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Research on the fixed network interconnection rate regulation

Executive Summary

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Executive Summary

I. Introduction

This research “Research on the fixed network interconnection rate regulation”, delegated by the NCC, is to study the rate regulation for fixed network interconnection services.

In order to facilitate fairness, competition and efficiency in fixed telecommunication market, the authority formulates the regulation regarding network access, imposing the operators on following the obligation of network interconnection, and the pricing should be cost oriented, fair and nondiscriminatory. The SMP operators should comply with the principle of unbundled network elements, and the pricing methodology of interconnection rate should adopt the TELRIC methodology.

The pricing structure of interconnection rate was designed for the traditional public circuit switch network structure, and the pricing is based on the usage time. The cost pricing calculates the usable amount of network elements. Because of the technology evolution, the network structure migrates to next generation all-IP network, the voice call pattern also transforms to VoIP application, and the delivery model of voice traffic transforms to the IP packet. This kind of situation forces the cost pricing methodology to be revised in response to the trends of technology and market development.

This research studies the regulation of fixed interconnection rate, focusing on the fixed network structure, cost pricing methodology and related regulation of fixed interconnection rate in comparative countries. This research also sets the recommended rate, based on the international benchmarking approach.

We summarize the research findings to organize the consultation document of the fixed interconnection rate regulation. We publish this

document for public and hold an expert seminar to collect the opinions from stakeholders and scholars.

We provide the recommendations based on our consulting result to revise the regulation. The recommendations include the amendment bill on regulation, advices for calculation methodology and recommended interconnection rate in the next years. In order to recognize the impact of setting the fixed interconnection rate, we estimate the prediction of fixed voice traffic and compare the revenue difference between the estimated rate and original value in the short term.

The fixed network structure is progressing from PSTN to next generation IP network, and this research also analyzes the pricing mechanism for network interconnection in all-IP network.

The structure of this project is as follows:

- Chapter II is to analyze four pricing rule of interconnection rate, includes marginal cost pricing, average cost pricing, Ramsay pricing, efficient component-pricing rule, and explaining the advantages and disadvantages of these four rules.
- Chapter III is to research the fixed telecommunication market and regulation of fixed interconnection rate for calling services in comparative countries. Those countries include the United Kingdom, Germany, Netherland, Australia, Japan and Korea.
- Chapter IV is to set the recommended fixed interconnection rate. We use the international benchmarking methodology to calculate the recommended fixed interconnection rate.
- Chapter V is to review the current regulatory status for fixed interconnection rate in Taiwan. This research reviews the regulation of fixed interconnection rate and provides the recommendation for revising the regulation and act. This research also evaluates the impact of setting recommended fixed interconnection rate. In the short term, the regulation may impact the revenue of incumbent operator of fixed interconnection

service. This research also analyzes the regulation for the IP interconnection fee of next generation network.

- Chapter VI is to summarize and respond the opinions from stakeholders and scholars. This research consults with the public for the recommendation of the regulation of fixed interconnection rate.
- Chapter VII is to provide gender statistics analysis about this research based on the request of proposal from NCC.

II. Research for calculation methodology on network interconnection rate

1. The theory and practice of fixed interconnection rate

Telecommunications policy has come a long way from the regulation of vertically integrated monopolies to the current status of the competition. As competition becomes self-sustainable, telecommunications policy in the form of industry-specific regulation should go away, if not, what form will it take? The insights from a review of the theoretical and empirical literature are applied to five policy areas. They are: (1) termination monopoly; (2) local bottleneck access; (3) net neutrality; (4) spectrum management; and (5) universal service. While in some of them, deregulation and a move to competition policy will soon sustain the efficient state, regulation will be in place to remain efficient in others for some time.

For policy makers, under reasonable regulatory burdens, access charges should help achieve a number of tasks, such as preventing the firm with monopoly power from setting its price too far above cost, and encouraging downstream entry, efficient network investment and network utilization, and most importantly encouraging sufficient cost-reducing activity. The pricing rules of access charges include: (1) marginal cost pricing, (2) average cost pricing, (3) Ramsey pricing, (4) efficient component pricing, (5) total service long run incremental cost, (6) total element long run incremental cost, (7) price caps, and (8) international benchmarking.

2. The principle of pricing rule of access charge

(1) Marginal cost pricing

The most familiar pricing principle of access charges is that of marginal cost pricing. It means that the level of output at which the marginal willingness-to-pay for the good just equals its marginal cost of production. Besides, for the cost advantages stemming from scale economies, it is likely to improve allocative efficiency for exploring all

the trade possibilities and productive efficiency for decreasing average cost, but at the expense of that it may entail the firm making a loss.

(2) Average cost pricing

The first-best access charges generally involve setting access price equal to marginal cost, but that for firms with economies of scale. Such pricing will result in the firm making a loss. Price being higher than average cost means the price is higher than marginal cost for firms increased returns. Hence, if the price exceeds average cost, welfare will be increased by a price reduction, and so it must be optimal to allow the firm to charge a price equal to average cost to make the firm break even.

(3) Ramsey pricing

Marginal cost pricing continues to be optimal in the multi-product case, and just with the single-product case that marginal cost pricing will lead to the firm being making a loss. Simply to say, Ramsey problem is to maximize consumer surplus subject to the firm breaking even. It could be viewed that Ramsey pricing is the average cost pricing for multi-product. However, it does not require that common costs be allocated in any sense to individual products. If consumer demand are independent, optimal Ramsey prices are guided by the familiar inverse-elasticity rule, that is, the price should be closer to marginal cost in markets where consumer is more sensitive to price.

(4) Efficient Component Pricing Rule (ECPR)

ECPR means that the incumbent should charge an access price equal to the average incremental costs of access plus the opportunity cost of access. This opportunity cost is the forgone benefit of the incumbent of providing access to competitor. The efficient component price could be derived by deducting the incremental costs of the downstream service from the incumbent's retail price. The reasons for its publicity are that:

- It is easily understood and practiced;
- It is usually embraced by incumbents, because it seems to transfer the status quo profit margin to the competitive status;

- It does not require a change in (regulated) prices of final services and does not interfere with potentially popular cross subsidies (and universal service policies).

(5) Total Service Long Run Incremental Cost (TSLRIC)

The measurement of economic costs of individual services or network components (elements) in telecommunications is a difficult task for the forward-looking nature of economic costs, the rapid technical progress, and the economies of scale and scope resulting from the use of long-lived assets (Vogelsang 2003). TSLRIC is the cost of providing an entire service as compared not to provide it at all. TSLRIC includes service-specific fixed costs, which will not be incurred when the service is not offered, in addition to direct variable and capacity costs.

(6) Total Element Long Run Incremental Cost (TELRIC)

TELRIC is the incremental cost a firm incurs in the long run to provide a network element, assuming all of its other service activities remain unchanged. The term TELRIC constitutes an evolution of the TSLRIC, first introduced by the U.S. Federal Communications Commission (FCC). FCC modifies TSLRIC to apply it to each unbundled network element, TELRIC considers an element-by-element consisting of the network and then price individual elements on the basis of the cost of the individual element. The fundamental difference between TSLRIC and TELRIC is that the latter includes shared common costs in addition. Although the TELRIC/ TSLRIC methodology has become so widespread, TELRIC/ TSLRIC is clearly much more cumbersome than price cap regulation.

(7) Price Caps

Price caps are defined by an index of the regulated services that is adjusted in a period by (1) an inflation factor such as consumer or retail price index that reflects the economy-wide price level, (2) an X-factor that requires efficiency improvement of the firm, and (3) a Y-factor that allows for pass-through of specific cost items that's out of control of the

firm. Price caps combine two characteristics that are essential for regulation: incentives for cost reductions, and freedom and incentives for re-balancing price. However, they are subject to review every few years, and this brings in ratcheting and has led some observers to equate them with rate-of-return regulation (Liston 1993).

(8) International Benchmarking

International Benchmarking is becoming a central instrument for improving the performance of the telecommunication industry. This development reflects that under the right conditions international comparison can be an important driver of performance for telecommunication operators. The basic idea behind benchmarking is simple as follows :

- Find an organization that is best at what your own organization does;
- Study how it achieves such results;
- Make plans for improving your own performance;
- Implement the plans; and
- Monitor and evaluate the results.

Benchmarking is to identify and implement best practice. International benchmarking can be initiated through a number of approaches :

- Macro benchmarking of major service sectors.
- Benchmarking of the same type of organizations in a limited number of countries.
- Process benchmarking using a standard.
- Partial benchmarking focusing on one or a few aspects of performance.

(9) Summary

International benchmarking has a number advantages that could not be achieved through other forms of regulation. Generally, growing globalization and international interdependency is the need for the international benchmarking. The development of the telecommunication technologies in one country depends on the development in other countries so that international benchmarking may be particularly useful for next generation access price regulation.

III. Research for International Comparative Studies on Fixed Telecommunication Market and Fixed interconnection Rate Regulate Mechanism.

This chapter analyzes the development of fixed telecommunication and the cost construction of fixed interconnection rate. To reinforce this research and advices, we discuss and analyze six comparative countries, including the United Kingdom, German, Netherland, Australia, Japan and Korea. The related issues are as follows:

1. Fixed telecommunication market development and trends

In this chapter, we collect the market data of fixed-line voice service and broadband service for comparative countries, including operators' retail revenue, fixed-line call volumes, subscription numbers, coverage and market share.

Because of the development of internet and OTT services, fixed voice markets are getting shriveled. In other side, we found that the income of the fixed broadband market has gradually increased. The reason is that most household and small-medium business on broadband services to super-fast broadband services, and the charge is higher than broadband service. This research also collects the market share of operators in selected countries. The market share of the largest incumbent in some countries like the United Kingdom and Netherlands is below 50%, and there is some incumbent's market share above 60% like Deutsche Telecom in Germany, Telstra in Australia, NTT Group in Japan and Korea Telecom in Korea.

This research observes the development trends from each kind of fixed service, it is easy to find out the factors that affect market share.

2. Regulatory mechanism of interconnection rate

(1) Network structure

This research illustrates the logical and physical network structure of comparative countries. By clarifying the structure, we analyze the related assets that the comparative countries construct their model used to calculate the interconnection rate. The network elements include transport network, controller, gateway, access node, routers and switches, server, rack, cabling, duct and fiber etc.

Most comparative countries built model to calculate the interconnection rate, and adopt BU-LRIC, BBM, or others methodology. Related assets include VoIP related equipment, DSLAMs, routers, and building.

Next generation Network (NGN) is also the factor might affect cost construction. Some comparative countries consider that NGN network elements are different to the PSTN, and adjusting their model and cost item. By analyzing NGN transform in comparative countries, we can know how those countries promote PSTN transform to NGN.

For example, the United Kingdom and Netherlands already consider the cost of NGN network to calculate the interconnection rate, there are also some countries like Australia, Japan and Korea consider the impact of the network structure migration from PSTN to NGN.

We classify the calculation interconnection rate based on different network structure in comparative country as follows:

- NGN IP network: Netherlands, United Kingdom;
- TDM network: Germany;
- Evaluate both on PSTN and NGN: Australia, Japan and Korea.

(2) Cost items

Furthermore, elements in core network, access network and transmission network are also the cost items used in calculating model, for example Pure-BULRIC model.

This research also lists out cost detail as the reference for Taiwan authority to calculate interconnection rate. By collecting and analyzing comparative countries' market structure, development, construction of cost, and benchmark analysis, we illustrate the possible trend and feasible market competitive effects analysis for fixed market.

In most comparative countries, the cost items includes the network cost for building and maintenance. For example Australia distinguish network to the core network and customer access network. The cost item in access network can be classified as ducts, pipes, copper cables, pair gain system, radio bearer equipment, communications plant, network building and network land. The cost items in core network includes switching equipment, inter-exchange cables, transmission equipment and also have network building and network land.

In some comparative country also consider capital expenditure as a cost item. In order to calculate the capital cost, the regulators consider the WACC value of the operators. The WACC value of most operators is between five to six per cent.

We summarize the cost item as follows:

- Network cost;
- Capital expenditure and cost
- Operational cost (include maintain cost)

(3) Regulation of interconnection rate

This research concentrates on the specific issue of the regulation of interconnection rate. We look into international regulation and policy as the comparative foundation to the regulation in Taiwan. We discuss the regulatory measure for the transformation of interconnection rate

calculation. In this part, we analyze all previous methods for interconnection rate determination of comparative countries, and find out the reason of changing calculation mechanism, such as BU-LRIC+ transforming to pure BU-LRIC. We notice that most of the comparative countries interconnection rate of each time shows a significant decline. That is to say, these countries are adjusting their cost item, model and calculation formula progressively.

For example, most of the member countries in the European Union like the Netherlands and United Kingdom adopt Pure LRIC models to set the fixed interconnection rate. Germany believe common cost should be calculated in the cost model of interconnection rate, the regulator Bundesnetzagentur (BNetzA) decides to adopt LRIC+, but the BEREC and European Commission oppose this decision and require BNetzA should adopt pure LRIC to set the new regulate rate.

Japan is another country adopt LRIC+. Most of the calculation methodology LRIC are bottom up mechanism, Korea adopt hybrid LRIC, they calculate the interconnection rate for different operators by Top-down model in early stage, after 2005, the cost model transforms to Bottom-Up.

A few of countries adopt the Top-Down model for calculating the regulated rate. Australia develops the Build Block Model (BBM) to evaluate the regulated rate for fixed line wholesale service. Australia regulator ACCC sets the Regulatory Asset Base (RAB) for estimating the asset value. ACCC believes the Top-Down BBM model is easier and simpler to set regulated rates for wholesale service.

We classify the calculation methodology to the following type:

- BU-LRIC : Netherlands, United Kingdom;
- LRIC+ : Germany, Japan;
- Hybrid LRIC : Korea;
- Top-Down BBM : Australia.

IV. Recommendation for setting fixed interconnection rate thought the methodology of international benchmarking

Ovum, which is a world-renowned telecom consultant developed their benchmarking methods to set the fixed interconnection rate. And they used their benchmarking methods to assist Peru telecom operators in the research on fixed interconnection rate. In this study, we take into account the international benchmarking methods used by Ovum. Then we adjust the benchmarking methods to set the fixed interconnection rate that can meet Taiwan industry conditions. In this study, we use our benchmarking methods to calculate the fixed interconnection rate as follows:

1. Step 1: Selection of fixed interconnection indicators

Through the selection of relevant indicators we can choose which countries' fixed voice market is relatively similar to Taiwan.

We consider operators build their network, the costs associated with the country's economic and demographic indicators.

So we select the key indicators to evaluate the fixed interconnection rate. Key indicators include (1) GDP per capita; (2) Population density; (3) Urbanization; (4) Fixed telephone penetration; and (5) Fixed broadband penetration.

2. Step 2: Selection of the benchmark countries

We use data from the World Bank database on the GDP per capita, population density and urbanization of 247 countries, as well as from the ITU website on fixed telephone penetration and fixed broadband penetration of 228 countries. We use cluster analysis to cluster more than two hundred countries by five indicators. According to the cluster results of the five indicators, we take the intersection with the same country in Taiwan's. So the countries which we choose are the similarities with Taiwan. They are UK, Germany, Netherlands, Japan, Korea, Belgium, France, Canada, USA and Australia. But the telecommunications industry in the USA and Canada, which operators originated from the private

sector is different between Taiwan. Coupled with the vast majority of the two countries, the main mode of operation of the industry in accordance with the regional mode of operation. It is difficult to sum up the representative of the region as a comparison object. And Australia's GDP per capita and population density compared to other benchmark countries with other big differences. So we chose UK, Germany, Netherlands, Japan, Korea, Belgium and France as benchmark countries to evaluate the fixed interconnection rate.

3. Step 3: Ranking benchmark countries and setting weights

This study takes into account the similarities between the indicators in Taiwan and other countries. We use "similarity factor method" to adjust the value, it's because background factors of Taiwan should be taken into account. By that way, we can evaluate the approximation of Taiwan's fixed interconnection rate.

Therefore, we use the "similarity factor method" and "standardized method" to produce the ranking of the top five factors of the seven benchmark countries. Then we weights the result based on the ranking to calculate fixed interconnection rate.

When the country's rank is higher than others, we give the country a larger weight. In "similarity factor method", the higher rank represents the country is more similar to Taiwan. In "standardized method", the higher rank represents the country is more similar to benchmark countries' normalized average.

In other words, we strengthen the importance of benchmark countries by larger weights which factors are more similar to Taiwan. And as a trade-off, we lessen the importance of benchmark countries by smaller weights which factors is not similar to Taiwan.

4. Step 4: Calculate the fixed interconnection rate

The fixed interconnection rate of each benchmark countries is multiplied by the weights of the two methods. Then we can get the suggested values of the fixed interconnection rate for the five factors of

"similarity rating method" and "standardization evaluation method". Finally, we average the suggested values of five factors to get the fixed interconnection rate recommended value of "similarity factor method" and "standardized method".

In view of the results of "standardized method" is lower than the results of "similarity rating method". So we propose the results of "standardized method" as the lower limit, and the results of "similarity rating method" as the upper limit.

Based on the pattern of retail price plan in Taiwan, we calculate the recommended rate and distinguish into local/long-distance single fixed interconnection rate, off-peak local fixed interconnection rate and mobile to fixed interconnection rate. This form has followed the regulated price structure in the past.

In this study, we use conversion factors including exchange rate, PPP and GNI per capita to calculate the fixed interconnection rate. In general, international benchmarking use exchange rate and PPP to execute the benchmark analysis. PPP can reflect the true value of money and the reaction of the national price level. At the same time, we consider the cost of transportation (including electricity cost, labor cost and rent) as the main expenditure items when the operators manage the telecom business. PPP is used to purchase the factor of production, according to the purchasing power of the local currency and resulting in revenue or cost of the situation. So we recommend using the PPP as a conversion factor which is more suitable for the final recommended value of the fixed interconnection rate.

This study sets the recommended value of the fixed interconnection rate in next four years. The recommended range of local calls to local fixed interconnection rate between per minute NT\$0.25 to NT\$0.26, and call type for off-peak is per minute NT\$0.0711 to NT\$0.0736. The recommended range of mobile calls to local fixed interconnection rate is per minute NT\$0.3211 to NT\$0.33.

Then we divide the recommended value of fixed interconnection rate by four years, each year in the same proportion. So we can calculate the recommended fixed interconnection rate of each year. The result is as follows:

- First year
 - Local calls to local: NT\$0.30~0.30 per minute.
 - Local calls to local in off-peak: NT\$0.0853~0.0859 per minute.
 - Mobile calls to local: NT\$0.4443~0.4463 per minute.
- Second year
 - Local calls to local: NT\$0.27~0.28 per minute.
 - Local calls to local (off-peak): NT\$0.0806~0.0818 per minute.
 - Mobile calls to local: NT\$0.4036~0.4076 per minute.
- Third year
 - Local calls to local: NT\$0.27~0.27 per minute.
 - Local calls to local (off-peak): NT\$0.0758~0.0777 per minute.
 - Mobile calls to local: NT\$0.3628~0.3688 per minute.
- Fourth year
 - Local calls to local: NT\$0.25~0.26 per minute.
 - Local calls to local (off-peak): NT\$0.0711~0.0736 per minute.
 - Mobile calls to local: NT\$ 0.3221~0.3300 per minute.

V. Recommendations for policy and regulation of fixed interconnection rate in Taiwan

1. Analysis for regulation and policy of the fixed interconnection rate in Taiwan

We review the regulation of fixed interconnection rate in Taiwan. The Telecommunications Act set the regulation for network interconnection, including principles of transparency, reasonableness, non-discrimination, unbundled network element and cost-based pricing.

The Regulations Governing Network Interconnection among Telecommunications Enterprise mandate that the calculation of interconnection rate should meet the principle of cost orientation, fairness, reasonableness and non-discrimination. The interconnection rate of fixed network operators with significant market power shall follow the principles to calculate the regulate rate. The cost should be determined on the basis of TELRIC. The SMP operators should submit the purposed rate to the regulator in advance and be verified by the regulator.

The principle of cost separation for type I operators in Taiwan requires the operating cost should be attributed to the following type, the services cost can be directly identified to costs of network components, supporting functions and general administrative and miscellaneous functions cost can be directly attributed to a particular service segment. The network components cost contains the various components of transmission, switching local loop and other network plant and system, those costs cannot be attributed directly to the particular service segment. The supporting cost contains the costs of functions necessary for the provision of services to the customer. General administrative and miscellaneous functions cost or the cost not related to the provision of a particular service, but are an important part of the operations of an operator.

2. Recommendations for regulation

The research finding of comparative country analysis indicates most regulators require the cost pricing of network interconnection to follow the principle for cost pricing. In general, a few of regulators set the specific calculation methodology in the Article of the Act in order to enhance the regulatory flexibility.

For example, the regulators in Australia, Netherlands and United Kingdom require the pricing for wholesale to follow the principle of cost pricing. Those regulators set the different price regulation to each wholesale service corresponding with the attributes of services, including cost pricing (for example LRIC), Retail-minus, Price Cap and International Benchmarking. The LRIC methodology can distinguish to TELRIC, TSLRIC and TSLRIC+ etc.

Some regulators like BNetzA set two or more calculation methodology, based on requirement of the regulation. BNetzA development the cost model of fixed networks, requiring the interconnection rate to follow the LRIC+ methodology, regulator also can adopt the reference value calculated from the international benchmarking methodology.

The legislative formulation of regulation for interconnection rate in Taiwan are different comparative countries, The Regulations Governing Network Interconnection among Telecommunications Enterprise require the calculation methodology of interconnection rate to follow the TELRIC.

However, because of the technology evolution, the network structure is migrating to next generation all-IP network, the delivery model of voice traffic is changing to fit the development of the market and technology, the practice of cost pricing becomes more complex in the Age of Digital Convergence.

In order to resolve the complex issue in practice and enhance regulatory flexibility, this research recommends the amendment bill for Telecommunications Act and The Regulations Governing Network Interconnection among Telecommunications Enterprise. We advise the cost calculation methodology can be revised from TELRIC to LRIC. We also recommend the regulator can add different methodology like Price Cap or the reference value from International Benchmarking into the regulation. It can enhance the adoption, ability of the regulator to fit the development of market and technology.

3. Analysis of impact for recommended interconnection rate

(1) Short term

In order to recognize the impact of setting recommended fixed interconnection rate, we estimate the prediction of fixed voice traffic and compare the revenue difference between recommended rate and original value in the short term.

We break down the call pattern based on the different destination to fixed local calls, fixed long distance calls, mobile calls and international calls. This classification is based on the network structure of the incumbent.

After calculating the voice traffic data over the past two years from the regulator, we will evaluate the prediction of fixed voice traffic for the next four years. We use the changing trends of voice origin call minutes to multiply by the present value and recommended rate, then compare the difference between those data. The decline range could indicate the impact of realizing recommended rate in the short term.

(2) Long term

The main purpose of regulation should promote competition of the market to benefit the public in the long term. This research recommends the regulator should review the market situation both in retail and wholesale service, if there exist the concern for the margin squeeze issue, the regulator should regulate the wholesale interconnection rate to

promote competition in the long-term.

The fixed telecommunication network structure is progressing from PSTN to Next Generation IP Network, this research also analyzes the pricing mechanism for network interconnection in all-IP network.

In the IP network structure, the transmission item transforms from voice call minutes to the IP packet, the delivery model of voice traffic also transforms to the IP packet. And the network structure also differs from traditional PSTN. The attribute of IP network including technology feature, transmission route and charging mechanism are also different with PSTN, it is necessary to revise the calculation methodology to fit the development of the market. The common pricing mechanism for network interconnection in an IP network is bill and keep.