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Phase out Mobile Communication Technology: An Analysis Based on Public Policy and Business Values

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Abstract

Through the progress of communication technology, the mobile services have brought lots of benefits for our daily lives. However, with the recent advances in cellular communications and new systems being deployed alongside existing ones, an emerging question about whether there still is some needs for the legacy infrastructure, in particular the widely deployed GSM systems at this moment. For the evolution of mobile communication, we have embrace convenience and efficiency offered by mobile service. We confront, however, so many problems after enjoying the benefits. For an example, the exponentially growing demand for wireless traffic has resulted in available spectrum shortage and thus national regulatory authorities (NRAs) worldwide are looking to re-farm their GSM spectrum to deploy more spectrally efficient technologies such as LTE or 5G.

Therefore, both NRAs and mobile network operators (MNOs) need to address the re-farming closely and efficiently. In addition, the regulators should contemplate how to balance subscriber protection and re-farming scheme for a smooth transition among different mobile communication services. In some cases, an easement model can be a practical option to achieve efficient use of spectrum. The FCC allows US mobile operators to decide when to phase out the legacy network. Compared with Taiwan or some countries in Europe, the FCC takes the laissez-faire approach in the termination process with some flexibility.

In the light of this, the NRA in Taiwan provides some subsidies to GSM users to facilitate their migration to more advanced services before the GSM service licenses expiration in June this year. However, who will derive the benefits? In fact, there are five mobile network operators in Taiwan, but three operators such as Chunghwa Telecom, Far EasTone and Taiwan Mobile offer the GSM services. According to current subsidy policy, GSM mobile operators will compete each other to decide who can convert those subscribers as many as possible into 3G or 4G subscribers through NRA's subsidy would

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the winner of this technology transition.

In addition, the NRA phasing out the legacy network confronts some potential tough issues. For instance, is the economics underlying the operation of the GSM infrastructure still viable? If it still exists the potential profits, how can regulator to make choice between consumers and the fast changing market ? In fact, the regulators and operators in other countries such as Norway are deciding how to manage a transition towards full network closure, given that machine-to-machine (M2M), voice, and roaming revenue cannibalization work smoothly and continuously.

Therefore, the research questions of this study are to discuss transition policy of mobile technology with regard to GSM service termination: 1.What strategies need NRAs to assess between limited resources and business values for the suitable time to phase out the mobile communication technology ? 2.What kind of approaches do NRAs can take between active involvement and laissez-faire in the termination process ? If NRAs take active involvement, they need to think how to get involving in and minimize some negative impacts for those stakeholders. This study adopts literature analysis, benchmarking analysis to review the termination of the GSM mobile network in Taiwan, and examined the GSM termination in other countries to make a comparison.

In order to analyze the decision of GSM termination from NRA in Taiwan, our study tries to apply the real options approach (ROA) to evaluate the optimal timing of phasing out GSM service and the establishment of the mechanism for market exit. The reason why this study uses the real options is that ROA is a method an organization's management makes to expand, change or curtail projects based on changing economic, technological or market conditions.

In sum, it offers policymakers some flexibility to cope with changing circumstances. In the recent years, the regulators and mobile network operators over the world confront the GSM termination issues. However, there has been few studies to analysis the process of termination and proposed policy suggestions for telecommunication regulators to facilitate MNOs' smooth transition to advanced mobile communications services while protecting subscriber benefits. Therefore, the outcome of the study indicates that the regulators should not adopt administrative means to force consumers into using a specific mobile system and take the laissez-faire method in the termination process.

Keywords: termination of GSM, mobile network operators (MNOs), real options, subsidy policy, the re-farming

1. Introduction

Historically, cellular technologies have adhered to an approximate 20-year cycle from launch to peak penetration, with around ten years between the launch of each new technology. However, with the recent advances in cellular communications and new systems being deployed alongside existing ones, one wonders whether there still is a need for the legacy infrastructure, in particular the widely deployed GSM systems. Given the significant improvements in efficiency evident in the technology embodied in the 3G, 4G and beyond technologies, is the economics underlying the operation of the GSM infrastructure still viable? Would the operators be better off phasing out these legacy systems or could these continue to be the cash cows they have been all along these years, especially amidst the emerging breed of applications - the Machine to Machine (M2M) paradigm?

Shutting down GSM service, however, also raises issues that MNOs and telecommunication regulators must address efficiently. MNOs need to make decisions on when to start the termination process, whether to implement forced termination, and how to construct compensation packages for voluntary and/or forced termination. MNOs would also want to induce existing subscribers to quit GSM service subscription voluntarily but at some point might have to terminate service provision without subscribers' consents. On the other hand, the regulator should balance subscriber protection and smooth development of mobile communications services. Regulators may assume leadership in the closing process or simply let MNOs handle the issues themselves. Of course, even in the case where MNOs need to obtain the regulator's permission for shutting down GSM services, the degree to which the regulator can get involved varies across countries, depending on specific legal environments.

The national regulatory authorities (NRA) of telecommunications in Taiwan, National Communications Commission (NCC), announced that GSM telecommunications services are to be officially terminated in June 2017, adding that GSM service subscribers would be given an additional six months to migrate to 3G or 4G services after the termination. The commission has also analyzed GSM service users and identified five user patterns, NRA spokesperson said: people who use only text messaging, those who use prepaid cards, those who subscribe to plans with low monthly fees, those who use push-button mobile phones, and those who use mobile phones for voice communication only. In addition, National Communications Commission (NRA) revealed that there were still around 710,000 customers on a GSM plan as of April 2016. Of these, the lion's share – around 460,000 – are subscribed to a plan offered by Chunghwa Telecom. Therefore, Chunghwa Telecom will reportedly continue to offer incentives designed to motivate their GSM subscribers to switch to a 3G or 4G service.

The objectives of this paper are to explore major policy and commercial issues with regard to GSM service termination. Other national regulatory authorities (NRAs) and MNOs worldwide are, or will be, facing the same issues sooner or later, and therefore this study should serve as a useful reference for MNOs and telecommunication regulators in preparing GSM service termination. In addition, this study applies the concept of real option to analyze what will be the optimal strategies for Chunghwa Telecom, and estimates the values of each option. Nevertheless, terminating GSM is going to influence not only the MNO but also mobile phone users. For this reason, this study also stands on the NRA's point to consider which approach between the involvement and laissez-faire will be the best method in the termination process. According to the NRA which is going to face the termination of GSM, this study chose Hong Kong to make a policy analysis and made a summary of the case to borrow an example from Hong Kong to enlighten the NRA in Taiwan.

2. Literature Review

2.1 Real Option Model

The real option model is a concept comes from the financial options. Financial options are one kind of contract, and it entrusts holder in certain time to purchase or sell specific quantity financial product right using the price which has agreed beforehand. While financial options are written on an underlying financial asset, a real option is based on an underlying real asset. Similar to a financial asset, the future value of the underlying real asset is uncertain. Real option entrusts with the right is also the options to investment or management. If company has real option to act the value change, chooses the investment plan or management nimbly depend on the basic property in certain deadline. Black and Scholes (1973) proposed the famous option pricing model, and this model solved the European stock option pricing problem; Cox, Ross and Rubinstein (1979) founded the discrete time binomial option pricing law. These three articles have laid the financial option pricing rationale, and impelled the 20th century finance option to develop enormously. The concept of option contains limits not merely of the financial derivation tool along with the option theory and the real situation development. Moreover, it has represented one kind of new financial thought, the financial theory and the real option theory. This kind of theory may widely apply in the each aspect of economic life, and smoothed the way for the economic evaluation in many domain applications. At the end of 1980s to the beginning of the 90's, the real option theory appeared in the domain application and the promotion of enterprise's investment strategy, and it have represented the West in the aspect of business management breakthrough recently. Myers (1977) for the first time proposed " the real option " concept, and first conducts the profundity research to the option pricing theory in the investment project. He proposed that

DCF-NPV is not suitable for to the investment strategy valuation, since the economic value of the investment strategy is composed completely by two parts: one was (static state, passive) direct cash flow NPV, and the other one was management elasticity and the strategy interaction option value.

2.2 The kinds of the Real Options

The real option is one new thinking mode, and it can help enterprise innovate their investment decision with this new method. Facing uncertainty environment challenge, the enterprise policy-makers should adopt positive treatment of the uncertainty of investment. In addition to discover any kind of uncertainty factor in the project, and uses these factors to enhance the project value. Specifically, enterprise can use the option to defer, option to growth, option to abandon, option to expend, and other corporate real options to increase project management flexibility and to dodge the risk of investment plan. Kester (1984) compared some investment strategy with the option who can bring the investment opportunities and create the value in the future, and proposed the investment strategy and the option had similarity; Amram and Kulatilaka (1999) pointed out the real option is one of the thinking who introduced into the interior of the enterprise investment strategy decision-making from the money market rule. It can help the superintendent uses it to mark out plan and manage the investment strategy effectively. Using the theory of real option to make investment strategy has further development and more comprehension. Since the investment strategy usually has many stage, many decision points, more and more scholars regard it as the compound option. At the same time, real option pricing method is no longer limits to Black-Scholes option pricing model and Cox-Ross-Rubinstein option pricing models. Instead, it depends on the revision and relaxation of situations which have certain conditions or proposes to set new pricing model.

2.3 binomial option pricing model

Traditional assessment methods usually use the net present value (NPV) method as the main decision-making method to assess the decision-making of power in one project. At the same time, the NPV method pointed out that in the future, the income of the corporation due to the choice for the future power using in each time plot have an appropriate discounted rate to retrace the value of net operating activities. If the NPV is greater than zero, companies should operate the strategy, but if the NPV is less than zero, companies should give up the choice of the strategy.

The binomial option pricing model in this thesis constructs that the retail electricity market is a perfectly competitive market, without containing tax. For electricity using corporations, in order to get close to the reality cases of the electricity strategic planning: model of this thesis will be divided into two parts: electricity consumption with no

emission ceiling and electricity consumption with emission ceiling. Applying two conditions mentioned above to illustrate the strategic content of the electricity consumption strategy.

3. Research methods

3.1 The Binomial Option Pricing Formula

In this section, we will develop the framework illustrated in the example into a complete valuation method. We begin by assuming that the stock price follows a multiplicative binomial process over discrete periods. The rate of return on the stock over each period can have two possible values: the value C_0 with probability q , or with probability $1 - q$. Thus, if the current stock price is S , the stock price at the end of the period will be either S_u or S_d . We can represent this movement with the following diagram:

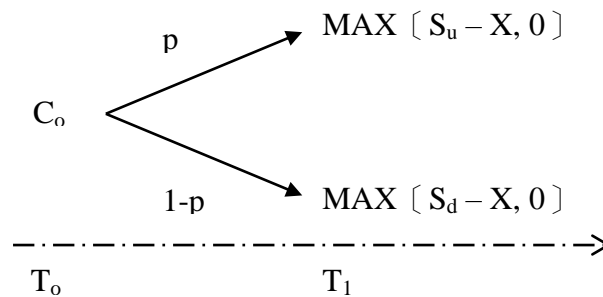


Fig. 1. Binomial tree

3.2 definition of variables

And then, this chapter beginning on every mathematical symbol for definition, and according to binomial option pricing model (Cox, Ross and Rubinstein, 1979), and joined historical data into the research model. We define the modified variables in our pricing as follows:

Table 1 variables

Variables	NPV ₂₀₁₅	PV _{Rev} at 2015	PV _{Cost} at 2015	R	u	d	p	1-p
Values	4,810,767,408	13,148,821,599	8,338,054,191	0.77%	1.05	0.95	0.477	0.523

Note: The values had been estimated in Pilot testing.

3.3 Hypothesis of Real Option

In this chapter we assume that Chunghwa Telecom have the authority to use different

kinds of real options. In the first instance, this study assumes Chunghwa Telecom can use the option to defer the project of migrating GSM subscriber to 4G. Secondly, this study assumes Chunghwa Telecom can get the allowance from government for migration in the situation of option to expand. Finally, this study assumes Chunghwa Telecom can cut down the GSM base station to reduce running cost.

4. Calculation and Analysis

4.1 Case of Chunghwa Telecom

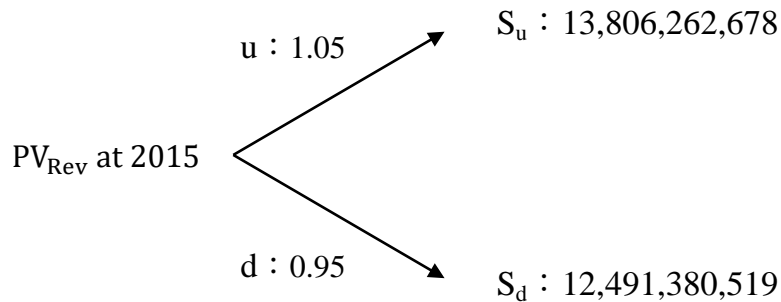
Because NRA announced that GSM telecommunications services are to be officially terminated in June 2017, this study assumed that Chunghwa Telecom had the project of migrating GSM subscriber to 4G. In addition, we suppose that the migrating project begins in January 2015 and ends in December 2017. The reason why we suppose is to estimate the business' values and to suggest what Chunghwa Telecom can do, when facing each kind of real option.

4.2 Build the event tree and use the expanded NPV approach

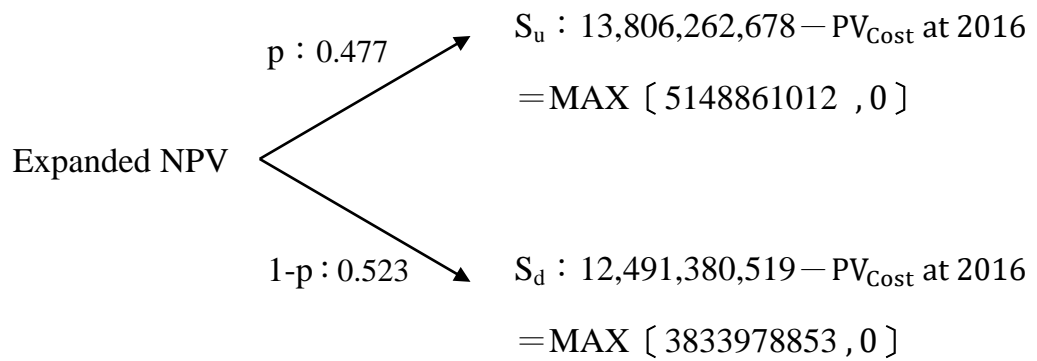
In the beginning, we build the event tree to explain the different kinds of real option. And then, we use the expanded NPV which is the total value of a project that owns one or more options to estimate the values of real options. It is given by: Expanded (Strategic) NPV = Static (Passive) NPV + Value of Options from Active Management.

1. Option to defer :

First step : Build the event tree



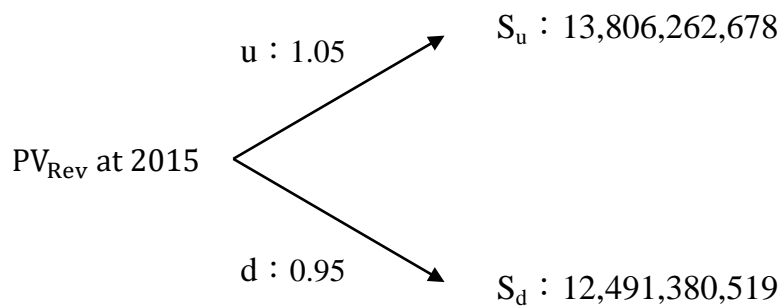
Second step : Backward event tree approach



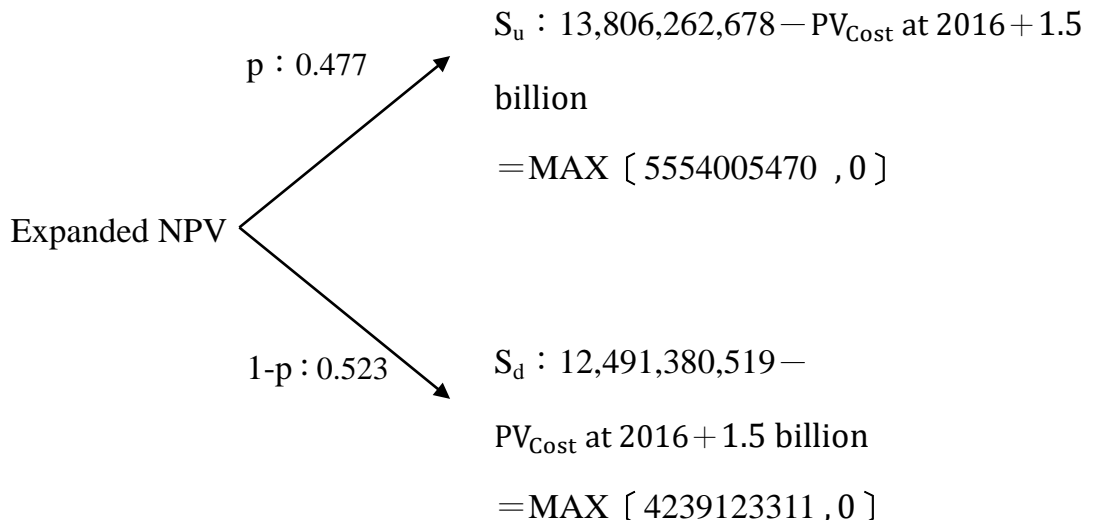
And then, we use the expanded NPV which is given by: Expanded (Strategic) NPV = Static (Passive) NPV + Value of Options from Active Management. Therefore, the values of option to defer are -383,678,352.

2. Option to expand :

First step : Build the event tree

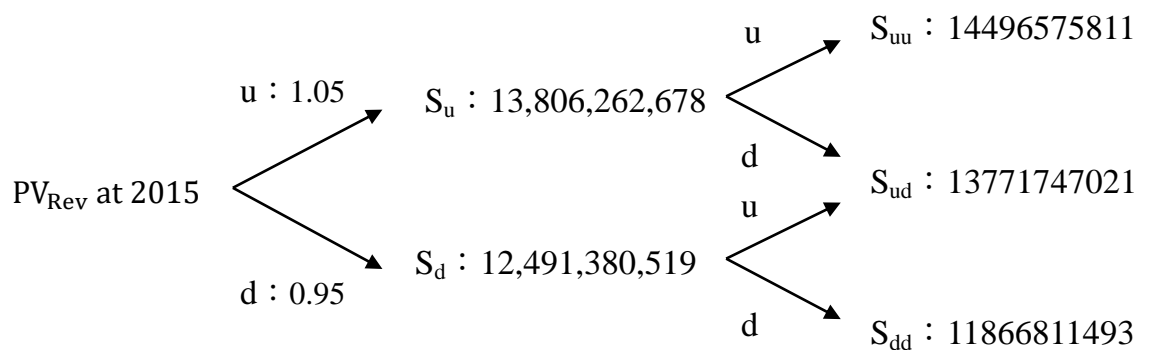


Second step : Backward event tree approach

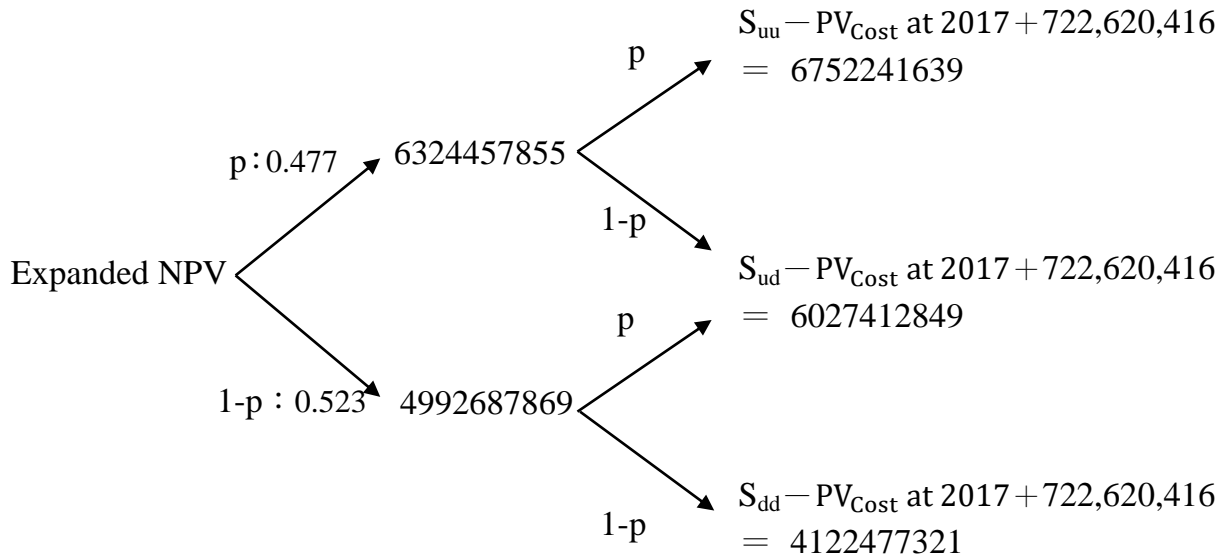


And then, we use the expanded NPV which is given by: Expanded (Strategic) NPV = Static (Passive) NPV + Value of Options from Active Management. Therefore, the values of option to expand are 18370331.

3. Option to contract :
First step : Build the event tree



Second step : Backward event tree approach



And then, we use the expanded NPV which is given by: Expanded (Strategic) NPV = Static (Passive) NPV + Value of Options from Active Management. Therefore, the values of option to contract are 774170719.

5. Policy issues

5.1 Hong Kong

In Hong Kong, 552 MHz of frequency spectrum in the 850/900 MHz, 1800 MHz, 1.9 – 2.2 GHz, 2.3 GHz, and 2.5/2.6 GHz bands has been assigned to mobile network operators (“MNOs”) for the provision of public mobile telecommunications services. The spectrum under consideration for re-assignment comprises 49.8 MHz of spectrum in the 900 MHz band and 148.8 MHz of spectrum in the 1800 MHz band, which constitutes 36% of the total spectrum assignment. The above 198.6 MHz of spectrum in the 900 MHz and 1800 MHz bands is deployed for the provision of second, third and fourth generation (“GSM”, “3G” and “4G”) mobile services. The existing assignments of this spectrum are due to expire between 19 November 2020 and 29 September 2021.

In the first round public consultation, the Communications Authority (CA) sets out the four objectives that the CA adopts in evaluating the options for the Re-assignment of the 900/1800 MHz Spectrum, viz.

- (a) Ensuring customer service continuity.
- (b) Efficient spectrum utilisation.
- (c) Promotion of effective competition.
- (d) Encouragement of investment and promotion of innovative services

In sum, the CA must consider not only the spectrum re-assignment for effective competition and innovative services, but also ensure the GSM service continuity. Therefore, to enhance the efficient spectrum utilization, CA had unlocked the technology limitation of GSM and increased the spectrum utilization fees on GSM service provider (MNO). For these reasons, the MNOs providing the GSM service have the incentive to migrate the GSM subscribers to 4G networks for cutting down the running cost and deploying the advanced technology.

5.2 Korea

The Korea Communications Commission has approved KT Corporation's plans to close its GSM mobile service in December, 2011. The KCC has allowed the South Korean operator to end GSM services in the 1,800 megahertz band, allowing the firm to use the spectrum for 4G. Because KT plans to invest \$1.1 billion in 2012 in 4G services, the operator needed 20 megahertz in the 1.8 gigahertz band to start LTE services. The commission's decision comes as good news for the firm, as its previous two requests over the matter had been rejected citing the vast number of GSM handset users. The operator had 1.1 million GSM mobile users in March, and after rigorous campaigns urging GSM users to upgrade to 3G phones, the number of GSM users declined to 150,000 in November. KT has been given two weeks to notify its GSM customers about its decision, before ending the service on December 8. Users will have to subscribe to 3G mobile services or switch mobile carriers.

Having rejected KT's two earlier requests for permission to switch off GSM services in April and July 2011, under the terms of its approval last month the KCC ordered KT to inform its remaining GSM customers of the switch-off by at least two different methods. Meanwhile, as part of plans to assist GSM subscribers in upgrading to 3G, KT revealed it would provide a support package that includes discounts on payment plans, the deduction of subscription fees and cancellation charges as well as a choice of a free mobile device. Such measures, however, failed to prevent almost 1,000 of the cellco's GSM subscribers from filing a class action lawsuit against KT, with a view to invalidating the November 2011 regulatory decision allowing KT to discontinue its second-generation products from 8 December 2011.

In this case, with regard to the termination of the legacy network, NRAs may or may not control the termination process and, if they choose to do so, they should determine the degree of their involvement. According to the Coase theorem (Coase, 1960), if the negotiation cost among stakeholders is pretty low, the government's involvement is not necessary, and the market negotiations will result in the optimal outcome.

6. Conclusion

Termination GSM service GSM service requires some basic consensus between the NRA and mobile operators for smooth transition and capturing business value as much as possible. However, we find that if Chunghwa Telecom defers a year to carry out the migrating project, the business Values will decrease. In the meantime, though the NRA migrate the GSM users with effect, announcing the timeline for GSM shut down is too late. Furthermore, the subsidy made Chunghwa Telecom ignore abundance of the upgrade program. In addition, because GSM license is under beauty contest and without technology neutrality, Chunghwa Telecom can only just reduce the base station for cutting down the running cost.

Based on analysis, although customers' preference is one thing, the NRA should not have used administrative means to force consumers into using a specific mobile system. Therefore, NRA should regard market leading as a principle. NRA should let MNOs handle the issues themselves and exploiting the stepped spectrum utilization fees to increase the MNOs' running cost to promote the migration to advanced technology.

For the License expired, NRA need to reset a standard about termination process such as the minimum lead time from announcement to termination and setting criteria for compensation packages. In addition, NRA also need to improve the transparency of public consultation and pass the news of termination to all those whom it concerns by official and unofficial channels.

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