Spectrum Refarming in Thailand

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Abstract - **Spectrum is a limited resource, but it can be reusable depending on spectrum management strategies. It is an underlying mechanism for communication and economic and social development. In order to utilize the spectrum at its maximum capacity, it is required that spectrum management needs to be based on efficiency, effectiveness, and plans for developing communication activities to support future spectrum consumption. This may include expansion of service area coverage, enhancement of service efficiency as well as promotion to create new innovations. It is required that the alignment with related national development plans needs to be taken into consideration when drawing a spectrum management plan.**

To support development of both the existing and new services, it is important that users of the existing spectrum must be forced out so that the spectrum can be assigned to a more modern technology or reallocated. Such operation needs to be in alignment with the content specified in the National Table of Frequency Allocations along with the mechanism which enhances spectrum allocation efficiency. Moreover, other options like spectrum sharing and spectrum utilization terms and conditions for overcoming various limitations may also be considered as well.

Spectrum refarming is challenging. Therefore, the management of complexity and obstacles must be prepared along with the spectrum monitoring and regulatory strategies which can be used as reference data for spectrum refarming consideration. Levels of complexity and operational options will affect the process of spectrum reallocation. Moreover, there are other factors needed to be considered such as the operational duration, consumption demand, system efficiency, assignment of spectrum for new services, and the policy decision made during the World Radio communication Conferences – WRC regarding the additional assignment of spectrum for various services. However, spectrum refarming for more suitable applications will bring about social benefit and be more appropriate for new innovative services so as to support the direction of economic and social development.

In this particular research, the analytical results of Thailand's spectrum refarming are featured for they are beneficial and be able to extend the telecommunications knowledge at the international level.

Keywords - **Refarming, Spectrum, Thailand**

I. INTRODUCTION

The NBTC formulated policy objectives for Thailand's spectrum management that are in alignment with the content provided in the Constitution of The Kingdom of Thailand, B.E. 2560 (2017), the Act on Organization to Assign Radio Frequency and to Regulate the Broadcasting and Telecommunications Services B.E. 2553 (2010) and its Amendment, and the Spectrum Management Master Plan, B.E. 2555 (2012). Such objectives are based on the principle underlying that provision of spectrum for various purposes, such as radio broadcasting, television broadcasting, telecommunications or others, has to provide the utmost benefit for people. This can be done through considering free and fair competition, widespread distribution of

spectrum to various activities related to education, culture, state security, and other social benefits as well as enabling people to take part in utilizing such spectrum to yield various benefits [1-2].

A. Policy Objectives for Thailand's Spectrum Management

Overall, the goals and objectives of spectrum management are as follows:

- **Objectives:**

1) To enable public and private organizations to utilize the spectrum resource for accelerating the country's economic and social development.

2) To support efficient spectrum management.

- **Main Goals:**

1) To support provision of efficient telecommunication services at domestic and international levels to yield business and personal benefits.

2) To develop innovations and spectrum-based communication infrastructure at present and in the future.

3) To protect national interest and state security.

4) To protect safety of life and property of people.

5) To support prevention of crime and support law enforcement.

6) To support domestic and international transport systems.

7) To support natural preservation.

8) To reinforce and support education as well as produce public benefits from providing news and entertainment services.

9) To support scientific research, development and exploration of natural resources.

II. LAWS RELATED TO SPECTRUM REFARMING

According to the Act on Organization to Assign Radio Frequency and to Regulate the Broadcasting and Telecommunications Services B.E. 2553 (2010) and its Amendment to Section 27 (12/1), it is formulated that the NBTC has the right to retrieve the spectrum that is not utilized or is not utilized at its maximum capacity from users of the existing spectrum, or has the right to reassign the spectrum to other services that yield greater benefit as specified in the plan under Section 27 (1); based on the principle, method, and conditions purposed by the NBTC. Such terms and conditions need to be equipped with the methods of replacement, reimbursement or compensation for users of the existing spectrum by considering the right of those affected by the spectrum retrieval, case by case. Such legal provision is the major mechanism which promotes the NBTC to manage spectrum more efficiently with the right to retrieve previously allocated spectrum for refarming, to yield the utmost benefit for people and the public [1].

According to the legal provision, the mission and responsibility of the NBTC to retrieve spectrum from users of the existing spectrum for refarming is based upon the following cases:

1) In case the spectrum is not utilized.

2) In case the spectrum is not utilized at its maximum capacity.

3) In case the spectrum can be reassigned to yield greater benefit.

The aim of spectrum retrieval is to relieve the impacts caused from this legal provision that the NBTC will enforce on the users holding a license of the spectrum which is considered not being utilized, not being utilized efficiently or having the capacity of yielding greater benefits. This is based on the alignment with the Spectrum Management Master Plan, the National Table of Frequency Allocations, the spectrum plan and regulations

of International Telecommunication Union (ITU), spectrum monitoring and regulatory data as well as the efficiency and value for technical, economic, and social utilization of spectrum. Nevertheless, spectrum retrieval or any activities supporting spectrum retrieval will not be enforced in case users of the existing spectrum wish to return spectrum voluntarily or in case there are some specific laws regarding spectrum licensing terms and conditions which have been already enforced: for example, in case users of the existing spectrum wish to leave the business or terminate the license or in case they do not comply with related laws and licensing terms, the NBTC may take any actions to make amendment or to revoke the license for utilizing the whole or part of the spectrum under Section 44 and Section 47 of the Radio Frequency Allocation Act B.E. 2553 (2010) and its Amendment, etc [1].

Furthermore, the Radio Frequency Allocation Act B.E. 2553 (2010) and its Amendment states that the spectrum allocation income after deduction of spectrum allocation expenses will be provided to the Funds for Radio, Television, and Telecommunications Activities (funds) for spending on various purposes as imposed by the laws [1]. Here, the function of the funds is to support retrieval of the spectrum for refarming and to support replacement, reimbursement or compensation for users of the existing spectrum. Such support need to rely solely on the income deriving from spectrum allocation and the retrieved spectrum as prescribed by Section 52 (6) and Section 53, Paragraph 1 (8/1) and Paragraph 2 of the Radio Frequency Allocation Act B.E. 2553 (2010) and its Amendment.

Therefore, in order to comply with the legal provision, the NBTC has imposed criteria, methods, and terms for spectrum retrieval for being used as a concrete operational framework. Such criteria will prescribe the methods for spectrum retrieval as well as consideration for replacement, reimbursement or compensation to reduce the impacts on those from whom the spectrum has been retrieved.

III. PRINCIPLES OF SPECTRUM REFARMING

Spectrum is a limited resource. The increasing demand in spectrum utilization raises the awareness on the importance of spectrum resource and efficient spectrum regulation to support utilization of spectrum among a large number of diverse users and to support economic and social development. However, in order to enable efficient utilization of spectrum, it is absolutely required that all actions must be in alignment with the rules, practices and regulations of domestic spectrum utilization and radio regulations proposed by the International Telecommunication Union (ITU) [3].

Generally, efficient spectrum regulation can be evaluated through the capacity to respond to the country's spectrum utilization demand and the facilitation provided for people who utilize spectrum domestically. The major aim of spectrum management is to provide chances for public and private organizations to make use of the spectrum in order to bring about the country's economic and social development and to encourage efficient regulation of spectrum [4].

The NBTC is responsible for managing the spectrum to be adequate for both domestic and international utilization demand, enabling successful missions of various organizations in the country, and serving public needs in all activities related to telecommunications, radio and television broadcasting, and radio services with the following spectrum utilization objectives as follows [1, 4].

1) To support provision of efficient telecommunication services at domestic and international levels to yield business and personal benefits.

2) To develop innovations and spectrum-based communication infrastructure at present and in the future.

3) To protect national interest and state security.

4) To protect safety of life and property of people.

5) To support prevention of crime and support law enforcement.

6) To support domestic and international transport systems.

7) To support natural preservation.

8) To reinforce and support education as well as produce public benefits from providing news and entertainment services and to support scientific research, development and exploration of natural resources.

A. Spectrum Refarming

Spectrum is a limited resource, but it can be reusable depending on spectrum management strategies. It is the important mechanism for communication as well as economic and social development. In order to enable utilization of spectrum at its maximum capacity, spectrum management needs to rely on efficiency and effectiveness, proposition of communication activity development schemes to support future utilization of spectrum, service coverage, enhancement of service efficiency as well as promotion of new service innovations. Moreover, it is important that relationship with related national development plans needs to be taken into consideration a long with the spectrum management plan [5].

In order to promote development of new services, in some cases, the current users of the existing spectrum must be forced out so that the spectrum can be reassigned to other more modern technologies or relocated. Such operation needs to comply with the National Table of Frequency Allocations and the mechanism which enhances the efficiency in spectrum allocation [2]. Moreover, other options like spectrum sharing and spectrum utilization terms and conditions to overcome limitations may be taken into consideration as well.

Spectrum refarming is challenging. It is required that the complexity and various obstacles can be managed and handled. Besides, the data base for spectrum utilization monitoring and regulating must be provided as a reference data for spectrum refarming consideration. Levels of complexity and operational options will affect the process of spectrum reallocation. Moreover, there are other factors needed to be considered such as the operational duration, consumption demand, system efficiency, spectrum assignment for new services and the policy decision made during the World Radio communication Conferences – WRC regarding the additional assignment of spectrum for various services [6]. However, spectrum refarming for more suitable applications will bring about social benefit and be more suitable for new innovative services so as to support the directions of economic and social development.

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IV. PRINCIPLES AND CONCEPTS OF SPECTRUM RETRIEVAL REPLACEMENT, REIMBURSEMENT, AND COMPENSATION

The Thailand's policy on spectrum retrieval is based on the fair and thorough principle of spectrum licensing which considers and responds to various demands for spectrum utilization among the population, public, and private sectors such as for the purposes of state security, public utility, education, public health, business operation, and other public benefits. Moreover, the principle of effectiveness and value for spectrum utilization should also be taken into consideration from related factors such as technical efficiency which relies on selection of appropriate technology, amounts of spectrum channels which match utilization demand and the spectrum utilization which does not seriously interfere domestic and international spectrum utilization. As for the economic efficiency, it is considered from the value, income, and interests deriving from spectrum utilization which occurs directly from utilization of the allocated spectrum. In the meantime, the social benefit can be

considered from additional benefits to the society which is caused indirectly from utilization of the allocated spectrum.

A. Principle and Concept of Spectrum Retrieval

The major factors for the principle of yielding greater benefit from spectrum utilization are considered from the efficiency and value for spectrum utilization on social purposes. The strategy for replacement, reimbursement, and compensation for users of the existing spectrum need to be focused on social benefits [7] which can be divided into two parts as follows:

1) Direct benefits refer to the benefits which the users whose spectrum has been retrieved gain and expect to gain in case the spectrum is not retrieved, including the current secure income, the future income, and decreasing costs, etc.

2) Indirect benefits refer to the benefits which are additional to provision of services on the spectrum to be retrieved (such as the income generated from utilization of broadband services) as well as other indirect benefits. Nevertheless, it is important that indirect benefits are evaluated reasonably and fair by considering solely the additional benefits caused from the spectrum to be retrieved.

The NBTC will carry out spectrum retrieval only when the social benefit incurred after spectrum retrieval is greater than that before spectrum retrieval combined with its operational costs (see Fig. 1).

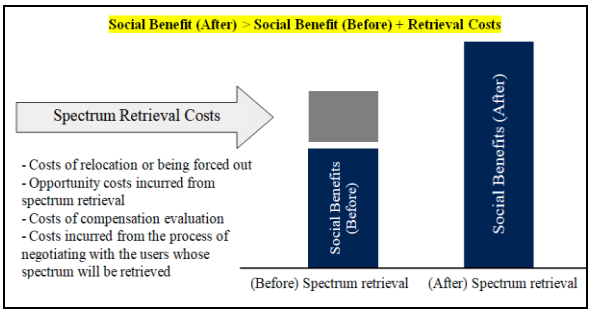

Fig. 1 Principle of Spectrum Retrieval

The costs incurred from spectrum retrieval are as follows:

1) Costs of relocation or being forced out.

2) Opportunity costs incurred from spectrum retrieval.

3) Costs of compensation evaluation.

4) Costs incurred from the process of negotiating with the users whose spectrum will be retrieved.

B. Principle and Concept of Replacement, Reimbursement, and Compensation for the Users of the Existing Spectrum

Means of efficient spectrum retrieval include replacement, reimbursement, and compensation. Generally, spectrum retrieval support can be carried out through the 3 means: 1) replacement, 2) reimbursement, and 3) compensation. In principle, the users whose spectrum will be retrieved will considered returning the spectrum in case the support for spectrum retrieval produces a greater value than the relocation cost and the opportunity cost from being unable to use such spectrum in the future (see Fig. 2).

- **Relocation Cost**

This includes the expenses incurred from relocating equipment and the network that supports spectrum band switching. This can be considered from the cost of relocating or moving from the frequency band to another by considering: 1) the data on spectrum utilization permission and the data on monitoring spectrum utilization, 2) the details, number, and current value of the previously used equipment, and 3) equipment retuning costs, and equipment replacement costs [8].

- **Opportunity Cost**

The compensation arranged for the users whose spectrum has been retrieved is considered form the opportunity cost, based on the reasonable and fair principle, incurred since the last day when the permission to utilize such spectrum is terminated for spectrum refarming until the due date authorized for utilization of such spectrum. This can be calculated through finding the Net Present Value (NPV) from the situation which

the users whose spectrum was retrieved has lost. However, the method which calculates the compensation by finding the opportunity cost is not limited to finding solely the net present value [9].

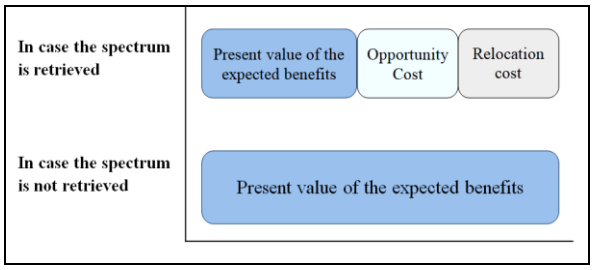

Fig. 2 Principle of Calculating Reimbursing Value and Compensation Cost

The licensees whose spectrum will be quashed in will consider returning the spectrum in case the Reimbursing Value or Compensation Cost produces a greater value than the opportunity cost and the relocation cost.

- Opportunity Cost is the cost incurred from losing opportunities as the spectrum is retrieved (such as monetary weighted average cost, operational income before interest and tax deduction, depreciation, etc.).

- Relocation is the cost incurred from relocating or moving from one frequency band to another (such as equipment retuning cost, equipment replacement cost, etc.).

V. CONCLUSIONS

Spectrum refarming is challenging. It is required that management strategies must be well prepared for the operation. Moreover, there are other factors needed to be considered such as the operational duration, consumption demand, system efficiency, allocation of spectrum for new services, policy decision made during the World Radio communication Conferences (WRC) regarding assignment of spectrum for various services, etc. As for additional allotments of spectrum for various activities, the NBTC will retrieve the spectrum only when the social benefit to be produced after spectrum retrieval is greater than that before spectrum retrieval combined with its operational costs. In the same way, the users whose spectrum will be retrieved will consider returning the spectrum in case the support for spectrum retrieval produces a greater value than the relocation cost and opportunity cost lost as the spectrum is not available for use anymore. Spectrum refarming for more suitable applications will be in alignment with the innovation development and the support for accelerating technological change which will provide the country with the utmost benefit in the future.

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(Arranged in the order of citation in the same fashion as the case of Footnotes.)

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