

# Licensing of Spectrum for Mobile Service in the Frequency Band of 900 MHz in Thailand

**Settapon Malisuwan**

*Vice Chairman of NBTC*

*National Broadcasting and Telecommunications Commission  
(NBTC), Thailand*

**Wassana Kaewphanuekrungsri**

*Assistant to Vice Chairman of NBTC*

*National Broadcasting and Telecommunications Commission  
(NBTC), Thailand*

**Noppadol Tiamnara**

*Assistant to Vice Chairman of NBTC*

*National Broadcasting and Telecommunications Commission  
(NBTC), Thailand*

**Dithdanai Milindavanij**

*Assistant to Vice Chairman of NBTC*

*National Broadcasting and Telecommunications Commission  
(NBTC), Thailand*

## Abstract

In Thailand, the National Broadcasting and Telecommunications Commission (NBTC) has established a policy on spectrum management and use of spectrum which are national communications resources, considering the utmost public benefits at national and local levels in education, culture, State security and other public interests including fair and free competition, as well as the procedures that will ensure thorough and appropriate distribution of benefits to various services and in line with State policy for the development of digital economy. On December 15, 2015, the NBTC conducted the spectrum auction to grant 900 MHz spectrum licenses by way of auction according to the licensing criteria and procedures prescribed in the NBTC's Notification regarding Criteria and Procedure for Spectrum Licensing for Telecommunications Service in the Frequency Band of 895 – 915 MHz/940 – 960 MHz. The objective of this paper is to review the licensing criteria and procedures for the 900 MHz Spectrum Licensing. The spectrum auction procedures are described and also the result of the auction is discussed in this paper. The paper also explains the positive impacts of spectrum licensing on national economy through the further expansion of 3G and 4G networks in Thailand.

**Keywords: Licensing, Spectrum, Mobile, Auction, Thailand**

## I. INTRODUCTION

Thai mobile network operators began offering 3G 2100 MHz services after spectrum auctioning in end-2012. It is eight years of delays caused by legal battles and regulatory transitioning. The NBTC raised 41.6 billion baht in the first spectrum auction in 2100 MHz for licenses of 3G cellular services. Advanced Info, Total Access and True won those licenses [1].

After the 1800 MHz and 900 MHz concessions ended, the 1800MHz spectrum licenses, allocated for 4G service, had been in auction for longer than 30 hours straight since the morning of 11<sup>th</sup> November 2015 without a break during the night. Total bidding time is 28 hours. True Move H Universal Communications has won the first license, in the frequency of 1710-1910 MHz and 1805-1820 MHz, at the price of 39.792 billion baht. Meanwhile, Advanced Wireless Network, a subsidiary of Advanced Info Service (AIS), got the second license in the frequency of 1725-1740 MHz and 1820-1835 MHz for 40.986 billion baht [2]

Soon after the 1800 MHz auction, the NBTC conducted the 900 MHz auction on 15<sup>th</sup> December 2015. It is not surprising that the competition at the NBTC's telecom-license auctions was intense, as it is not only competition among the three incumbent operators but between them on the one side and a new comer on the other, as they battle to prevent the new comer from becoming the fourth market player. The details of the auction are described in the following sections.

The NBTC has duties, by law, in spectrum management. The objectives of spectrum assignment must be conformed with policy objectives stipulated in relevant laws, particularly the Act on the Organization to Assign Radio Frequency and to Regulate the Broadcasting and Telecommunications Services, B.E. 2553 (2010) [3], the Master Plan on Spectrum Management, B.E. 2555 (2012) as well as international theories and principles [4].

The Act on the Organization to Assign Radio Frequency and to Regulate the Broadcasting and Telecommunications Services, B.E. 2553 (2010), Section 41, Paragraph Four and Section 45 Paragraph One prescribe that the permission to use radio frequency for telecommunications service shall be carried out with due regard to maximum public interests at the national, regional and local levels in education, culture, State security and other public interests, including free and fair competition, and shall be carried out in the manner that extensively and appropriately distributing the utilities as the national communications resource to all segments of enterprises for public interest [3].

Therefore, it is very clear that the policy objectives of spectrum assignment are based on the principle of public interest together with free and fair competition. The NBTC thus set policy objectives for the spectrum auction for telecommunications service in Thailand with the priority as follows:

- Efficiency of spectrum assignment thereby creating the utmost benefits to the public;
- Promoting competition in the market with the aim to improve quality of service and reduce costs of services thereby benefiting people at large;
- Transparency in the spectrum auction which include the auction design and the auction implementation thereby creating common understanding among all stakeholders and the mutual acceptance of the auction results;
- Development of telecommunications industry in Thailand including the development of infrastructure and services thereby improving capability in supporting the increasing demands in the future;
- Revenue to State, the revenue arising from the auction should be appropriated for the State benefit.

In granting the spectrum license for telecommunications service, the NBTC strives to achieve the regulatory balance composing of three equally important principles in order to bring about the greatest benefits to the people and the country. These principles are:

- The most efficiency of spectrum assignment. Since the spectrum is a national communications resource, the assignment process must ensure that the spectrum will be assigned to the person who can best utilize it, whereby the most efficient spectrum assignment method is the auction. Furthermore, the spectrum assignment must also be able to catch up with the usage demand from both operators and end users;
- Free and fair competition. The regulation must help creating the regulatory environment that is conducive for market entry and have appropriate competition measures in place to prevent the abuse of market power. The regulation must also be proportionate and not place undue burden to the licensee;
- State benefits that reflect the value of the resource. The State benefits come in the form of revenues from the spectrum auction and business operation taxes, as well as the socioeconomic benefits and the development brought about by the spectrum utilization.

The mission set forth in the Master Plan on Spectrum Management, B.E. 2555 (2012) is to assign spectrum and to regulate the spectrum utilization efficiently by having due regard to the public interest, the necessity of business operation, the spectrum utilization and the advancement of technologies. In doing so, there must be certain rules with clarity and justification as well as the transparent and fair process. Article 8.2.1 of the Master Plan prescribes a strategy regarding spectrum reframing for reassignment or for utilization improvement [4] that “For the government sectors, state-enterprises and other government agencies who allowing other operators to use their spectrum by granting permission, concession or contract which its legality was already examined by the NBTC, after the end of their permission, concession or contract such spectrum shall be returned to the NBTC.”

The spectrum being used for mobile phone businesses in Thailand are granted permission under the regime of concession from the TOT Public Company Limited (TOT PLC.) and CAT Telecom Public Company Limited (CAT PLC.) and under the licensing regime of the NBTC. The end of concession periods of government agencies and the end of permission of the NBTC can be summarized in year-ordering as follows:

Table – 1  
1800 MHz spectrum which the concession was ended in year 2013

NO	Licensee	Concessionaire	Frequency (MHz)	Contract End
1	CAT PLC.	True Move Co., Ltd.	1710.0-1722.6 1805.0-1817.6	15/09/2013
2	CAT PLC.	Digital Phone Co., Ltd.	1747.9-1760.5 1842.9-1855.5	15/09/2013

Table - 2  
Other spectrums which the concession was ended after year 2013

NO	Licensee	Concessionaire	Frequency (MHz)	Contract End
1	TOT PLC.	Advance Info Service PLC.	897.5-915.0 942.5-960.0	30/09/2015
2	CAT PLC	Total Access Communications PLC.	839.0-849.0 884.0-894.0	15/09/2018
3	CAT PLC.	Total Access Communications PLC.	1722.6-1747.9/1817.6-1842.9 1760.5-1785.0/1855.5-1880.0	15/09/2018

## II. THE LICENSE

### A. Spectrum to be licensed

- The spectrum to be licensed is 2 x 20 MHz of 900 MHz spectrum in the band of 895 – 915 MHz/940 – 960 MHz according to the International Mobile Telecommunications (IMT) Spectrum Plan in the frequency band of 895-915/940-960 MHz, which consists of:
- The 2 x 2.5 MHz spectrum obtained from the revision of the Spectrum Master Plan according to the NBTC resolution No. 3/2105 on 18 March 2015 which resulting in the consideration to reduce guard band between spectrum in the band of 900 MHz and 800 MHz from 3.5 MHz to 1 MHz, therefore the additional 2.5 MHz of spectrum is available for the auction. In this regard, The NBTC’s Notification Regarding the Spectrum Master Plan No. 2 (B.E. 2558 (2015)) has been published in the Government.

## **B. Number of Licenses**

The NTC will grant two spectrum licenses, with a bandwidth of 2 x 10 MHz each as shown in Table 4.1. Each bidder is entitled to bid only one spectrum lot or 2 x 10 MHz.

In the case where there is any remaining spectrum after the auction, the NTC will begin the process to grant the license for such remaining spectrum within one year as from the end of the previous auction.

In the case where there is no Bidder, the NTC reserves the right to dismiss the auction and will consider schedule of next auction as appropriate.

## **C. License Duration**

The 900 MHz Spectrum License and Type Three Telecommunication Business License will be valid for a period of 15 years as from the date of obtaining the License.

In the case where the Licensee is already a spectrum Licensee or a Type Three Telecommunication Business Licensee, the License duration for only the telecommunications services using 900 MHz Spectrum in accordance with the scope of License will be valid for a period of 15 years as from the date of obtaining the rights.

The Licensee must comply with the conditions precedent to service dissolution as specified by the NTC and must submit service users' management plan at least 2 years in advance before the end of the license period in order to avoid effects on service users. The Licensee must return the granted spectrum to the NTC when the license period lapses.

## **D. Annual License Fee**

The Licensee has the duty to pay the Type Three Telecommunication Business Annual License fee, spectrum administrative fee, telecommunication numbering fee, revenue contribution to the Broadcasting and Telecommunications Research and Development Fund for the public Interest, and any other related fees under the criteria and procedures set forth by the NTC.

## **E. Licensing Terms and Conditions**

1) *The Licensee must strictly comply with the terms and conditions on the use of radio frequency and telecommunications business operation under the Act on the Organization to Assign Radio Frequency and to Regulate the Broadcasting and Telecommunications Services B.E. 2553 (2010), the Telecommunications Business Act B.E. 2544 (2001) and its amendment, the NBTC's Notification regarding Spectrum Plan for the International Mobile Telecommunications (IMT) Spectrum Plan in the Frequency Bands of 895-915/940-960 MHz, conditions for Type Three Telecommunications Business License, as well as rules, regulations, notifications, orders and any criteria prescribed by the NTC.*

2) *Coverage Obligation:*

The Licensee must provide telecommunications network for rendering services covering at least 50 percent of the population within 4 years as from the date of obtaining the License and at least 80 percent of the population within 8 years as from the date of obtaining the License.

3) *Service of Mobile Virtual Network Operator (MVNO)*

The licensee must provide telecommunications network service with the minimum capacity of 10% of its networks to the MVNO who is not the connected person with any licensee when receiving such service request, and must comply with the NBTC's Notification Regarding Mobile Virtual Network Operator Service B.E. 2556 (2013).

4) *Social and Consumer Protection Measures*

- The Licensee must prepare its Corporate Social Responsibility (CSR) plan covering the electronic waste management, users' health, risk management plan for rapidly changing technologies, and services for disabled which include at least special tariff and special invoice or contract with large font or in Braille at no additional charge. In this regard, the Licensee must submit such CSR plan to the NTC prior to launching its service and must implement according to its plan within 1 year as from the date of launching its service.
- The Licensee must prepare a consumer protection plan covering measures to handle complaints free of charge, measures to handle unsatisfactory service, procedure to develop understanding among the public regarding the establishment of radio communications stations, as well as building the consumer recognition regarding rights to use telecommunications service which include publication of consumer rights in consuming mobile phone service as specified by the Office of the NBTC. In this regard, the Licensee must submit the consumer protection plan to the NTC prior to launching its service and must implement according to its plan immediately after the launch of its service.
- The Licensee must provide the service in a fair nature, which includes setting of tariff that is clear, reasonable and not taking advantage of consumer, and shall provide service with quality as prescribed by the NTC. For this purpose, the Licensee must set forth the tariff for voice and data services which is, on average, lower than the average tariff of mobile phone service using 2.1 GHz spectrum on 25 August 2015. In doing so to promote and increase the opportunity for users in accessing the mobile telecommunications service using 900 MHz spectrum, the Licensee must provide at least one promotion which has tariff lower than average tariff of mobile phone service using 2.1 GHz spectrum on 25 August 2015, as well as charges based on actual usage and has the quality not lower than the average quality of mobile phone service using 2.1 GHz spectrum. All this will apply until the NTC prescribed criteria relating to the regulation of tariff and quality of service otherwise.

## F. Licensing Phase

The spectrum licensing process can be divided into 6 phases as summarized in table 3:

Table - 3  
Licensing Phases [5]

<i>Regulations Preparation</i>	<i>Formulation of spectrum licensing criteria Preparation of Information Memorandum (IM) Published the Notification regarding criteria and procedure for spectrum licensing in the Government Gazette</i>
<i>Auction Invitation</i>	<i>Auction invitation and publication of Information Memorandum</i>
<i>Pre-Qualification</i>	<i>Consideration of compliance with application method Consideration of Applicant's qualification</i>
<i>Auction Training</i>	<i>Bidder information session and mock auction</i>
<i>Auction Phase</i>	<i>Bidding session</i>
<i>License Granting Phase</i>	<i>Fulfillment of conditions precedent License granting</i>

## G. Spectrum Auction Fee

### 1) Minimum Price of the 900 MHz Spectrum Licensing

The minimum price of the Spectrum Licensing for each spectrum lot is equal to 12,894,000,000 Baht and in the case where the number of bidders is less than or equal to the number of spectrum lots to be auctioned, the minimum price of the Spectrum Licensing for each spectrum lot is equal to 16,080,000,000 Baht.

### 2) Payment of the 900 MHz Spectrum Auction Fee

The Winning Bidder must pay the 900 MHz Spectrum auction fee according to the highest bid price of each Winning Bidder. The payment of 900 MHz Spectrum auction fee is defined as follows:

#### a) Case 1 –

The Winning Bidder must pay the Spectrum auction fee according to the highest bid price of each Winning Bidder in three installments as follows:

The first installment - the Winning Bidder must pay 50 percent of its highest bidding price and submit a letter of guarantee, issued by a financial institution operating commercial banking business under the Financial Institutions Business Act B.E. 2551 (2008), for the remaining of spectrum auction fee within 90 days as from the date it is notified in writing as being a Winning Bidder. The Office of the NBTC will offset the deposit placed by the Winning Bidder from this installment, and each Winning Bidder must completely pay the remaining amount within the specified period;

The second installment - the Winning Bidder must pay a further 25 percent of its highest bid price and submit a letter of guarantee, issued by a financial institution operating commercial banking business under the Financial Institutions Business Act B.E. 2551 (2008), for the third installment within 15 days after the lapse of 2 years as from the date of the license award. The Office of the NBTC will return the bank guarantee submitted with the first installment within 15 days as from the date of the receipt of the second installment;

The third installment - the Winning Bidder shall pay the remaining 25 percent of its highest bid price within 15 days after the lapse of 3 years as from the date of license award. The Office of the NBTC will return the letter of guarantee submitted with the second installment within 15 days as from the date of the receipt of the third installment.

#### b) Case 2 –

In the case that the highest bid price exceed 16,080,000,000 Baht, each Winning Bidder will be liable to pay the spectrum auction fee according to its highest bid price in four installments as follows:

The first installment - the Winning Bidder must pay 8,040,000,000 Baht and submit a letter of guarantee, issued by a financial institution operating commercial banking business under the Financial Institutions Business Act B.E. 2551 (2008), for the remaining of spectrum auction fee within 90 days as from the date it is notified in writing as being a Winning Bidder;

The second installment - the Winning Bidder must pay 4,020,000,000 Baht and submit a letter of guarantee, issued by a financial institution operating commercial banking business under the Financial Institutions Business Act B.E. 2551 (2008), for the third and the fourth installment within 15 days after the lapse of 2 years as from the date of the license award. The Office of the NBTC will return the bank guarantee submitted with the first installment within 15 days as from the date of the receipt of the second installment;

The third installment - the Winning Bidder must pay 4,020,000,000 Baht and submit a letter of guarantee, issued by a financial institution operating commercial banking business under the Financial Institutions Business Act B.E. 2551 (2008), for the fourth installment within 15 days after the lapse of 3 years as from the date of the license award. The Office of the NBTC will return the bank guarantee submitted with the second installment within 15 days as from the date of the receipt of the second installment;

The fourth installment - the Winning Bidder must pay the remaining of its highest bid price within 15 days after the lapse of 4 years as from the date of license award. The Office of the NBTC will return the letter of guarantee submitted with the third installment within 15 days as from the date of the receipt of the fourth installment.

The spectrum auction fee to be paid by each of the Winning Bidder is excluded from tax, other fees and interest as prescribed by law. In the case that the Licensee fails to make a full payment of the second or third or fourth installment within the specified

period, the Licensee must pay additional fee equal to the amount of the outstanding spectrum auction fee multiplied by the interest rate of 15 percent per year, calculated daily. In the case that the Licensee fails to pay within the specified period, it will be deemed that the Licensee fail to comply with conditions specified in this Notification and the NBTC may consider suspending or revoking its License.

### III. AUCTION METHODOLOGY AND RULES

#### A. Auction Methodology

The NTC will open the bid for all lots of 900 MHz Spectrum to be licensed simultaneously and shall proceed in multiple rounds. The bid price in each round will increase correspondingly (Simultaneous Ascending Bid Auction). A bidder can place bid for a desired lot. The 900 MHz Spectrum to be auctioned consists of two lots of spectrum.

#### B. Spectrum to be Auctioned and the First Round Price

The spectrum to be auctioned and the first round price are shown in the following table. The first round price will be the sum of the minimum price of the spectrum licensing according to clause 8(2) and (3) of the NBTC's Notification Regarding the Criteria and Procedures for the Licensing of Spectrum for Telecommunications Service in the Frequency Band of 895 – 915 MHz/940 – 960 MHz and the bid in each round as specified in Section 6.4.1 of Auction rules. In this auction, there are 4 bidders.

Table - 4

Spectrum Lots and the first round price [5]

<i>Spectrum Lot</i>	<i>Frequency Band (MHz)</i>	<i>Minimum Price (Million Baht)</i>	<i>First Round Price (Million Baht)</i>
<i>Lot 1</i>	<i>895 – 905 / 940 – 950</i>	<i>12,864</i>	<i>13,508</i>
<i>Lot 2</i>	<i>905 – 915 / 950 – 960</i>	<i>12,864</i>	<i>13,508</i>

#### C. Auction Round

The timetable for auction rounds will be announced via auction software. Each round of the auction consists of three stages as follows:

##### 1) Bidding Stage

Each round of the auction begins with the bidding stage which lasts for 15 minutes. The bidders can place their bids within this 15 minutes period.

##### 2) Processing Stage

The processing stage will begin after the end of the bidding stage.

##### 3) Result Reporting Stage

For this result stage, the round result, the bid price of each spectrum lot for the next round, and other information as specified in Section 6.6 will be announced five minutes prior to the beginning of bidding stage in the next round.

The auction process is described in the Information Memorandum of the 900 MHz Licensing.

#### D. Termination of a Bidder Status

The bidder will no longer have the right to place bid in the following case:

- In the case where a bidder fails to place a bid for any spectrum lot in the first round, it will be considered that such bidder does not comply with the auction requirements and its bidder status will be terminated, whereby the NTC reserves the right to forfeit the auction guarantee of that bidder.
- In the second and subsequent rounds, in the case where a bidder who is not a provisional winner in any spectrum lot fails to comply with requirements as described in Section 6.4.3 1) while having no waiver left, it will be deemed that such bidder no longer has right to place bid in the subsequent rounds.
- In the second and subsequent rounds, in the case where a bidder who is not a provisional winner and still has waivers choose not to use the waiver. Such bidder will no longer have the right to place bid or use the waiver in the subsequent rounds.

### IV. CONCLUSION OF THE AUCTION

The spectrum auction will be concluded in the round where there is no bidder placed the bid for any spectrum lot and no bidder used the waiver. The provisional winner of each spectrum lot will be deemed as the winning bidder of the given spectrum lot.

The auction process will be concluded after the winning bidders have duly signed in verification of their highest bid prices they have placed and the NBTC announces the auction result on the date which the spectrum auction is concluded.

## V. RESULT AND DISCUSSION

In the auction process, on the 199th auction round, the first license received no bid and the lastest price was 75.654 billion baht. In the same round, no bidder submitted a bid for the second license, which made the price stand at 76.298 billion baht. Jas Mobile Broadband Co. Ltd. and True Move H Universal Communications won the auction of two 900 MHz license, ending an 87 -hour-long auction process. The auction was over with the final prices of the two licenses of 151,952 billion baht [6]. The winners and details of the 900 MHz spectrum auction are shown in Table 5.

Table - 5  
The winners and details of the 900 MHz spectrum auction

<i>Spectrum Lot</i>	<i>Bidder</i>	<i>Auction price (Million Baht)</i>
<i>Lot 1: 895-905 MHz/940-950 MHz</i>	<i>Jas Mobile broadband Co Ltd.</i>	<i>75,654</i>
<i>Lot 2: 905-915 MHz/950-960 MHz</i>	<i>True move H Universal Communication</i>	<i>76,298</i>
	<i>Total</i>	<i>151,952</i>

The factors that made very high competition in the 900 MHz auction can be described as follows:

- Mobile network operators need to occupy high and low frequency bands in order to serve the different objectives. Higher frequency bands can provide smaller coverage, requiring more base stations. They are therefore suitable for densely-populated areas such as business areas and cities. On the other hand, low frequency bands can serve larger coverage and do not require extensive transmission network. As a result, they are suitable for urban and rural areas. Since this was the last 900 MHz bidding in the next 15 years, every service provider was intent on winning the bands.
- More flexible payment of the 900MHz spectrum auction fee, as compared to 1800 MHz, contributed to a highly intense competition. As a consequence, the total price of the two licenses was bid up to almost five times the expected reserve price of the frequency bands.

Thailand has more than 40 million mobile internet users compared with 35 million desktop-only internet users. Thailand ranks No.1 in the world for watching videos online. Users watch Line TV three days a week. The country has the world's third-largest Facebook population with 35 million and the second-largest number of YouTube video views in Asia after Japan.

According to an Ericsson Consumer Lab survey, 89% of 1,600 respondents in Thailand use social media on a weekly basis. Mobile data traffic will continue to grow at an impressive rate, driven by an uptake in smart devices and applications. Deployment of 4G LTE wireless networks will provide operators with more efficient networks to deliver high-quality services.

4G will also be an expressway to equal access to information and education for everyone. It will also help businesses to expand online while attracting more global technology firms to invest more in ICT infrastructure in Thailand. Based on NBTC research project, the recent 4G spectrum auctions could stimulate direct and indirect investment valued at 1.3 trillion baht over the next five years in Thailand.

The big trends in 4G mobile applications next 1-2 years will be video streaming, social commerce, mobile games, mobile advertising, big data, cloud services and machine-to-machine communication or the Internet of Things.

Mobile operators will have to own more and more telecom bandwidth, both low and high bands, to maintain their service quality and accommodate increasing data traffic. The low band comprises those spectrum ranges below 1000 MHz, while the upper band contains those beyond 1000 MHz including the 1800-MHz and 2100-MHz bands.

Furthermore, mobile operators would need to hold a variety of spectrum bands, especially when 5G technology is expected to be commercially launched in 2020. Detail of frequency bands ownerships is shown in Table 6.

Table - 6  
Detail of frequency bands ownerships

<i>Provider</i>	<i>Frequency Band</i>	<i>Spectrum Allocation</i>	<i>Contract Types</i>	<i>Contract Expirations</i>
<i>AIS</i>	<i>1800 MHz</i>	<i>15 MHz</i>	<i>Auctioned license</i>	<i>2033</i>
<i>AIS</i>	<i>2100 MHz</i>	<i>15MHz</i>	<i>Auctioned license</i>	<i>2027</i>
<i>DTAC</i>	<i>850 MHz</i>	<i>10 MHz</i>	<i>BTO concession from CAT</i>	<i>2018</i>
<i>DTAC</i>	<i>1800 MHz</i>	<i>25 MHz</i>	<i>BTO concession from CAT</i>	<i>2018</i>
<i>DTAC</i>	<i>2100 MHz</i>	<i>15 MHz</i>	<i>Auctioned license</i>	<i>2027</i>
<i>TRUE</i>	<i>850 MHz</i>	<i>15 MHz</i>	<i>Wholesale contract with CAT</i>	<i>2025</i>
<i>TRUE</i>	<i>900 MHz</i>	<i>10 MHz</i>	<i>Auctioned license</i>	<i>2030</i>
<i>TRUE</i>	<i>1800 MHz</i>	<i>15 MHz</i>	<i>Auctioned license</i>	<i>2033</i>
<i>TRUE</i>	<i>2100 MHz</i>	<i>15 MHz</i>	<i>Auctioned license</i>	<i>2027</i>
<i>JAS</i>	<i>900 MHz</i>	<i>10 MHz</i>	<i>Auctioned license</i>	<i>2030</i>

## VI. CONCLUSIONS

The objective of this paper is to report and analyze the results of 900 MHz spectrum auction in Thailand. The paper also oversees the positive impacts of the spectrum licensing. Thailand's telecom landscape will experience a total change next year with the consumer ultimately benefiting with a newcomer in the market. The industry opens a new chapter with the introduction of mass-market fourth-generation (4G) commercial services next year after the recent success of spectrum auctions. Mobile operators

need ever more bandwidth to serve growing bandwidth-intensive activities, fuelled by the proliferation of smartphones and faster speed of wireless broadband networks. Having a variety of mobile spectrum bands will enable them to greatly manage frequencies and data traffic flows. Technology transition from 3G to 4G will continue to provide a positive driver for infrastructure developers and other value-added markets, such as application and content developers. Subsequent intensified data use will require large scale network upgrade and investment that will create a positive impact on the jobs market in Thailand by creating new skilled jobs. This will contribute positive changes in the general population and the workforce in Thailand by developing abilities and skills to use new infrastructure and the latest emerging technologies. The research in this paper will be beneficial to telecommunications industry and policy makers.

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