

Universal Telecommunications Service of Thailand

by

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Thailand is now engaged in the important process of reforming the country's telecommunications structure. New telecommunications acts have been passed and regulators have been designated to regulate this telecommunications transformation. However, there are many critical details that must be determined. This thesis aims to identify appropriate universal service mechanisms for Thailand. It focuses on universal service with regard to telecommunication regulatory policies for fixed telephone services. This study uses a qualitative analysis of multiple case comparisons as the methodology for exploring the universal service mechanisms in five countries: the United States of America, the United Kingdom, Chile, Peru and Malaysia. Each of these countries was selected after consideration of the telecommunications mechanisms they have implemented, as well as for key criteria that typically should be considered when choosing universal service mechanisms. After considering the key criteria with regard to characteristics of telecommunications in Thailand, this thesis concludes that the appropriate universal service mechanism for the country is a hybrid scheme that employs both Mandatory Service Obligations (MSOs) and Auctions through the Universal Service Fund (USF). The application of MSOs has been chosen to ensure that telecommunications providers fulfill their universal service obligations, while auction has been chosen in compliance with the USF. The recommendations from this thesis can serve as guidelines for universal service for telecommunications regulatory policies of Thailand. Nevertheless, additional specific details of

implementation should be considered and other comprehensive methodologies should be conducted in order to increase the ability to generalize these results.

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1.0 INTRODUCTION

1.1. Background

Over the course of the past decade, telecommunications services have become vitally important, and the need for these services continues to increase. Telecommunications services include both basic telecommunications such as voice telephone service and value-added services such as on-line data processing or email [WTO, 1997a]. Telecommunications have been increasingly seen as central to the effective facilitation of desirable social, economic and political changes [Taylor and Webster, 1996]. Consequently, there are many concerns about how to effectively distribute these services. This leads to the need for and enforcement of telecommunication regulatory policies [Housel and Skopec, 2001].

As a result of liberalization in international trade brokered by the World Trade Organization (WTO) [WTO, 1997b], telecommunications regulations policies address competition, price regulation, interconnection between providers, licensing of scarce resources and universal services [Intven et al., 2000]. Each topic is critically important, and all are inter-related in providing objective, transparent and non-discriminated telecommunications services.

Of all the concerns of telecommunications regulatory policies, this thesis focuses on universal service. The two most important concerns in telecommunications policies are effective

and efficient distribution of services. Also of importance is equitable distribution to society. These concerns will be addressed in this thesis.

There are many definitions of universal telecommunications services [Kaserman and Mayo, 1997]. These range from those services which ensure the availability of telephone service in all areas of a country to those which provide equal opportunity to access information age services, such as the Internet. Basically, the goal of universal telecommunications services is to provide sufficient services to the general public. Policies that demand universal services raise many concerns about mechanisms for achieving it, such as sources of funding, determination of contributors, and the amount of money needed to be subsidized [OECD, 1995]. There are options for resolving each mechanism, and telecommunications regulators must choose among them to best meet the specific needs and characteristics of their telecommunication environments.

The country of Thailand is now working on the important step of developing its telecommunication policies. In the process, it has become an interesting case study of telecommunications regulation. Historically, Thailand was the world's first country to provide nationwide Voice over Internet Protocol (VoIP) services [Hurdeman, 2003]. The VoIP services connect Bangkok with other cities. According to the Telecommunication Business Act 2001, the universal service policy in Thailand has recently undergone some major changes. In the past, services have been provided by a government-owned telecommunication incumbent; now, the universal service fund has been formed. The National Telecommunication Commission (NTC), the independent official telecommunication regulator, is legally responsible for implementation of the universal service policy. Under the direction of the new agency, the Telecommunication Business Act and the Constitution have provided the basic framework for universal services. However, many critical details remain undetermined.

This thesis intends to identify suitable universal service mechanisms for implementation of telecommunications policy in Thailand. The characteristics of existing universal service mechanisms in other countries will be evaluated as the multiple case comparisons. The key criteria for consideration when making universal service decisions will be identified and linked to the characteristics of the universal service mechanisms. These criteria will then be applied to evaluate the telecommunications characteristics of Thailand. Ultimately, a possible candidate of universal telecommunications service mechanism for Thailand will be proposed.

1.2. Overview of Research Objective

The characteristics of telecommunications services differ from country to country. If universal services are to be effectively implemented in Thailand, the service mechanism must comply with the specific characteristics of the country's telecommunications industry. The methodology for strategically choosing an appropriate universal service mechanism will be developed.

The main objectives of the thesis are:

- Investigate and identify the criteria used by different selected countries to examine their universal service mechanisms and select appropriate criteria for this study.
- Identify the characteristics of each universal service mechanism.
- Develop the key criteria to choose the universal service mechanisms for this study.
- Analyze the universal telecommunications service of Thailand to propose appropriate universal telecommunications service mechanisms.

1.3. Overview of Proposed Methodologies

This research will be conducted as a qualitative analysis. In order to identify the possible universal service mechanisms for Thailand Telecommunications, the study methodology will involve multiple case comparisons. The countries have been carefully chosen for this study of the characteristics of their universal service mechanisms. The selected countries are chosen based on their levels of development, universal service mechanisms and periods of universal service implementation. The criteria that are typically considered during the process of choosing the universal service mechanism in each selected country will be identified. The relationship between those criteria and the characteristics of the universal service mechanism in each selected country will be analyzed in order to identify the common key criteria among the studied countries. Finally, the research will use the common key criteria in the evaluation of universal telecommunications service in Thailand to propose the appropriate mechanisms.

1.4. Perceived Contributions of Research

This thesis is expected to make following contributions:

- Development of methodology for determining universal service mechanisms.
- Identification of telecommunications key criteria that must be considered when choosing universal service mechanisms.
- Identification of alternative mechanisms to allocate universal services.
- Recommendation of universal service mechanisms for Thailand.

1.5. Thesis Structure

This paper is organized in six chapters. Chapter 1 describes the background, objectives and expected outcomes of the thesis. Reviews of the literature about basic telecommunications regulations as well as about universal service of international interests and Thailand are presented in chapter 2. Chapter 3 details the research design of the study, which consists of research questions, research methodology, selection of case study, unit of analysis, data collection and data analysis. Chapter 4 examines the implementation of universal service mechanisms in five different selected countries. The characteristics of each mechanism and the criteria that must be considered when choosing universal service mechanisms will be also examined in the chapter. Chapter 4 concludes with the development of key criteria for choosing the universal service mechanisms. Chapter 5 applies the key criteria in an evaluation of the telecommunications system of Thailand. In addition, the chapter presents an analysis of each of Thailand's key criteria. Finally, it proposes and examines recommendations for universal telecommunications service mechanisms in Thailand. The last section, chapter 6, presents the conclusions of this thesis, discusses the results of the study, and provides comments on limitations, contributions and future research.

2.0 LITERATURE REVIEW

This chapter presents the fundamental concepts of telecommunications regulatory and universal service policies. Telecommunications regulatory policy addresses the following issues: licensing telecommunication service, interconnection, price regulation and competition policy. This chapter also provides background information about the Thailand Universal Telecommunication Service Policy. Finally, summarizes the information and explains the resulting research direction.

2.1. Telecommunications Regulatory Policy

Over the past decade, telecommunications services have moved from a monopolistic structure to a competitive structure [Housel and Skopec, 2001]. Many countries have privatized their telecommunications and other utilities sectors. This change facilitates compliance with the current market-based approach to telecommunications, in which price of services and competitions for services are driven by market power. The World Trade Organization (WTO) has expressed support for transparency, non-discrimination and timely basis trading in its liberalization regime [WTO, 1997b].

In light of these concerns, together with the emergence of new telecommunications-related services, the liberalization of the telecommunications market is inevitable [Hulsink,

1999]. However, the transformation of the telecommunications market cannot be driven only by the market forces. Rather, the intervention of regulators is both necessary and, generally, required to ensure fair competition and meet the key objectives of such competition. InfoDev, the information resources component of the World Bank, identified the key components of telecommunications regulation for the Telecommunications Regulation Handbook 2000 [Intven et al., 2000]. Specifically, the key elements are:

- Licensing Telecommunications Services
- Interconnection
- Price Regulation
- Competition Policy
- Universal Service

InfoDev's statement of the key objectives has been widely accepted as one of the best frameworks for telecommunications regulatory policy. The regulator needs to pay attention to all five of the objectives during implementation of a policy. The first four topics will be discussed in detail here; universal service will be discussed in section 2.2.

2.1.1. Licensing Telecommunications Service

Licensing is one of the most important mechanisms that support the effective distribution of telecommunication services. In their *Telecommunication Regulation Handbook*, Intven, et al. explains that licensing is “*a legal document granted or approved by a regulator or other government authority that defines the rights and obligations of a telecommunication service provider*”

Therefore, the regulator usually acts in favor of public interests such as universal services provision or service regulation, and the license is the means for clarifying the role of the telecommunications service provider. Generally, the terms “license,” “concession” and “franchise” may be applied interchangeably, depending on the laws of each country [Intven et al., 2000].

Objectives for licensing telecommunications services vary according to each country’s telecommunications policies, but there are a few objectives that many have in common. One such objective is to regulate the provision of essential public services (e.g., basic telecommunications). Another is to support universal service objectives, such as network roll-out and service coverage. Additionally, many countries use licensing to increase competition amongst telecommunication operators in the market during or after the privatization process. If the processes and details are defined strategically, licensing of telecommunications services can generate significant revenues for governments. Conditions to ensure consumer protection, such as those related to price regulation, dispute resolution and mandatory service are typically addressed in telecommunications licenses.

In addition to ensuring that telecommunications licensing procedures meet their public objectives, regulators in each country also must adhere to international trade agreements. Licensing is officially addressed in the WTO’s 1997 Agreement on Basic Telecommunications (ABT), part of its Fourth Protocol to the General Agreement on Trade in Services [WTO, 1997b]. This document specifies trade rules about telecommunications regulation and licensing. Members of the World Trade Organization and countries applying for membership generally ensure that their regulatory and licensing policies comply with the WTO’s trade rules. These

rules require that licensing processes be non-discriminatory and transparent and that they minimize trade barriers.

There are three common approaches to issuing service licenses. First, individual licenses may be issued. These grant specific operators with the rights to use a scarce resource. This type of license is suitable for the regulation of significant power provider. Contents of individual licenses are usually customized with regard to details, such as the provision of telephone and mobile phone services. Second, there are class licenses, also known as general authorizations. This type of license is useful when there is a need for conditions on the regulatory objectives. All qualified telecommunication operators are authorized to provide services (e.g., data transmission service or private networks). The final approach to licensing, called fully liberalized services, is the absence of licensing. Operators may only need to meet general requirements (e.g., registration with the regulator) before providing the services. Typically, operators of this type provide value-added or Internet services.

There are many types of licensing processes which regulators must apply appropriately, depending on the policies, laws and market structures of each country. For example, most countries that have privatized their telecommunications sector have licensed incumbent operators, as well as new entrants into the industry. Spectrum licenses are becoming increasingly important due to the limited scope of the radio spectrum [OECD, 1993]. Regulators traditionally use auctions lotteries, or comparative evaluation processes to grant providers the rights to use radio spectrum. Even though different kind of licenses may be issued in different manners, they all need to be transparent. Conducting licensing processes with public consultation and careful revision increases transparency, thus speeding up liberalization, increasing the benefits of privatization and developing investor confidence.

Instead of licensing, some developing countries use short-term or long-term concessions to authorize providers to operate telecommunications services [Intven et al., 2000]. Build-Transfer-Operate (BTO) (also known as Build-Operate-Transfer (BOT)) is the theme of such joint ventures between private sector investors and government telecommunication sectors. According to the terms of this type of contract, investors do not build or own any facilities, but share in revenues produced by state-owned operators in return for providing financing, management or both. Both BTO (Thailand) and BOT (India, Indonesia) arrangements have proven to be effective means of promoting network expansion.

2.1.2. Interconnection

In the liberalization of the telecommunications market, interconnection of providers is a critical factor that promotes competition [Lapuerta and Tye, 1999]. Broad-ranging interconnection creates a variety of services and leads to innovation in telecommunications services. Interconnection is defined differently by the regulatory and policy regimes of each country. A good definition is proposed by the Commission of the European Communities:

the physical and logical linking of public electronic communications networks used by the same or a different undertaking in order to allow the users of one undertaking to communicate with the users of the same or another undertaking, or to access services provided by another undertaking. Services may be provided by the parties involved or other parties who have access to the network [CEC, 2000].

As explained here, interconnection involves not only the connection between users who receive services from the same provider; rather, it also includes the provision of access and availability of services by other providers and their users.

Typically, in a competitive market, incumbents have little incentive to facilitate the entry of new service providers, who are their future competitors. The WTO's 1997 Agreement on Basic Telecommunications requires interconnection to be non-discriminatory, transparent, and reasonable [WTO, 1997b]. In order to fulfill the promise of interconnection, regulators' action is generally required. Regulators have two strategies for guiding interconnection. The first is an *ex post* approach, which is based on the belief that regulatory intervention should be minimized in order to maximize the benefits of market competition. Because the details of interconnection are generally complex and the providers usually have understand the arrangements better regulators do, this approach discourages regulators' action and promotes negotiation between service providers to develop arrangements about interconnection. However, due to the increasing competition, such negotiations between incumbents and new entrants normally end in dispute. This phenomenon leads to the implementation of the *ex ante* approach, which supports the idea of advance regulatory guidelines. According to this approach, specific interconnection rules and regulatory intervention are required for the development of successful interconnection arrangements and resolution of negotiation disputes in a timely basis [Intven et al., 2000]. *Ex ante* has received support from regulators and policy makers in past few decades for its efficiency in promoting market competition.

Even though regulators can intervene differently according to the specific telecommunications market of each country, there are some proven approaches from which the regulator can choose. Variations and combinations of these approaches can assist the successful completion of interconnection arrangements. Regulators can:

- Establish guidelines in advance of negotiations. This action aligns with the *ex ante* approach and includes the development of “best practices” and “benchmarks” of interconnection charges;
- Set default interconnection arrangements in advance of negotiations. The “sunset” clause for providers’ applicability will reduce concerns about the appropriateness of arrangements and minimize future disputes;
- Establish deadlines for various stages of negotiations. In theory, this approach provides an incentive for the negotiating parties to make reasonable offers;
- Establish industry technical committees. Such committees usually consist of representatives from both parties, and regulators takes responsibility for the details of technical interconnection arrangements;
- Offer incentives for completion of interconnection arrangements. Regulators can increase the incumbents’ incentives by linking successful interconnection agreements to approval for further services; and
- Appoint mediators and arbitrators. When agreements cannot be reached, mediators can provide additional information, develop compromises, propose alternatives, and persuade, while arbitrators are empowered to make binding decisions. These experts can be either regulatory staff members or outside experts with significant experience.

Serious problems with interconnection can sometimes result from the use of dominant powers from major suppliers. One obvious barrier is suppliers significantly over-charging their competitors. This deters the development of competition, pushes the excessive charge on the consumer and gives the pool of revenues to the incumbent for other subsidizations. Therefore, fair interconnection charges play a critical role in the liberalization of telecommunication market.

While there is no single best strategy for determining appropriate interconnection charges, most regulators and trade experts agree that ideal interconnection charges should be based on a cost-oriented calculation and related to projected costs of supplying the relevant facilities and services. As a result, the long-run incremental cost (LRIC) approach is becoming the main implementation of many countries.

LRIC can be implemented in a varied form, such as the Long Run Average Incremental Costs (LRAIC) adopted by the European Commission or the Total Service Long Run Incremental Costs (TSLRIC) and Total Element Long Run Incremental Costs (TELRIC) developed by the Federal Communications Commission (FCC), the formal regulator of the USA [Benjamin et al., 2001]. Normally, the LRIC calculation starts by estimating the long run costs, usually at least 10 years, incurred by an operator in providing interconnection services. Acceptable costs in calculation of the LRIC are capital costs, joint costs and common costs. Common costs reimburse the operators for the costs of financing interconnection facilities; joint costs and common costs are the indirect cost caused by the interconnection services.

There are also some non-LRIC approaches for calculating interconnection charges, such as Sender Keep All, Revenue Sharing and Efficient Component Pricing Rule (ECPR). Each of these approaches has weaknesses and strengths. Therefore, the appropriate method of calculation must be carefully chosen by regulators according to the particular circumstances of their country.

2.1.3. Price Regulation

Success of the competitive telecommunications market will typically lead to “efficient” prices that maximize society’s welfare. According to economic theory, “efficient” prices are those that equate the amount of a service sellers want to supply with the amount of a service that buyers

demand. When telecommunication markets fail to produce competitive prices, price regulation is justified. There are three main objectives of price regulation: financing, efficiency and equity objectives [Intven et al.].

Financing ensures that regulated operators are permitted to earn suitable revenue. Suitable revenue should be determined to be above the revenue “floor” but not over the revenue “ceiling” [Xavier, 1997]. This means that regulated operators are permitted to earn revenue over the amount required to finance their current operations and future investments, but they are not permitted to earn excessive revenue such as would be associated with monopolies or dominant market positions.

Efficiency of telecommunication services supplies is associated with the effective allocation of scarce resources and the productivity of services. This is an additional objective of price regulation.

Equity means that price regulation is generally related to society’s welfare and fair distribution of resources. Benefits can be shared between consumers and operators or between different classes of consumers.

Although price regulation strives to ensure the design and implementation of effective regulatory approaches, these three objectives can conflict with each other. Therefore, regulators will have to make trade-offs between the objectives depending on the main goals of their regulations.

One of the primary issues in price regulation is rate rebalancing. Rate rebalancing refers to the offsetting the price of telecommunications services more closely to the actual cost of providing the services [Cronin et al., 1997]. Many countries traditionally set the prices of local calls or monthly subscription under the actual cost. The resulting deficits are subsidized by

higher-than-actual long-distance and international calling prices which are unsustainable in the competitive market. As a result, many industrialized countries have implemented rate rebalancing policies in recent years. The Organisation for Economic Co-operation and Development (OECD) has conducted a comprehensive price comparison study of its 29 member countries since 1990. Their study shows that, between 1990 and 2002, the total of fixed and usage charges for both residential and business telephone usage decreased continuously while overall teledensity increased steadily [OECD, 2003].

Over the past few decades, several approaches have been developed to regulate the price of telecommunications services. Three common, rules-based approaches are traditional discretionary price setting, rate-of-return regulation and price cap regulation [Intven et al., 2000].

One traditional approach to price regulation is discretionary price setting. This scheme is based on the fact that, in the past, government-owned providers tended to be the dominant players in the telecommunications market. In this situation, the prices of telecommunications services were typically set by the government in order to promote equitable access to services. Prices for telephone subscription and local calls were set below their actual costs, and they were subsidized by the higher-than-cost prices of long-distance and international calls. In a discretionary price setting scheme, telephone prices are sometimes increased to make up government budget deficits, and telephone revenues are treated as part of the government revenues. Even though the main objective of discretionary price setting is to promote the equity among consumers with regard to their ability to receive telecommunications services, experience has shown that governments who use this approach seldom achieve their social and economic goals, at least on a long-term basis.

A second approach to price setting is rate-of-return regulation. This rules-based method of price regulation was developed to promote certainty and stability. The primary objective of rate-of-return (ROR) regulation is to set the prices of services to comply with the required revenues [Benjamin et al., 2001]. Regulators initiate the ROR scheme by reviewing the operating and financing costs of the telecommunications providers. They then calculate the rate of return over a given time period (normally one to three years) based on a review of financial market conditions. Eventually, based on an approved rate of return, regulators will calculate the revenue requirements that will recover the sum of all services provided by the telecommunications provider. If an operator earns more than its allowable rate of return, the prices of services are decreased. However, if an operator earns less than its allowable rate of return, the prices may be increased.

ROR price regulation has some weaknesses that the system lacks incentives for operators to reduce their operating costs, since they can recover most of their costs through rate increases [Benjamin et al., 2001]. Consequently, many countries have developed new ROR-incentive regulations that address this weakness. The ROR-incentive regulation typically provides more flexibility and applies goal-setting and reward-penalty schemes to the operators. For example, a ROR-incentive regulation might specify that operators earn all of the revenues under 10%, revenues from 10% to 15% are shared with the consumer and revenues over 15% lead to the reduction of services prices.

The third approach to price setting, which is the preferred form of price regulation around the world, is price cap regulation [Braeutigam and Panzar, 1993]. Price cap regulation is a rules-based approach that uses a formula to calculate the allowable price increases of telecommunications services. This approach provides both the greatest price flexibility and the

most incentives for better efficiency because it includes telecommunications measurement factors in the formula [Benjamin et al., 2001]. In the basic price cap formula, the price cap annually determines the allowable price increases by finding the rate of change in prices from a baseline figure. Telecommunications providers are permitted to increase the prices of their services to include the effects of inflation, but they must also pass productivity benefits to their customers by lowering the services prices. The simple price cap formula, adapted from the *Telecommunications Regulation Handbook*, is detailed in figure 2-1.

Allowable price increases for a year = Starting Price + I – X
Notes: I = Inflation Factor for the year X = Productivity Factor
Example: In year 2003, the price is 100 Inflation rate of 2003 = 6% Industry productivity in 2004 is assumed to have increased by 3% Therefore, the allowable price increase for 2004 equals $100 + 6 - 3 = 103$

Figure 2-1: Price Cap Formula [Intven et al., 2000]

As shown in the basic price cap formula, regulators have to carefully choose the values of inflation and productivity factors. Several different indices can be used to measure inflation, including:

- Gross Domestic Product (GDP) or Gross National Product (GNP). GDP is the economy price index used to measure the cost of a fixed basket of goods and services while GNP measures economy-wide coverage;
- Consumer Price Index (CPI) or Retail Price Index (RPI). Both of these measure the changes in the prices of goods and services purchased by typical consumers;
- Producer Price Index (PPI). This measures the changes in the price of goods and services purchased by different types of production industries;
- Inflation Index. Derived from another country, this can be an alternative for the I factor;
- “Composite” Index. This is a new measure of inflation that more accurately reflects the cost structure of the operators.

Like the inflation factor, the productivity (X) factor needs to be reasonably determined. The X-factor may be divided into “basic offset” and adjustment factors [Bernstein and Sappington, 2000]. The basic offset is normally reflected by the regulated operators’ historical achievement of productivity growth. The adjustment factors take into account any changes in the operating environments of the regulated operators. There are two main approaches to determining the value of the X-factor:

- Historical productivity method. This approach relies on historic information about the operator’s productivity performance to set the basic offset;
- Regulatory benchmarking method. This choice is suitable for countries that lack the details of historical data or those which have experienced significant changes in their telecommunications structures. In this approach, the X-factor particularly relies on

adjustment factors and may have to be based on the informed judgment of regulators and advisors.

2.1.4. Competition Policy

In the ideal competitive market, two or more suppliers would contend with each other to sell goods or services to customers. In such a market, individual suppliers would lack “market power,” the power to unilaterally set and maintain prices or conditions of sale, and there would be little or no reason for government intervention. However, no markets are ideally competitive. Imperfect condition such as the existence of a monopoly or the formation of collusive agreements by suppliers can lead to the failure of the market. Therefore, government intervention by regulators or competition authorities is inevitable for the promotion of competitive policies.

In competition policy, also known as “antitrust policy,” regulators promote competition by trying to protect new entrants from anti-competitive incumbent market powers. This strategy is based on the fact that incumbent, dominant providers usually have advantages in providing telecommunication services, such as control of essential facilities, de facto of network standards and customer inertia. As a result, competition policies generally exist to minimize barriers to entry in the market and to ensure fair use of essential facilities by both dominant providers and new entrants. Competition policy then has the following basic concepts:

- **Market Definition.** It is critical to define the scope of the market in the competitive regime. The market is typically defined by product or geographic area;
- **Barriers to Entry.** In the telecommunications market, barriers to entry slow the competitive process. Government restrictions, economies of scale and high costs are examples of barriers;

- Market Power and Dominance. Market power can be determined by market share, pricing behavior or profitability. It depends on the regulators of each country to define the concept of Significant Market Power (SMP) providers or market dominance. These differ slightly, but generally relate to the provider with the significantly high market share and power to create barriers to entry; and
- Essential Facilities. Sometimes called “bottleneck facilities,” these are typically those facilities that are supplied on a monopoly basis, are required by other operators in order to compete and cannot be practically duplicated. Local loops, which are the circuits between the customers’ premises and the first node of Public Switching Telephone Network (PSTN), are a good example of essential facilities. In competition policy, essential facilities should be available to all competitors according to reasonable terms.

Most competition policies have been developed to address anti-competitive behaviors. Many types of anti-competitive conduct and their typical remedies are briefly described below:

- Abuse of Dominance means that dominant market power providers use their power to abuse or harm the competition (i.e., refusal to supply essential facilities). This conduct can normally be remedied as a result of the regulators’ ability to conduct an investigation. The regulatory powers applied here include issuing enforceable orders, revoking licenses, levying fines or restructuring the dominant entity;
- Refusal to Supply Essential Facilities relates to providers’ refusal to deal with competitors. Even though some experts said that this discourages new entrants from building their own infrastructures, most experts believe this scheme accelerates competition;

- Cross-Subsidization usually occurs when dominant providers increase their service price in a dominant market and use their excess revenues to subsidize lower prices in other competitive markets. This anti-competitive concept is gradually being eliminated by the implementation of rate rebalancing policies. Other solutions to this problem include accounting separations between different services, structural separation of different line businesses entities and divestiture of ownerships;
- Vertical Price Squeezing is when dominant power operators wholesale a service to a retail provider and, at the same time, provide the retail's service directly to the customer at a lower price [Aron and Wildman, 1999]. This problem can be solved by applying the imputation test. The imputation test is the process for verifying that a wholesale provider provides services at a suitable cost (not too low) subjected to similar cost recovery requirements of the competitors in the market [CRTC, 1994];
- In Predatory Pricing, dominant power providers provide the services at prices that are low enough to drive their competitors out of the market. The associated regulatory approach is to implement price regulation that deters predatory behavior;
- Misuse of Information. Because dominant providers are usually able to get competitively useful information about competitors via the interconnection processes, it is possible for them to use the information to approach and induce the prospective competitor's consumers to switch to their own services. This behavior may be prevented by the establishment of an Interconnection Service Group (ISG) that can maintain and secure interconnection-related information;
- "Locking-in" Customers relates to the attempt of dominant providers to capture particular subscribers through specific agreements (i.e., SIM card locking of GSM

- mobile services). This situation requires the enforcement of particular regulations, such as those that require mobile services to enable their customers to unlock the SIM Lock feature;
- Tied Sales and Bundling are the selling of a product or service with condition that the buyer must purchase another product as an integrated offer. The remedy can be requiring dominant providers to provide bundled service availability on reasonable terms to be resold as part of competitors' own competing bundles; and
 - Restrictive Agreements in telecommunications include price-fixing, bid-rigging, and market allocation. Price-fixing means that competitors agree to manipulate their prices. Bid-rigging means that bidders scheme to pre-determine the winner and winning price in an auction. Market allocation means that providers agree not to compete in each other's market. Regulatory approaches for these three problematic types of agreements are similar to those applied to abuse of dominance and include levying fines, requiring compensation, and awarding damages.

2.2. Universal Services

2.2.1. Objectives and Definitions

There are two types of universal policies: universal service and universal access. Universal service policy focuses on promoting or maintaining universal availability by individual households to public telecommunication networks. Universal access refers to every person having reasonable ability to access a publicly-available telephone [Intven et al., 2000].

The objectives of universality policies are to provide and/or maintain the availability of affordable services to the public. The thesis will mainly focus on universal service policy. As identified by Kaserman and Mayo, there are four general definitions of universal service [Kaserman and Mayo, 1997]. These definitions are explained below:

- 1) In early discussions, universal service typically meant the availability of telephone service in all areas of the country.
- 2) Later, the definition seemed to be influenced by the political motivation of keeping residential telephone rate as low as possible. Here, universal service was said to mean providing affordable local residential telephone service.
- 3) Universal service has also been used for the equality of opportunity to access information age services. Generally, the set of telecommunications services that includes both telephone and digital access services are considered in the definition of universal telecommunications service.
- 4) The definition of universal service most widely accepted by economists is that it is “*the promotion of increased subscribership to the telecommunication network in the most economically efficient manner.*” [Wenders, 1987]. This definition relates to the concept that the addition of new subscribers increases the overall value of the existing network.

In conclusion, universal service means the provision of basic services to the general public. Universal service can include education and hospitality services. The specific conditions and objectives of telecommunications services must be defined by each country’s regulators. Basically, universal telecommunications services relate only to telephone, Internet or other digital services.

In this thesis, the term “universal service” will refer to the definition to provide the availability of fixed telephone services in all areas of the country. This means that universal service policies are aimed at both providing and maintaining service to the general public. The general public includes people who are located in high cost service areas, those who reside in rural or remote regions and those who belong to lower income groups.

Telecommunications services that are included in the concept of universal service differ according to the local economic and telecommunications conditions. For example, the definition of universal service might be influenced by the distribution of population and national income between urban and rural areas. Generally, developing countries place greater emphasis on basic universal telecommunications services, such as telephone service. Industrialized or developed countries usually include advanced features, such as data transmission, in their concept of universal service.

2.2.2. Universal Service Mechanism

The mechanism for promoting universal service varies in each country and depends on the objectives and concepts of universal service. In order to determine the suitable mechanism for promoting universal service, several criteria must be considered. These criteria are explained in detail below [Intven et al., 2000]:

- **Compliance with International Trade Rules:** International trade rules such as the WTO Agreement on Basic Telecommunications (ABT) [WTO, 1997b] deal with universal service and subsidy issues. The ABT requires committed countries to provide universal service in a transparent, non-discriminatory and competitively

neutral manner. Agreements like this can have an impact on the regulators' choices of universal service mechanism.

- **Economic Efficiency:** Some universal service mechanisms are more efficient than others. Implicit cross subsidies, for example, are usually less efficient than others because they use profits from high revenue services to subsidize loss incurred as a result of low revenue services. The high revenue services usually have higher-than-cost service rates (i.e., international call service), while the low revenue services usually have lower-than-cost service rates (i.e., local call service). This concept can lower demand for higher rate services and, ultimately, decrease overall revenues for the operator. The most efficient universal service mechanism should rely on small, targeted subsidies to promote specific universal service initiatives. It should also collect the revenue based on a wide range of telecommunications services, rather than only specific, high-margin services, such as international or long-distance calls.
- **Political Considerations:** Public relations and political considerations can slow the processes of the universal service mechanism and decrease the incentive for international investors. Regulators must play an important role in analyzing and publishing the benefits of universal service for politicians and the general public.

This set of criteria must be strategically revealed before the selection of appropriate universal service mechanism. After carefully considering these criteria, regulators should be able to determine the suitable mechanism for promoting universal service. There are five main mechanisms of universal service that have been implemented around the world [Intven et al., 2000]: market-based reforms, mandatory service obligations, cross subsidies, access deficit charges (ADCs), and universal service fund (USF). These mechanisms can be used singularly or

in combination to promote universal service. In the following paragraphs, each mechanism will be discussed including its strengths and limitations.

I. Market-Based Reforms

The experiences of countries indicate that the introduction of market-based reforms can significantly increase the supply of telecommunications services. Such reforms can be implemented through privatization, competition and/or cost-based pricing.

- Privatization has significantly increased telephone penetration in various countries. Network expansion targets are usually included in the contracts developed during the privatization processes.
- Competition promotes universal service by reducing the telephone waiting lists and increasing public telephone penetration.
- Cost-based pricing is related to the concept of rate rebalancing discussed in subsection 2.1.3. Penetration levels increase after rate rebalancing.

Market-based reform has proven effectiveness in expanding services in the economic telephone monopoly. However, sometimes, all three reforms fail to expand service to uneconomic areas unless they are supplemented by targeted subsidies.

II. Mandatory Service Obligations

This is the most commonly used mechanism for promoting universal service. This obligation is typically described as a “duty to serve” all customers willing to pay the subscribed rates.[Intven et al., 2000] When this strategy is used, governments or regulators impose mandatory service

obligations on newly licensed or newly privatized operators. Operators with universal service obligations are generally called universal service providers.

The major benefit of this mechanism is that the funding for universal service is generally provided by universal service providers. However, this also becomes the disadvantage of the approach because it imposes excessively high roll-out obligations on specific operators. If the universal service burden outweighs profits from the service, operators may consider cross-subsidies to be a remedy to the deficits. Cross-subsidies are generally considered to be an inefficient approach to telecommunications services; details are discussed below.

III. Cross-Subsidies

Cross-subsidization uses surplus revenues earned from profitable services to cover losses from non-profitable services. [Intven et al., 2000] This mechanism typically is used to maintain low service rates in high-cost or low-income areas [Benjamin et al., 2001]. While this mechanism is the traditional approach of providers in many countries, it has significant weaknesses. Specifically:

- Cross-subsidization provides competitive unsustainability since new entrants will only need to provide services in profitable areas.
- Untargeted subsidies are inefficient because all existing users generally receive the subsidy, whether they can afford to pay the full economic price or not.
- Anti-competitive use of subsidies can be implemented by the incumbent. Surplus revenues from the international service monopoly may be used to provide lower cost services than their competitors in competitive areas, such as Internet service.

- Only existing users receive the subsidy. In cross-subsidies, although local service rates may be low in many urban areas, those who are without telephone service, reside in rural areas or are on waiting lists do not benefit from the subsidy.

IV. Access Deficit Charges (ADCs)

ADCs are a variation of the traditional cross-subsidy mechanism. Instead of being responsible for re-allocating cross-subsidy revenues from profitable services to unprofitable services, incumbent providers receive contributions from other profitable service providers [Intven et al., 2000]. In other words, competing long-distance service providers (usually with high rates and profitable services) have to share the deficits incurred by incumbent providers from local services (usually low rates and unprofitable services). The deficit charges are usually collected in the same manner as interconnection charges; however, the World Trade Organization recommends that providers separate these charges from the interconnection tariff. [WTO, 1997b]

The advantage of ADCs is that they spread the deficits created by the provision of unprofitable services across all operators in a non-discriminatory fashion. Nevertheless, ADCs have many disadvantages. ADCs make it difficult to calculate access costs and benefits for universal service providers, and they lead to the possibility that incumbent providers charge excessive ADCs from other operators. Because they are based on cross-subsidies, they suffer from the same weaknesses as cross-subsidies.

V. Universal Service Fund (USF)

A universal service fund (USF) collects revenues from various sources and distributes them in a targeted manner to achieve specific universal service objectives. [Intven et al., 2000] Such funds are normally used to finance specific high-cost areas or low-income subscribers. USFs can also be used to subsidize existing universal services or to provide new universal services through the deployment of new networks.

There are various possible sources of USFs, such as: direct funding from the government, contributions from telecommunications operators (e.g., a proportion of revenues from specified services), proceeds from privatizations, spectrum auctions or license and concession payments, subscriber levies (i.e., embedded taxes in user tariffs) collected by telecommunications operators, and funding from international development agencies [Noam, 1994].

USFs can be used to finance various types of universal service objectives. However, they are generally used to finance the expansion of services to specific high-cost areas or populations. In such cases, the subsidy that is required must be determined. Typically, the amount of the subsidy is determined in one of two ways, as detailed below:

- **Cost models.** There are two types of universal service objectives that are able to implement cost models. First, cost models are used in the expansion of new services. These financial models are used to calculate the difference between capital and operating costs of providing services in specific regions and the projected telecommunications revenues of those regions. The universal service fund should only pay for expansion of services to uneconomic areas. Additionally, cost models can be used to maintain existing universal service. The processes are somewhat difficult and controversial due to the large, diverse scope of existing services to be

- considered. In this application, cost models are generally used to maintain the below-cost rates of subscribers already on the network. The costs are calculated based on the long run incremental costing (LRIC) method discussed in subsection 2.1.2.
- **Auction.** Auctions or competitive bidding processes are used when regulators have less information than telecommunications operators about the real costs and benefits of implementing universal service [Weller, 1999]. The final costs for providing universal service will be determined during the auction. Regulators usually estimate the amount of the subsidies for specific areas using cost models or other financial models. This amount is then set as the maximum limit for the bidding. Next, specific areas are put up for auction. Universal service licenses will be granted to the bidders that offer to provide the designated services for the lowest subsidy. This strategy has the significant advantage of reducing the total funding required to meet universal service objectives. Many licenses typically are granted with zero-subsidy, meaning that there is no need to subsidize the winning bidders at all. The winner also achieves intangible benefits from becoming the universal service providers. For example, they gain in corporate reputation, brand recognition and access to customer data. The weaknesses of the auction strategy are the complexity of the bidding process and difficulty defining the objects to be auctioned.

2.2.3. Universal Service Processes

In order to provide universal service, many processes need to be considered. Basic universal service processes are discussed as follows:

- 1) Consider suitable universal service mechanisms to promote universal service objectives. The alternatives are discussed in subsection 2.2.2.
- 2) Determine sources of financing for universal service provision. This process addresses issues about how to find the money for universal service objectives. In USFs, this is the process of identifying funding sources and collecting the funds.
- 3) Determine the mechanism for allocating universal service. This is the process of determine suitable universal service providers for specific areas. The possible mechanism can be mandatory service obligations that impose universal service as part of the license contracts.
- 4) Calculate the costs necessary to provide universal service in specific areas. Competitive bidding processes and financial models can be applied.
- 5) Determine the areas that need universal service. This process depends on the regulators' policies. Some countries receive requests for universal services from designated areas. However, in many countries, the governments or regulators determine the designated areas that will receive universal service according to their policies and objectives.

2.3. Thailand Universal Telecommunications Service Policy

As a developing country that is in the process of liberalizing its telecommunication infrastructure, Thailand provides policymakers with useful lessons about trends of telecommunications services in Southeast Asia. This section discusses the background of telecommunications in Thailand, giving special attention to the universal services regime there.

2.3.1. Background of Telecommunications in Thailand

In the past, the telecommunications structure of Thailand was a monopoly, as are other main utilities there. The Telephone Organization of Thailand (TOT) and the Communication Authorities of Thailand (CAT), which are both owned by the government, have exclusive and dominant power in the telecommunications market. TOT is responsible for providing telecommunications services to domestic customers and neighboring countries, while CAT is responsible for all international services. The Post and Telegraph Department, under CAT administration, is an important agency responsible for radio spectrum and frequency management. Both TOT and CAT are departments of the Ministry of Transport and Communications (MOTC), recently renamed to be the Ministry of Information and Communications Technology (MICT).

However, due to the need for network expansion in 1993, TOT has granted Build-Transfer-Operation (BTO) concessions to joint venture operators. Under this scheme, private operators build telecommunications infrastructures, and then transfer their ownership to TOT immediately upon completion of construction and installation [Rattananubal and Somboontanon, 2001]. After that, private firms operate the telecommunications services and share the revenue with TOT for a period of time, normally between fifteen and twenty years. Telecom Asia (TA) has been granted the concession to provide basic telephone services in the Bangkok metropolitan area while Thai Telephone and Telecommunication (TT&T) has been granted concession for the same services in Thailand's rural areas.

In addition to basic telephone services, TOT and CAT also distributed BTO concessions in paging, Internet and mobile services. Under the control of CAT, which has a monopoly on Thailand's Internet gateway to international networks, all Internet service providers (ISP) must request permission from CAT to provide Internet services, and CAT has to hold at least 30% of each provider's shares.

In mobile services, many operators have been granted the concession from both TOT and CAT. Advance Information Service (AIS), operating services at 900MHz, is the largest wireless phone company, with 60% of the market share in 2003 [PTD, 2003]. Total Access Communication (DTAC) and Telecom Asia Orange (TA Orange) are the second and third largest mobile companies, respectively. Most of wireless telephone companies in Thailand have developed strategic foreign partnerships, such as AIS's relationship with SingTel or DTAC's with Telenor. These foreign partners are expected to bring globalization and professional practices to Thailand's telecommunications market.

In response to global liberalization and the World Trade Organization (WTO) agreements, Thailand is committed to fully opening its telecommunications market to competition by 2006 [WTO, 1997b]. In order to reach this goal, the government has introduced the Telecommunication Master Plan. In addition, in 2000, it issued laws about frequency spectrum management and, in 2001, the Telecommunication Business Act. These main telecommunication laws provide the framework for introducing competition and liberalization, as well as for establishing the telecommunication regulatory body known as the National Telecommunication Commission (NTC). Details about the NTC and Thailand's telecommunication laws will be provided in chapter 4.

Liberalization generally supports openly competitive markets and requires the privatization of state enterprise monopolies. To meet the government's goals of achieving liberalization by 2006, TOT and CAT were privatized in 2003. The companies will be owned by the government until the opening of the telecommunication market in 2006; however, at that point Thailand will allow domestic and foreign private companies to apply for licenses to operate telecommunication services.

2.3.2. Thailand Universal Services Initiatives

The universal service obligations of Thailand have primarily been the responsibility of the Telephone Organization of Thailand (TOT). The basic network is being extended through use of telecommunication BTO schemes [Rattananubal and Somboontanon, 2001]. Such BTO schemes are intended to extend basic telecommunication services (i.e., fixed-line telephone and mobile phone services) across the country. Since official regulators have not been established yet, TOT is the regulator of the universal service initiatives.

Thailand's universal service objectives are broadly defined in its telecommunication laws and information technology master plan. The telecommunication laws provide the framework for the establishment of a universal service fund to support the operations of telecommunications services for the public's benefit. However, the laws have not detailed the specific requirements and scope of the country's universal service.

The National Information and Communication Technology (ICT) Master Plan 2002 – 2006 does provide some details about Thailand's universal service objectives. The master plan is the guideline for enhancing the quality of Thai life and society through the development of a

basic telecommunications infrastructure [NITC, 2002]. The objectives of universal telecommunications service are:

- Every village has to have at least 7 lines of telephone service by 2005.
- Every city must have affordable broadband service by the end of 2006.
- Every district (Tumbon) must have a telecenter by 2006.
- 300,000 teachers must use ICT for education benefits by 2006.

According to the telecommunications laws and the ICT master plan, many universal service projects are to be implemented by TOT. These include: the Rural Long-Distance Public Phone Project, Support for Distance Learning via Satellite, Public Telephones for the Disabled, Schoolnet Computer Network Project for Thai School, and Internet Tumbon (districts).

The universal service projects listed above have created significant deficits for TOT because they are not profitable. For example, in 2001, the Rural Long-Distance Public Phone Project caused TOT to have annual deficits approximately equal to \$US 200 million [Narong Pomlaktong, 2003]. Consequently, the organization has had to use revenues from monopoly telephone services to cross-subsidize these losses. When the telecommunications market is fully opened to competition in 2006, this cross-subsidization will reduce TOT's competitive ability and limit the benefits of overall competitive market.

In response to liberalization, telecommunications laws have specified frameworks for universal service policy. The Universal Service Fund (USF) will be established as the primary mechanism for promoting universal service objectives. The USF consists of initial funding allocated by the government, as well as the contributions of telecommunications providers through license fees, spectrum fees and a proportion of their revenues. The USF is generally

administered by the official telecommunications regulator, the National Telecommunications Commission (NTC).

Following the universal service processes discussed in subsection 2.2.3, Thailand has already developed the frameworks for the first two processes, determining a suitable universal service mechanism and funding collection mechanism, respectively. However, the remainder of the processes (e.g., determining the suitable mechanism for allocating universal service, calculating costs, and determining suitable areas for universal service) have still not been detailed. It is basically NTC's responsibility to determine the details for these processes.

2.4. Summary and Resulting Research Direction

The scope of universal service discussed in subsection 2.3.2 is not consistently defined by Thailand's laws or government. The thesis will focus on the scope of universal telecommunications service, specifically basic fixed line telephone service. Other universal service concepts, such as those related to Integrated Services Digital Network (ISDN) and the Internet will not be addressed by this research.

As discussed in the previous subsection, some universal service processes of Thailand have already been specified by the country's telecommunication laws. The Universal Service Fund (USF) has been selected to be a main regime of universal service policy. The laws have also stipulated that the USF will be funded by the government, as well as contributions from providers through license fees or a proportion of their revenue. Processes for identifying the universal service area and amount of subsidies needed are outside the scope of this research.

Consequently, this thesis will focus mainly on the mechanisms for allocating universal telecommunications service. It will also consider with the process of proposing the candidate for Thailand's universal service mechanism.

In order to fulfill the main objective of the thesis, which is to propose a possible mechanism to allocate universal telecommunications service in Thailand, this research will begin with a review of the universal service mechanism implementation in different countries. The countries have been carefully chosen based on their development according to the list of the United Nations (UN) country grouping [UN, 2004], universal service mechanisms and period of universal service implementation. The universal service mechanism implementations in these countries are analyzed in order to identify criteria which must be considered when making decisions about universal service mechanisms. The criteria of each country will be linked with characteristics of their telecommunications. The key criteria will be those that all countries have in common. These will be considered for application to Thailand's universal service mechanisms, based on that country's characteristics. Finally, the study will apply the key criteria to Thailand in order to determine the possible universal telecommunication services mechanisms. Limitations and advantages of the implementation will be discussed.

3.0 RESEARCH DESIGN

This chapter will present the details about this study's research design. It begins with the research questions that this study aims to answer. Following that is the proposed research methodology with details about the selection of case studies, unit of analysis, data collection and analysis of collected data.

3.1. Research Question

The research aims to find the answers of these questions:

- What criteria do countries use and how do they use them to choose their universal service mechanisms?
- What are the relationships between criteria and universal service mechanisms?
- What are the possible universal service mechanisms for Thailand Telecommunications?

3.2. Research Methodology

The research will be conducted as a qualitative analysis. The qualitative research fundamentally depends on watching people in their own territory and maintains a holistic approach [Kerlinger and Lee, 2000]. In order to find the possible universal service mechanisms for Thailand Telecommunications, a multiple case comparisons methodology will be used. Steps of the methodology are listed below:

- 1) Choose the countries as case studies to study their characteristic of the universal service mechanism.
- 2) Identify the criteria that typically must be considered when choosing universal service mechanism in each selected country.
- 3) Analyze the relationship between those criteria and the characteristics of the universal service mechanism in each selected country in order to identify the key criteria that all studied countries have in common.
- 4) Apply the key criteria in an evaluation of the universal telecommunication service in Thailand in order to propose the appropriate mechanisms.

In addition, this research will give attention to the other elements, such as the culture, politics, and environments of Thailand, as well. Effective and efficient telecommunications service aims to provide equity for all of the country's people as it become one of the necessities of everyday life.

3.3. Selection of Case Studies

The countries chosen as case studies have been selected based on three factors: levels of development, universal service mechanisms and periods of implementation. These factors are detailed below. The countries selected are the United States of America, the United Kingdom, Chile, Peru and Malaysia.

- 1) Levels of Development are categorized with respect to the United Nations (UN) list of country groupings [UN, 2004]. This factor is considered because developed and developing countries have differences in characteristics, such as culture, politics and economy, and these differences directly and indirectly affect the implementation of universal service mechanisms. With high penetration of telecommunications services, universal service policy in developed countries tends to maintain telephone service connectivity for individual households and provide a range of additional sophisticated services, such as emergency access and operator assistance [Intven et al., 2000]. On the other hand, universal service policy in developing countries focuses on expansion of basic telecommunications services, such as bringing telephones or telecenters to the general public in high cost and low income areas. The chosen countries represent both developed and developing countries. The United States and the United Kingdom are chosen from the list of developed countries, Chile, Peru and Malaysia are chosen from the list of developing countries while Malaysia is also chosen as a neighboring country of Thailand.
- 2) Universal Service Mechanisms. Each chosen country has implemented different types of universal service mechanisms. The different implementations are the result of different factors and telecommunication industry characteristics that the policymakers

in each country consider. The United States has implemented Access Deficit Charges (ADCs) and the Universal Service Fund (USF) to subsidize deficits of universal service providers and promote universal service in specific areas. The United Kingdom uses Mandatory Service Obligations as the universal service mechanism to provide basic telephone services for people who need them. Chile and Peru use auctions to expand universal service to unserved areas, while Malaysia uses a combination of these mechanisms, called a hybrid mechanism, to promote the country's universal service. This study does not seek to identify a single mechanism as being best for all countries in all situations. Each mechanism can be well selected and implemented by each country after the appropriate analysis of its factors. Rather, this study seeks to identify the core factors that countries consider when making decisions about which universal service mechanisms to use. In addition, this study attempts to categorize the decision-making criteria systematically. Finally, these criteria will be applied to Thailand and a proposal will be made about the appropriate telecommunication universal service mechanism the country should use.

- 3) Periods of Implementation. This study examines countries that have been implementing universal service mechanisms for at least 5 years. Implementation of universal service for this time period facilitates the availability of data. Five years is a long enough period of implementation time for the results and effectiveness of implementation to be demonstrated. During this period, it is expected that changes and corrections have been made in the countries' implementations of the mechanisms. The development of such mechanisms in each country helps researchers understand the criteria each country used more effectively. Improvement and termination will describe how this factor is applied.

3.4. Unit of Analysis

This research primarily will analyze universal telecommunications service through the regulatory agencies of the chosen countries. It studies telecommunications activities at the organizational level. Each country's regulatory agency may have different perspectives about significant levels for each criterion applied in choosing the appropriate universal service mechanism. Factors that are usually considered by each agency when making such decisions about implementing universal service mechanisms will be examined. Additionally, the work and performance of the agency provides specific information about the influence of other factors which should be considered in the decision-making process, such as the economy, politics and management

3.5. Data Collection

This research uses archived data collected from a review of literature and other telecommunications resources. Main sources of data collections in the study are explained below:

- Core ideas about telecommunication policy and regulations have been drawn from Intven, et al.'s *Telecommunications Regulation Handbook* published by the *infoDev* division of the World Bank [Intven et al., 2000]. The handbook has been accepted worldwide as a guideline for regulatory policy in telecommunications. The study

- examined some concepts and important issues in regulatory policy of telecommunications from the book.
- Some data about international agreements has been collected from the World Trade Organization (WTO). The agreement on basic telecommunications [WTO, 1997b] has been studied its detail about the commitment of each country on the regulatory framework of telecommunications.
 - Data about the implementations of universal service mechanisms in the chosen countries come from documents of the telecommunications regulatory agencies of each country. The Federal Communications Commission (FCC) of the United States, the Office of Telecommunications (OFTEL) of the United Kingdom, the Subsecretaria de Telecomunicaciones (SUBTEL) of Chile, the Organismo Supervisor de Inversion Privada en Telecomunicaciones (OSIPTEL) of Peru and the Communications and Multimedia Commission (MCMC) of Malaysia.
 - The regulatory body of Thailand, the National Telecommunications Commission (NTC) is in the establishing process. The telecommunication regulatory data of Thailand's market mainly comes from other related telecommunications sectors such as the Telephone Organization of Thailand (TOT) and the Communications Authority of Thailand (CAT). Furthermore, specific information about the telecommunications industry in Thailand as well as general information about Thailand is collected from research conducted by the Thailand Development Research Institute (TDRI) and the Bank of Thailand.
 - International statistical data drawn from the World Bank [Group, 2003] are examined in the study as well as some specific telecommunication statistics from the

International Telecommunication Union (ITU) [ITU, 2002, ITU, 2003b, ITU, 2003a]. Moreover, the thesis examines some studies from the Organization for Economic Cooperation and Development (OECD) about telecommunication penetration and trends in developed countries [OECD, 2003].

3.6. Data Analysis

The strategy for analysis used during the course of this research starts by analyzing the characteristics of universal service mechanisms in chosen countries, and identify their implementation. After that, the implementation of mechanisms in selected countries will be examined to identify advantages and limitations of each scheme.

Next, the research will identify existing criteria that each country uses when choosing universal service mechanisms. This step will be performed to examine the factors that policymakers or regulatory agencies in the selected countries consider when developing their universal service policies. The variety of criteria used is based on differences in the telecommunication policies and goals of the countries' universal service.

After the criteria that selected countries used when choosing their universal service mechanisms are identified, the relationship between the criteria and the mechanisms will be examined. Next step is to pinpoint the reasons why each country chooses its universal service mechanisms and how that relates to its criteria. During this process, the research will consider the possibility of the existence of strong relationships between the criteria themselves. Such relationships may be formed between as few as two or among at least three criteria. Some criteria

may not affect the decision making on their own, but they may strongly affect the decision-making process when combined with other criteria.

In the last step of data analysis, the research will develop key criteria to be applied in this study from the above criteria. Among the criteria used by each of the chosen countries, there are some criteria in common. These are considered to be the key criteria that should be applied when choosing a universal service mechanism. Finally the key criteria will be applied to develop a proposal about the appropriate universal telecommunications service mechanisms for Thailand. The telecommunications of Thailand will be mainly examined in light of the identified key criteria. The relationship between key criteria and universal service mechanisms will be applied with the characteristics of Thailand's telecommunications needs and industry to propose the universal service mechanism.

4.0 ANALYSIS OF UNIVERSAL SERVICE MECHANISMS

This chapter details the methodology used to fulfill objectives of this study. The study uses qualitative analysis as the main methodology. The appropriate universal telecommunications service mechanisms for Thailand will be identified through multiple case comparisons of other countries and mechanisms. The first section of this chapter, 4.1, identifies the selected countries which represent different types of universal service mechanisms. Characteristics of universal service mechanisms and criteria that selected countries use to choose their mechanisms are analyzed in sections 4.2 and 4.3, respectively. In section 4.4, the analysis of the relationship between the criteria and universal service mechanisms is conducted and the key criteria for choosing the universal service mechanisms are developed which will be applied in the study.

4.1. International Universal Service Mechanisms

Multiple case comparisons of universal service mechanisms are the method of qualitative analysis used in this research. Several countries that implement universal service are selected to study their mechanisms, as well as the criteria they used to choose their mechanisms. As mentioned in section 3.3, countries have been selected for inclusion in the study based on three factors: levels of development, universal service mechanisms and periods of implementation.

Selected countries are both developed (the United States of America and the United Kingdom) and developing (Chile, Peru and Malaysia) in nature. Each represents a different type of universal service mechanism, and each has been implementing its mechanism for more than 5 years, to assure that data about the implementation are available.

The study has chosen the United States and the United Kingdom as the representative of developed countries because they are two of the most developed countries according to the United Nation (UN) list [UN, 2004]. Furthermore, both of them are implementing different universal service mechanisms that are good examples to study their characteristics.

Chile is chosen among other developing countries in the study because it is the first country to implement auction as the universal service mechanism. The study tends to examine the characteristics of auction mechanism and its competitive bidding processes. Moreover, Peru is chosen to study different ways to implement auction mechanism.

Malaysia is one of the neighboring countries of Thailand. It is chosen to examine the universal service mechanism because it has closed characteristics of telecommunications structure to Thailand. In the study, the implementation of universal service mechanism of Malaysia is examined after its telecommunications reform has been started. It is associated with the case of Thailand that is also in the process of telecommunications reform.

This section briefly describes the implementation of universal telecommunications service mechanisms in each of the selected countries. The universal service approaches of these international cases will be used in the analysis of multiple cases comparison later in this paper. Countries are discussed in order from developed countries (the United States and the United Kingdom), developing countries (Chile and Peru) and neighboring country (Malaysia).

4.1.1. United States of America

Most developed countries include not only basic access to telephone in their universal service policies, but also digital data transmission. In many cases, the universal services must be provided at a regulated price which is lower than the actual cost of providing the services. The universal service approaches such as ADCs, Universal Service Fund (USF) or Mandatory Service Obligations are typically applied by these countries.

The United States of America (USA) has implemented a relatively complex universal service mechanism. Basically, the Federal Communications Commission (FCC), the country's official telecommunications regulator, applies both ADCs and the Universal Service Fund scheme to the market [FCC, 1996]. The ADCs scheme finances access deficits of incumbent providers while the USF promotes universal service in specific areas. The ADCs specify that interstate carriers must pay access charges to compensate for the incumbent local carriers' deficits incurred as a result of providing universal services. The USF receives mandatory contributions from all telecommunications carriers that provide interstate telecommunications. It is then distributed to any qualified operators that provide universal services.

There are many telecommunications providers in the USA. The providers must compete in the market of local and long-distance services [Benjamin et al., 2001]. Compared to other countries, the penetration of telecommunications in the USA is above average. In 1996, when the USA implemented the universal service mechanisms associated with the Telecommunications Act 1996, the fixed telephone density was 64% while the world average was 12.88% [ITU, 2002]. The USA Telecommunications Act of 1996 specifies that the scope of universal service must include voice public switch, touch tone signaling, and 9-1-1 services. The Act also requires

compensation for universal service obligations from most of the telecommunication providers [FCC, 1996].

4.1.2. United Kingdom

Unlike the USA, the United Kingdom (UK) implements Mandatory Service Obligations. The UK assigns universal service obligations to the two main incumbents, British Telecom (BT) and Kingston [Curven, 1997]. The Office of Communications (Ofcom), formerly known as the Office of Telecommunication (OfTel), has stated that the provision of universal service provides intangible benefits, such as increased company reputation, to the universal service providers [OFTEL, 2000]. In order to calculate the amount of subsidy needed for universal service obligations to be met, intangible benefits have to be included. According to Ofcom, there is no need to distribute subsidies to the UK's universal service providers because the intangible benefits they receive compensate for the competitive disadvantages of providing universal service.

There are many telecommunication providers in the UK. As mentioned above, British Telecom and Kingston are the universal service providers. The UK's telecommunications market was fully opened in 1997, when BT had around 90% of the fixed telephone market share and the fixed telephone service density was 55% [ITU, 2002]. The goals of the UK's telecommunications services are to provide connections to the fixed telephone network with alternatives for subscribing to economic service plans at a low price and fulfilling most of the telephone service's needs.

4.1.3. Chile and Peru

Chile has adopted a very interesting universal service approach in its use of the Universal Service Fund (USF) and Auctions. Universal service is not considered to be the responsibility of any specific operator; therefore, the government establishes and sponsors the USF [Winslow, 2004]. People in rural areas have the opportunity to request universal service. Chile's regulator categorizes universal service obligations with regard to projects associated with the areas. The cost of providing universal services in each project is calculated, and this is set as the maximum allowable auction bid. In this way, the universal service provider for each project is chosen during a competitive bidding process. Universal service projects are auctioned off individually, and providers that require the smallest subsidies to provide the services are the winners. This scheme is very successful because most of the winning projects need less financial support from the USF than government-defined maximum, and some of them need no compensation at all [SUBTEL, 1994].

Chile has more than twenty telecommunication providers in its competitive market. In 1994, fixed telephone density was 11%, it has 11 fixed telephone lines in 100 populations [ITU, 2002]. Consequently, the main objective of Chile's universal service program is to provide service to areas that lack telephone service (unserved areas). The provision of universal service is focused more on community service (i.e., public telephones) than on individual service (i.e., household telephones). The Telecommunication Law of 1994 stipulated that the universal service fund is to support service to rural and low-income areas with low teledensity.

Peru also uses both USF and Auctions in its universal service approach. However, the details of implementation are different. Peru's telecommunications sector is dominated by a privatized company which holds a monopoly on services and must direct 1% of its gross revenue

to the USF. Peru's regulator administers a specific type of auction, called simultaneous competitive bidding, to distribute universal service. In this scheme, providers are allowed to bid on any combination of the universal service projects [OSIPTTEL, 1998]. After the bidding is completed, the regulator determines the combination of bids that minimizes the amount of money to be distributed.

4.1.4. Malaysia

Malaysia's universal service mechanism is divided into two phases [MCMC, 2001]. During phase 1, the incumbent is contractually mandated to provide universal services. Other telecommunication operators are required to compensate the incumbent equal to the amount calculated by the regulator using a specific formula. In phase 2, the government chooses the appropriate universal service provider in each area. The incumbent normally has an advantage for providing universal service in its area. However, if the incumbent refuses to provide the service or there are other qualified operators that can provide the service promptly and with fewer subsidies, then universal service provision will be granted to the new operator. Typically, the universal service providers are funded by the Universal Service Fund.

There are five main telecommunications providers in Malaysia. The telecommunications market is an open market. The fixed telephone density was 19.71% in 2001 [ITU, 2002]. In phase 1, the goals of universal service focused on the provision of basic telephone and public telephone services in rural areas. In phase 2, the goals were extended to include both telephone and Internet services.

4.2. Characteristics of Universal Service Mechanisms

A study of the universal service mechanisms discussed in section 4.1 shows that they are used very differently and very broadly by the selected countries. Nevertheless, they can be categorized in to four main approaches: auction (competitive bidding process), mandatory service obligations, access deficit charges (ADCs), and hybrid (combinations of these approaches). This section explores the characteristics of each universal service mechanism and examines its approach.

4.2.1. Auction (Competitive Bidding Process)

The auction approach is usually used to allocate universal service in unserved rural areas. The universal service license is granted to the bidders that offer to provide the designated services at the lowest subsidy. The winner becomes the universal service provider (USP) in the area and usually receives funds from the Universal Service Fund (USF).

This approach can also be applied to areas that already have universal service, but of doing so is more difficult. Situations in which the regulators have less information than the telecommunications operators about the real costs of universal service provision are also suitable for the competitive bidding process. Auctions are normally used by developing countries (i.e., Chile and Peru).

Auctions provide many benefits to the telecommunications market. They usually reduce the total funding required to meet the universal service objectives, as is the case with both Chile and Peru. The multiple bidding approaches applied by Peru increases the incentive for bidders and investors to meet their economies of scale [Nett, 1998]. Auctions also support competition

because market players will determine the suitable costs of providing services via the bidding process. Finally, auctions are accepted by worldwide regulators as highly transparent and effective processes.

With regard to the objective of allocating universal service, the auction mechanism has some limitations. In order to effectively perform the auction, the telecommunications market in a given country has to be competitive in nature. Moreover, the auction requires there be a sufficient number of potential bidders in each service area in order to ensure the benefits of the processes. In addition, before the auction can be performed, the object to be auctioned must be sufficiently identified, detailed and categorized. [Nett, 1998].

4.2.2. Mandatory Service Obligations

As discussed in section 2.2 that, mandatory service obligations are an imposition of universal service obligations by license conditions or other regulatory measures. Universal service providers are required to provide designated services within a specified time of receiving the license. In this approach, universal service providers generally do not receive money from the universal service fund.

Mandatory service obligations are effective when applied to new licenses or newly privatized operators. This approach is commonly used to expand the telecommunications network and ensure the regulators' exclusive power in the telecommunications market. Countries which use mandatory service obligations include Malaysia, South Africa, and the Philippines.

The primary advantage of this scheme is that there are no funding requirements for the government. Rather, funding for universal service obligations is provided by the providers themselves. When this approach is feasible, it is not anti-competitive [Intven et al., 2000].

However, sometimes mandatory service obligations impose excessively high obligations on the private operators. If the burden of the universal service obligation outweighs the benefits, universal service providers may be forced to rely on anti-competitive approaches (e.g., cross-subsidization of monopoly profits) to compensate themselves for the loss.

4.2.3. Access Deficit Charges (ADCs)

Access deficit charges assign universal service to be the obligation of incumbent providers. Other operators have to pay subsidies to finance the total local access deficits incurred by the incumbents in providing local services, which is normally priced below cost. Australia and Canada have modified ADCs for use only in the high-cost or low-income subscribers' areas [ACA, 2000]. ADCs, sometimes called "supplementary charges," are often collected in a similar manner to interconnection charges, but the tariffs are reported separately, according to the terms of the WTO Agreement on Basic Telecommunications (ABT) [WTO, 1997b].

Access deficit charges (ADCs) are actually modified from cross-subsidization that occurs in monopoly markets in order to comply with competitive markets. In competitive markets, use of ADCs is a suitable strategy for replacing internal cross-subsidization in onset competition [Intven et al., 2000]. ADCs are used widely in the USA, Australia and Canada.

The main benefit of using ADCs is that the charges spread the burden of financing unprofitable universal services across all service operators. On the other hand, ADCs have many limitations. [Intven et al., 2000] First, it can be difficult to calculate actual costs and benefits for

universal service providers, which can lead to excessive charges for competitors. Second, ADCs may be ineffective because only existing users receive benefits from subsidization; unserved users do not benefit. Third, ADCs can cause prices of subsidized services to be inflated, thereby reducing the demand for the services. Finally, ADCs encourage other operators to bypass the incumbents' networks so that they can avoid paying interconnection charges.

4.2.4. Hybrid

There are many combinations of hybrid mechanisms. Malaysia has adopted a hybrid approach to its universal service concerns. The country's mechanism is a mix between mandatory service obligations and auction approaches.

First, using mandatory service obligations, regulators assign universal service providers (USP) to each designated area according to the appropriateness of the providers' operations and policies. Chosen USPs are generally the incumbent or experienced operators in each area. After that, if additional qualified providers are willing to provide telecommunications services in the same areas at a lower cost, regulators administer further processes by considering the following factors:

- If the incumbent can afford to operate at the new, lower cost, it continues to provide the universal service in the area.
- If the incumbent cannot afford to provide services at the new, lower cost, it has to negotiate with the new operator and transfer its operations to the new operator.
- In a situation in which there is more than one provider willing to provide the service, a competitive bidding process (auction) will be used to determine the winner.

The universal service provider in each area may be funded by the universal service fund or it may itself, depending on the regulatory policy of the country. The best example of this hybrid scheme is in Malaysia.

The hybrid mechanism is flexible and adaptable, able to be modified in accordance with the specific characteristics of the telecommunications market of each country. However, the mechanism does consume a significant amount of time and, of the extensive nature of its processes may limit its usage.

4.3. Analysis of Universal Service Mechanisms and Criteria

Sections 4.1 and 4.2 have examined the implementation and characteristics of universal service mechanisms in selected countries. Many criteria have been considered by the countries in their implementation of universal service mechanisms. This section analyses those criteria and examines the relationship between the criteria and the chosen mechanisms.

When selecting universal service mechanisms, regulators have to consider many criteria. Some criteria may not have strong relationships to universal service mechanisms, but they are considered because they are correlated to other criteria.

The selected countries have many telecommunications providers in their markets. The high number of telecommunications providers in Chile enables the regulator there to use auctions in assigning universal services, since auctions require a sufficient number of providers. However, the number of telecommunications providers sometimes has to be considered together with telecommunications market structure. In the UK, although there are many telecommunications providers in the market, British Telecom is the undisputed leader with 90% of the market share

in 1997 [ITU, 2002]. This reflects the company's strength. As a result, Oftel, the official regulator of the UK's telecommunications industry, has determined that BT should continue to provide universal service in order to facilitate the continuity of supplying services. Besides that reason, the mandatory service obligations are applied to ensure the efficiency and quality of service provision. In this way, incumbents, as universal service providers, may be mandated to provide universal service without subsidization through mandatory service obligations, or they may receive subsidies to offset their deficits via access deficit charges.

The penetration of telecommunications services also relates to other criteria and the selection of mechanisms. The high fixed telephone service densities of the USA and the UK are associated with universal service policies that aim both to maintain basic telecommunications services and promote additional services to the general public. In contrast, low fixed telephone densities in Chile and Peru result in universal policies that promote and extend basic services for unserved areas.

In Chile and Peru, telecommunications laws promote universal service funds as the main mechanism for supporting universal service. The USA's Telecommunications Act of 1996 states that telecommunications providers must compensate to universal service obligations. These telecommunications laws have influenced the regulator to select universal service mechanisms that comply with the laws. In addition, international commitments play an important role in the selection of universal service mechanisms. The selected countries have formed agreements with the World Trade Organization (WTO) to open their telecommunications market as associated with the liberalization of international trade [WTO, 1997b].

Regulators of some countries may have difficulty calculating the costs of universal services. The UK has relied on the application of access deficit charges (ADCs) as the main

universal service mechanism until 1997. Oftel based its calculations of the cost of universal service on historical data, an inefficient strategy of estimation compared to other long-run incremental cost calculations. Finally, the telecommunications situation in the UK has changed. The collection of ADCs has been stopped, and British Telecom no longer receives subsidies to cover the deficits of its universal service obligations from other providers. Some mechanisms, such as auction, help regulators to calculate the actual costs of providing universal service. In auction, the actual cost of universal service obligation is calculated by the telecommunications market via the competitive bidding processes.

4.4. Development of Telecommunications Key Criteria

This study has found that some of the criteria discussed in section 4.3 can be considered to be key criteria. That is, they are criteria that several countries have used in the application of their universal service mechanisms. These criteria are: the number of potential telecommunications providers, the structure of the telecommunications market, telecommunications penetration, universal service scopes and policies, telecommunications laws, international commitments, and difficulty of cost calculations. These criteria are detailed below.

- **Number of potential telecommunications providers.** Information about telecommunications providers and their capabilities with regard to providing universal service are consistently required for consideration. The limited number of potential universal service providers can lead to limited options for universal service mechanisms.

- **Structure of the telecommunications market.** The structure of the telecommunications market plays a critical role in providing universal service. Some kind of universal service mechanisms only work effectively in a competitive market.
- **Telecommunications Penetration.** Telecommunications penetration, usually called “teledensity” is the indicator that measures the number of basic telecommunications services (e.g., fixed telephone or mobile phone lines) per 100 inhabitants. This indicator is useful for evaluating the distribution of telecommunications services among people in each region. Since the population distribution varies from region to region, teledensity is generally calculated within each specific geographic area to ensure better efficiency and accuracy.
- **Universal Service Scopes and Policies.** The scope of universal services in each country has a strong relation to the policy to be implemented. As discussed in section 2.2, the scope of universal services to be provided differs between developed and developing countries. This contributes to the different objectives and mechanisms of universal service obligations.
- **Telecommunications Laws.** Basically, universal service mechanisms must be in compliance with the telecommunications laws. The constitutions and telecommunications laws will generally provide the framework for universal service policy, and this will effect the determination of possible mechanisms.
- **International Commitments.** Universal service mechanisms not only have to comply with telecommunications laws, they are also required to comply with international commitments. These are the commitments that the governments of the countries have promised to apply in order to join an international organization or

request international funding. The World Trade Organization (WTO) and World Bank are two international organizations that have commitments on telecommunications services.

- **Difficulty of Cost Calculations.** Most of the mechanisms that allocate universal service require cost calculations to be performed. Calculating costs is the process of determining the necessary costs that must be funded in order to meet the universal service obligations for specific areas. Regulators might choose to use basic cost-benefit analyses or complex cost models depending on the particular characteristic of their countries. If there are difficulties in calculating the actual cost of universal service provision, this limitation must be included in the consideration of suitable mechanism.

5.0 ANALYSIS OF THAILAND'S TELECOMMUNICATIONS AND RECOMMENDATIONS

5.1 Evaluation of Telecommunications in Thailand

In order to determine the universal service mechanisms to be used, regulators are encouraged to review and analyze the key criteria identified in section 4.4. This section provides information about telecommunications in Thailand for each of those criteria. The section is divided to 3 parts. The key criteria information for Thailand will be defined in subsection 5.1.1. Subsection 5.1.2 will analyze and evaluate the data. Subsection 5.1.3 will provide recommendations for a suitable mechanism for Thailand to apply to its universal telecommunications service.

5.1.1. Key criteria of Thailand

Chapters 3 and 4 have presented the research methodology for find the universal service mechanism. According to this methodology, regulators must define the key criteria (developed in section 4.4) of telecommunications in Thailand. This subsection will provide information about telecommunications in Thailand regarding key criteria. This information will be discussed in light of the key criteria in the next subsection.

I. Number of Potential Telecommunications Providers

Because Thailand's specific telecommunications structure combines a monopoly basis with a concession scheme, telecommunication providers there can be divided to three groups: monopoly government agencies, fixed line service operators and mobile service operators. Telecommunications operators and their market share will be discussed by category, and each group of potential operators will be considered. [PTD, 2003]

Monopoly government agencies are incumbent providers that have monopoly power to provide telecommunications service in the market. Thailand has two main telecommunications monopolies: Telephone Organization of Thailand (TOT) and Communication Authority of Thailand (CAT). TOT has a monopoly on domestic and local telephone services while CAT has a monopoly on international and Internet services.

Fixed line operators are basically those that are granted concessions by TOT to provide basic telephone lines in designated areas. Telecom Asia (TA) and Thai Telephone and Telecommunication (TT&T) are the two fixed line operators.

Mobile service operators normally receive spectrum concessions to provide mobile wireless services from both TOT and CAT. The main mobile service operators in Thailand are Advance Information Service (AIS), Total Access Communication (DTAC), TA Orange, CAT Hutchison and Thai Mobile.

- **Telephone Organization of Thailand (TOT).** TOT is the government-owned monopoly that provides basic telecommunications services in domestic and adjacent neighboring countries. In 2003, TOT had 40% of the market share in Bangkok and 53% of the market share in Thailand's rural market. TOT was privatized in 2003, but it is still owned by the government.

- **Communication Authority of Thailand (CAT).** CAT is the monopoly of international and Internet services. In addition, together with Hutchison, it provides the 3G mobile services through CAT Hutch. Like TOT, CAT was privatized in 2003, but it is still owned by the government. It will not be owned by the government after the liberalization of Thailand's telecommunications market in 2006.
- **Telecom Asia (TA).** Since 1993, TOT has granted this company Build-Transfer-Operate (BTO) concessions to provide telephone services in Bangkok and the surrounding cities. In 2003, the company had 60% market share of fixed line telephone service in Bangkok and metropolitan. The company changed its name to *TRUE* in the beginning of 2004.
- **Thai Telephone and Telecommunications (TT&T).** Also since 1993, TOT has granted TT&T BTO concessions to provide telephone services in rural areas of Thailand. The company had a 47% market share of telephone services in rural areas in 2003.
- **Advance Information Service (AIS).** AIS is the largest mobile telephone company in Thailand, with 60% of the market share in 2003. This joint venture company (owned by SingTel of Singapore and Chin Corporation of Thailand) has been granted concessions from TOT to provide 900MHz mobile telephone services.
- **Total Access Communication (DTAC).** CAT has granted concessions to this company to provide mobile telephone services at 800 and 1800 MHz. The company has a strategic partnership with Telenor (Norway) and claims second place in the market with 30% of the market share.

- **Telecom Asia (TA) Orange.** This company was originally owned by TA and France Telecom Orange. Granted a concession from CAT to provide mobile telephone service at 1800 MHz band, the company served 7% of the cellular telephone market in 2003.
- **CAT Hutch.** A partnership between CAT and Hutchison, this company provides 3G technology mobile services. This service was launched in February 2003 and covered only 25 of Thailand's 76 cities.
- **Thai Mobile.** Owned by both TOT and CAT, this company provides mobile telephone service at 1900 MHz. It claims a small portion of market share.

In order to provide universal services in Thailand, potential operators are required to have sufficient experience and accountability in telephone service provision. The companies listed above are the potential operators for their existing services. Additional concerns that need to be considered when choosing universal service mechanisms are geographic areas and technologies of services.

In addition to fixed line and mobile telephone companies, Thailand has other telecommunications services companies, such as Internet service providers and paging companies. However, because regulators of universal telecommunications services in Thailand emphasize the provision of basic telephone service, other telecommunication services and possible technologies, such as Voice over Internet Protocol, are not discussed in this research.

II. Structure of the Telecommunications Market

As described in section 2.3, the telecommunications structure in Thailand is moving towards liberalization. Even though the main state monopolies, TOT and CAT, have been privatized

since 2003, the country's market structure is still considered to be non-competitive. This is because other private operators are not allowed to enter the telecommunications market until the full liberalization in 2006.

The fixed line telephone market is limited, with only two players in each region. TOT competes with TA in Bangkok and other metropolitan areas. It competes with TT&T in rural areas. Under the conditions of concessions, TA and TT&T are not permitted to adjust the price structures of their services unless they consult with TOT.

The mobile telephone market is quite competitive because of the variety of services provided by from wireless phone operators. Competition in price, quality of services and user flexibility are widely seen in the market.

III. Telecommunications Penetration

Telecommunications penetration is an important indicator of telecommunications development. It gives an idea of how broadly telecommunications services have been distributed. The most widely used indicator for assessing the penetration of telephone services is "teledensity." Teledensity reflects the number of telecommunication (e.g., telephone, mobile service) lines per 100 inhabitants.

Since the population distribution varies from area to area, teledensity calculations also need to consider geographic areas of service. Separating calculations of teledensity into urban and rural areas helps determine the need for universal telecommunications services (US) in a specific area. In 2002, 20% of Thailand's population lived in urban areas while 80% lived in rural areas [PTD, 2003, Group]. Table 5-1 provides teledensity information in urban and rural areas of Thailand for 2000 through 2002 [PTD, 2003, Group, 2003, ITU, 2003a].

Besides teledensity, other telecommunications information should be considered to be useful indicators. Table 5-2 provides information about numbers of customers on the telephone service waiting list, as well as mobile and Internet users' penetration [ITU, 2003a].

Table 5-1: Teledensity of Thailand

Years	Urban area (lines/ 100 people)	Rural area (lines/ 100 people)	Total (lines/ 100 people)
2000	38	3	9
2001	45.20	4.40	10.50
2002	53	6.55	12.64

Table 5-2: Other telecommunications indicators of Thailand

Years	Waiting lists for telephone service (thousands)	Mobile subscribers per 100 inhabitants	Internet user per 100 inhabitants
2000	415	5	3.83
2001	544	12.3	5.77
2002	700	23	7.75

IV. Universal Service Scopes and Policies

The main purpose of universal service in Thailand is to supply basic telephone services to rural areas, thereby reducing the digital divide between urban and rural area. However, telecommunications laws provide a framework, but no clear definition or scope of universal service. The determination of what universal service means for Thailand is likely to be left in the

hands of the telecommunications regulators. Even a general framework of universal service requires fairness in assigning the responsibilities of telecommunications providers to meet universal service goals.

V. Telecommunications Laws

The telecommunications framework in Thailand is administered under three main laws: the Constitution, the Frequency Spectrum Management Act and the Telecommunication Business Act.

- **Constitution, 1997.** Section 78 of the Constitution of Thailand provides general ideas about universal service. It states that the government has to develop a basic Information and Communication Technology (ICT) infrastructure and to provide equitable universal service to people throughout the country. Section 40 requires the establishment of an independent regulatory agency to regulate the frequency spectrum and telecommunications markets. These sections contribute to the tension created by the need to follow two different telecommunications laws.
- **Act on the Organizations to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services, 2000.** This act generally provides the regulatory body of Thailand's telecommunications market. It gives details the establishment and administrative functions of the regulatory agency, the National Telecommunication Commission (NTC). It also introduces the Universal Service Fund (USF) and its mechanism to support universal services.
- **Telecommunication Business Act, 2001.** This important act provides a more specific framework for telecommunications regulatory policies and universal service

mechanisms in Thailand. According to this act, regulators are allowed to mandate the universal service obligations to the providers that apply for basic telecommunications services licenses. In case those providers cannot commit to universal service obligations, contributions to the USF are required.

VI. International Commitments

Thailand's telecommunications policies have been bonded to comply with the WTO Agreement on Basic Telecommunications Services (ABT) since 1997. The commitments identified are about competition and the country's liberalization policy, as explained below. [WTO, 1997b]

In its revised offer of February 1997, THALAD undertook to introduce revised commitments to ensure public local, long-distance and international voice telecommunications services by 2006. These commitments were consistent with the provisions of the new telecommunications acts. In addition, some regulatory principles were made conditional, dependent upon the passage and entry of the new telecommunications acts. THALAD committed to introduce regulatory principles in the future.

According to WTO's specifications, Thailand must open its telecommunications market to competition by 2006. To meet this schedule, Thailand privatized its two main government-owned telecommunications operators, TOT and CAT, in 2003. The telecommunications market is, thus far, on schedule to fully open to competition in 2006.

To meet its international commitments and liberalization goals, Thailand must issue regulatory principles. In 2000, the government issued the Act on the Organizations to Assign Radio Frequency and to Regulate Broadcasting and Telecommunications Services, and in 2001, it issued the Telecommunications Business Act. These acts contain details about the country's

telecommunications regulatory principles, the establishment of the National Telecommunication Committee (NTC) and the framework of the Universal Service Fund.

VII. Difficulties of calculating Universal Service Costs

As stipulated by the government's acts, universal telecommunications service is to be provided by the incumbent, TOT. However, calculating the cost of those services is difficult. Due to the internal cross-subsidization regime of the incumbent, the actual cost of universal service provision has never been generated attention. Furthermore, information about universal services in Thailand is not structurally managed. It may take time to find data about universal service, which leads to the difficulty in calculating universal service costs.

5.1.2. Analysis of key criteria

The process of determining which universal service mechanism to use requires the evaluation and analysis of telecommunications information available for the market. As described in chapter 3, telecommunications key criteria must be identified and defined for the particular country in question. Subsection 5.1.1 examined the key criteria information for Thailand. This section will analyze those criteria and, based on that information, propose the suitable mechanism for allocating universal service in Thailand.

The evaluation of telecommunications information to find the suitable universal service mechanism of Thailand relies on several factors: number of potential telecommunications providers, structure of the telecommunications market, telecommunications penetration,

universal service scopes and policies, telecommunications laws, international commitments, and difficulty of universal service costs calculations.

I. Number of Potential Telecommunications Providers

Thailand has approximately seven to nine big telecommunications providers that have experience providing basic telecommunications services (e.g., fixed line telephone or cell phone). This increases the possibility that more than one provider will be willing to provide services for a designate area. In this situation, the regulators must choose to either picks the appropriate providers and assigns them universal service obligations or administer a competitive bidding process from which suitable providers will be chosen.

II. Structure of the Telecommunications Market

The telecommunications market of Thailand is in the process of being liberalized. There are still dominant power operators in both fixed and wireless telephone market. Primarily, as described in section 2.3, TOT is the major incumbent responsible for universal service obligations with internal cross-subsidization mechanism. Currently, TOT is a government-owned, but privatized company. In 2006, after privatization is completed and the market is fully liberalized, TOT will be a private company that will have to compete with other telecommunications operators in the market. Responsibility for unprofitable universal services without subsidization will reduce TOT's competitive power. The suitable universal service mechanism then needs to introduce universal service contribution to all other telecommunications providers as a measure of fairness.

Another key concern of telecommunications structure that needs to be carefully considered is the concession. As mentioned in section 2.3, most of Thailand's telecommunications providers have been granted the Build-Transfer-Operate concession by one of the two government monopolies, TOT and CAT. According to the terms of this concession, private operators must build and operate the new infrastructure while sharing their revenues with the monopoly for ten and twenty years. However, after liberalization of the telecommunications market in 2006, all concessions are supposed to cease, and the contract details change to focus on compliance with the competitive market. All telecommunications providers will have to apply for licenses from the regulators. At that time, regulators likely will choose to assign universal service obligations to the providers. The possible mechanism can be the strategic imposition of universal service obligations as part of the license contract.

III. Telecommunications Penetration

As shown in Table 5-1, telephone penetration in Thailand is quite low, with only 12.64 lines per 100 inhabitants in 2002. As a result, the universal service policy places higher priority on the provision of basic telephone service than on the upgrade of existing telecommunications services. Moreover, the low teledensity in rural area (6.55 in 2002) highlights the need for network expansion to provide universal service.

Table 5-2 provides additional information in support of the need for network expansion in Thailand. Continuous increases in the number of entries on the telephone services waiting list from 2000 through 2002 reflect the demand for basic telecommunications services. The suitable mechanism for allocating universal service should effectively promote network expansion and universal service to rural areas. From table 5-2, the rapid growth of mobile telephone penetration

from 5% in 2000 to 23% in 2002 shows that wireless technology may be the alternative technology of universal service.

IV. Universal Service Scopes and Policies

Basically, universal service in Thailand is the responsibility of all telecommunications providers. The details and levels of obligation will be determined by the regulators. To ensure the fairness of the universal service obligations, mechanisms to allocate universal service are required to be transparent and non-discriminated.

V. Telecommunications Laws

As dictated by Thailand's laws, the Universal Service Fund (USF) must be established and funded by contributions collected with license fees from telecommunications providers, as well as a proportion of their revenues. When applying for telecommunications licenses, providers need to accept universal service obligations in the license contract or contribute to the USF. In order to ensure fair competitive power for each provider, the regulator needs to carefully determine the details of providers' universal service obligations and the amount of contributions to the USF.

VI. International Commitments

Thailand's commitment to the WTO as specified in the ABT [WTO, 1997b] requires the country to liberalize its telecommunications market and create a regulatory body by 2006. The National Telecommunication Commission (NTC) has been established to be the official

telecommunications regulator of Thailand. The universal service mechanism, like other telecommunications services mechanisms, is required to be transparent and fair.

VII. Difficulty of Universal Service Cost Calculations

As discussed in subsection 5.1.2, Thailand has difficulty identifying the actual costs of service provision, especially as they relate to universal service. These difficulties are in part due to the newly liberalized market and the lack of experience with telecommunications regulations. The universal service mechanism that enables the market to determine the cost of service provision should be appropriate.

5.1.3. Recommendations for Mechanism

If Thailand's regulator considers only some of the key criteria discussed in the previous subsection, some possible mechanisms may be suitable. However, in order to identify the most suitable mechanism for allocating universal telecommunications service, the regulator must consider all of the key criteria together. This section presents the set of possible mechanisms and their limitations when the telecommunications key criteria are separately considered. Next, the suitable mechanism that can be derived from consideration of all key criteria will be proposed.

Taking only the existence of a sufficient number of potential telecommunications operators together with the fact that the country's universal service scope and policy requires the most transparent and non-discriminated mechanism, auctions should be determined to be an appropriate mechanism for Thailand. The potential difficulty of calculating universal service costs and the lack of regulatory experience also support the auction regime. However, because

major rural areas of Thailand already have been supplied with universal service by the incumbents, the implementation of the auction mechanism may face the several difficulties.

First, the primary characteristic of the telecommunications auction is that it is suitable for areas that have never received service before and its process is complex. The major rural areas of Thailand have already received service from the incumbent providers. If all rural areas are included in the bidding process to find a universal service provider, the complexity will be increased in any areas where the auction winner is not the incumbent. Discontinuity of service provision may occur when operations are transferred to the new provider. In addition, it is possible that there will be no operator interested in the bidding process for some uneconomic areas. Additional mechanisms may be required to remedy this problem.

Alternatively, according to the requirement of network expansion to increase teledensity, mandatory service obligations (MSO) may be a good mechanism for allocating the universal telecommunications service of Thailand. The telecommunications laws of Thailand allow the regulator to impose universal service obligations as part of license contracts. When the telecommunications market is fully opened in 2006, every telecommunications operator will have to apply for the telecommunications license. That will be a good opportunity for the regulator to apply the MSO mechanism to promote universal service across Thailand. Nevertheless, the separate implementation of MSO mechanism may not be suitable for Thailand for several reasons.

First, the MSO mechanism requires that the regulator engage in strategic consideration to determine the universal service provider in each area. If the MSO mechanism is discriminatorily applied by the regulator, it will reduce the benefits of the competitive market. The awareness of political intervention in Thailand's regulatory administration cannot be ignored. For example, the

biggest mobile telephone company is the family business of the current prime minister of Thailand.

Also, according to the telecommunications structure of Thailand, TOT is now the major universal service provider. To ensure continuity of service and reduce the complexity of the process, the regulator may mandate excessive universal service obligations to TOT. Thus, TOT may use the cross-subsidization scheme to compensate this uneconomic business, which is the anti-competitive regime.

Another mechanism, access deficit charges (ADCs), may be a suitable means of allocating universal service if the fairness of universal service obligations is considered. By the ADCs mechanism, after the market is liberalized, TOT may continue to be the major universal service provider of Thailand and receive compensation for its universal service deficits from other operators. This regime is also associated with the framework in the telecommunications laws that all telecommunications operators are responsible for universal service. However, ADCs may not be a suitable mechanism for Thailand because this approach is generally applied to areas that have been serviced by the incumbent. There are still some areas in Thailand that have never received universal service. The benefit of ADCs will not be shared with the people in those areas.

This discussion shows that the mechanism to allocate universal service in Thailand cannot be applied separately. Therefore, a combination of mechanisms may provide the balance needed for implementation. Considering the characteristics and limitations of telecommunications key criteria, the universal service mechanism of Thailand should be a hybrid mechanism.

Thailand's hybrid mechanism should be composed of mandatory service obligations and auction schemes. Use of mandatory service obligations is in compliance with telecommunications laws that state that all operators must share responsibilities for meeting universal service obligations. Imposing universal service obligations as part of the license contract also efficiently promotes network expansion and telecommunications service penetration. Furthermore, the mandatory service mechanism is applied to ensure that there exists universal service provider in every designated area. While mandatory service obligations respond to the requirement of social welfare, auction also serves as one of the most effective mechanisms for providing telecommunications service. Because the introduction of a liberalized telecommunications market is quite new for Thailand, the auction mechanism will assist the regulator in determining the actual cost required to fulfill universal service obligations in designated areas. Effectively conducted, auctions are capable of providing services to both existing and unserved customers.

The universal service mechanism of Thailand is based on the Universal Service Fund (USF). As stipulated in the telecommunications laws, the USF is funded by the government, by contributions of license fees and by a proportion of providers' revenues. The fund is administered by the National Telecommunication Commission (NTC), the official regulator of Thailand. In 2006, when the telecommunications market has fully opened, all providers will have to apply for telecommunications licenses. That will be major opportunities for regulator to implement universal service mechanisms as a tool for improving social welfare.

Thailand's regulator will identify the areas that require universal services and geographically group them into projects. The approximate cost of fulfilling universal service obligations in each project will be calculated based on cost models, briefly discussed in

subsection 2.1.3. The technology to provide universal service should be flexible so that both fixed and mobile telephone operators can meet the user's needs.

In general, there are two types of areas: those that currently receive service (i.e., served areas) and those that have never received service (i.e., unserved areas). The regulator will need to make different decisions for each. In served areas, the regulator must choose a suitable universal service provider, which is usually the local incumbent. If the provider agrees to continually provide universal service for the area, the regulator must decide how the universal service obligations will be funded. Options include funding by the USF or by the provider itself as part of the license contract. However, if the incumbent does not agree to provide the service, or if other operators are willing to provide service in the same area, an auction should be processed. If the winner is a new operator, the incumbent will have to negotiate with the new universal service provider for the transfer of service operations.

By comparison, for unserved areas, an auction mechanism should be applied. If there is no operator applying to provide service for a given area, the regulator should exercise the legal responsibility of choosing the appropriate universal service provider. In this case, I recommend that the provider should be funded by the USF.

In the auction mechanism, the costs estimated by use of cost models will be set as the maximum amount of subsidy for each project. The winner will be the provider with the lowest bid for meeting service obligations. The winner will be granted the license to provide universal services in the project areas, and it will be financed by the USF for an amount equals its bid.

Telecommunications operators that have not been assigned as universal service providers must contribute to USF. In addition, all operators will provide a proportion of their

telecommunications revenues to the regulator to cover the administrative costs of the regulatory agency.

5.2. Discussion of recommended Universal Service Mechanism

Section 5.1 analyzed telecommunications key criteria and presented the universal service mechanism to be implemented in Thailand. This section will discuss the prospective benefits and limitations as well as some concerns to be realized by the implementation of the proposed mechanism.

Most rural areas of Thailand have existing universal service providers. The proposed mechanism will become more complex when the regulator chooses a universal service provider that is not the incumbent in the area. The process of transferring service operations from incumbents to new operators have to be closely administered to ensure continuity of services.

The regulatory agency, NTC, has experienced some difficulties establishing itself as a telecommunications authority in Thailand. In large part, this is due to concerns about its independence from telecommunications operators. Given its level of authority, a biased regulator could be quite dangerous in a country where the mandatory service obligation mechanism was the telecommunications regulatory means of choice. That is because the regulator could assign universal service obligations discriminatorily.

Additional details of the auction process should be carefully applied by the regulator. Auctions may vary according to the number of auction rounds, allowable auction winners, and acceptance of complimentary bids [Weller, 1999]. Auction details must be reviewed annually or

every two to three years to allow the framework to adapt to changes in technology, market and policy objectives [Weller, 1999].

The auction mechanism has been used as the standard method for identifying suitable providers in Thailand's industries for a long time. The standard problem found in the auctions of other industries is "bid-rigging." As described in subsection 2.1.4, bid-rigging is an anti-competitive practice in which bidders form agreements before the auction starts to determine a winner and winning price. Strategies for preventing bid-rigging include increasing the number of bidders, keeping the identity of bidders secret and adopting generic specifications. [Canada, 2004]

Another concern is related to the telecommunication plans and laws in Thailand. The ICT Master Plan 2002 – 2006, discussed in subsection 2.3.2, has proposed some objectives of universal telecommunications service including fixed telephone and broadband services. While the scope of universal service in Thailand is not defined, there exists a possibility that the scope of universal service in future telecommunication laws may not consistent with the ICT plan, especially the universal broadband services. Even though this conflict unlikely happens because the policymakers, the commissions, normally try to follow plans in considering telecommunications policies but it can happen because some aspects of the future plans may not consistent with current policy, scopes and technology availability. The followings are some recommendations if the conflict happens:

- The plans can be reviewed periodically, 1-2 years, to comply with issued laws.
- Some plans or goals can be achieved first depending on the laws and policies, for example, scope of universal service in incoming laws can start by the provision of fixed telephone services. After an appropriate period of time, scope of universal

service can be extended to cover other telecommunications services such as broadband and internet services.

Auction and the Universal Service Fund (USF) will be used as part of the mechanisms to universal telecommunications service in Thailand. There are many sources of the USF, discussed in subsection 2.2.2. Direct government funding and proportions of revenues from telecommunications providers are issued as main sources in the laws of Thailand. The study recommends that USF can also be funded by proportions of telecommunications license and levies of subscriber line charges.

The hybrid mechanism recommended in this study will start with the consideration of universal service areas. This study recommends that Delphi technique should be used to obtain opinions from experts. The commissions, NTC, should request for information and comments about universal service areas from; government agencies, telecommunications providers and scholars. This information will be used to classify areas that need universal service. After the areas have been categorized, public hearing from people in each designated areas can help the commissions to identify order of universal service provision.

There are additional details about the proposed mechanism in which additional regulatory exercises are required when there is no provider wants to deploy universal service in the area. This concern can happen in both served and unserved areas. The study recommends the commissions to mandate local telecommunications providers in that area, if existing, and the providers in adjacency areas to participate in competitive bidding process. This mechanism provides an opportunity for telecommunications providers in other areas who may want increase their economy of scope. This mandated auction mechanism also provides the chance that costs of

universal service obligations in the designated area may lower than ceiling set by the commissions. Nevertheless, mandatory service obligations are also another alternative.

Besides the privatization of telecommunication sectors, other public utilities sectors such as energy and electricity are going to be transformed to private company in the future. The electricity private companies in the future can become competitors of telecommunication providers because their facilities are also deployed to most part of the country. They, eventually, could be considered to join some parts of universal service mechanism as being occurred in the USA.

Finally, there are many concerns that the commissions have to carefully consider when they are going to exercise regulatory frameworks of universal service in Thailand. The following concerns require strategic considerations both from the commissions and other related government agencies:

- Scope and definition of universal service in Thailand
- Time frame of universal service implementations
- Determination of service areas and details of universal service obligations
- Funding mechanisms to support universal service obligations
- Choosing of universal service providers associated with designated areas

6.0 FINDINGS AND CONCLUSIONS

This chapter provides the conclusions of the research. The results of the research and the perceived contributions will be presented in sections 6.1 and 6.2, respectively. Sections 6.3 and 6.4 will be dedicated to discussion of research limitations and future studies for the research. Finally, concerns and remarks about the research will be provided in section 6.5.

6.1 Overview of Research Finding

Telecommunications services have become an important part of today's life. There are many concerns about how to effectively distribute telecommunications services, leading to the regulation of telecommunications policy. The main interest of this thesis is universal service regulation, which is related to the mechanism of telecommunications services provision to the general public.

Working through the process of liberalizing its telecommunications market, Thailand presented an interesting case study for this thesis. Even though telecommunications laws have provided a framework for the country's universal service policy, Thailand still needs more details about the mechanism by which its regulator should allocate universal service obligations.

The thesis was undertaken to find suitable mechanisms of Thailand to allocate universal service obligations.

The research methodology helps determine the suitable universal service mechanism. First, effective mechanisms used by other countries were identified and categorized. Then, this thesis discussed the necessary key criteria for telecommunications universal service determination. Next, Thailand's telecommunications information was assessed and the key criteria considered for this particular country were provided. Finally, universal service mechanisms for the telecommunications regulator of Thailand were recommended.

The thesis finds that the most suitable mechanism for allocating telecommunications universal service in Thailand is the hybrid approach. This approach combines the use of mandatory service obligations and auctions. Suitable providers would be assigned through their telecommunications licenses to provide universal service obligations for designated area. Auctions would be used to find suitable providers requiring the lowest subsidies when there is more than one provider in the area or for those areas that are currently unserved.

6.2. Perceived Research Contribution

This thesis has contributed to the structural determination process of telecommunications mechanisms. The main contributions of the thesis are as follows:

- 1) This thesis has developed steps to identify the best mechanism for allocating telecommunications universal service.

- 2) It has developed a list of telecommunications key criteria that must be considered when selecting a universal service mechanism.
- 3) It has categorized effective mechanisms to allocate telecommunications universal service, including the proposed mechanism from this thesis.
- 4) It has evaluated and formed conclusions about the telecommunications industry of Thailand.

6.3. Limitations of Research

The thesis has some limitations and difficulties. Existing universal service mechanisms applied by countries around the world differ widely both in their approaches and details because of the specific characteristics of the telecommunications industry in each country. This requires a significant amount of time for studying and categorizing the mechanisms into specific groups. The thesis has studied only 5 countries; therefore, the results are used as useful guidelines to Thailand and not generalizable.

The thesis sometimes has some difficulty to retrieve telecommunications information of Thailand. The data about specific services, especially as related to universal services, are not easily determined. This is primarily due to variations in the status of telecommunications service from area to area. This thesis, then, mainly relies on information provided by external, international organizations. The external organizations are those who are not in the telecommunication industry but have information about telecommunications. They are, for example, the Bank of Thailand (BOT) and the Thailand Development Research Institute [Narong Pomlaktong, 2003]. The international organizations that provide useful information are, for

example, the World Bank, the International Telecommunications Unit (ITU) and the World Trade Organization (WTO). Thus the data from external and international organizations are usually based on 2002 or prior years data. The more up to date data may make results of the thesis closer to recent status of telecommunications of Thailand.

Last but not the least, the thesis has time constraints, the literature review in section 2.3 about Thailand does not provide details about other telecommunications services in Thailand, such as Internet or broadband services. These services are sometimes included in universal service obligations.

6.4. Recommendations for Future Research

There are some future studies and recommendations that can improve the existing research. First, the scope of telecommunications services can be extended to include Internet and broadband services. This will help to develop an understanding of commercial electronics providers and other Information Communications Technology (ICT) of the country. Second, the set of telecommunications key criteria in this thesis could be improved by considering other factors that affect telecommunications services. Examples of additional key criteria are political issues, economic information, and customer norms. The set of key criteria could also be refined by adding more countries to the analysis. This will improve generalization of the study.

In the light of future study, this thesis has proposed the appropriate universal service mechanism for meeting universal service demands in Thailand. Additional research could explore the implementation details, such as cost calculations or the definition and scope of services in the universal service obligation. Moreover, it is recommended that universal service

obligations should comply with each type of telecommunications service. Future study could focus on the determination of suitable universal service obligations associated with different types of service providers.

The thesis methodology is based on qualitative analysis. The determination of universal service mechanism could be done differently using other methodologies. Quantitative analysis is one of the alternatives. It provides the opportunity to test the hypotheses regarding the relationship of dependent and independent variables, for example in this thesis, the criteria and mechanisms. Quantitative analysis can help interpret the direction and the influence of those independent variables on dependent one or even among themselves [Creswell, 1994]. The correlation or effects that might be resulted from the analysis may direct the better solution. In addition, the numbers of counties selected in the further study may consider the concept of effect size or the more appropriate representatives of each categories those countries may be divided.

Finally, further study may take into account of the significance of the more complex study. The evaluation of choosing well-fit universal service mechanisms for each country depends on not only its technological structure but also the content of socio-technological matters such as politics, economics, and bureaucratic culture. Statistical analysis as suggested above gives a strong relationship between the criteria and the mechanisms that helps understand the factors that tie to the choosing process. Benefit-cost analysis and decision model analysis may ease the complication of investment in term of finance and non-finance issues, especially when it comes to the national budget.

6.5. Concluding Remarks

Determination of the universal service mechanism is composed of many processes, as described in section 2.2. This thesis focuses on the process of finding a mechanism to allocate universal service in Thailand. This thesis finds a suitable mechanism for determining the appropriate universal service provider for designated areas. Some processes, such as the funding of the Universal Service Fund (USF), are imposed by telecommunications laws. Other processes, such as those to determine the amount of subsidies to be given to providers and the area to be subsidized, are outside the scope of this study.

The objectives of this thesis have been met. It proposes a suitable mechanism for Thailand's regulator to use to allocate universal service according to the existing USF regime. The proposed mechanism is rationally supported by the research methodology using telecommunications key criteria as the determining factors. In summary, the mechanism and proposed methodology can be used as guidelines and presented to the telecommunications regulatory agency of Thailand.

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