table describes implementation timeline for each project.

No.	Project	5G Inclusion Stage			5G Transformation Stage					Priority Level
		B.E. 2564	B.E. 2565	B.E. 2566	B.E. 2567	B.E. 2568	B.E. 2569	B.E. 2570		
Strategy 1: 5G Infrastructure Development										
1	5G Network in Rural Area					Expand 5G coverage to cover the remaining Tambon Health Promoting Hospitals (THPHs) and Community ICT Learning Centers/Digital Community Centers.				***
Strategy 2: 5G for Economic Expansion										
2	5G Precision Farming Trials				Extend to other types of farming (livestock, fish farming, etc.).				***	
3	5G Automated Manufacturing Factory				Continue the developments and promote the applications of 5G industrial use cases in industrial-related businesses.				***	



Project Implementation based on Project Work Plans in section 2.6

No.	Project	5G Inclusion Stage			5G Transformation Stage					Priority Level
		B.E. 2564	B.E. 2565	B.E. 2566	B.E. 2567	B.E. 2568	B.E. 2569	B.E. 2570		
4	5G Smart Airport				Extend the applications of 5G use cases to other ports in Thailand.					***
5	5G Augmented Tourist Attraction				Continuously improve and develop the platform and contents.					***
6	5G Smart Greenhouse				Continue the developments and encourage the farmers to adopt 5G agricultural use cases in their cultivation.					**
7	5G Remote Support for Machine Maintenance									**
8	5G Smart Monitoring for Industrial Sector				Extend to the remaining industrial estates throughout the country.					**
9	5G Smart Port				Extend the applications of 5G use cases to other international airports within the country.					**
10	5G Intelligent Traffic System				Extend to the remaining Smart Cities.					**
11	5G V2X and Drone Development									**



No.	Project	5G Inclusion Stage		5G Transformation Stage					Priority Level
		B.E. 2564	B.E. 2565	B.E. 2566	B.E. 2567	B.E. 2568	B.E. 2569	B.E. 2570	
12	5G Financial Service Inclusion				Extend the development to cover a wider range of financial services.				**
Strategy 3: 5G for Social Development									
13	5G Telehealth				Extend to the remaining hospitals in Thailand.				***
14	5G Real-Time Surveillance				Extend to the remaining Smart Cities in Thailand.				***
15	5G Virtual Classroom				Continuously improve and develop the platform and contents.				***
16	5G Smart Hospital				Extend the applications of 5G use cases to the remaining large-scale hospitals				**
17	5G Ambulance				Extend to the remaining hospitals in Thailand.				**
18	5G Remote Monitoring for Elderly Care & People with Special Needs				Extend the development to cover wider range of target groups in Thailand.				**



Project Implementation based on Project Work Plans in section 2.6

No.	Project	5G Inclusion Stage			5G Transformation Stage					Priority Level
		B.E. 2564	B.E. 2565	B.E. 2566	B.E. 2567	B.E. 2568	B.E. 2569	B.E. 2570		
19	5G Disaster Sentinel System				Extend to the remaining Smart Cities in Thailand.					**
20	5G Environmental Monitoring				Extend to the remaining Smart Cities.					**
21	Vocational Skill Enhancement with 5G				Continuously improve and develop the platform and contents.					**
22	5G Government e-Service Kiosk				Extend the development to cover a wider range of e-government services and expand the service points to cover more locations.					**
Strategy 4: 5G Ecosystem Acceleration										
23	5G Accelerator Program				Continuously promote cross-sector collaboration between all relevant sectors.					***
24	5G Awareness									***
25	Upskills Digital Workforce for 5G Technology				Continuously improve and develop the skills of the existing digital workforce, as well as develop new digital workforce to meet the industrial's demands.					***

No.	Project	5G Inclusion Stage		5G Transformation Stage					Priority Level		
		B.E. 2564	B.E. 2565	B.E. 2566	B.E. 2567	B.E. 2568	B.E. 2569	B.E. 2570			
26	Thailand 5G Incubator				Continuously improve and develop the research and development on new 5G innovations.					**	
27	5G Economic & Social Impact Assessment				Continuously assess the economic and social impacts of the targeted vertical industries and extend the assessment to other vertical industries to develop suitable strategies for promoting the adoption of 5G technology in those industries.					**	
28	Incentive for 5G Data Center Expansion									**	
29	Cyber and Network Security Sandbox									**	
30	5G IoT Monitoring & Market Potential Assessment				Continuously assess the development of IoT market on an annually basis to analyze the market condition and competitive landscape.					**	
31	5G Equipment Tax Incentive & Exemption									**	



Project Implementation based on Project Work Plans in section 2.6



Section 3 |

Mechanisms for Driving the
Adoption of 5G Technology

Section 3 Mechanisms for Driving the Adoption of 5G Technology

3.1 Mechanism for Effective Implementation of the Action Plan for Promoting the Adoption of 5G Technology in Thailand

In the near future, 5G technology will have a significant role in various industries and it will also be a key factor that helps stimulate the economic and social developments in Thailand. Thus, there is a need to foster participation and collaboration between all sectors, and ensure that all sectors understand the benefits and opportunities of adopting 5G technology in their respective sectors, including understanding their roles and responsibilities in promoting the adoption of 5G technology in Thailand. In addition, a close collaboration between government agencies is also necessary to promote information and resource sharing, as well as aligning key activities to ensure that all government agencies are working toward the common goals. The mechanism to ensure effective implementation of the Action Plan for Promoting the Adoption of 5G Technology in Thailand includes the following components.

1. Foster Collaboration Between All Sectors

In the Action Plan for Promoting the Adoption of 5G Technology in Thailand, the organizations and businesses which have the potential to become the key players in driving the adoption of 5G technology in Thailand must be engaged in contributing their opinions on the vision, goals and strategies for promoting the adoption of 5G technology in Thailand. This is to ensure that the direction of development is in line with the demands from all relevant sectors, and that the Action Plan is plausible to implement. Also, by getting relevant government agencies involved in the Action Plan, those agencies will be aware of their roles and responsibilities in promoting the adoption of 5G technology in Thailand and prepare appropriate operational plans to proceed once the Action Plan is approved by the National 5G Steering Committee. The collaboration can be fostered by the National 5G Steering Committee or other related committees.

2. Strengthen Cooperation Between the Relevant Government Agencies

After the Action Plan for Promoting the Adoption of 5G Technology in Thailand has been approved by the National 5G Steering Committee, the relevant government agencies must come together to discuss on the mechanism for strengthening cooperation between all relevant government agencies. This is to ensure that the relevant government agencies do not perform overlapping tasks and to determine tasks that work integration between relevant agencies are possible, as well as to ensure the efficient uses of resources and to encourage

the sharing of resources that are essential for promoting the adoption of 5G technology in Thailand. In addition, in order for every government agency to work towards a common goal, it is necessary for all relevant agencies to jointly define both the specific key performance indicators for each agency and the key performance indicators for the common goals. Thus, the Sub-Steering Committee will be the main organization responsible for strengthening cooperation between the relevant government agencies, as well as being the center of communication and coordination between the relevant agencies in ensuring that the Action Plan is being implemented effectively.

3. Monitor and Evaluate the Performance and Progress

The National 5G Steering Committee or the Sub-Steering Committee or the 5G working group will be responsible for monitoring and evaluating the performance and progress of the Action Plan implementation by each relevant government agencies according to the responsibilities specified in the Action Plan. This is to keep track on the progress of each government agencies, which will also contribute to the overall progress of the Action Plan implementation in achieving the established goals. Moreover, it is also necessary to determine appropriate mechanism and tools for monitoring and evaluating the performance and progress of the Action Plan implementation, in which the results of the assessment must be collected and stored systematically to ensure that the relevant agencies are able to access the information conveniently and keep track of the status and results of the projects that may affect their operations as well. In addition, at nearly the end of fiscal year, the Sub-Steering Committee is required to hold the meeting among responsible organizations of each flagship projects to discuss, review and revise the project work plans in case of there are any necessities to make the adjustment, where it is more suitable to the current situation or the change of technology and innovation.

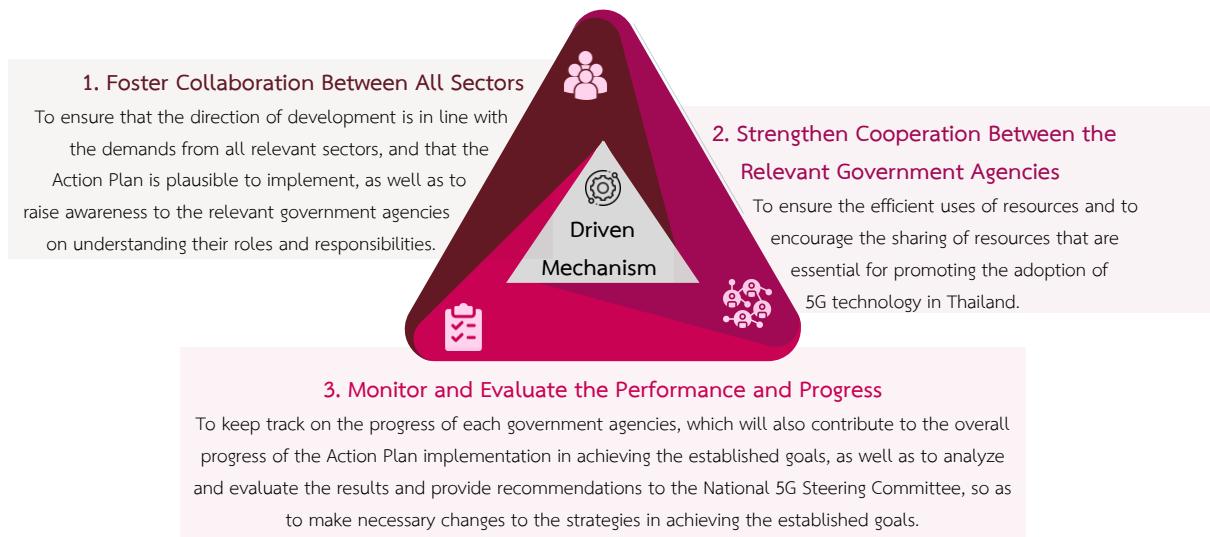


Figure 3-1: Mechanism for Effective Implementation of the Action Plan for Promoting the Adoption of 5G Technology in Thailand

The mechanism and tools for monitoring and evaluating the performance and progress of the Action Plan implementation includes the following components.

1. Coordinate with Relevant Government Agencies to Track Their Progresses

The Sub-Steering Committee is responsible for collecting the information and data regarding the progress of each activities or projects as defined in the Action Plan. The information and data that must be collected include; 1) self-assessment report prepared by relevant government agencies, in which each government agency shall prepare short half-year reports and comprehensive annual report regularly to report the progress and problems faced while carrying out the action plan, 2) opinions from key stakeholders and experts regarding the implementation of action plan by various government agencies to gather opinions from various perspectives and foster participations from various sectors, in which this could be done on a yearly basis and 3) statistical data of relevant industries or sectors and regarding the economic or society to analyze the development progress and outcomes of adopting 5G technology in Thailand, in which this could be done on a yearly basis as well. In addition, the collected data shall be stored electronically via the 5G Accelerator platform so that the data could be accessed and extracted conveniently.

2 Analyze and Evaluate the Results and Performance

The Sub-Steering Committee shall analyze and evaluate the collected data in a way that reflects 1) milestones 2) output or 3) outcome on the implementation of the Action Plan by each government agency. The evaluation on each government agency may not need

to cover all three factors but must be in line with the key performance indicators as defined in the Action Plan for Promoting the Adoption of 5G Technology in Thailand.

3 Prepare Summary Reports and Provide Recommendations

The Sub-Steering Committee in each strategy shall prepare summary reports based on the evaluated data and information. In each year, the Sub-Steering shall prepare a short mid-year report describing the progress and problems faced while implementing the Action Plan and a complete year-end report that also includes the development status on the adoption of 5G technology in Thailand, as well as the output and outcome of adopting 5G technology in each respective sectors. Also, the Sub-Steering Committee shall develop a set of recommendations on how to revise the action plan so as to achieve the defined vision and goals. The Sub-Steering Committee shall then present the summary reports and the recommendations to the National 5G Steering Committee. Thereafter, the evaluation results and meeting conclusions shall be stored systematically on the 5G Accelerator platform to allow all sectors to track the progress and performance on the implementation of the Action Plan, so that the relevant agencies could make use of the information to make necessary changes to their operations.

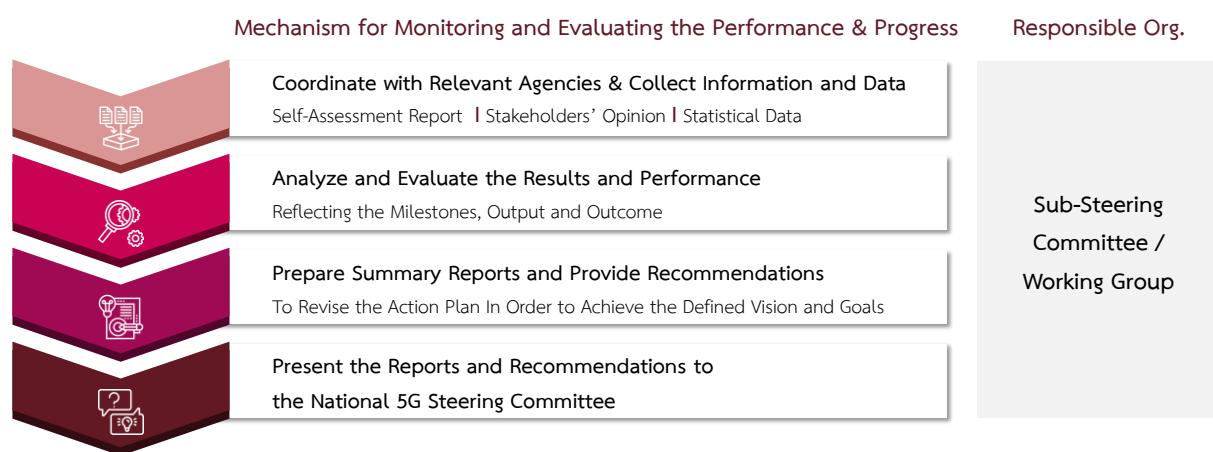


Figure 3-2: Mechanism for Monitoring and Evaluating the Performance and Progress



Appendix

Appendix

Appendix A: Explanation of the Indicators

The indicators are divided into 2-year phase (B.E. 2563 – 2565) and 5-year phase (B.E. 2566 – 2570), which are in accordance with the direction of development as defined in section 2.3: Thailand's 5G Technology Adoption Landscape.

Strategy	Indicators	Indicators Explanation
Strategy 1: 5G Infrastructure Development	The 5G network covers at least 98% of the population within B.E. 2570.	Considering the revolution of mobile wireless technology and the growing demand for 5G technology, together with the opinions from the telecommunications experts, the 5G network has the potential to covers 98 percent of the population in Thailand.
	5G network covering 50% of the total areas in the Special Economic Promotional Zones within the Eastern Economic Corridor (EEC) by B.E. 2565 and the entire areas of all zones declared as the Special Economic Promotional Zones within the EEC by B.E. 2570.	The Notification of the National Broadcasting and Telecommunications Commission on the Criteria and Procedures for Spectrum Licensing for International Mobile Telecommunications in the 700 MHz, 1800 MHz, 2500 MHz and 26 GHz Bands (Published in the Royal Thai Government Gazette on 27 th December B.E. 2562) specified that the 2600 MHz spectrum licensees must provide the network coverage not less than 50% of the areas in the Special Economic Promotional Zones within the Eastern Economic Corridor (EEC), as specified in the Eastern Special Development Zone Act effective as of the date the notification is published, within one year after the license was granted. Thus, in order to be aligned with the notification and Thailand's 5G technology adoption landscape, the

	<p>indicators for the strategy includes having 5G network covering 50% of the defined Special Economic Promotional Zones within the Eastern Economic Corridor (EEC) by B.E. 2565 and the entire areas of all zones declared as the Special Economic Promotional Zones within the EEC, as specified in the Eastern Special Development Zone Act effective as of B.E. 2570.</p>
	<p>5G network covering 50% of the residents in each Smart City by B.E. 2565 and all residents in the Smart Cities by B.E. 2570.</p> <p>The Notification of the National Broadcasting and Telecommunications Commission on the Criteria and Procedures for Spectrum Licensing for International Mobile Telecommunications in the 700 MHz, 1800 MHz, 2500 MHz and 26 GHz Bands (Published in the Royal Thai Government Gazette on 27th December B.E. 2562) specified that the 2600 MHz spectrum licensees must provide the network coverage in the economically-strategic urban areas, which includes Bangkok Metropolitan Region, Chiang Mai, Nakhon Ratchasima, Khon Kaen, Songkhla and Phuket, to drive the development on the infrastructure that supports the Smart City development as well as the developments in various industries and in service businesses. The network coverage must not be less than 50% of the total population in each province within four years after the license was granted. Therefore, in order to be aligned with the notification that requires the network coverage to be at least 50% of the</p>

	<p>population in the economically-strategic urban areas within B.E. 2567 and the trend of 5G network expansion in Thailand, the indicators for the strategy includes 5G network covering 50% of the residents in each Smart City by B.E. 2565 which is expected to cover approximately 30% in 2-Year Phase and all residents in the Smart Cities by B.E. 2570.</p>
5G network covering at least 500 Tambon Health Promoting Hospitals and 100 Community ICT Learning Centers/Digital Community Centers by B.E. 2565 and at least 7,800 Tambon Health Promoting Hospitals and 1,800 Community ICT Learning Centers/Digital Community Centers by B.E. 2570.	<p>Out of 9,863 Tambon Health Promoting Hospitals (data as of B.E. 2561) and 2,277 Community ICT Learning Centers/Digital Community Centers (data as of B.E. 2562), it is forecasted that the 5G adoption rate will be around 5% in B.E. 2565 and 80% in B.E. 2570. Therefore, within B.E. 2565, the 5G network must covers at least 500 Tambon Health Promoting Hospitals and 100 Community ICT Learning Centers/Digital Community Centers, and within B.E. 2570, the 5G network must covers at least 7,800 Tambon Health Promoting Hospitals and 1,800 Community ICT Learning Centers/Digital Community Centers.</p>
Thailand's ranking for Technological Infrastructure sub-factor in the IMD World Competitiveness Index improved by at least 3 rankings in B.E. 2565 and improved by at least 8 rankings by B.E. 2570.	<p>The International Institute for Management Development (IMD) publishes the World Competitiveness Index annually, in which the technological infrastructure is a sub-factor of the factor on measuring infrastructure competitiveness. In B.E. 2562, Thailand was ranked at 38th position, and it is anticipated to rise by one position per year. Therefore, Thailand has the potential to be</p>

	<p>ranked at 35th position by B.E. 2565 and at 30th position by B.E. 2570. The relevant elements that contributes to the ranking includes the followings:</p> <ol style="list-style-type: none"> 1. Investment in Telecommunications (% of GDP) 2. Mobile Broadband Subscribers 3. Communications technology meets business requirements 4. Internet Bandwidth Speed 5. Development and Application of Technology are Supported by the Legal Environment 6. Funding for Technological Development is Readily Available
	<p>The amount of spectrum allocated in all bands is enough to serve all 5G telecommunication service providers and is in line with the market conditions and competitive situation.</p>
	<p>The telecommunications service providers are able to refarm the existing spectrum for providing 5G network services.</p>

		licenses are still valid for providing 5G network services.
	The sharing of public facilities, such as utility poles and street light poles, is not less than 2,000 poles by B.E. 2565 and not less than 10,000 poles by B.E. 2570.	The specified number of poles that are opened for sharing to facilitate the installation of Small Cells for the expansion of 5G network is analyzed from the inputs of the experts in the telecommunications industry.
	Tower Tenancy Ratio equals to or higher than 1.5 by B.E. 2570.	Tower tenancy ratios are expressed as a fraction of total number of operators sharing towers divided by total number of sites present. In B.E. 2562, Thailand's tower tenancy ratio is at 1.1, which is considered low as compared to other countries, such as the United States had a high tenancy ratio of 2.2, India had a high tenancy ratio of 2.1 and Singapore had a moderate tenancy ratio of 1.6. The aim for promoting infrastructure sharing is to reduce redundant costs.
Strategy 2: 5G for Economic Expansion	Thailand's ranking for the Overall Productivity (PPP) sub-factor under the Business Efficiency factor in the IMD World Competitiveness Index improved by at least 3 rankings by B.E. 2565 and improved by at least 8 rankings by B.E. 2570.	The Overall Productivity (PPP ⁷⁷) sub-factor refers to the estimation of Gross Domestic Product (PPP) per person employed, whereby Thailand was ranked at 54 th position in B.E. 2562. Thus, promoting the adoption of 5G technology in Thailand is anticipated to create positive impacts to the ranking and raise the ranking by at least one position per year.

⁷⁷ The Organization for Economic Co-operation and Development (OECD) defined purchasing power parity (PPP) as the rates of currency conversion that try to equalize the purchasing power of different currencies, by eliminating the differences in price levels between countries.

	<p>The adoption of 5G technology in the vertical industries increases the Gross Domestic Product (GDP) by at least 6.6% within B.E. 2570.</p>	<p>The number is calculated based on the formula provided by the Office of The National Broadcasting and Telecommunications Commission as described in the report on “5G Technology and the Economic Benefits of Thailand”. The formula includes forecasting the future growth of GDP based on the historical average GDP growth rates and the assumption that the percentage of the benefits of 5G technology on the local economy is equals to the percentage of the benefits of 5G technology on the global economy based on the research from HIS Markit. Then, the numbers are further calculated using the Logistic Function Model, which explains the adoption of new innovations, to calculate the impact of 5G technology on the economy in each year. Thus, it is calculated that by B.E. 2570, the impacts of 5G technology on the GDP will be around 6.6%.</p>
	<p>The number of enterprises utilizing 5G technology for their business operations must include at least 2,000 small and medium-sized enterprises (SMEs), which is equivalent to 0.4% of SMEs by B.E. 2565 and at least 10,000 SMEs, which is equivalent to 2.2% of SMEs by B.E. 2570.</p>	<p>The indicator is adapted from the 5-Year Action Plan for Digital Economy and Society (B.E. 2561 - 2565), under the strategy on driving the economy with digital technology, which aims to transform 500,000 SMEs into Digital SMEs, as well as considering the recommendation from representative of key stakeholders in related industry. Therefore, the number of enterprises utilizing 5G technology is concluded to have at least 2,000 SMEs, which is equivalent to 0.4% of SMEs by B.E. 2565 and at least 10,000 SMEs, which is equivalent to 2.2% of SMEs by B.E.</p>

		2570. Regarding the Percentage of SMEs, the numbers are calculated from the data of Office of Small and Medium Enterprise Promotion (OSMEP) which, in B.E. 2563, Thailand has 460,002 SMEs excluding micro-sized enterprises.
	Thailand's ranking for the Use of Digital Tools and Technologies sub-factor in the IMD World Competitiveness Index improved by at least 3 rankings in B.E. 2565 and improved by at least 8 rankings by B.E. 2570.	The Use of Digital Tools and Technologies sub-factor refers to the companies that are very good at using digital tools and technology in improving their performance, whereby Thailand was ranked at 40 th position in B.E. 2562. Thus, promoting the adoption of 5G technology in the private sector is anticipated to create positive impacts to the ranking and raise the ranking by at least one position per year.
Strategy 3: 5G for Social Development	Thailand's ranking for the Education sub-factor in the IMD World Competitiveness Index improved by at least 8 rankings by B.E. 2565 and improved by at least 12 rankings by B.E. 2570.	It is adapted from the indicator in the National Scheme of Education (B.E. 2560-2579) under the section on the adjustments that comply to the changing context (Relevancy), which specifies that Thailand must be ranked at 48 th position within year 1-5 and ranked at 44 th position within year 6-10 for the Education sub-factor in the IMD World Competitiveness Index. In B.E. 2562, Thailand was ranked at 56 th position and hence, the ranking must be improved by at least 8 positions by B.E. 2565 and at least 12 positions by B.E. 2570.
	At least 4 5G use cases regarding the health technologies that are used for providing medical services, enhancing	It is adapted from the indicator in the 3-Year Action Plan of the Ministry of Public Health (B.E. 2563 -2565) which indicates that in B.E. 2564 and B.E. 2565, there must be at least 4 additional new or improved health

	<p>consumer protection or for commercial purposes must be developed by B.E. 2565 and at least 14 5G use cases by B.E. 2570.</p>	<p>technologies that are used for providing medical services, enhancing consumer protection or for commercial purposes being developed per year. It is anticipated that the 5G technology will help stimulate the development on the technology and innovation by at least 50% and hence, there shall be at least 2 5G use cases pertaining to health technologies being developed each year.</p>
	<p>Every Smart City must adopt at least 1 5G use case that promote public safety and/or enhance the public wellbeing per city by B.E. 2565 and at least 6 5G use cases per city by B.E. 2570.</p>	<p>The indicator for the 2-year phase is set at the minimum of 1 5G use case per city to ensure that all Smart Cities place an importance on promoting public safety or enhancing public wellbeing. The indicator for the 5-year phase is set at 6 5G use cases per city to ensure that all the dimensions regarding the social sectors are taken into account in the development of Smart Cities, which includes Smart Environment, Smart Energy, Smart Governance, Smart Living, Smart Mobility and Smart People. The public services that utilize 5G technology could be a mixture of different dimensions, depending on the context and needs of each Smart City.</p>
	<p>Thailand's ranking for E-Government Development Index improved by at least 10 rankings by B.E. 2570.</p>	<p>The E-Government Development Index was developed by the United Nations to measure the capability of the government in utilizing information and communications technology for providing public services to the people, and in B.E. 2560, Thailand was ranked at the 73rd position. Therefore, the</p>

		adoption of 5G technology in public services has the potential to raise the ranking by at least 1 position per year, and since the index is measured every 2 years, the indicator is set for 5-year phase only. Also, the indicator is in accordance with Thailand Digital Economy and Society Development Plan (B.E. 2561-2580).
	At least 300,000 students in the basic educational level are able to access digital education services that leverage the capabilities of 5G technology to enhance the learning experience by B.E. 2565 and at least 700,000 students in the basic educational level by B.E. 2570.	In B.E. 2562, Thailand has 41,073 education institutions responsible for 10,841,688 students and hence, on average, one education institution is responsible for 263 students. In total, Thailand has 29,715 institutions offering basic educational level, in which 15% of the institutions are located in the Bangkok Metropolitan Region and the central district of each province ⁷⁸ . With the assumption that the students who are studying in the Bangkok Metropolitan Region or the central district of each province are the group of people who can easily access the broadband network and digital technologies, therefore, the students in this group must be able to access the digital education services by B.E. 2565, which is equivalent to approximately 300,000 students. In the 5-year phase, the digital education services must be able to be accessed by 90% of the students in the basic education level, which is equivalent to approximately 700,000 students by B.E. 2570.
	At least 300,000 people are able to receive remote medical diagnostic and	In B.E. 2562, Thailand has 10,873 primary care units which is responsible for 39.87

⁷⁸ Source: Bureau of Information and Communication Technology, Office of the Permanent Secretary, Ministry of Education

	consultation from the experts through leveraging the capabilities of 5G technology by B.E. 2565 and at least 700,000 people by B.E. 2570.	million people ⁷⁹ . In B.E. 2561, there are approximately 18.25 million patients with non-communicable chronic diseases in Thailand, in which 3.33 million are inpatients ⁸⁰ . Hence, the remaining 14.92 million are outpatients who are required to have checkups at the hospital regularly, which is accounted for 22% of the total population ⁸¹ . Therefore, the primary care units need to take care of approximately 8.8 million outpatients with non-communicable chronic diseases annually. Telehealth is one of the solutions that can help the patients get access to the medical consultation from the experts without the trouble of traveling to the hospital. In the United States, 8% of the consumers have tried receiving medical consultation through Telehealth. Therefore, if Thailand started using Telehealth, it should be able to support at least 4% of the patients and if the emphasis is on the outpatients with non-communicable chronic diseases, Telehealth needs to support at least 300,000 patients by B.E. 2565. In the 5-Year phase, it needs to support at least 8% of the outpatients with non-communicable chronic diseases, which is approximately 700,000 patients.
Strategy 4: 5G for Economy Acceleration	Thailand's ranking for the Knowledge factor in the IMD World Digital Competitiveness Rankings improved by at least 3	The IMD World Digital Competitiveness Ranking ⁸² is calculated based on the average of 3 factors, which includes factor on 1) Knowledge, 2) Technology and 3) Future Readiness. In B.E. 2562, Thailand received

⁷⁹ Source: Office of the Primary Care System Support, Strategy and Planning Division, Office of the Permanent Secretary, Ministry of Public Health

⁸⁰ Source: Bureau of Non-Communicable Disease, Department of Disease Control, Ministry of Public Health

⁸¹In B.E. 2561, the National Statistical Office recorded a total of 66,413,979 population in Thailand.

⁸² Source: International Institute for Management Development (IMD)

	<p>rankings by B.E. 2565 and improved by at least 8 rankings by B.E. 2570.</p>	<p>the score of 58.4 for the factor on knowledge, and in the past 3 years, Thailand was ranked at the 44th position in B.E. 2560, 44th position in B.E. 2561 and 43rd position in B.E. 2562 for the factor on knowledge. This shows a sign of improvement in the digital knowledge for Thailand as a whole. Nonetheless, there could still be further improvement by enhancing the sub-factors. The 3 sub-factors include Talent, Training & Education and Scientific Concentration which are ranked at 40th position, 50th position and 35th position respectively in B.E. 2562. Therefore, organizing trainings and education for the personnel on enhancing their digital skills will help improve the ranking for the factor on knowledge by at least 1 position per year, using the ranking in B.E. 2562 as the base year.</p>
	<p>At least 20% of the digital workforces are equipped with the appropriate 5G-related skills that cater to the industrial needs by B.E. 2565 and at least 70% of the digital workforces by B.E. 2570.</p>	<p>The indicator is adapted from the 5-Year Action Plan for Digital Economy and Society (B.E. 2561 - 2565), under the strategy on developing workforce for the age of digital economy and society. The growth rate on the number of digital workforces in Thailand between B.E. 2560 and B.E. 2561 is approximately 8%. Therefore, the development of skills that are applicable for the application with 5G use cases need to at least cover the new digital workforces being developed each year, or at least 10% of the total workforce each year. Hence, at least 20% of the digital workforces must be</p>

		equipped with the appropriate 5G-related skills that cater to the industrial needs by B.E. 2565 and at least 70% of the digital workforces by B.E. 2570. The indicator focuses on the digital workforces that are being hired, which in a way reflected that they contain the appropriate skills that are needed by the industrial sector.
	The public sector, private sector, educational sector and the general public are engaged through the central platform to jointly develop a conducive 5G ecosystem that facilitate widespread adoption of 5G technology.	In promoting the collaboration and cooperation between all relevant sectors, a central platform that is managed by the government agency must be established. The central platform shall offer a one-stop service that facilitate the collaboration between all sectors and promote the establishment of networking groups, which together support the exchange of information, services and innovations, and drive the adoption of 5G technology in Thailand.
	At least 30% of the total 5G use cases being developed are commercialized by B.E. 2565 and at least 50% of the total 5G use cases by B.E. 2570.	The indicator is adapted from the Action Plan regarding Science, Research and Innovation (B.E. 2563-2565), which is a plan under the Policy and Strategy for Higher Education, Science, Research and Innovation (B.E. 2563-2565), with the purpose to measure the competitiveness of Thai innovations, and ensure that the research and development on innovations that are related to the 5G technology are utilizes in the targeted industries and public sector and fit the Thai context. Thereafter, in the 5-year phase, the researchers and developers would have the relevant know-hows and thus, able to develop 5G use cases that fit the Thai context at a more rapid pace.

	<p>At least 2 measures that promote the development of 5G ecosystem are issued by B.E. 2565 and at least 7 measures by B.E. 2570.</p>	<p>This is to create the incentives for engaging all relevant sectors in developing an ecosystem that supports the adoption of 5G technology. In the 2-year phase, there should be at least 1 measure being issued each year to ensure that the 5G ecosystem is continuously being developed. In the 5-year phase, there should be new measures being issued, as well as the continuous development of the existing measures, which fit the changing context.</p>
	<p>5G mobile adoption rate covers at least 5% of the population by B.E. 2565 and covers at least 80% of the population by B.E. 2570.</p>	<p>The forecast is in line with the 5G penetration rate forecasts from AT Kearny, a management consulting firm, and OVUM, consultancy firm specializing in telecommunication, media, and technology, and sets B.E. 2563 as the launching year of 5G technology in Thailand.</p>
	<p>The technical standards of at least 10 5G use cases that support the economic and social development are issued by B.E. 2565 and the technical standards of at least 100 5G use cases are issued by B.E. 2570.</p>	<p>In the 2-year phase, there must be at least 10 technical standards on 5G use cases being issued, which must include at least one 5G use case per targeted industry that are being supported by the government. This is to build confidence in adopting 5G technology and protect the safety of users, as well as ensure that those who adopted 5G technology are able to receive quality services that match with the international standards. In the 5-year phase, there shall be at least 100 technical standards on 5G use cases being issued to ensure that the new 5G use cases across all industries are being supported.</p>

Appendix B: Examples of Key Technical Requirements for 5G Use Cases

Verticals	5G Use Cases	Minimum Technical Requirements ⁸³							
		Data Rate	Latency	Mobility	Density	Reliability	Security	Coverage	Availability
Telecommunications and Media	Mobile Video Streaming (4K)	DL: 15 Mbps UL: 500 kbps	<1s	Medium	<10,000/km ²	99.9%	Low	Nationwide	99.9%
	Cloud VR for Media Entertainment (8K Panorama)	140 Mbps	<20ms	Low	<10,000/km ²	99.9%	Low	Nationwide	99.9%
	Mobile VR Cloud Gaming (4K)	DL: 15 Mbps UL: 1 Mbps	<10ms	Medium	<10,000/km ²	99.9%	Low	Nationwide	99.9%
	Live Mobile Video Sharing (Full HD)	DL: 250 kbps UL: 5 Mbps	<500ms	Medium	<10,000/km ²	90%	Low	Nationwide	99.9%
	Fixed Wireless Access	DL: 300 Mbps UL: 100 Mbps	<50ms	None	5000/km ²	99.9%	Medium	Nationwide	99.9%

⁸³ Source: 5G Americas and Nokia

Verticals	5G Use Cases	Minimum Technical Requirements ⁸³							
		Data Rate	Latency	Mobility	Density	Reliability	Security	Coverage	Availability
Industrial	Environmental Monitoring	1 Mbps	<60s	None	<10,000/km ²	99.9%	Medium	Industrial Zones	99.99%
	Automated Guided Vehicle	DL: 1 Mbps UL: 0.01 Mbps	<150ms	Low	120/km ²	99.99%	Medium	Industrial Zones	99.999%
	AR-Enabled Support & Maintenance	15 Mbps	<10ms	Low	<10,000/km ²	99%	High	Industrial Zones	99.9%
	Remote-Controlled Machinery	DL: 1 Mbps UL: 100 Mbps	<20ms	Low	100/km ²	99%	Medium	Industrial Zones	99.9999%
Smart City	Vehicle-to-Everything (V2X)	DL: 1 Mbps UL: 25 Mbps	<5ms	Medium	-	99.999%	Medium	City	99.999%
	Video Surveillance (4K)	DL: 300 kbps UL: 10 Mbps	<1s	None	500/km ²	99.999%	Medium	City	99.999%
	Slow Moving Autonomous Driving Vehicle	DL: 1 Mbps UL: 30 Mbps	<50ms	Low	-	99.999%	High	Private areas in business or industrial zones	99.9999%

Verticals	5G Use Cases	Minimum Technical Requirements ⁸³							
		Data Rate	Latency	Mobility	Density	Reliability	Security	Coverage	Availability
Transportation and Logistics	Tracking and Tracing	DL: 100 kbps UL: 100 kbps	<1s	Medium	1000/km ²	99.99%	Medium	Nationwide	99.99%
	Automated Empty Container Handler	DL: 50 Mbps UL: 150 Mbps	<150ms	Low	172/km ²	99.99%	Medium	Port or Warehouse areas	99.9999%
	Delivery Drone	25 Mbps	<100ms	Medium	-	99.999%	High	City	99.9999%
Public Health	Telehealth	DL: 1.5 Mbps UL: 1.5 Mbps	<250ms	Low	-	99%	High	Nationwide	99.99%
	Wearable Medical Devices	1 Mbps	<60s	Medium	-	99.99%	Medium	Nationwide	99.99%
	Connected Ambulance	100 Mbps	<150ms	Medium	-	99.99%	High	City	99.999%

Verticals	5G Use Cases	Minimum Technical Requirements ⁸³							
		Data Rate	Latency	Mobility	Density	Reliability	Security	Coverage	Availability
Agricultural	IoT for Smart Farming	1 Mbps	<60s	None	<10,000/km ²	99.9%	Medium	City / Agricultural zones	99.99%
Education	VR for Technical Training	50-100 Mbps	<30ms	Low	<10,000/km ²	99%	Low	Education Institutions	99.9%
Tourism	AR-Enabled Tourism	15 Mbps	<10ms	Low	<10,000/km ²	99.9%	Low	Nationwide / Tourist Attractions	99.9%
Financial	Usage-Based Insurance	1 Mbps	<60s	Medium	-	99.99%	Medium	Nationwide	99.99%

Appendix C: Overview of the Approaches in Each Key Dimension for Promoting the Adoption of 5G Technology

	Law & Regulation	Infrastructure	Demand	Innovation	Human Capital	Working Group
S. 1	<ul style="list-style-type: none"> ■ RAN Infrastructure Network and Optical fiber Laws ■ Small Cell Regulations 	S1 <ul style="list-style-type: none"> ■ Expand networks covering strategic areas e.g. EEC and Smart City ■ 5G network covering public service places e.g. THPHs and Digital Community Centers ■ Sharing Infrastructure ■ Sufficient Spectrum Allocation 	<p>Strategy 1 focuses on high-efficient 5G network development therefore emphasizing on enhancing supply side.</p>			
S. 2	<ul style="list-style-type: none"> ■ Laws Supporting 5G Services e.g. Drone and V2X ■ Sandbox Guidelines 		<ul style="list-style-type: none"> Provide simulations for operators to estimate the value of 5G service investment 	<ul style="list-style-type: none"> Support operators to improve 5G services for the economic section 	<ul style="list-style-type: none"> Improve SMEs entrepreneurs & farmers' knowledge & understanding regarding 5G adoption 	
S. 3	Laws Supporting 5G Services e.g. Telehealth		<ul style="list-style-type: none"> Apply 5G technology in providing public services for citizens 	<ul style="list-style-type: none"> Support to develop 5G services for the social section 	<ul style="list-style-type: none"> Enhance instructors and students' general knowledge 	
S. 4	<ul style="list-style-type: none"> ■ 5G Service Standard Regulations ■ Definitions & Regulations IoT Devices 		<ul style="list-style-type: none"> Integrate all sectors for driving 5G adoption concretely 	<ul style="list-style-type: none"> ■ Support funding for 5G service R&D ■ Promotion measures for smart devices manufacture 	<ul style="list-style-type: none"> ■ Create knowledge and understanding regarding 5G in all sections ■ Develop skills for digital workforces. 	<p>5G Accelerator</p>

Figure C-1: Overview of the Approaches in Each Key Dimension for Promoting the Adoption of 5G Technology

Appendix D: Glossary

5G Fixed Wireless Access (5G FWA)	A type of service that integrate 5G technology into providing fixed wireless broadband services, especially in areas that are inaccessible by the fiber optic cable or the cost of deploying and maintaining the fiber optic cable are high, in which the 5G FWA will alleviate the problem on providing last mile access of fiber optic cable to the users' premises ⁸⁴ .
5G Small Cell	The small cell refers to the radio access nodes or base station that is designed to increase the mobile network capacity and coverage and is especially use with the high-band spectrum which has low signal coverage ⁸⁵ .
Active Infrastructure	Active infrastructure refers to the electronic infrastructure of the network such as antennas/ transceivers, base station, backhaul networks, core network functionalities and spectrum ⁸⁶ .
Artificial Intelligence (AI)	The technology that is programmed to ‘think’ like human and stimulate human behaviors, but also includes the ability to learn and solve problems based on machine learning ⁸⁷ .
Augmented Reality (AR)	It is the integration between the real environment and the virtual objects such as image, video, audio and other data that are processed from computers, mobile phones, tablet or wearable devices, in which the users can interact with the virtual objects ⁸⁸ .
Critical Information Infrastructure (CII)	The computers or computer systems that are used by public or private sector with the purpose related to public safety, security, economic stability, and infrastructure of the nation.

⁸⁴ Source: ZTE

⁸⁵ Source: Office of The National Broadcasting and Telecommunications Commission

⁸⁶ Source: GSMA

⁸⁷ Source: Stanford University

⁸⁸ Source: National Electronics and Computer Technology Center, Office of the Permanent Secretary, Ministry of Higher Education, Science, Research and Innovation

Eastern Economic Corridor (EEC)	The special economic zones that support the systematic and efficient development of the economy as managed by the Eastern Economic Corridor Policy Committee, chaired by the Prime Minister, whereby the first phase focuses on the development of the areas in the following 3 provinces: Chonburi, Rayong and Chachoengsao ⁸⁹ .
Enhanced Mobile Broadband (eMBB)	The usage scenario that requires high-speed data transmission at the level of gigabit per second (Gbps), which cater to the growing demand for uploading and downloading massive amount of data ⁹⁰ .
Extended Reality (XR)	Technology that focuses on Spectrum of Human Experience by offering the seamless experience between the real world and the virtual world and thus, providing immersive experiences for the users. XR integrates virtual reality technology with augmented reality technology and adjusting the viewpoints to be more realistic ⁹¹ .
Frequency Division Duplex (FDD) and Time Division Duplex (TDD)	There are two directions for the transmission of data between the base station and the users, which are 1) Data transmission from the user to the base station (Uplink) and 2) Data transmission from the base station to the user (Downlink). FDD technology refers to the transmission of uplink and downlink with different frequency bands, in which the data can be sent at the same time. Whereas, the TDD technology refers to the transmission of uplink and downlink using the same frequency band but requires the allocation of different time slots for each direction of data transmission ⁹² .
HealthTech	Technology that can solve various medical and health issues, which can be both the devices or solutions.

⁸⁹ Source: The Eastern Economic Corridor Office

⁹⁰ Source: Office of The National Broadcasting and Telecommunications Commission

⁹¹ Source: Suan Sunandha Rajabhat University

⁹² Source: Qualcomm

Industrial Internet of Things (IIoT)	The use of IoT devices in the industrial sector for various purposes, such as the detection of the changes in the temperature or productivity in the automation system in order to enhance the production to be more efficient, accurate and secure, and the collection of data to enhance the analysis and decision-making. Also, the IIoT devices are generally more reliable and accurate than the IoT devices that are designed for consumers ⁹³ .
Internet of Things (IoT)	The communication between devices that are connected via wired or wireless communication protocols, in which the identification of each device is plausible, and the devices are able to recognize the surrounding context. The use of IoT devices will transform the industrial sector into industrial 4. 0 which focuses on the

⁹³ Source: Digi International Inc.

	communication between the machines, humans and data to support a more accurate and rapid decision-making ⁹⁴ .
Low Power Wide Area (LPWA)	LPWA technology supports wide area coverage with low-power network connectivity, which is designed for Machine to Machine (M2M) communications and for IoT devices. The key features include the ability to support high connection density and the cost of deployment that is considerably low.
Macro Site	Telecommunications poles and antennas that supports wider network coverage than the Micro Site and can be installed both on the rooftop and on the ground. There are 4 main types of pole; 1) Monopole 2) Self-Support, 3) Guyed and 4) Pipe.
Massive Machine Type Communications (mMTC)	The usage scenario that support high device connection density in which 5G technology can connect up to 1 million devices per square kilometer. In this usage scenario, the devices only need to transmit small amount of data, and high data rate and low latency communication is not a required. Also, the cost of the devices used in this scenario are generally low and the battery life is longer than other types of devices. Thus, with the above-mentioned capabilities and benefits, 5G technology is suitable for uses with IoT devices ⁹⁵ .
Micro/Pole Site	The site that covers the network coverage of approximately 100-200 meters, in which the 5G technology requires a massive number of Micro/ Pole Site in order to maximize the capabilities of 5G technology, especially in the crowded areas. There are 3 main types of Pole Site; Utility Pole, Street Light and Smart Pole.
Millimeter Wave (mmWave)	Millimeter Wave refers to the high frequency band (24 GHz to 100 GHz), which is an important band for maximizing the capabilities of

⁹⁴ Source: National Electronics and Computer Technology Center, Office of the Permanent Secretary, Ministry of Higher Education, Science, Research and Innovation

⁹⁵ Source: Office of The National Broadcasting and Telecommunications Commission

	5G technology, especially in areas with high connection density and in applications that require high data rate ⁹⁶ .
Mixed Reality	A technology that combine the use of both Virtual Reality (VR) and Augmented Reality (AR).
Multicast	A type of data transmissions which focuses on transmitting the data to the specific group of recipients. The network devices (e.g. routers and switches) which are used for the Multicast system will only transmits one set of data to the specified stations, whereby this method helps reduce the amount of bandwidth usage ⁹⁷ .
NR Positioning	The real-time positioning of devices with high accuracy to support the applications of 5G technology in new services across a variety of industries that require high precision, such as in emergency services, vehicles-related services, and in smart factories ⁹⁸ .
Passive Infrastructure	Passive infrastructure refers to the non-electronic infrastructure at a cell site, for example, telecommunications tower, land, buildings and other facilities such as power supply, battery backup and shelter. ⁹⁹
Precision Farming	Precision farming is the integration of digital technologies in the farming processes, such as the use of information technology, sensors, biotechnology and nanotechnology, for enhancing the productivity and quality of the agricultural products. Thus, the precision farming involves giving the appropriate amount of water, fertilizer and pesticides at the suitable time in order to achieve the maximum yield and ensure the efficient use of resources for the cultivation of crops in the greenhouse or individual plots ¹⁰⁰ .

⁹⁶ Source: Telecom Italia

⁹⁷ Source: Kasetsart University

⁹⁸ Source: IEEE

⁹⁹ Source: GSMA

¹⁰⁰ Source: National Electronics and Computer Technology Center, Office of the Permanent Secretary, Ministry of Higher Education, Science, Research and Innovation

Private/Local Network	It refers to the local area network (LAN) and the network that is only used within the specified areas. Thus, the private network can cater to the technical requirements for each type of usage scenario as specified and the private network is highly secure as there will be no third party accessing the same network ¹⁰¹ .
Regulatory Sandbox	The areas which are designated for conducting the development and trials on the innovations that may initially face constraints on the regulatory measures. Thus, the regulatory sandbox will provide a conducive environment for the development of the specified innovations until the innovations can be commercialized and it also provides a more convenient way to track and monitor the progress of the development ¹⁰² .
Release 14	The technical specifications for cellular systems which is developed by the 3 rd Generation Partnership Project (3GPP). In Release 14, some technical requirements of 5G technology are mentioned ¹⁰³ .
Release 15	The technical specifications for cellular systems which is developed by 3GPP. Release 15 is the first phase of development for determining the technical specifications for 5G technology and also includes determining technical specifications for several 5G use cases, such as the technical specifications for usage scenarios related to Massive Machine Type Communications and Internet of Things and technical specifications for Vehicle-to-Everything Phase 2 ¹⁰⁴ .
Release 16	The technical specifications for cellular systems which is developed by 3GPP. Release 16 is the second phase of development for determining the technical specifications for 5G technology and also includes determining technical specifications for several 5G use cases, such as the technical specifications for usage scenarios related to Ultra- Reliable and Low Latency

¹⁰¹ Source: 5GUK

¹⁰² Source: Office of The National Broadcasting and Telecommunications Commission

¹⁰³ Source: 3GPP

¹⁰⁴ Source: 3GPP

	Communications and technical specifications for Vehicle- to- Everything Phase 3 ¹⁰⁵ .
Release 17	The technical specifications for cellular systems which is developed by 3GPP. Release 17 develops the technical specifications that are related to 5G technology, such as the technical specifications for New Radio Multiple-input and Multiple-output (NR MIMO) and the technical specifications for Dynamic Spectrum Sharing (DSS). It also includes the technical specifications for additional 5G use cases, such as the Industrial Internet of Things, including the enhancement to Vehicle- to- Everything services ¹⁰⁶ .
Smart City	A city that takes advantage of modern technology and innovation to increase the efficiency of the city service and management, reduce the cost and resource usage of the target city and citizen. It focuses on good design and participation of business and public sectors in urban development, under the concept of a modern and livable city development, for people in the city to have a good quality of life and sustainable happiness ¹⁰⁷ .
Special Economic Zone (SEZ)	The border areas that are designated by the National Committee on Special Economic Zone Development (NC-SEZ) as the special economic zones. The Government provides supporting measures and other promotions for the development of Infrastructure, including tax and non-tax incentives, setting up One Stop Service Center (OSS) and other facilitating measures with the aim to support the community expansion around the border areas and enhance the people's well-beings ¹⁰⁸ .

¹⁰⁵ Source: 3GPP

¹⁰⁶ Source: 3GPP

¹⁰⁷ Source: Smart City Thailand Office

¹⁰⁸ Source: Government Strategic Information Center, National Statistical Office

Telehealth	A medical consultation via a conference call or other telecommunication systems and/or other data transmission such as medical records, X-ray images, or heartbeat detection ¹⁰⁹ .
Ultra-Reliable and Low Latency Communications (URLLC)	The usage scenario that requires highly reliable data transmission and ultra-low latency data transmission with the rate of data transfer as low as 1 millisecond, in which the 4G technology could only offer the latency of no lower than 10 milliseconds. This makes 5G technology suitable for uses in critical application such as telesurgery, remote-controlled machinery and remote-controlled vehicle ¹¹⁰ .
Unmanned Aerial Systems	The aircraft without a human pilot on board but is still controllable, in which it exists in several shape, size and features. Generally, it refers to drone, which is remotely controlled by either using the remote controller or by the automated system ¹¹¹ .
Vehicle-to-everything (V2X)	The communication between the vehicle and the surrounding objects that impact the vehicle navigation and routes, in which the communication can be in the form of vehicle-to-vehicle, vehicle-to-infrastructure, vehicle-to-pedestrians and many more ¹¹² .
Vertical Industry	The reference of all businesses across the value chain.
Virtual Reality (VR)	It is a simulated experience involves displaying a 3D virtual world and for some scenarios, the users can interact with the situations in the virtual world, whereby the VR glasses is the necessary device in experiencing the virtual world ¹¹³ .

¹⁰⁹ Source: Electronic Transactions Development Agency

¹¹⁰ Source: Office of The National Broadcasting and Telecommunications Commission

¹¹¹ Source: Defence Technology Institute

¹¹² Source: 5G Automotive Association

¹¹³ Source: Virtual Reality Society

Appendix E: Abbreviations for Organizations

Abbreviation	Organization Name
AIAT	Artificial Intelligence Association of Thailand
AOT	Airports of Thailand PCL.
BAR	Board of Airline Representatives Business Association
BOI	Board of Investment
BOT	Bank of Thailand
CAAT	The Civil Aviation Authority of Thailand
CAT	CAT Telecom PCL.
Custom	Thai Customs
DCT	Digital Council of Thailand
DDC	Department of Disease Control
DDPM	Department of Disaster Prevention and Mitigation
DEPA	Digital Economy Promotion Agency
DGA	Digital Government Development Agency
DIP	Department of Industrial Promotion
DIW	Department of Industrial Works
DLA	Department of Local Administration
DLT	Department of Land Transport
DMS	Department of Medical Services
DOA	Department of Airports
DOA	Department of Agriculture
DSD	Department of Skill Development
EECO	The Eastern Economic Corridor Office
ETDA	Electronic Transactions Development Agency
FTI	The Federation of Thai Industries
GISTDA	Geo-Informatics and Space Technology Development Agency
IB	Immigration Bureau
MEA	Metropolitan Electricity Authority
M-Industry	Office of the Permanent Secretary, Ministry of Industry
NBTC	Office of the National Broadcasting and Telecommunications Commission
NCSA	National Cyber Security Agency

Abbreviation	Organization Name
NIA	National Innovation Agency (Public Organization)
NIEMS	National Institute for Emergency Medicine
NSC	Office of the National Security Council
NSO	National Statistical Office Thailand
NSTDA	National Science and Technology Development Agency
OIE	The Office of Industrial Economics
ONDE	Office of the National Digital Economy and Society Commission
OPSMDES	Office of the Permanent Secretary, Ministry of Digital Economy and Society
OPSMHESI	Office of the Permanent Secretary, Ministry of Higher Education, Science, Research and Innovation
OPSMNRE	Office of the Permanent Secretary, Ministry of Natural Resources and Environment
OPSMOAC	Office of the Permanent Secretary, Ministry of Agriculture and Cooperatives
OPSMOC	Office of the Permanent Secretary, Ministry of Culture
OPSMOEN	Office of the Permanent Secretary, Ministry of Education
OPSMOE	Office of the Permanent Secretary, Ministry of Energy
OPSMOF	Office of the Permanent Secretary, Ministry of Finance
OPSMOI	Office of the Permanent Secretary, Ministry of Interior
OPSMOPH	Office of the Permanent Secretary, Ministry of Public Health
OPSMNRE	Office of the Permanent Secretary, Ministry of Natural Resources and Environment
OPSMOT	Office of the Permanent Secretary, Ministry of Transport
OPSMOTS	Office of the Permanent Secretary, Ministry of Tourism and Sports
OTP	The Office of Transport and Traffic Policy and Planning
PAT	Port Authority of Thailand
PEA	Provincial Electricity Authority
TAT	Tourism Authority of Thailand
TCSD	Technology Crime Suppression Division
TISI	Thai Industrial Standards Institute
TMD	Thai Meteorological Department
TOT	TOT PCL.
TPQI	Thailand Professional Qualification Institute (Public Organization)
VEC	Office of Vocational Education Commission