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Access regulation in the next generation access network environment: A comparative study of Hong Kong and Singapore from the transaction cost economics perspectives

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The 19th ITS Biennial Conference 2012
**“Moving Forward with Future Technologies:
Opening a Platform for All”**

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**Access Regulation in
the Next Generation Access Network Environment –
A Comparative Study of Hong Kong and Singapore
from the Transaction Cost Economics Perspectives**

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AU Man Ho*

Abstract

Hong Kong and Singapore have adopted two different models in the regulation of the next generation access (NGA) networks. In Hong Kong, the government has decided that access regulation will not be applied to fibre-based access networks and its strategy will be to rely on facilities-based competition to promote investment in the NGA networks. Singapore, on the other hand, has promoted access/services-based competition over a next generation broadband infrastructure subsidised by public funding and operated on an “open access” basis.

This paper applies the theories of transaction cost economics (TCE) to analyse the two different regulatory models adopted in Hong Kong and Singapore for the NGA networks. Transaction cost economics is concerned with the study of “governance structures”. Governance structures operate within the relationship between transacting parties for the purpose of dealing with “contractual hazards”. Market, firms, regulation, public franchise and public ownership are alternative governance structures operating in the NGA environment. Governance structures aim to minimise transaction costs caused by contractual hazards.

Three research questions are asked in the study – what are reasons for adopting the two different regulatory models, what has been the effect of the regulatory models and what lessons can be learnt on the optimal regulatory model for the NGA networks. The methodology of the study is based on document analysis supplemented by interviews.

This paper has found that the theories of TCE provide useful tools for the analysis of access regulation in the NGA network environment. The “discriminating alignment hypothesis” in TCE theories has been found to be generally true. The economic agents have chosen the governance structures to minimise transaction costs and a mismatch between the transactions and the governance structures is unlikely to minimise transaction costs, as predicted by the “discriminating alignment hypothesis”. However, this hypothesis needs some further elaborations. First, the agents have

chosen the governance structures that can minimise the sum of transaction costs, production costs, other economic costs and social costs. Second, the choice of governance structures has been affected by the institutional environment. Finally, this study has found that consideration of only “market failure” or “significant market power” in the larger neoclassical market may not adequately protect end-users’ interests in the NGA network environment. “Asset specificity” should also be considered in deciding the optimal form of governance structure.

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1. Introduction

The industrial economy of the twentieth century depended on the manufacture and transportation of physical goods. The knowledge economy of the twenty-first century will depend on the “generation, distribution, and application of knowledge”.¹ The distribution of knowledge requires the transportation of information of all types over a communications infrastructure. A communications infrastructure is made up of the backbones or core networks for wide area transportation, and the access networks connecting the end-users to the backbones or core networks. The first generation access networks comprise the copper networks for telephony and cable television that have been upgraded to carry broadband signals. The next generation access (NGA) networks involve substantial investment in extending optical fibres to reach locations close to, or terminate on, the end-users’ premises.² A pervasive and affordable broadband communications infrastructure is expected to be a key enabler of the competitiveness, economic growth and social well-being of a nation. Therefore the rollout of NGA networks has been on the top of political agenda in many developed economies.

Access regulation has been applied to the first generation access networks to enable “access-based” or “services-based” competition if the operation of access networks is considered to be a natural monopoly. If the rollout of alternative access networks is economically and technically feasible, access regulation is applied as a temporary measure to stimulate the emergence of “facilities-based” competition based on the “ladder of investment” or “stepping stone” theories.³ There are concerns that the substantial economic and technical barriers involved in the rollout of fibre-based NGA networks could lead to re-emergence of monopoly or dominance if access regulation is lifted or relaxed prematurely for such networks. However, access

¹ William H. Melody, "Markets and Policies in New Knowledge Economies" in Robin Mansell, et al. (eds.), *The Oxford Handbook of Information and Communication Technologies* (Oxford: Oxford University Press, 2007), p. 56.

² NGA networks may be based on wireless technologies, but in the foreseeable future, due to spectrum limitations, wireless networks are expected to be complements rather than substitutes for fibre-based NGA networks. Cave and Hatta (2009) have noted that there is “a persistence of an order-of-magnitude gap between fixed and mobile speeds, with a lag of 4 years.” See Martin Cave & Keiko Hatta, "Transforming Telecommunications Technologies - Policy and Regulation" (2009) 25 *Oxford Review of Economic Policy* 488, p. 491. Noam (2011)'s observation is that “[w]ireline seems to stay roughly two orders of magnitude ahead, i.e. about 100 times as fast, while actually accelerating over wireless in recent years.” See Eli M. Noam, "Let Them Eat Cellphones: Why Mobile Wireless is No Solution for Broadband" (2011) 1 *Journal of Information Policy* 470, p. 476.

³ Martin Cave & Ingo Vogelsang, "How Access Pricing and Entry Interact" (2003) 27 *Telecommunications Policy* 717, p. 724; Martin Cave, "Encouraging Infrastructure Competition via the Ladder of Investment" (2006) 30 *Telecommunications Policy* 223, pp. 224 – 226; Martin Cave, "Snakes and Ladders: Unbundling in a Next Generation World" (2010) 34 *Telecommunications Policy* 80, pp. 81 – 82.

regulation is often regarded by infrastructure operators as having negative impact on investment and innovation. Striking the optimal balance between promoting competition and preserving incentives for investment and innovation is the common concern of policymakers and regulators.

In developed economies, the models for access regulation applied to NGA networks fall into two broad classes – withdrawal of access regulation and reliance on facilities-based competition (e.g. the models adopted in USA and Hong Kong) and “open access” to the network infrastructure⁴ and reliance on access-based or services-based competition (e.g. the models adopted in UK, Australia and Singapore).

The advantages and disadvantages of facilities-based competition and access/services-based competition are well known. With facilities-based competition, there is more scope for product differentiation, more robust and self-sustained competition without the need for regulatory intervention. With access/services-based competition, the entry barriers (for new entrants to enter the market) and switching barriers (for end-users to switch between alternative service providers in the market) are lower and inefficient duplication of infrastructure can be avoided. It should also be noted that many scholars and regulators, particularly those in European countries, regard access-based competition as a form of facilities-based or “infrastructure-based” competition as the competitors gaining access to the final access links of the infrastructure have to invest substantially in the rest of the infrastructure, and the infrastructure controlled by the competitors provides considerable scope for product differentiation.⁵

There is a general consensus among scholars and regulators that, in an environment where facilities-based competition is economically and technically feasible, the regulators should promote facilities-based competition instead of access/services-based competition. In such an environment, access regulation is to promote the emergence of facilities-based competition, leading to the ultimate withdrawal of the

⁴ The open access may be applied to different layers of the network architecture, including the passive layer or the active layer.

⁵ There is an ambiguity of the meaning of “facilities-based competition” or “infrastructure-based competition”. Some scholars refer to competition between multiple networks sharing common bottleneck facilities based on access (full or shared) to unbundled local loops as “facilities-based competition”. However some regard this as “access-based competition”. To them “facilities-based competition” is based on entirely separate and independent infrastructure. See Harald Gruber, “European Sector Regulation and Investment Incentives for Broadband Communications Networks” (2007) *SSRN Paper* obtainable at <http://ssrn.com/abstract=976887>, pp. 4 and 12; Jorg Kittl, et al., “Infrastructure-Based Versus Service-Based Competition in Telecommunications” (2006) 64 *Communications & Strategies* 67, p. 70; Anders Henten & Knud Erik Skouby, “Regulation of Local Loop Access - Infrastructure versus Service Competition in Fixed Broadband Access: The Case of Denmark” (2005), ITS Europe Conference, Porto, Portugal, 4 - 6 September 2005, p. 2.

access regulation when effective facilities-based competition has materialised.⁶ Based on these theories, in the environment of Hong Kong and Singapore, with high population and building densities, promoting facilities-based competition and withdrawing access regulation would seem to be the optimal choice of regulatory model to deliver public interests. Hong Kong and Singapore have, however, adopted two different models in the regulation of the NGA networks.

In Hong Kong, the government has decided that access regulation will not be applied to fibre-based access networks and its strategy will be to rely on facilities-based competition to promote investment in the NGA networks. As self-built customer access networks of competitors to the fixed network incumbent have extensive coverage of the households, mandatory access to the incumbent's copper local loops from telephone exchanges for competitors has been withdrawn in phases from July 2004 and fully terminated by 30 June 2008.⁷ There is no government policy to invest, or subsidise the investment, in telecommunications infrastructure.⁸ Market-driven investment has delivered four NGA networks serving the consumer sector, with speeds up to 1 Gbps⁹ and coverage currently at about 85% of all households.

Singapore, on the other hand, has promoted access/services-based competition over a next generation broadband infrastructure operated on an "open access" basis. In 2006, as part of the Intelligent Nation 2015 (iN2015) master plan, the government announced that it would catalyze the rollout of a next generation broadband network (called the "Next Generation Nationwide Broadband Network" or Next Gen NBN) with universal coverage providing speeds up to 1 Gbps to all homes, offices and schools.¹⁰ The Next Gen NBN is an "open access" network providing wholesale services to Retail Service Providers (RSPs) that in turn provide services to end-users. To ensure that the operators of the Next Gen NBN will treat RSPs on a non-discriminatory basis, there is operational separation between the operator of the active

⁶ Jerry Hausman & J. Gregory Sidak, "Telecommunications Regulation: Current Approaches with End in Sight" (2007), NBER Conference on Economic Regulation and Its Reform: What Have We Learned, Conference held in 2005 (Paper revised in October 2007), p. 68.

⁷ Hong Kong SAR Government (Communications and Technology Branch), "Legislative Council Brief: Review of Type II Interconnection Policy" (2004), 6 July 2004, para. 1; Mandated access to the local loops from the telephone exchanges has been withdrawn, but mandated access to the in-building wiring systems is still available should commercial negotiations for access fail. Office of the Telecommunications Authority (Hong Kong), "Review of Type II Interconnection Policy" (2004), Statement of the Telecommunications Authority, 6 July 2004, para. 16.

⁸ Office of the Telecommunications Authority (Hong Kong), "Development of Broadband Infrastructure in Hong Kong" (2009), Regulatory Affairs Advisory Committee Paper No. 4/2009, p. 5.

⁹ Gigabits per second, or 1,000 Megabits per second (Mbps).

¹⁰ The Next Gen NBN is the wired component of the Next Generation National Infocomm Infrastructure (Next Gen NII). The wireless component of the Next Gen NII is a pervasive wireless network, including a Wi-Fi service called "Wireless@SG".

infrastructure (the Operating Company, or OpCo) and its affiliated RSP, and in order to foster competition in the operation of the active infrastructure, there is structural separation between the OpCo and the operator of the underlying passive (dark fibre) infrastructure (the Network Company, or NetCo). The government has provided grants of up to S\$750 million and S\$250 million respectively to NetCo and OpCo. The Next Gen NBN was scheduled to cover 95% of all premises by mid-2012 and universal service obligation will commence in 2013. To ensure that the RSPs can gain access to the wholesale services on terms that meet the policy objectives of the government, access regulation will be applied to the passive and the active infrastructures throughout the licence period (25 years).¹¹

As the functions of the network layer of a communications infrastructure are mainly for the transmission of data, the scope for product differentiation is bound to be limited. Product variety is far greater at the content and applications layer where the scope for innovation is limitless. Some scholars (e.g. Bauer (2010)¹²) are of the view that where the innovation potential is greater at the content and applications layer than at the network layer, open access of the network layer that fosters innovation at the content and applications layer may deliver greater public interests. This suggests that, even in a high building/population density environment, access/services-based competition may be considered as a suitable model capable of delivering the desired public interests.

This paper applies the theories of transaction cost economics (TCE) to analyse the two different regulatory models adopted in Hong Kong and Singapore for the NGA networks. Three research questions are posed in the study – what are reasons for adopting the two different regulatory models, what has been the effect of the regulatory models and what lessons can be learnt on the optimal regulatory model for the NGA networks.

This paper has found that the theories of TCE provide useful tools for the analysis of access regulation in the NGA network environment. The “discriminating alignment hypothesis” in TCE theories has been found to be generally true. The economic agents have chosen the governance structures to minimise transaction costs and a mismatch between the transactions and the governance structures is unlikely to

¹¹ Info-Communications Development Authority of Singapore, "Singapore's Next Generation National Broadband Network" (2009), Information brochure; Info-Communications Development Authority of Singapore, "Next Generation Nationwide Broadband Network" (2012), Fact Sheet published in June 2012.

¹² Johannes M. Bauer, "Regulation, Public Policy, and Investment in Communications Infrastructure" (2010) 34 *Telecommunications Policy* 65, p. 76.

minimise transaction costs, as predicted by the “discriminating alignment hypothesis”. However, this hypothesis needs some further elaborations. First, the agents have chosen the governance structures that can minimise the sum of transaction costs, production costs, other economic costs and social costs. Second, the choice of governance structures has been affected by the institutional environment. Finally, this study has found that consideration of only “market failure” or “significant market power” in the larger neoclassical market may not adequately protect end-users’ interests in the NGA network environment. “Asset specificity” should also be considered in deciding the optimal form of governance structure.

The remainder of this paper is divided into the following sections. Section 2 gives the analytical framework based on TCE. Sections 3 and 4 outline the regulatory models in Hong Kong and Singapore respectively. Section 5 compares the regulatory models in the two jurisdictions and analyses the reasons for divergence of the regulatory models, the effect on end-users’ interests and the lessons that can be learnt on the optimal form of regulation based on the TCE analytical framework. Section 6 draws some conclusions.

2. The Analytical Framework

2.1 An Outline of the Theories of Transaction Cost Economics

TCE is a branch of new institutional economics which is concerned with the study of “institutions”. North (1991) has defined “institutions” as “the humanly devised constraints that structure political, economic, and social interactions. They consist of both informal constraints (sanctions, taboos, customs, traditions, and codes of conduct), and formal rules (constitutions, laws, property rights).”¹³ Since access regulation is a type of institutions, TCE potentially provides a useful theoretical framework for the analysis of access regulation.

“The transaction is the basic unit of analysis” in TCE.¹⁴ The conduct of welfare-enhancing transactions may be impeded by “transaction costs”. According to Arrow (1970), transaction cost is the source of market failures.¹⁵ Williamson (1996) has

¹³ Douglass C. North, "Institutions" (1991) 5(1) *The Journal of Economic Perspectives* 97, p. 97.

¹⁴ Oliver E. Williamson, *The Economic Institutions of Capitalism* (New York: The Free Press, 1985), p. 41.

¹⁵ In Arrow’s words, “[m]arket failure is the particular case where transaction costs are so high that the existence of the market is no longer worthwhile.” See Kenneth J. Arrow, "The Organization of Economic Activity: Issues Pertinent to the Choice of Market versus Nonmarket Allocation" in Robert H. Haveman & Julius Margolis (eds.), *Public Expenditures and Policy Analysis* (Chicago: Markham

defined “transaction cost” as “[t]he ex ante costs of drafting, negotiating, and safeguarding an agreement and, more especially, the ex post costs of maladaptation and adjustment that arise when contract execution is misaligned as a result of gaps, errors, omissions, and unanticipated disturbances.”¹⁶ How to minimise transaction costs is at the heart of TCE.

Institutions are the means to minimise transaction costs. New institutional economics is particularly concerned with institutions at two separate levels, namely the “institutional environment” and the “institutional arrangement”.¹⁷ Williamson (1996) has provided the following succinct definitions for the “institutional environment” and the “institutional arrangement”:

“Institutional environment” – The rules of the game that define the context in which economic activity takes place. The political, social and legal ground rules establish the basis for production, exchange and distribution.

“Institutional arrangement” – The contractual relation or governance structure between economic entities that defines the way in which they cooperate and/or compete.¹⁸

To minimise transaction cost, a conducive institutional environment must first be set up. Property right must be protected by property law and exchange of property must be protected by contract law. Such laws are part of the “institutional environment”.¹⁹ However, even when such an environment is available, transactions may still be impeded by factors related to the attributes of the economic agents and the transactions. This calls for the need for “institutional arrangements”.²⁰ The layer of institutional arrangements is where TCE operates. Institutional arrangements refer to the “governance structures”, and regulation is just one type of governance structures.

Publishing Company, 1970), p. 68.

¹⁶ Oliver E. Williamson, *The Mechanisms of Governance* (Oxford: Oxford University Press, 1996), p. 379.

¹⁷ The top level is the “social embeddedness” level. “This is where the norms, customs, mores, traditions, etc. are located”. The second and the third levels are “institutional environment” and “institutional arrangement” respectively. The fourth level at the bottom is “the level with which neo-classical economics and more recently, agency theory have been concerned”. The parameters are price and output, efficient incentive alignment. See Oliver E. Williamson, “Transaction Cost Economics: How It Works; Where It Is Headed” (1998) 146(1) *De Economist* 23, pp. 27 – 28; Oliver E. Williamson, “The New Institutional Economics: Taking Stock, Looking Ahead” (2000) 38 *Journal of Economic Literature* 595, p. 596.

¹⁸ Williamson, *The Mechanisms of Governance*, p. 378.

¹⁹ Williamson, “The New Institutional Economics: Taking Stock, Looking Ahead”, p. 598.

²⁰ Williamson, “Transaction Cost Economics: How It Works; Where It Is Headed”, p. 28; Williamson, “The New Institutional Economics: Taking Stock, Looking Ahead”, p. 599.

The theories of TCE have identified three factors that can potentially create “contractual hazards” that impede the conduct of transactions. Two factors are related to the behaviour assumptions of human agents – “bounded rationality” and “opportunism”.²¹ The third factor, “asset specificity”, is an attribute of the transaction itself.²²

“Bounded rationality” is the “limited cognitive competence” of human agents.²³ According to Simon (1961), the behaviour of human agents is “*intendedly* rational, but only *limited* so”.²⁴ As a result, “[a]ll complex contracts are unavoidably incomplete.”²⁵ Gaps, errors and omissions exist in contracts as a result of bounded rationality.²⁶

“Opportunism” is “a condition of self-interest seeking with guile.”²⁷ This does not necessarily carry negative connotations. The economic agents are always expected to exploit new circumstances to enhance their own interests. “Mere promise, unsupported by credible commitments, is not self-enforcing by reason of opportunism.”²⁸

“Asset specificity” is a situation where economic agents may have invested in assets specific to a transaction and they may depend on each another. “Parties engaged in a trade that is supported by non-trivial investments in transaction-specific assets are effectively operating in bilateral trading relation with one another.”²⁹ Asset specificity can take the form of “physical assets, human assets, site specificity, dedicated assets, brand name capital, and temporal specificity”.³⁰

The combination of “bounded rationality”, “opportunism” and “asset specificity”, referred to as “the three pillars of transaction cost economics”, results in contractual hazards. To address the contractual hazards, economic agents adopt the appropriate governance structure. Initially, TCE theories are applied to study organisations – when do economic agents decide to buy intermediate goods from the market and

²¹ Williamson, *The Economic Institutions of Capitalism*, p. 44.

²² Williamson, “Transaction Cost Economics: How It Works; Where It Is Headed”, p. 36.

²³ Williamson, “The New Institutional Economics: Taking Stock, Looking Ahead”, p. 600.

²⁴ Quoted in Williamson, *The Economic Institutions of Capitalism*, p. 45.

²⁵ Williamson, “Transaction Cost Economics: How It Works; Where It Is Headed”, p. 31.

²⁶ *Id.*, p. 31.

²⁷ Williamson, *The Economic Institutions of Capitalism*, p. 30.

²⁸ Williamson, “Transaction Cost Economics: How It Works; Where It Is Headed”, p. 31.

²⁹ Williamson, *The Economic Institutions of Capitalism*, p. 30.

³⁰ Williamson, “Transaction Cost Economics: How It Works; Where It Is Headed”, p. 36.

when do they decide to vertically integrate so as to build the goods within their own organisations. The governance structures range from “market” to “hybrids” and “hierarchies”. Subsequently, TCE theories have been extended to cover relationships beyond the procurement of intermediate goods. The full range of governance structures from “market” to “hybrids”, “hierarchies”, “regulation” and “public bureau” is referred to by Williamson (1998) as an extension of the “simple contracting schema”, as shown in Figure 1.³¹

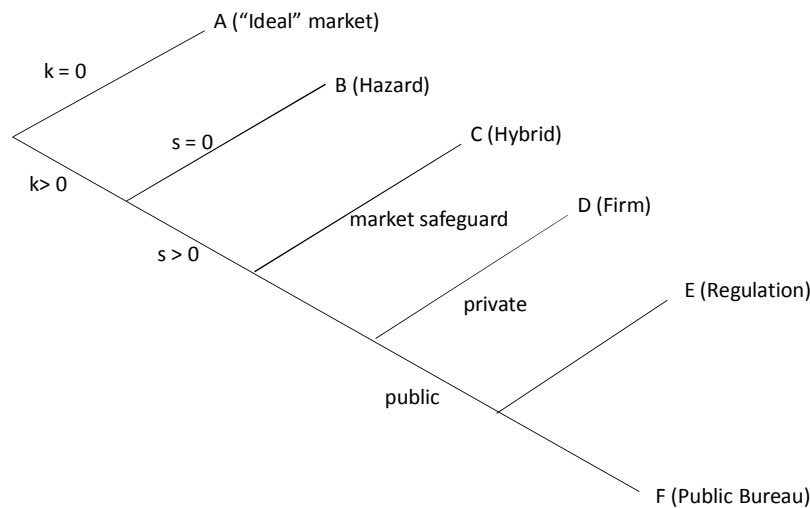


Figure 1 - Simple Contracting Schema (Extended)
 Source: Williamson (1998), p. 47

The Schema in Figure 1 consists of two parts – private ordering and public ordering. The governance structures are chosen in accordance with the different degrees of asset specificity (k) and safeguard (s). Where contractual hazards are low, economic agents may simply contract in the market. This is Node A which represents the ideal market where $k = 0$, $s = 0$. If there is a certain degree of asset specificity ($k > 0$), but no safeguard ($s = 0$) is incorporated, this is denoted by Node B where unsafeguarded hazard exists. Such unmitigated risk is likely to be reflected in the price of the transaction. When asset specificity and contractual hazards are higher ($k > 0$), economic agents may adopt more complicated safeguards in their contracts ($s > 0$). Such safeguards are incorporated into contracts, such as penalties to deter breaches, enhanced information disclosure, dispute settlement mechanisms, etc. designed to deal with contractual hazards that may arise after the contracts have been entered

³¹ Id., Figure 3, p. 47.

into.³² Such governance structures denoted by Node C are termed “hybrids”. When contractual hazards are sufficiently high, economic agents may integrate and become firms or “hierarchies” in TCE terms. The transaction concerned is taken out of the market and is conducted within a firm. What would have been contractual hazards in transactions between separate entities would become internal issues that can be coordinated internally through management “fiat”. This is denoted by Node D which represents a “firm” or “hierarchy”. “Transaction cost economics regards the firm not as a production function but as a governance structure.”³³

Under certain circumstances, private ordering may not sufficiently address the contractual hazards. Transactions that would deliver public interests may not be conducted due to transaction costs. In such case, the governance structure may have to be extended to include public ordering by “regulation” (Node E) and “public bureau” (Node F). As a first step, the government may introduce regulation. In the extreme case, the government may wish to provide the goods or services by itself, in the form of “public bureau”. “[T]he public bureau is usefully thought of as the organization form of *very* last resort: try markets, try hybrids, try firms, try regulation, and resort to public bureaus only when all else fails (comparatively).” (emphasis in original)³⁴ Nodes A to F are then the full spectrum of alternative structures of governance. There may be other forms of governance structures between Node E and Node F. For example, a public franchise may be awarded to govern the provision of goods or services by an operator in the private sector. There may also be different types of regulation at Node E, such as “command and control” regulation and industry self-regulation.

According to the so-called “discriminating alignment hypothesis” of TCE theories, “transactions, which differ in their attributes, are aligned with governance structures, which differ in their cost and competence, so as to effect a (mainly) transaction cost economizing result”.³⁵ Williamson (1998) has identified three attributes of transactions, namely, the condition of asset specificity, the uncertainty to which the transactions are subject and the frequency at which the transactions recur.³⁶ The higher the level of asset specificity, the higher would be the risks of contractual hazards because of bilateral dependency. The higher the level of uncertainty, the more likely would the contract be incomplete due to bounded rationality of the contracting

³² Williamson, “The New Institutional Economics: Taking Stock, Looking Ahead”, p. 603.

³³ Williamson, “Transaction Cost Economics: How It Works; Where It Is Headed”, pp. 23 and 37.

³⁴ Id., pp. 46 – 47.

³⁵ Id., p. 37.

³⁶ Id., p. 36.

parties. The higher the frequency of recurrence of the transactions, the more likely would the parties invest in relation-specific resources that lead to bilateral dependency. Based on the “discriminating alignment hypothesis”, transactions with similar attributes should be aligned with governance structures that have similar capabilities of minimising the transaction costs.

Comparing the transaction costs of alternative governance structures is the focus of an analysis based on TCE. According to the “remediableness criterion”, “an extant mode of organization for which no superior *feasible* alternative can be described and *implemented* with expected net gains is *presumed* to be efficient” (emphasis in original).³⁷ A governance structure that reduces transaction costs may bring about increase in production costs.³⁸ The governance structure that can minimise the sum of the transaction costs and production costs should be chosen by the economic agents.

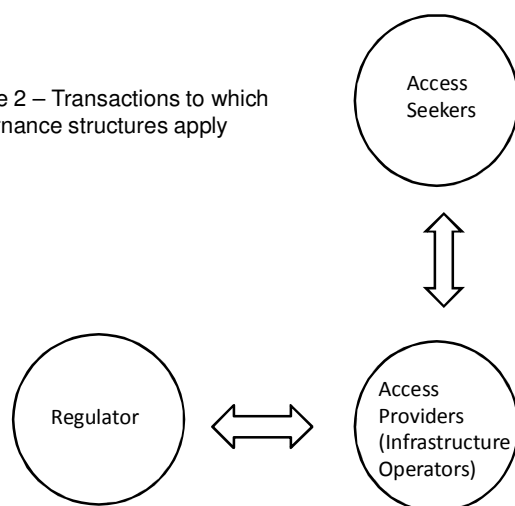
2.2 Application to Access Regulation

In this study, the framework illustrated in Williamson (1998)’s extension of the “simple contracting schema” shown in Figure 1 will be applied for analysis of access regulation for the NGA networks. The governance structures adopted for the NGA networks around the world have spread over the spectrum of the governance structures shown in Figure 1. For example, the governance structures adopted in Hong Kong and US are to promote facilities-based competition among a number of firms vertically integrated in the operation of the access network infrastructure and the provision of access services to end-users. The governance structure is therefore located at Node D. In Singapore and Australia, the governance structure adopted is somewhere between Node E and Node F. Although the operator of the next generation network infrastructure is not exactly a “public bureau” as the operator is not part of the government, but the government has tighter control over the company through a franchise. Thus the governance structure in Singapore and Australia is close to Node F. The governance structure in UK employs regulation to facilitate the access by access-based competitors to the network infrastructure operated by the incumbent. The governance structure in UK is located at Node E.

³⁷ Williamson, "The New Institutional Economics: Taking Stock, Looking Ahead", p. 601.

³⁸ Williamson, *The Economic Institutions of Capitalism*, pp. 92 – 93.

Figure 2 – Transactions to which governance structures apply



The governance structure adopted in a particular jurisdiction operates in the transactions between the regulator and the access providers by restraining the behaviours of the access providers in providing access to the access seekers in a certain manner. In this context, the access providers are mostly the infrastructure operators. The access seekers include access-based or services-based operators seeking access to the network infrastructure for the provision of competing services at the transmission level, or content and applications providers seeking access to the network infrastructure for the delivery of content and applications to end-users.

The transactions between the regulator and the infrastructure operators take the form of “regulatory commitments”. The regulator makes these commitments to the industry by establishing and promulgating the regulatory framework (governance structure) to deal with access problems in the NGA network environment. Although a regulatory commitment is not a contract as the regulator promulgating the governance structure is unable to fetter the discretions of itself and its successors, and the governance structure may be modified or new regulation introduced to cope with evolving circumstances of the industry, nevertheless, the infrastructure operators do expect a stable and predictable operating environment over a reasonably long period in which they can plan and carry out their investment and earn a reasonable return. In a democratic society, the institutional environment restrains the regulator’s actions in departing from the regulatory commitments. Actions of the regulator may be appealed or judicially reviewed and subject to supervision by the legislature. The regulator is also expected to implement policies of the government. Accordingly, the

regulatory commitments are long-term relationships between the regulator and the actors in the industry that can be analysed as contract problems.³⁹ According to the theories of TCE, “[a]ny problem that can be posed directly or indirectly as a contracting problem is usefully investigated in transaction cost economizing terms.”⁴⁰

All agents, including the access providers, access seekers, policymakers, legislators and regulators, are limited in their capabilities to predict and understand the future. There are substantial unforeseen circumstances, or uncertainties, in the NGA network environment with regard to the future development in end-user demands, capacity requirements of content and applications, capacity trends of communications infrastructure, technologies, and so on. As a result, the regulatory commitments are necessarily incomplete. Legislators do not have the time and expertise to deal with the details of access arrangements and leave considerable amount of discretion to the regulators. The regulatory frameworks established by the regulators are also incomplete due to the limited ability of all involved to anticipate future events. Typically, after the regulatory commitments are promulgated, the access seekers and access providers will attempt to negotiate and finalise the access agreements. Disputes may be brought to the regulators for resolution. Decisions of the regulators concerning the regulatory commitments and dispute resolutions may be challenged in appeal tribunals or the court. The parties involved are expected to engage in opportunistic behaviours at the pre-contract and post-contract stages. All players are expected to interpret the regulatory commitments in a way that would further their interests in the new circumstances.

The third pillar of TCE, namely, asset specificity, also exists in the relationship between the regulator and the infrastructure operators, and that between the access providers and the access seekers. As Williamson (1999) recognises, “[r]egulatory transactions are often beset with asset specificity.”⁴¹ The infrastructure operators have made sunk investments in assets in the form of the network infrastructure. The assets are highly specific to a particular locality and cannot be redeployed to other locations without substantial or even complete loss in value. Infrastructure operators rely on the regulators for a regulatory environment to enable them to earn a reasonable return on their sunk investment. Regulators have been appointed to enhance and protect public interests. Regulators depend on the infrastructure operators engaging in certain

³⁹ Brian Levy & Pablo T. Spiller, "The Institutional Foundations of Regulatory Commitment: A Comparative Analysis of Telecommunications Regulation" (1994) 10(2) *The Journal of Law, Economics, & Organization* 201, p. 203.

⁴⁰ Williamson, *The Economic Institutions of Capitalism*, p. 41.

⁴¹ Oliver E. Williamson, "Public and Private Bureaucracies: A Transaction Cost Economics Perspective" (1999) 15(1) *The Journal of Law, Economics, & Organization* 306, p. 320.

conduct that would enable the government to attain the public interest objectives. Therefore there will always be a degree of interdependence between the regulators and the infrastructure operators. Similarly, to the extent that access providers control the final access links to the end-users, access seekers depend on access providers to provide the access links to the end-users for the provision of competing transmission services or the delivery of content and applications. Access seekers have to make investment specific to the relationship with the access providers, such as backhauls to, and co-location of equipment at, the exchanges of the access providers where access is to be provided.

Based on the above, most of the elements affecting transaction costs have their place in the relationships among the regulator, access providers and access seekers. As a result, transaction costs arise. These costs again can be *ex ante*, being the costs of industry consultation and negotiations before decision on the regulatory commitments, and *ex post*, being the costs of compliance, monitoring and enforcement, costs of negotiations (for the access agreements), costs of dispute resolutions, litigations and any uncertainties during the period before legal settlement. TCE therefore offers a useful theoretical framework to analyse access regulation applied to NGA networks.

3. Access Regulation in Hong Kong

3.1 Access Regulation at Local Access Link Level

To understand the factors leading to the deregulatory policies in Hong Kong for the NGA networks, it is necessary to review the history of the introduction and withdrawal of access regulation in the telecommunications industry. Access regulation was brought into Hong Kong to implement the liberalisation of the local fixed telecommunications market in 1995.

Local telephone networks and services were operated under an exclusive local telephone franchise held by the incumbent, Hong Kong Telephone Company Limited (HKTC, now part of the PCCW group), before 1 July 1995. From 1 July 1995, the local fixed telecommunications network market was partially liberalised with the licensing of three new Fixed Telecommunications Network Services (FTNS) operators, but the Hong Kong government imposed a moratorium for three years, barring further market entry by additional FTNS operators, whether facilities-based or services-based.

The Telecommunications Ordinance (TO) was amended in 1993 to prepare for

liberalisation of the local fixed telecommunications market. Provisions for “interconnection” were added to the TO. In line with the pro-market policies of Hong Kong, the “negotiate-arbitrate” model was adopted and commercial settlement of the interconnection terms was preferred to intervention by the regulator, the Telecommunications Authority (TA).⁴² The interconnecting parties were encouraged to negotiate and agree the terms and conditions for interconnection. The TA would exercise the power under section 36A of the TO to determine the terms and conditions only if commercial agreement could not be reached.

The law at this stage did not draw a distinction between “interconnection” and “access” as the terms were defined in, say, the Access Directive of the European Union (EU).⁴³ “Interconnection” was an arrangement for interconnection to and between licensed telecommunications systems or services.⁴⁴ It was unclear whether a local loop in the customer access network of an operator was a “telecommunication system” or “service”. In a series of Statements issued by the TA in June 1995 just preceding the commencement of the market liberalisation, the TA promulgated details on how the TA intended to interpret and apply the law on interconnection. The TA considered there were two types of interconnection authorised by section 36A of the TO at that time, “Type I” being interconnection between network gateways and “Type II” being interconnection at points in the local loops.⁴⁵ Type II interconnection enabled one local fixed network operator to interconnect to the local loops of another local fixed network operator, typically at the telephone exchanges where the local loops were terminated, so as to reach the customers of the former operator connected to the local loops owned by the latter operator. In the TA’s opinion, the owner of the local loops would be supplying a telecommunications service to the other operator seeking interconnection and such an arrangement came within the scope of

⁴² From 1 April 2012, the functions of the Telecommunications Authority (TA) have been taken over by the Communications Authority, formed by a merger of the TA and the Broadcasting Authority, the regulator of the broadcasting industry.

⁴³ Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive) as amended by Directive 2009/140/EC, Article 2.

⁴⁴ “Interconnection” was defined as “an arrangement among 2 or among more than 2 parties for interconnection to –

- (a) and between telecommunication systems or services licensed under section 7; and.....
- (d) and between telecommunication services being the subject of an order made under section 39 [exempting the services from the licensing requirement under section 7]; and
- (e) and from the telephone system provided by the Hong Kong Telephone Company Limited under the Telephone Ordinance (Cap. 269).”

See Telecommunications Ordinance, as amended by Telecommunication (Amendment) Ordinance 1993, section 36A(3). This version of the Ordinance was in effect until it was amended in 2000.

⁴⁵ Office of the Telecommunications Authority (Hong Kong), “Interconnection Configurations and Basic Underlying Principles” (1995), Statement by the Telecommunications Authority of Hong Kong, Interconnection and Related Competition Issues Statement No. 6, 3 June 1995, para. 5.

“interconnection” as defined in the section 36A(3) then in effect. Through this interpretation of section 36A(3), the TA established a regime of access regulation that was equivalent to the arrangements known as “unbundling of local loops” in other jurisdictions, like EU countries.⁴⁶

In the interpretation of the law on “interconnection”, the TA was bound to work within the policy framework of the government for the telecommunications industry.⁴⁷ One of the policy objectives that telecommunications services should be available “at reasonable cost” and provided “in the most economically efficient manner possible” tended to suggest an emphasis on promoting allocative and productive efficiencies in applying the law on interconnection. The objective to promote investment in infrastructure was not explicitly mentioned in the objectives although it could be argued that such an objective was a necessary part of the objective to promote Hong Kong as “the preeminent communication hub”. Other policy objectives including minimising environmental disruption and avoiding wasteful and uneconomic duplication of facilities⁴⁸ would support TA’s interpretation of “interconnection” that would avoid unnecessary road opening for the construction of parallel infrastructure.

Despite these justifications, it was apparent that the Type II interconnection arrangements based on the TO amended in 1993 was not on firm legal ground. The definition for “interconnection” under the then prevailing section 36A(3) apparently only referred to interconnection between complete telecommunications systems and services and did not explicitly refer to access to parts of a network or service on an unbundled basis. It was not clear whether unbundled access to local loops was envisaged when the provisions on “interconnection” were enacted in 1993.⁴⁹ The

⁴⁶ Regulation (EC) No. 2887/2000 of the European Parliament and of the Council of 18 December 2000 on unbundled access to the local loop (OJ L336/4 - L336/8, 30 December 2000), repealed by the “Better Regulation Directive” 2009/140/EC of 25 November 2009 (see recital (74)).

⁴⁷ The policy objectives of the government in telecommunications at that time were set out in a position paper issued by the Economic Services Branch, Government Secretariat in January 1994:

- “- That the widest range of quality telecommunications services should be available to the community at reasonable cost;
- That telecommunications services should be provided in the most economically efficient manner possible; and
- That Hong Kong should serve as the preeminent communications hub for the region now and into the next century.”

See Office of the Telecommunications Authority (Hong Kong), “Interconnection Configurations and Basic Underlying Principles”, para. 2.

⁴⁸ *Id.*, para. 4.

⁴⁹ As the Hon. Hartman in a subsequent case *PCCW-HKT Telephone Ltd. v The Telecommunications Authority* [2004] HKCU 747 commented, he did not agree that the supply of an unbundled local loop involved the operation of a telecommunications service over it. *PCCW-HKT Telephone Ltd. v The Telecommunications Authority*, [2004] HKCU 747 (Court of First Instance, High Court of the Hong Kong SAR, 30 June 2004), para. 47.

government found it necessary to provide a firmer legal basis for Type II interconnection. Telecommunication (Amendment) Ordinance 2000 was enacted to amend the TO. Among other things, the provisions on interconnection were “clarified” in the amendment.⁵⁰

The amended section 36A defines “interconnection” as “any connection between systems or services or elements of systems or services for the delivery of any communication, message or signal over the connection ...” and “element” means “any cable, component, unit, equipment, hardware or software used to provide a telecommunications service.....”⁵¹ “Interconnection” includes “access to, or interconnection with, any element of a telecommunications network, system, installation or service on an unbundled basis at any point that is technically feasible.”⁵² After these amendments, access to network elements on an unbundled basis is referred to explicitly in the definition for “interconnection”, and local loops are undoubtedly elements of a network.⁵³

In contrast with the obligation of unbundling of local loops in other countries which is imposed upon the incumbent carrier or the carrier with dominant market position, the obligation to provide Type II interconnection in Hong Kong was applied on a reciprocal basis to all local FTNS operators, although for all intents and purposes, it was the incumbent which had all the local loops for access as the entrants had hardly commenced the rollout of their customer access networks at the initial stage of market liberalisation. The TA stipulated that Type II interconnection should be available on a reciprocal basis for all “local loops” of the local wireline-based fixed networks.⁵⁴ Optical fibre was not regarded as “local loops” and the entrants’ networks were all based on fibre-to-the-building, with hardly any “local loops” from local exchanges.⁵⁵

⁵⁰ The implementation of Type II interconnection requires the physical location of the equipment of the entrants in the telephone exchange buildings of the incumbent in arrangements known as “co-location”. There was no explicit provision in the TO before 2000 that empowered the TA to compel the incumbent to share the space within the exchange buildings with its competitors. In the 2000 amendments, section 36AA was added empowering the TA to direct a licensee to share with other licensees any facility owned or used by it.

⁵¹ Telecommunications Ordinance, as amended by Telecommunication (Amendment) Ordinance 2000, section 36A(3E).

⁵² *Id.*, section 36A(3D)(b).

⁵³ In *PCCW-HKT Telephone Ltd. v The Telecommunications Authority* [2004] HKCU 747, although Hon. Hartman had doubt on whether Type II interconnection was a connection of one telecommunications service to another, because of the expansion in section 36A(3D), he was satisfied that Type II interconnection came within the scope of the power of the TA in directing a licensee to connect one service to another under section 36B. See *PCCW-HKT Telephone Ltd. v The Telecommunications Authority*, paras. 53 – 80.

⁵⁴ Office of the Telecommunications Authority (Hong Kong), “Broadband Interconnection” (2000), Statement by the Telecommunications Authority, Hong Kong, 14 November 2000, para. 3.2.11.

⁵⁵ *Id.*, para. 3.2.14.

Thus the entrants had not been the providers of Type II interconnection, apart from interconnection to wiring systems with the customers' buildings.

Another difference between the Type II interconnection and the unbundling of local loops in other countries was that, while in other countries, the access to the unbundled local loops is opened to any market entrant, the beneficiaries of the Type II interconnection arrangements were restricted to the four FTNS operators licensed in 1995. This was due to the 3-year moratorium for the licensing of local fixed network operators during which no access-based or services-based operators could enter the market, but when the moratorium was later terminated, there were deliberate policies implemented in 1999 and 2003 to exclude new entrants from relying on Type II interconnection at telephone exchanges for market entry.

In 1999, the TA took the position that the application of Type II interconnection was to be contained, and further market entry had to be facilities-based. The agreement in 1999 between the government and the 1995 entrants for the extension of the licensing moratorium for wireline-based local fixed network operators permitted entry by wireless operators and also the cable operator hitherto barred from operating telecommunications services over its hybrid fibre-coaxial cable (HFC) network. The wireless FTNS operators and the cable operator that entered the telecommunications market in 2000 were however not given the rights to seek Type II interconnection to the incumbent's local loops at the telephone exchanges, although they had rights and obligations for other forms of Type II interconnection, e.g. interconnection to in-building wiring systems.⁵⁶

From 1 January 2003, the local and external FTNS markets were fully liberalised.⁵⁷ The application of the Type II interconnection was not to be further extended for market entrants from 2003. The TA would not consider granting fixed carrier licences to operators who intended to rely primarily on access to the infrastructure of other FTNS or fixed carrier licensees to roll out their networks or to provide their services.⁵⁸

Type II interconnection therefore remained as arrangements among the four FTNS operators that were in the market in 1995. There was the practical consideration of

⁵⁶ Office of the Telecommunications Authority (Hong Kong), "Review of the Regulatory Policy for Type II Interconnection" (2003), Consultation Paper, 23 May 2003, para. 19.

⁵⁷ Office of the Telecommunications Authority (Hong Kong), "Implementation of the Full Liberalization of the Local Fixed Telecommunications Network Services Market from 1 January 2003" (2002), Statement of the Telecommunications Authority, 11 January 2002, para. 4.

⁵⁸ *Id.*, para. 13.

space limitation in the local exchanges of the incumbent and it would not be possible to accommodate the requirements of too many operators seeking co-location.⁵⁹ The policy objective was to encourage the entrants that entered the market after 1999 to construct alternative customer access networks. To facilitate the rollout of alternative access networks, the regulator set up various measures such as the coordination of ducting works (to streamline the process of obtaining the necessary permits for road opening), specifying adequate equipment rooms and ducting facilities within buildings for telecommunications equipment/cabling, and facilitating the access to buildings for the installation of equipment and wiring systems to reach the end-users. Extensive publicity campaigns were mounted by the regulator to educate the public and the building management companies on the benefits of allowing telecommunications operators to upgrade telecommunications facilities in buildings.⁶⁰

Yet another difference was the limitation in bandwidth over the local loops usable by the access seekers. In the subsequent negotiations between the incumbent and the entrants for Type II interconnection arrangements, the TA found it necessary to clarify that the Type II interconnection “is not leasing of dark copper” and “should not be interpreted as the total transfer of the right of use of the [local access links] as this is not the spirit behind the type II interconnection requirement”. Type II interconnection was “an interconnection service capable of conveying up to basic rate [Integrated Services Digital Network (ISDN) at 144 kilobits per second (kbps)].” “Any requirement for other kinds of services using existing or new [local access links] should be the subject of a separate agreement between parties concerned or a separate determination if requested.”⁶¹ Based on such principles, a commercial agreement was reached between the incumbent and New World Telephone, one of the 1995 entrants, to limit the bandwidth to 300 Hz to 50 kHz which was expected to provide satisfactory services up to basic rate ISDN.⁶² It was not until 1999 that the TA commenced a review of the Type II interconnection for broadband services. The conclusion of the consultation was that Type II interconnection for broadband was to commence from March 2001.⁶³

⁵⁹ Office of the Telecommunications Authority (Hong Kong), "Broadband Interconnection" , para. 3.2.20.

⁶⁰ Legislative Council (Hong Kong), "Panel on Information Technology and Broadcasting - Minutes of Meeting held on Monday, 10 June 2002" (2002), LC Paper No. CB(1)2182/01-02, para. 36.

⁶¹ Office of the Telecommunications Authority (Hong Kong), "Type II Interconnection between New World Telephone and Hong Kong Telephone" (1999), Statement of the Telecommunications Authority, Hong Kong, 19 April 1999, para. 6(b).

⁶² Id., para. 10.

⁶³ Office of the Telecommunications Authority (Hong Kong), "Broadband Interconnection" , para. 3.2.38.

Type II interconnection was therefore intended as an option available to the three 1995 entrants to reach their customers. If it was more efficient to reach the customers using Type II interconnection, they would have the option of reaching their customers through this arrangement. Conversely, if it was more efficient to reach the customers through self-built customer access networks, they would invest in their own customer access networks. Interconnection charge based on Long-Run Average Incremental Costs (LRAIC) was the tool to influence the entrants to make efficient “build-or-buy” decisions.⁶⁴

However the continued existence of the Type II interconnection arrangements could have distorted the investment incentives of market players because Type II interconnection could always be less costly and risky. As pointed out by some scholars⁶⁵, the option value of delaying the investment in self-built networks had not been included in the calculation of interconnection charges based on forward looking incremental costs. Moreover, because the beneficiaries of the Type II interconnection arrangements were confined to the three entrants in 1995, there was no support for the continuation of the arrangements by other carriers in the market who had to build their own customer access networks to enter the market. To the incumbent and the other operators with their own customer access networks, the existence of Type II interconnection was seen as a potential threat to their competitive position in the market. By 2002, it was apparent that alternative access networks were emerging in the market. Hutchison Global Communications (Hutchison), one beneficiary of the Type II interconnection policy, decided to invest in self-built facilities. Hutchison claimed that since 1995, it had invested heavily in building its own customer access networks. Since 2000, it had already introduced 10 Mbps symmetrical broadband services based on its self-built facilities.⁶⁶ Therefore even though Hutchison was one of three 1995 entrants committed to connecting to HKTC exchanges for Type II interconnection in the negotiations with the government in 1999, its commitment was offered merely to exchange for the extension of the moratorium of licensing local fixed networks until the end of 2002. It had not relied on Type II interconnection for access to its customers. Hong Kong Broadband Network (HKBN) that entered the

⁶⁴ Office of the Telecommunications Authority (Hong Kong), "Carrier-to-Carrier Charging Principles" (1995), Statement by the Telecommunications Authority of Hong Kong, Interconnection and Related Competition Issues Statement No. 7, 10 June 1995, para. 5.

⁶⁵ For example, Robert W. Crandall, et al., "Do Unbundling Policies Discourage CLEC Facilities-Based Investment" (2004) 4 *The B.E. Journal in Economic Analysis and Policy: Topics in Economic Analysis & Policy* Article 14, p. 5 – 6; Hausman & Sidak, "Telecommunications Regulation: Current Approaches with End in Sight", p. 12.

⁶⁶ Hutchison Global Communications Limited, "Response to OFTA's Consultation Paper on Review of the Regulatory Policy for Type II Interconnection dated 23 May 2003" (2003), Submission to the Office of the Telecommunications Authority, 22 August 2003, p. 14.

market in 2000 built its own access networks based on wireless technologies before the end of 2002 and then fibre-optics from 2003 onwards.⁶⁷ By August 2003, when the review on the future of Type II interconnection policy was initiated, HKBN claimed to have built a network that covered 1.2 million households (some 55% of all households in Hong Kong). As the local loops of the incumbent's customer access networks were no longer bottlenecks, the justifications for continuation of the Type II interconnection arrangements were called into question. The government initiated a review of the Type II interconnection arrangements in 2003.

It was apparent that the issues escalated to the political level as the Executive Council of the Hong Kong SAR Government was involved in making the final decision.⁶⁸ Whilst the introduction of Type II interconnection in 1995 was a regulatory decision of the TA under the TO, the review of the continuation of the arrangements was treated as a policy matter under the responsibilities of the policy bureau, the equivalent of a ministry. The review of Type II interconnection was referred to as "one of its major tasks for 2003" of the Commerce, Industry and Technology Bureau.⁶⁹ The review emphasised the policy objective of "promoting a market environment conducive to investment in network and facilitating effective facilities-based competition".⁷⁰ This signalled a change in the regulatory policy.

The government pronounced that the revised policy in the telecommunications sector was "promoting the telecommunications industry", "encouraging investment in network" and "facilitating effective competition in the telecommunications market and enhancing consumer choice."⁷¹ Putting "encouraging investment in network" before "facilitating effective competition" and referring to "encouraging investment in network" instead of "encouraging efficient investment in network" are significant when compared with the policy objectives that placed more emphasis on allocative and productive efficiencies in the initial stage of market liberalisation. The government emphasised that it was necessary to promote investment in access networks of higher speeds and capacity meeting the future demands of the digital society.⁷² This provided for a deregulatory environment for the investment in NGA

⁶⁷ Hong Kong Broadband Network Limited, "Submission of Comment on 'Review of the Regulatory Policy for Type II Interconnection'" (2003), Submission to the Office of the Telecommunications Authority, 22 August 2003, p. 10.

⁶⁸ Hong Kong SAR Government (Communications and Technology Branch), "Legislative Council Brief: Review of Type II Interconnection Policy", p. 1.

⁶⁹ Office of the Telecommunications Authority (Hong Kong), "Review of the Regulatory Policy for Type II Interconnection", para. 1.

⁷⁰ *Id.*, para. 20.

⁷¹ *Id.*, para. 2.

⁷² Office of the Telecommunications Authority (Hong Kong), "Review of the Regulatory Policy for

networks.

The review of Type II interconnection policy was concluded in July 2004. The review affirmed that Type II interconnection will not be applied to fibre-based access networks. Type II interconnection policy applicable to telephone exchanges was to be fully withdrawn by 30 June 2008, except for buildings for which the local loops of the incumbent met the “essential facilities” criteria. There was to be a transitional programme under which Type II interconnection from telephone exchanges was to be withdrawn on a building-by-building basis for buildings connected by at least two self-built customer access networks including the local loops of the incumbent.⁷³ The HFC network of the cable operator was not to be treated as an alternative access network until it was upgraded to provide IP telephony services, provided with sufficient capacity and operated as an open platform.⁷⁴ Mandatory Type II interconnection to copper-based in-building wiring systems would be maintained as a backup in case commercial negotiations fail, although the TA preferred commercial settlement of the interconnection terms.⁷⁵

3.2 Access Regulation at Wholesale Access Level

Although the TA has established Type II interconnection for the facilities-based operators, all along, the TA had not made available regulated access to the networks at the wholesale access level for the services-based operators. The TA stated that the policy intention was to promote effective competition in the provision of network services and then use market forces to drive network operators to supplying wholesale network services on terms acceptable to service providers.⁷⁶ Service providers are to be interconnected with network operators on a tariff basis and the TA may consider determination of interconnection terms if the circumstances so justify.⁷⁷ However, in practice, no such determination had been made by the TA.

Service providers could gain access to wholesale services through the competition

Type II Interconnection: Analysis of Comments Received, Preliminary Conclusions and Further Consultation” (2003), Consultation Paper, 16 December 2003, paras. 7 – 8.

⁷³ Hong Kong SAR Government (Communications and Technology Branch), “Legislative Council Brief: Review of Type II Interconnection Policy”, paras. 10, 16 – 20.

⁷⁴ *Id.*, para. 14.

⁷⁵ Office of the Telecommunications Authority (Hong Kong), “Review of Type II Interconnection Policy”, paras. 10 – 27.

⁷⁶ *Id.*, para. 34.

⁷⁷ Office of the Telecommunications Authority (Hong Kong), “Broadband Interconnection”, paras. 3.2.40 to 3.2.45.

provisions in the TO.⁷⁸ To avoid breaches of the competition provisions, a dominant infrastructure operator has to offer wholesale services to other operators without “margin squeezing” or discrimination that harms competition if it offers such services to its subsidiary or affiliated company. The difficulty with this route is that if the infrastructure operator is not dominant in the market, the prohibition of anti-competitive “margin squeezing” and discrimination does not apply. So far no operator in Hong Kong has been found to be dominant in the broadband service market. Even if an infrastructure operator is dominant in the market, it can avoid the breaches if it adopts the vertical integration approach in the service provision, unless the network facilities are regarded as “essential facilities”. In 2003, a complaint was lodged with the TA by a services-based operator against the incumbent and its affiliated service provider for the anti-competitive conduct of “margin squeezing”.⁷⁹ TA concluded that the balance of evidence did not support the allegation of margin squeezing in breach of the competition provisions in the TO on the grounds that multiple access networks existed and the incumbent’s affiliated service provider was not the price leader in the market.⁸⁰ This case has illustrated the difficulty with relying on competition law to gain access to the network infrastructure in an environment like Hong Kong where multiple network operators exist.

A condition under the cable operator’s licence requires the licensee to supply cable open access upon request by a licensed provider of public telecommunications service.⁸¹ However, as the cable operator was declared non-dominant in the supply of the cable open access service, the tariff was not subject to approval by the regulator. The “negotiate-arbitrate” approach was again adopted in determining the access terms. If the requesting service provider was not satisfied with the tariff, the requesting

⁷⁸ There was no general purpose competition law in Hong Kong before 2012. A Competition Ordinance was enacted in 2012, but has not yet commenced operation. Sector-specific competition law is however in operation for the telecommunications and broadcasting industries. There are provisions in the TO prohibiting anti-competitive conduct of telecommunications licensees. These are sections 7K and 7L of the TO prohibiting anti-competitive practices and abuse of dominant position respectively.

⁷⁹ Office of the Telecommunications Authority (Hong Kong), "Complaint Against PCCW-HKTC's Conduct Relating to its Residential Broadband Internet Service" (2004), Investigation Report, Case Reference T249/03, Closed September 2004.

⁸⁰ *Id.*, para. 23.

⁸¹ The licence condition requires the cable modem service to be “interconnected with the public telecommunications service such that customer connected to the cable modem service may have access to the public telecommunications service through the cable modem service. Such public telecommunications service shall include, but not be limited to, services to enable customers to access the Internet.....” The condition has envisaged a temporary situation when the requirement to provide open access may not be met due to technical problems associated with the use of proprietary designs of the cable modem service. See Special Conditions 30.1 and 30.4, Fixed Carrier Licence granted to Hong Kong Cable Television Limited under the Telecommunications Ordinance (converted from Fixed Telecommunication Network Services Licence issued on 1 June 2005).

service provider was required to endeavour to reach a commercial agreement with the cable operator.⁸² Only if a commercial agreement could not be reached within a reasonable period would either party be entitled to request the regulator to make a determination of the terms and conditions of the access to the cable modem service. No request for such determination had been received by the regulator.

In sum, the effectiveness of access regulation in Hong Kong has been limited in increasing the number of choices to end-users. Type II interconnection was more of arrangements of mutual access between the facilities-based operators that were already in the market at the time of initial liberalisation of the local fixed network market. The arrangements for Type II interconnection were regulatory measures for the entrants to reach their customers for the provision of narrowband, mainly telephone, services before they could roll out their own customer access networks. At that time, the policy priorities were to foster competition in the telephone service market after the termination of the monopoly held by HKTC. Type II interconnection had not been designed as a measure to lower the barriers to market entry by access-based or services-based operators. Type II interconnection had not been extended to fibre-based access networks. When some operators in the market have rolled out their own access networks, the access regulation applied to copper networks has been withdrawn. Although the TA believed that market forces would make wholesale services available to services-based operators, this did not materialise. No regulatory actions were taken to facilitate the market entry by services-based operators as the policy is to promote facilities-based competition.

4. Access Regulation in Singapore

4.1 Access Regulation at Local Access Link Level

The telecommunications market in Singapore has been fully liberalised from April 2000. Operators are licensed by the regulator, Info-communications Development Authority of Singapore (IDA), under Facilities-Based Operator (FBO) Licences and Services-Based Operator (SBO) Licences under the Telecommunications Act. Before liberalisation, two fixed networks providing access connections to end-users were already in operation with territory-wide coverage. These were the copper-based network of Singapore Telecommunications Limited (SingTel) and the cable television

⁸² Office of the Telecommunications Authority (Hong Kong), "Hong Kong Cable Television Limited: Statement Concerning Opinions and Directions Further to General Condition 44 of the Fixed Telecommunication Network Services Licence" (2004), Issued on 20 August 2004, para. 61.

network of Singapore Cable Vision Limited (SCV)⁸³. There was a third network operated by Singapore ONE which was a backbone network only and access to end-users was relying on the access networks of SingTel and SCV. Originally the government had plans to foster the rollout of a third fixed customer access network by licensing StarHub Pte. Ltd. as another fixed network operator from April 2000.⁸⁴ StarHub Pte. Ltd. and SCV subsequently applied to merge and approval was granted by IDA in June 2002.⁸⁵ After the merger (forming StarHub Cable Vision Ltd. (StarHub)), StarHub Pte. Ltd.'s obligation to roll out a fixed network was met by relying on the cable network of SCV. Therefore before the government decided to roll out the Next Gen NBN, the networks of SingTel and StarHub remained as the only two territory-wide fixed networks with access connections to end-users.

The Telecommunications Act does not spell out the details of the rights and obligations of operators in providing interconnection and access and the powers of IDA in determining the terms of such provisions. It just provides that a licence granted under the Act by IDA may include conditions requiring the licensee to enter into agreements or arrangements with any person or another licensee for the interconnection of, and access to, telecommunications systems on such terms and conditions as may be agreed between the parties or in default of such agreement, as may be determined by IDA.⁸⁶ Furthermore, licence conditions may require the licensee to comply with codes of practice.⁸⁷ IDA has been given broad powers to issue or approve codes of practice for the operation of telecommunications systems and provision of telecommunications services.⁸⁸ Enforcement of such codes of practice is backed up by various sanctions provided for under the Telecommunications Act.⁸⁹ The potential coverage of such codes of practice is very broad as they may

⁸³ Singapore Cable Vision was originally the exclusive cable operator.

⁸⁴ The first phase of market liberalisation took place in 1995 when Mobile One (M1) was granted a licence to provide mobile services from April 1997. SingTel originally had exclusive rights under its licence to provide basic domestic and international telecommunications services until 31 March 2007. The government announced in 1996 that SingTel's exclusivity period would be shortened to terminate in April 2000. However, full competition in the telecommunications sector would commence only from April 2002, allowing two years in which limited fixed line competition would be allowed. The government licensed StarHub Pte. Ltd. as the second fixed line operator from April 2000. This may be regarded as the second phase of market liberalisation in Singapore. As part of this second phase, the government licensed StarHub Mobile Pte. Ltd. as the third mobile operator from April 2000. However, before StarHub Pte. Ltd. commenced operation, the government announced in January 2000 that full liberalisation would be brought forward from 1 April 2002 to 1 April 2000.

⁸⁵ Info-Communications Development Authority of Singapore, "Explanatory Memorandum Issued by the Info-Communications Development Authority of Singapore [Regarding the Approval of the Consolidation of StarHub Pte. Ltd., StarHub Mobile Pte. Ltd. and Singapore Cable Vision Limited]" (2002), issued on 21 June 2002, p.1.

⁸⁶ Telecommunications Act, section 5(2)(a).

⁸⁷ Id., section 5(2)(d).

⁸⁸ Id., section 26(1).

⁸⁹ If the IDA is satisfied that a licensee contravenes any provision in the code of practice, it may issue

“specify the duties and obligations of any person in relation to his business operation in the telecommunication industry”.⁹⁰ In exercise of its powers under the Telecommunications Act, IDA issued the Code of Practice for Competition in the Provision of Telecommunication Services (the Telecom Competition Code) in 2000⁹¹ and amended it in 2005⁹², 2010⁹³ and 2012. The 2012 amendments did not concern access regulation.⁹⁴ It is in the Telecom Competition Code that most of the substantive provisions regulating the provision of access and interconnection are contained.

The IDA has made it clear about its preference for facilities-based competition⁹⁵, but it also recognised that there may be “technological, market or other impediments that would hamper competing Licensee’s ability to [build/deploy] facilities” and where such impediments exist, IDA would strike a balance between providing the economic incentives to build/deploy facilities and permitting/facilitating services-based competition.⁹⁶ The Telecom Competition Code is already definitive in identifying which licensees are subject to the obligation of providing access to their networks and what network elements are subject to this obligation. Presumably, the balancing between promoting investment in infrastructure and promoting services-based competition was done in the process of formulating the Code, and the Code represents the decision of this balancing exercise. Thus no further balancing or threshold test is required in the administration of the Code.

In all versions of the Code, a distinction is drawn between “Dominant Licensee” and “Non-dominant Licensees” in the imposition of the obligations of providing access

written order to secure the compliance of the code and impose a financial penalty up to S\$1 million. If contravention should continue, the ultimate sanction is cancellation, suspension of the licence or reduction of the licence validity period. See *id.*, section 8(1) and 8(2).

⁹⁰ *Id.*, section 26(2)(a).

⁹¹ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Services [2000]" (2000), published in Singapore Government Gazette on 15 September 2000.

⁹² Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Services 2005" (2005), published in the Singapore Government Gazette on 18 February 2005.

⁹³ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Service 2010" (2010), issued on 22 December 2010.

⁹⁴ The 2012 revisions of the Code amended only Section 10 concerning mergers and acquisitions in the telecommunications industry. The revisions are not connected with access regulation.

⁹⁵ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Services 2005" , section 1.5.3; Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Service 2010" , section 1.5.3.

⁹⁶ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Services 2005" , section 1.5.3; Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Service 2010" , section 1.5.3.

and interconnection.⁹⁷ Only the Dominant Licensees are subject to such obligations.

The definition of a “Dominant Licensee” has undergone minor modifications from the 2000 version to the 2005 version of the Code.⁹⁸ Since the 2005 version of the Code, IDA will classify a licensee as “dominant” if either one of two conditions is satisfied. The first condition is that “[the licensee] is licensed to operate facilities.....that are sufficiently costly or difficult to replicate such that requiring new entrants to do so would create a significant barrier to rapid and successful entry into the telecommunication market in Singapore by an efficient competitor”. The second condition is that “[the licensee] has the ability to exercise Significant Market Power in any market in which it provides [telecommunication services] pursuant to its licence.”⁹⁹ Thus in addition to the criterion (the second condition) of having significant market power as adopted in EU regulatory framework for electronic communications networks and services, there is the additional criterion (the first condition) of operating facilities that resemble “essential facilities” under competition law. For this reason, SingTel and StarHub operating the final access links to end-users are classified as “dominant”.

Another significant feature of the Code is that the classification of a licensee as “dominant” is applied on a “licensed entity” basis. Thus if a licensee is classified as “dominant”, it will be subject to the Dominant Licensee obligations for all facilities it operates and all services it provides under the licence¹⁰⁰ unless specific exemption is granted by IDA for application of the obligations to specified facilities or services.¹⁰¹

⁹⁷ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Service 2010" , section 2.2.

⁹⁸ In the 2000 version of the Code, the first element of the definition of “Dominant Licensee” was that the licensee “controls facilities which provide a direct connection to end users within Singapore, regardless of the technology used”. The second element of the definition was either “the facilities are sufficiently costly or difficult to replicate that requiring new entrants to do so would create a significant barrier to rapid and successful entry by an efficient competitor” or “the Licensee has the ability to restrict output or raise price above competitive levels for telecommunication services provided to end users over those facilities”. The former element was similar to the essential facilities criteria while the latter was equivalent to “dominance” in competition law. However, only those licensees that control the final connections to end users, namely fixed and mobile network operators that provide direct connections to their customers, could potentially be classified as “Dominant Licensee”. See Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Services [2000]" , section 2.2.1.

⁹⁹ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Services 2005" , section 2.2.1 ; Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Service 2010" , section 2.2.1.

¹⁰⁰ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Services 2005" , section 2.2(b); Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Service 2010" , section 2.2(b).

¹⁰¹ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in

This approach is different from the “market-by-market” approach adopted in competition law in finding a particular operator dominant in the defined market. IDA has explained that such an approach was necessary as Singapore started from a position of monopoly and it was presumed that the incumbent was dominant in every market it operated in. The dominant operator would be found non-dominant in a market-by-market approach. It was also a pragmatic approach as it would be quite impracticable for IDA to engage in a market-by-market analysis of the market position of the incumbent within the short time preceding the liberalisation of the market.¹⁰² The implication of this classification approach is that SingTel will be found dominant because of its dominance in the narrowband market. Once it is classified as a “Dominant Licensee”, it will be subject to the obligations of a Dominant Licensee to provide to requesting licensees interconnection and access to broadband facilities unless exemption is granted by IDA.

A Dominant Licensee must provide “Interconnection Related Services and Mandated Wholesale Services” (IRS and MWS) to other licensees.¹⁰³ “Access” is treated as a type of “interconnection”. The scope of IRS in the 2000 version of the Code was broad. The scope included local loops, sub-loops, line sharing and essential support facilities.¹⁰⁴ The Dominant Licensee was even required to construct additional loops if none was available.¹⁰⁵ MWS then included the supply of domestic dark fibre, including access and inter-exchange fibre, on a “retail minus” price basis.¹⁰⁶ The 2000 Code had made it clear that the unbundled loops can be used for broadband services using the DSL technology.¹⁰⁷ The scope of IRS and MWS has been somewhat scaled back in subsequent revisions of the Code. The current scope of IRS includes, inter alia, unbundled access to local loops, sub-loops, line sharing and essential support facilities such as space for co-location for connection to the unbundled network elements.¹⁰⁸ No MWS has been specified in the 2010 Code.¹⁰⁹

the Provision of Telecommunication Service 2010” , section 2.5.

¹⁰² Info-Communications Development Authority of Singapore, “Consultation Document: Second Public Consultation on the First Triennial Review of the Code of Practice for Competition in the Provision of Telecommunication Services” (2004), issued on 11 May 2004, para. 9.3.

¹⁰³ Info-Communications Development Authority of Singapore, “Code of Practice for Competition in the Provision of Telecommunication Service 2010” , section 6.2.

¹⁰⁴ Info-Communications Development Authority of Singapore, “Code of Practice for Competition in the Provision of Telecommunication Services [2000]”, Appendix 2, section 5.

¹⁰⁵ Id., Appendix 2, section 5.3.1.1. This obligation was removed in the 2005 Code after the first triennial review of the Code.

¹⁰⁶ Id., Appendix 2, section 7.

¹⁰⁷ Id., Appendix 2, section 5.2.

¹⁰⁸ In the 2005 version of the Telecom Competition Code, the scope of Interconnection Related Services and Mandated Wholesale Services was specified by the IDA by notice in the Gazette. In the 2010 version, the scope of Interconnection Related Services and Mandated Wholesale Services is set out in Appendix 2 to the Code

¹⁰⁹ Info-Communications Development Authority of Singapore, “Code of Practice for Competition in

IDA confirmed in the second triennial review of the Code that it applies a “bottleneck test” in deciding the list of IRS and MWS. IDA will require the Dominant Licensee to offer an IRS or MWS “if the service is technically or operationally required to provide a competing telecommunication service, and cannot be replicated, or obtained from a source other than the Dominant Licensee, at commercially reasonable rates”.¹¹⁰

A Dominant Licensee has the duty to develop a Reference Interconnection Offer (RIO) and submit it for the approval of the IDA.¹¹¹ The Code spells out the detailed requirements for the RIO¹¹² and IDA has the powers to seek public comments on the proposed RIO, approve or reject the proposed RIO or direct the Dominant Licensee to incorporate required modifications or specific language into the RIO.¹¹³ The requesting licensee may simply enter into an interconnection agreement with the Dominant Licensee based on the terms of the approved RIO, or seek to negotiate an “individualised interconnection agreement” or enter into an agreement based on an existing agreement with another similarly situated licensee.¹¹⁴ The requesting licensees are aware of the terms of the other interconnections not based on the RIO as the interconnection agreements with the Dominant Licensee are published.¹¹⁵

Pursuant to the Telecom Competition Code, IDA has approved the RIOs of SingTel and the details of the RIOs are published on IDA’s website. The prices for the IRS must be cost-based. The prices of the IRS designated by IDA are reviewed by the IDA based on the Forward Looking Economic Cost (FLEC) using the Long Run Average Incremental Cost (LRAIC) methodology.¹¹⁶ As required, the SingTel’s RIOs are comprehensive and have included the licensing of local loops, sub-loops and line sharing.

SCV has been granted exemption from the obligations to provide interconnection and access as a Dominant Licensee, including the obligation to unbundle its cable modem

the Provision of Telecommunication Service 2010” , section 8.3.

¹¹⁰ Info-Communications Development Authority of Singapore, "Consultation Paper Issued by the Info-Communications Development Authority of Singapore: Second Consultation on the Second Triennial Review of the Code of Practice for Competition in the Provision of Telecommunication Service" (2009), issued on 23 November 2009, para. 41.

¹¹¹ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Service 2010" , section 6.3.1.

¹¹² Id., section 6.3.3.

¹¹³ Id., section 6.3.6.

¹¹⁴ Id., section 6.2.

¹¹⁵ Id., section 6.5.

¹¹⁶ Id., Appendix 1.

service, under the 2000 Code.¹¹⁷ This exemption was said to be “temporary” at that time, pending a review of the technical and policy issues related to unbundling of cable network.¹¹⁸ This exemption has, however, continued in the 2010 Code.¹¹⁹

There were various non-discriminatory requirements in all versions of the Code since 2000. For example, in the 2000 version of the Code, a Dominant Licensee must offer to provide all IRS to a Requesting Licensee “on prices, terms and conditions that are no less favourable than the prices, terms and conditions on which it provides comparable services to itself or its affiliates.”¹²⁰ In the provision of unbundled local loops, the Dominant Licensee must “provision the loops in a timely and non-discriminatory manner”, “provide loops that are of the same quality and capable of supporting the same transmission characteristics as those it supplies to its own End Users” and “provide maintenance and repair services on the unbundled loops that is equivalent to the service it would provide on loops serving its own End Users”.¹²¹ When the loops were used for DSL services, the Dominant Licensee must “supply loops to other Requesting Licensees for DSL that perform at a level equivalent to the loops the Dominant Licensee use for its own DSL.”¹²² Similar non-discriminatory requirements exist in the 2005 and 2010 versions of the Code. However, no operational separation was specified in the Code although the Telecommunications Act was amended in 2011 empowering the Minister to issue “separation order” requiring certain licensees to implement operational or structural separation if he is satisfied that it is in the public interest to do so.¹²³

4.2 Access Regulation at Wholesale Access Level

The Telecom Competition Code has not mandated wholesale services to be supplied to services-based operators. In the 2000 Code, all MWS are specified for facilities-based licensees only.¹²⁴ In the 2005 and 2010 versions of the Code, no MWS have

¹¹⁷ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Services: Designation of Dominant Licensees" (2000), published in Singapore Government Gazette on 15 September 2000, para. 2.

¹¹⁸ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Services [Explanatory Statement]" (2000), issued on 15 September 2000, para. 3.2.2.

¹¹⁹ Info-Communications Development Authority of Singapore, "Notice - Classification of Dominant Licensees under Code of Practice for Competition in the Provision of Telecommunication Services 2010" (2011), issued on 21 January 2011, para. 3(a).

¹²⁰ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Services [2000]" , section 5.3.5.1.

¹²¹ Id., Appendix 2, sections 5.3.1.2 and 5.3.1.3.

¹²² Id., Appendix 2, section 5.3.1.5.

¹²³ Telecommunications Act, section 69C(1).

¹²⁴ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in

been specified.¹²⁵ A Dominant Licensee is not required to offer any wholesale services unless directed by the IDA. However, if the Licensee chooses to do so, it must offer the wholesale services “at prices, terms and conditions that are just, reasonable and non-discriminatory.”¹²⁶ If the Dominant Licensee chooses to offer a wholesale service, it must file a tariff with the IDA for approval.¹²⁷ In reviewing the tariff, the IDA will determine whether the prices and other terms and conditions are no less favourable than those based on which the Dominant Licensee offers any comparable retail service to its customers.¹²⁸ Once a tariff is in effect, approval from the IDA is required before withdrawing the service, despite the fact that the Dominant Licensee has no obligation to offer the wholesale service in the first place.¹²⁹ In this way, the provision of wholesale access services by SingTel is effectively regulated.

The provision of wholesale access services by StarHub is also regulated. In the approval of the consolidation between StarHub Pte. Ltd. and SCV, IDA required SCV to implement “Cable Open Access to IASPs” by 31 December 2002. This was to be enforced by an additional condition under SCV’s licence.¹³⁰ SCV is required to file a tariff for the provision of cable open access service with the IDA for approval and has the obligation of offering the service in accordance with the approved tariff.¹³¹

4.3 Access Regulation on Next Generation Nationwide Broadband Network

The financing of the Next Gen NBN by the Singapore government has enabled the IDA to extend access regulation to the operators of the Next Gen NBN throughout the licence period of 25 years. The government has also taken the opportunity to reform the industry structure for the operation of the Next Gen NBN.

The industry structure for the operation of the Next Gen NBN consists of multiple layers. The bottom layer is the NetCo responsible for the construction and operation of the passive infrastructure (the dark fibres). The underlying assets such as ducts,

the Provision of Telecommunication Services [2000]”, Appendix 2, section 7.

¹²⁵ See list of IRS in the consultation draft, first triennial review of Telecom Competition Code, 11 May 2004, section 3.7.

¹²⁶ Info-Communications Development Authority of Singapore, “Code of Practice for Competition in the Provision of Telecommunication Service 2010” , section 4.3.

¹²⁷ Id., section 4.4.1.

¹²⁸ Id., section 4.4.3.1(c).

¹²⁹ Id., section 4.4.1(b).

¹³⁰ Info-Communications Development Authority of Singapore, “Explanatory Memorandum Issued by the Info-Communications Development Authority of Singapore [Regarding the Approval of the Consolidation of StarHub Pte. Ltd., StarHub Mobile Pte. Ltd. and Singapore Cable Vision Limited]”, paras. 4.9.3.7 and 5.5.3.

¹³¹ Info-Communications Development Authority of Singapore, “Code of Practice for Competition in the Provision of Telecommunication Service 2010” , section 4.6.

manholes and exchanges are to be transferred from SingTel to, and owned by, a “neutral party”, and NetCo is to have a financial lease with the neutral party for the use of the co-location and duct space.¹³² This neutral party, the AssetCo, is now managed by CityNet Infrastructure Management Pte. Ltd. (CityNet) as the trustee-manager of the AssetCo. CityNet has been awarded an FBO Licence and declared a Dominant Licensee. CityNet has published tariffs for leasing of space in ducts, building lead-in ducts and manholes and central offices. Access is provided to NetCo, SingTel and other FBOs for rolling out their networks. IDA reserves the right to regulate the prices of CityNet’s services.¹³³

NetCo is to be structurally separated from the OpCo in the middle layer responsible for the construction and operation of the active infrastructure operating on the passive infrastructure supplied by the NetCo. The OpCo provides wholesale services to the RSPs that will supply services to the end-users. The OpCo appointed by the IDA is allowed to operate as an RSP, but the OpCo needs to be operationally separated from its affiliated RSP.

The structural separation of the NetCo is specified in the licence granted to NetCo. The control and ownership restrictions ensure that the licensee has no “effective control” of other telecommunications or broadcasting licensee, or is not under the “effective control” of such licensee or an entity that has “effective control” of such licensee.¹³⁴ NetCo is also forbidden from supplying retail telecommunications services to end-users or wholesale transmission services unless approval from the IDA

¹³² AssetCo is a business trust, NetLink Trust. SingTel will reduce its unit holdings in the AssetCo to less than 25% within 60 months of OpenNet’s Contractual and Financial Close. NetLink Trust will be managed by a neutral trust manager. See Info-Communications Development Authority of Singapore, "Media Briefing - Award for Next Generation NBN Network Company (NetCo) RFP" (2008), 26 September 2008, Slides 16 and 17; Info-Communications Development Authority of Singapore, "Singapore's Next Gen NBN Deployment on Track with OpenNet's CFC and Nucleus Connect Contract Signed" (2009), Opening remarks by Ms Yong Ying-I, Chairman for IDA at the Next Generation National Broadband Network OpCo Contract Signing Ceremony on 4 May 2009, paras. 6 and 7. CityNet Infrastructure Management Pte. Ltd. has subsequently been appointed as the trustee-manager and holds the assets on trust for the benefit of the unitholders of NetLink Trust.

¹³³ Info-Communications Development Authority of Singapore, "Licence to Provide Facilities-Based Operations Granted by the Info-Communications Development Authority of Singapore to CityNet Infrastructure Management Pte. Ltd. (in Its Capacity as Trustee-Manager of NetLink Trust) under Section 5 of the Telecommunications Act (Chapter 323)" (2011), granted on 22 September 2011, Condition 4, Schedule C – Specific Terms and Conditions.

¹³⁴ “Effective control” is the ability of a controlling entity to cause a controlled entity to take, or prevent the controlled entity from taking, a decision regarding the management and major operating decisions of the controlled entity. Info-Communications Development Authority of Singapore, "Licence to Provide Facilities-based Operations Granted by the Info-Communications Development Authority of Singapore to OpenNet Pte. Ltd. under Section 5 of the Telecommunications Act (Chapter 323) " (2009), granted on 1 April 2009, Conditions 1 and 3, Schedule C – Specific Terms and Conditions.

is given. NetCo is not allowed to offer any broadcasting services.¹³⁵ NetCo however has appointed SingTel to roll out and maintain the fibre network to all commercial and residential premises in Singapore.¹³⁶

The OpCo must comply with the operational separation requirements specified in the licence granted to OpCo.¹³⁷ This means that OpCo must be a separate legal entity, but may be affiliated with a telecommunications or broadcasting licensee, provided that it is operated on a stand-alone basis, at arm's length from the affiliated operators. OpCo must have a separate and distinct brand, established on separate premises, use separate business and operations support systems, and have a separate management whose remuneration and incentive schemes are aligned solely with the performance of the OpCo rather than the performance of affiliated operators. OpCo must apply "Equivalence of Inputs" (EOI) to EOI services. This means that the licensee must provide the same service, deliver the service on the same timescale, on the same terms and conditions and by means of the same systems and processes, and provide the same commercial information, as services to affiliates. Compliance with the requirements is to be monitored by a Monitoring Board comprising members appointed by IDA.¹³⁸ These are similar to the obligations of the UK incumbent's OpenReach in the supply of services to affiliated and non-affiliated operators.

The IDA has chosen to regulate the interconnection and access to the Next Gen NBN through instruments separate from the Telecom Competition Code. The obligations of NetCo and OpCo in the provision of interconnection and access are contained in the terms of the licences of NetCo¹³⁹ and OpCo¹⁴⁰ and in separate codes of practices – the NetCo Interconnection Code¹⁴¹ and the OpCo Interconnection Code.¹⁴² Under these

¹³⁵ Id., Condition 4, Schedule C – Specific Terms and Conditions.

¹³⁶ Singapore Telecommunications Limited, "OpenNet Consortium Has Been Selected as NetCo" (2008), News Release, 28 September 2008.

¹³⁷ Info-Communications Development Authority of Singapore, "Licence to Provide Facilities-based Operations granted by the Info-Communications Development Authority of Singapore to Nucleus Connect Pte. Ltd. under Section 5 of the Telecommunications Act (Chapter 323)" (2009), granted on 30 October 2009, Condition 2 and Appendix 1, Schedule C – Specific Terms and Conditions.

¹³⁸ Id., Appendix 1, Schedule C – Specific Terms and Conditions.

¹³⁹ Info-Communications Development Authority of Singapore, "Licence to Provide Facilities-based Operations Granted by the Info-Communications Development Authority of Singapore to OpenNet Pte. Ltd. under Section 5 of the Telecommunications Act (Chapter 323) ", Condition 5, Schedule C – Specific Terms and Conditions.

¹⁴⁰ Info-Communications Development Authority of Singapore, "Licence to Provide Facilities-based Operations granted by the Info-Communications Development Authority of Singapore to Nucleus Connect Pte. Ltd. under Section 5 of the Telecommunications Act (Chapter 323) ", Condition 4, Schedule C – Specific Terms and Conditions.

¹⁴¹ Info-Communications Development Authority of Singapore, "Code of Practice for Next Generation National Broadband Network NetCo Interconnection" (2009), issued on 25 February 2009.

¹⁴² Info-Communications Development Authority of Singapore, "Code of Practice for Next Generation National Broadband Network OpCo Interconnection" (2009), issued on 18 August 2009.

Codes, NetCo and OpCo are required to offer the “mandated services” under “standard interconnection offers” (ICOs) submitted by the licensee and approved by the IDA.¹⁴³ The ICOs of any new services offered by the OpCo are also to be approved by the IDA.¹⁴⁴ In accordance with the bids submitted leading to the selection of the NetCo and OpCo, OpenNet (the consortium selected to be the NetCo) will offer a wholesale price for a basic fibre connection¹⁴⁵ of S\$15 per month to residential premises and S\$50 per month to non-residential premises.¹⁴⁶ Nucleus Connect (a wholly-owned subsidiary of StarHub Ltd. selected to be the OpCo) will offer a wholesale price to RSPs for defined basic services¹⁴⁷ of S\$21 per month to residential premises¹⁴⁸ and S\$75 per month to non-residential premises based on the NetCo wholesale prices.¹⁴⁹

In sum, the law in Singapore has provided for broad powers for the regulator to establish access regulation under the Telecom Competition Code. The regulator has established a comprehensive regime for access regulation at the levels of access to the local access links as well as wholesale access. Such a comprehensive access regulation has been extended to the NGA networks and strengthened to include structural and operational separations and strict non-discrimination obligations (the EOI requirements).

¹⁴³ Info-Communications Development Authority of Singapore, "Code of Practice for Next Generation National Broadband Network NetCo Interconnection", section 2; Info-Communications Development Authority of Singapore, "Code of Practice for Next Generation National Broadband Network OpCo Interconnection", section 2.

¹⁴⁴ Info-Communications Development Authority of Singapore, "Code of Practice for Next Generation National Broadband Network OpCo Interconnection", section 8.

¹⁴⁵ For a 1:16 split ratio in the GPON configuration.

¹⁴⁶ OpenNet Pte. Ltd., "Interconnection Offer" (2009), Interconnection Offer under the terms of OpenNet's FBO Licence, approved by IDA on 30 October 2009 and updated on 30 November 2011, Schedule 15 – Charges, paras. 1.2 and 2.2.

¹⁴⁷ 25 Mbps downlink on a best-effort basis.

¹⁴⁸ Nucleus Connect Pte. Ltd., "Interconnection Offer (ICO) Agreement Service Schedule - Residential Per-End-User Connection" (2010), Interconnection Offer, approved by IDA on 19 April 2010, para. 5.1.

¹⁴⁹ Nucleus Connect Pte. Ltd., "Interconnection Offer (ICO) Agreement Service Schedule - Non-Residential Per-End-User Connection" (2010), Interconnection Offer, approved by IDA on 19 April 2010, para. 5.1.

5. Comparison and Analysis

5.1 Comparison

Access regulation is more comprehensive and prescriptive in Singapore than in Hong Kong

In almost every aspect, the access regulation in Singapore is more comprehensive and prescriptive than the counterpart in Hong Kong.

The unbundling regulation in Hong Kong has not been implemented to lower the barriers to entry for entrants. It was merely a measure of mutual sharing of bottleneck facilities among the incumbent and the entrants that entered the market in 1995 to facilitate competition among them. On the other hand, the unbundling regulation in Singapore can in principle lower the entry barriers for any player that wishes to enter the market. The access seeker only needs to apply for an FBO Licence.

Hong Kong has commenced the liberalisation of the local fixed network market in 1995. At that time, the priority was to promote competition in the provision of fixed-line telephone services (which were also used for narrowband access to the Internet). Type II interconnection to the local loops introduced in 1995 was therefore designed to promote competition in the provision of narrowband services. In order to facilitate commercial agreements between the incumbent and the entrants, the TA clarified that the application of Type II interconnection was to be restricted to narrowband services until a review was carried out in the future. In contrast, Singapore liberalised the local and international fixed network markets at the same time in 2000. At that time, the demand for broadband services had emerged. Therefore the access regulation was designed to cover narrowband and broadband services from the initial version of the Telecom Competition Code issued in 2000.

The Singapore Telecom Competition Code has included many of the tools that are necessary for effective implementation of access regulation. Particularly useful is the requirement for the Dominant Licensees to make reference interconnection offers for the interconnection and access services that these licensees are obliged to provide. In contrast, the interconnection regulation in Hong Kong was based on the “negotiate-arbitrate” model. This model adopted in the Australian regulation until its reform in connection with the implementation of the National Broadband Network had been regarded by the policymaker and regulator as ineffective in achieving the desired

policy objectives.¹⁵⁰ Another useful tool in the Singapore Telecom Competition Code is the explicit *ex ante* prohibition of discrimination in the provision of interconnection and access. In Hong Kong, such *ex ante* prohibition was absent in the Type II interconnection arrangements. Discrimination could only be pursued on an *ex post* basis as a breach of the sector-specific competition law. This was a more uncertain route and can be pursued only after discrimination had occurred.

In Singapore, the imposition of access regulation is linked to the dominance classification of a licensee. Once a licensee has been classified as a Dominant Licensee in Singapore, it has the obligations of supplying the IRS and MWS specified by the regulator under the Telecom Competition Code unless the regulator exempts it from such obligations.¹⁵¹ There are no explicit requirements for the regulator to balance the objectives of promoting competition and maintaining the incentives to invest in enforcing these obligations under the Code. In contrast, in Hong Kong, the dominance classification was mainly linked to tariff regulation, not to access regulation.¹⁵² The making of determinations on access regulation is explicitly subject to the considerations of a number of factors set out in the legislation, including government's policy objectives, consumer interests (which are promoted by competition) and encouraging efficient investment in telecommunications infrastructure.¹⁵³ The experience in US shows that such balancing is susceptible to legal challenges when the regulator and the court may not share the same view about the optimal point of balance.¹⁵⁴ The absence of any explicit requirement for the regulator to perform the balancing means that the Singapore regulator's decisions are less susceptible to legal challenges.

The access regulation at the wholesale level has also been more comprehensive in Singapore than in Hong Kong. Facilities-based operators in Hong Kong have no legal obligation to offer wholesale services to services-based operators unless they are dominant in the market and offer wholesale services to subsidiary or affiliated

¹⁵⁰ The Parliament of the Commonwealth of Australia: House of Representatives, "Telecommunications Legislation Amendment (Competition and Consumer Safeguards) Bill 2010: Explanatory Memorandum" (2010), Circulated by authority of the Minister for Broadband, Communications and the Digital Economy, p. 48.

¹⁵¹ Info-Communications Development Authority of Singapore, "Code of Practice for Competition in the Provision of Telecommunication Service 2010", sections 2.5 and 6.2.

¹⁵² In Hong Kong, a dominant Fixed Telecommunication Network Services Licensee was also required to implement accounting separation requirements under licence conditions.

¹⁵³ Telecommunications Ordinance, section 36A(10).

¹⁵⁴ In the US, the implementation of the unbundling regulation under the Telecommunications Act 1996 has been bogged down in 10 years of litigations. The court approved of the regulator's interpretation of the law only when the regulator has shifted the balance between promoting access-based competition and maintaining investment incentives towards favouring facilities-based competition.

companies. This resulted in a lack of offer for wholesale services in the market. In contrast, through the Telecom Competition Code and conditions under SCV's licence, wholesale services offered by SingTel and StarHub in Singapore are effectively regulated.

The level of transaction costs was higher in Hong Kong than in Singapore

The implementation of Type II interconnection in Hong Kong had been beset with high transaction costs. The access seekers, the access provider and the regulator had spent considerable amount of resources in dealing with disputes in connection with the implementation. The provisions in the TO are based on the "negotiate-arbitrate" model which intends to restrict regulatory intervention to situations where commercial settlement of the terms and conditions of interconnection cannot be achieved. This means that the access provider was not obliged to develop reference interconnection offers for TA's approval and the determination process of the TA was not to be initiated until the parties had been given a reasonable period to negotiate. Given the policy intention of favouring commercial settlement, there was a tendency to allow longer, rather than shorter, periods of negotiations so as to give sufficient opportunities for the parties to reach commercial agreement. For the Type II interconnection for narrowband services, the negotiations between HKTC (the incumbent as access provider) and New World Telephone (an entrant as access seeker) took some seven months for the price to be agreed, and a further four months for the full commercial agreement to be concluded¹⁵⁵, only after mediation by the regulator and a clarification or possibly a concession that the capability of Type II interconnection was to be confined to narrowband services pending a future review.¹⁵⁶ Before commercial agreement was reached, when the regulator accepted New World Telephone's request for determination, HKTC mounted a legal challenge on the regulator's power to make such a determination, arguing that Type II interconnection was not within the scope of interconnection defined under the TO at that time.¹⁵⁷

The problems of lengthy commercial negotiations recurred in the implementation of Type II interconnection for broadband services. In a court case decided in 2004¹⁵⁸, as the commercial negotiation between the incumbent and Wharf T & T (another entrant)

¹⁵⁵ Audit Commission (Hong Kong), "Liberalisation of the Local Fixed Telecommunications Market" (2002), Chapter 1, Director of Audit's Report No. 38, Chapter 1, 20 March 2002, Case Study B, p. 22.

¹⁵⁶ Office of the Telecommunications Authority (Hong Kong), "Type II Interconnection between New World Telephone and Hong Kong Telephone", para. 6(b).

¹⁵⁷ Ming Pao, *Hong Kong Telecom Litigates to Break Shackles of the Authority*, in Chinese, 22 October 1998.

¹⁵⁸ *PCCW-HKT Telephone Ltd. v The Telecommunications Authority*, [2004] HKCU 747.

on the terms and conditions for interconnection took 18 months without reaching agreement, the TA issued a direction to the parties, requiring the parties to commence Type II interconnection, before the terms and conditions for interconnection could be agreed on a commercial basis or determined by the TA under section 36A of the TO.¹⁵⁹ The TA then considered that the direction needed not contain the terms and conditions of interconnection as “the terms and conditions finally decided in the determination proceedings are capable of being retrospectively applied to govern the interconnection.”¹⁶⁰ The court ruled against the TA.¹⁶¹ The court was persuaded that the direction “involve[d] the surrender of part of [PCCW’s] network” and without the interim terms, the direction “may act to the commercial prejudice of [PCCW]”.¹⁶² This judgment was made nearly four years after the TA decided to extend Type II interconnection to broadband.

It also turned out that it was not only the access price that could be the subject of disputes. The nature of Type II interconnection was such that implementation required close cooperation between the access provider and the access seekers. The access seekers needed to enter the exchange buildings of the access provider and co-locate equipment inside the exchanges. When the access seeker had acquired a new customer that needed to be served through Type II interconnection, the local loop of that customer needed to be physically disconnected from the equipment of the access provider and re-connected to the equipment of the access seeker. Therefore there were numerous detailed and technical issues that needed to be agreed between the access provider and the access seekers. It was obvious that the incumbent did not have the incentive to facilitate a process that affected its business. Disputes frequently arose. These disputes included the time taken and the cost involved to prepare exchanges for Type II interconnection¹⁶³, the rejection of applications for Type II interconnection due to alleged incomplete or incorrect information provided by the access seekers¹⁶⁴, the rate at which local loops could be “cut over” from the

¹⁵⁹ After the decision in November 2000 of the TA to extend Type II interconnection to broadband, Wharf commenced negotiations with PCCW on the applicable terms and conditions from December 2000. Wharf sought TA’s determination of the terms and conditions in July 2001. See *PCCW-HKT Telephone Ltd. v The Telecommunications Authority*, [2004] HKCU 783 (Court of Appeal, High Court of the Hong Kong SAR, 8 July 2004), para. 11. The TA issued a direction to PCCW on 15 May 2002

¹⁶⁰ *PCCW-HKT Telephone Ltd. v The Telecommunications Authority*, para. 11.

¹⁶¹ *Id.*, para. 105.

¹⁶² *Id.*, para. 87.

¹⁶³ Legislative Council (Hong Kong), “Panel on Information Technology and Broadcasting - Minutes of Meeting held on Monday, 12 February 2001” (2001), LC Paper No. CB(1)776/00-01, paras. 7(b) and 9.

¹⁶⁴ Audit Commission (Hong Kong), “Liberalisation of the Local Fixed Telecommunications Market”, paras. 3.12 and 3.16(c); Hong Kong Daily News, *New T & T Claims Customer Cutover Unreasonably Obstructed by PCCW*, in Chinese, 6 June 2002..

access provider's equipment to the access seeker's equipment¹⁶⁵, and so on. These disputes had been openly voiced in the public media and meetings of a panel on information technology and broadcasting affairs in the Legislative Council.¹⁶⁶ Very often the regulator had to be involved in resolving the disputes concerning these technical issues. The regulator had to set up a working group to prepare an industry code of practice (CoP) on the implementation of Type II interconnection¹⁶⁷ and later on set up an "CoP Forum" to coordinate on the implementation.¹⁶⁸

In contrast, there had been few disputes openly reported or legal challenges on the access regulation in Singapore.¹⁶⁹ SingTel had repeatedly disagreed with the regulator's approach in dominance classification, arguing that the approach was a significant deviation from that adopted under competition law, but IDA had stood by the "licensed entity" approach arguing that this approach had led to the same result as a "market-by-market" approach.¹⁷⁰ SingTel had also asked IDA to remove its obligations to provide unbundled access to local loops, sub-loops and line sharing on the ground that "two competing nationwide wireline networks" existed, but IDA disagreed.¹⁷¹ However, no legal challenge had ever been mounted against the regulator's decisions. Legal challenge based on the merits of the regulator's decisions is not easy as appeals lies with the Minister and it is understood that the Minister was involved in the approval of the Telecom Competition Code.¹⁷² In a recent court case

¹⁶⁵ Restrictions were placed by the incumbent on the rate of physical cut-over of customers to unbundled loops on grounds of manpower and physical limitations, there being cut-over quota of 9 local access links per new entrant every two hours, and maximum 36 cut-overs per new entrant per day. This slowed down the pace at which end-users could be switched from the incumbent to the new entrants through Type II interconnection. See Audit Commission (Hong Kong), "Liberalisation of the Local Fixed Telecommunications Market", Case Study A, p. 21.

¹⁶⁶ Legislative Council (Hong Kong), "Panel on Information Technology and Broadcasting - Minutes of Meeting held on Monday, 12 February 2001"; Legislative Council (Hong Kong), "Panel on Information Technology and Broadcasting - Minutes of Meeting held on Monday, 10 June 2002".

¹⁶⁷ Hong Kong SAR Government (Information Services Department), "Reply to Legislative Council Questions: Competitive Environment for Local Wireline Fixed Telecommunications Network Services" (2001), 14 February 2001.

¹⁶⁸ Audit Commission (Hong Kong), "Liberalisation of the Local Fixed Telecommunications Market", para. 3.14.

¹⁶⁹ OpenNet Pte Ltd. had taken the IDA to court in 2012. The disputes were about whether the AssetCo and/or CityNet met the control and ownership requirements specified in the Deed of Undertaking between IDA and SingTel, and granting CityNet an FBO Licence and designating it as a Public Telecommunications Licensee. See *OpenNet Pte Ltd v Info-communications Development Authority of Singapore*, [2012] SGHC 168 (High Court, 7 June 2012).

¹⁷⁰ Info-Communications Development Authority of Singapore, "Cover Note Issued by the Info-Communications Development Authority of Singapore - Code of Practice for Competition in the Provision of Telecommunication Services 2010" (2010), issued on 22 December 2010, paras. 17 and 18.

¹⁷¹ Info-Communications Development Authority of Singapore, "Consultation Paper Issued by the Info-Communications Development Authority of Singapore: Second Consultation on the Second Triennial Review of the Code of Practice for Competition in the Provision of Telecommunication Service", para. 42.

¹⁷² International Telecommunication Union, "Effective Regulation Case Study: Singapore 2001" (2001),

against the IDA, the court ruled against OpenNet because it had not pursued alternative remedies (i.e. applying to the IDA for reconsideration or appealing to the Minister) under section 69 of the Telecommunications Act.¹⁷³

There was a higher take-up of unbundling regulation in Hong Kong than in Singapore

In Hong Kong, although the capability of Type II interconnection was initially confined to narrowband service, Type II interconnection (in combination with self-built networks) did result in a steady increase of the market share of the entrants in local wireline telephone services from 5% in 1999 to around 28% by February 2004.¹⁷⁴ By February 2004, Type II interconnection for telephone services covered 58% of the households. 11% of the market was served by Type II interconnection.¹⁷⁵ 2001 – 2004 saw a period of intense competition in the market for local wireline telephone services with steady decline of the prices in the market and the market share of the incumbent.

However, Type II interconnection had made little practical impact on the development of the broadband market. By the end of December 2002, for broadband, new entrants achieved a market share 44.7% through self-built networks, with insignificant number of unbundled local loops for broadband.¹⁷⁶ The TA's attempt to short-circuit the full "negotiate-arbitrate" process failed as a result of the court ruling in the case concerning Type II interconnection in 2004.¹⁷⁷ At that time, the government was about to issue its decision to withdraw Type II interconnection. As a result, the number of broadband connections using Type II interconnection constituted only a "tiny and insignificant portion" of the number of lines based on the ADSL technology.¹⁷⁸

On the other hand, the comprehensive set of unbundling regulation in Singapore did not result in significant market entry based on access-based competition. A wide range of IRS had little or no take up.¹⁷⁹ According to statistics published by IDA and

Report on a case study, pp. 21 – 22.

¹⁷³ *OpenNet Pte Ltd v Info-communications Development Authority of Singapore*, para. 58.

¹⁷⁴ Hong Kong SAR Government (Communications and Technology Branch), "Legislative Council Brief: Review of Type II Interconnection Policy", para. 7.

¹⁷⁵ *Id.*, para. 7.

¹⁷⁶ Office of the Telecommunications Authority (Hong Kong), "Review of the Regulatory Policy for Type II Interconnection" para. 13 and Table 2.

¹⁷⁷ *PCCW-HKT Telephone Ltd. v The Telecommunications Authority*, [2004] HKCU 747.

¹⁷⁸ Office of the Telecommunications Authority (Hong Kong), "Review of the Regulatory Policy for Type II Interconnection: Analysis of Comments Received, Preliminary Conclusions and Further Consultation", para. 72.

¹⁷⁹ In response to a consultation initiated by IDA in 2008 on the industry structure for the next

reports published by market analysts, for example, in September 2008, the number of xDSL lines supplied by operators other than SingTel, through unbundled access to SingTel's local loops or wholesale services provided by SingTel, constituted only 0.6% of the total number of residential broadband connections.¹⁸⁰ Although the unbundling regulation had lowered some barriers to entry, other barriers apparently remained. There has not been much information in the public domain about the barriers as Singapore operators rarely voice their disputes in public. However, in response to a consultation initiated by IDA in 2008 on the industry structure for the NGA networks, StarHub commented as follows:

“[T]he key reasons why RIO services are not subject to higher demand because they are (i) expensive; (ii) subject to onerous terms and conditions (particularly in regard to ordering processes); and (iii) very difficult to use in practice (and we would highlight StarHub's experience with Line Sharing in this regard.) We would also respectfully query whether SingTel's own retail operations must follow all of the terms and conditions set out in RIO”.¹⁸¹

This suggests that the lack of structural or operational separation between the network operation and service provision units within SingTel may constitute part of the problems. SingTel argued that the reason for the low take-up was “the existence of extensive facilities and services-based competition, which has resulted in telecommunications licensees either deploying and utilising their own infrastructure, or availing themselves of one of the various other wholesale services that is available in the marketplace”.¹⁸² One of the wholesale services referred to by SingTel was the service provided under “open access” to StarHub's cable network.

generation access networks, StarHub commented: “As IDA will be aware, the majority of services covered by SingTel's RIO are not used, or are only used to a limited extent [*sic*] by a small number of operators.” See StarHub Limited, “Industry Structure for Next Generation Access Networks” (2008), Submission to the IDA by the StarHub Group, 13 June 2008, paras. 4.4 and 4.5.

¹⁸⁰ According to IDA statistics, the number of residential broadband connections at the end of September 2008 was 1,074 thousand. The number of xDSL lines was 500.8 thousand. The number of SingTel broadband customers, based on xDSL, was 494 thousand. Thus the number of xDSL lines supplied by operators other than SingTel was 6,800, 0.63% of the total number of residential broadband connections. See Business Monitor International, “Singapore Telecommunications Report Q1 2009” (2009), Industry Report, February 2009, pp. 41 – 42.

¹⁸¹ StarHub Limited, “Industry Structure for Next Generation Access Networks” , paras. 4.4 and 4.5.

¹⁸² Singapore Telecommunications Limited, “Submission on the Second Triennial Review of the Code of Practice for Competition in the Provision of Telecommunication Services” (2008), Submission to the IDA, 30 December 2008, p. 29. In response to a question put to the IDA by the author on the reason why the take-up of unbundling regulation in Singapore is low, the IDA pointed to the availability of wholesale services from the incumbents, SingTel and StarHub as the main reason.

It is apparent that in both Hong Kong and Singapore, the implementation of unbundling regulation for the broadband services has not been successful. However, multiple access networks in competition with the incumbents' copper-based and cable networks have been rolled out in Hong Kong, but in Singapore, access networks in competition with the incumbents' networks have not emerged in the market. SingTel's Annual Reports 04/05 and 05/06 made no reference to future plans for upgrading its fixed network. Only StarHub, which has been granted exemption for unbundling of its cable network, has upgraded its network. By 2006, StarHub has completed the upgrade to DOCSIS 3.0 standard, enabling nationwide 100 Mbps residential broadband service.¹⁸³ The lack of prospects of significant rollout of fibre-based networks has led to the Singapore government's intervention to roll out the Next Gen NBN.

5.2 Reasons for Divergence

Williamson (1998) has identified three attributes of transactions – asset specificity, uncertainty and frequency.¹⁸⁴ In the context of access regulation, asset specificity and uncertainty are certainly relevant to the transactions for access to the final access links of an access network, but in addition, the attributes of the transactions involved should include at least the extent to which cooperation is required between the access provider and the access seeker, the incentives of the access provider to cooperate with the access seeker, the ability of the regulator to monitor and detect discriminatory practices and the ability of the regulator to resolve disputes concerning such practices. Based on the experience in the first generation access networks, the nature of access to the final access links is such that the implementation requires close cooperation between the access provider and the access seeker. As the access seeker gains access to the final access links to compete with the access provider in the retail services supplied to end-users, the access provider has no commercial incentive to cooperate with the access seeker. Due to information asymmetry, the regulator usually does not possess adequate information to monitor discrimination and resolve the disputes expeditiously. As such the level of contractual hazards associated with access to the final access links is high. If the “discriminating alignment hypothesis” is true, one would expect that the transactions for the access to the final access links should be aligned with a stronger form of access regulation or vertical integration between the access providers and the access seekers. A mismatch between the attributes of transactions and the capabilities of governance structures is unlikely to lead to

¹⁸³ StarHub Cable Vision Limited, "Annual Report 2006" (2006), p. 13.

¹⁸⁴ Williamson, "Transaction Cost Economics: How It Works; Where It Is Headed", p. 36.

minimisation of transaction costs. There is evidence to show that these predictions have been correct for the first generation access networks.

Choice of governance structures by access seekers

In Hong Kong, the transaction costs in the implementation of access regulation on the local loops had been relatively high. This suggests a mismatch between the attributes of the transactions for access to the local loops and the relatively “light-handed” access regulation based on a “negotiate-arbitrate” model in the determination of the access terms. The “negotiate-arbitrate” arrangement has put too much faith in the process of commercial negotiation and agreement implementing what is an intrusive form of regulation opposed by the incumbent.

The high level of transaction costs had diminished the usefulness of the Type II interconnection arrangements as an option to reach customers before self-built customer access networks were rolled out. Furthermore, the copper local loops were subject to severe physical limitations in their capability to provide NGA services. Because of these restrictions, Type II interconnection had not suppressed all investment incentives of the entrants – much depended on the strategies of individual operators. An entrant that aimed to build up its market position in the next-generation communications environment would still invest in its own infrastructure rather than taking advantage of the Type II interconnection arrangements. In fact, one of the three beneficiaries of Type II interconnection arrangements had adopted the strategy of constructing its own customer access networks instead of relying on Type II interconnection and by 2002, its self-built access networks had covered a substantial number of customer buildings.¹⁸⁵ For entrants that entered the market after 1995, the level of transaction costs for seeking access to the local loops of the incumbent was even higher as the access was not backed up by regulation. They were forced to invest in their own access networks. The relatively high level of transaction costs in the implementation of unbundling regulation in Hong Kong had therefore pushed operators to adopt the vertical integration mode at Node D of Williamson (1998)’s extension of the “simple contracting schema” shown in Figure 1.

In contrast, the comprehensive access regulation and low transaction costs in

¹⁸⁵ Legislative Council (Hong Kong), "Panel on Information Technology and Broadcasting - Minutes of Meeting held on Monday, 12 February 2001" , para. 6(b); Hutchison Whampoa Limited, "Hutchison Global Crossing Launches Online Enquiry on Local Phone Service" (2001), Press Release, 31 October 2001; Legislative Council (Hong Kong), "Panel on Information Technology and Broadcasting - Minutes of Meeting held on Monday, 10 June 2002" , para. 29.

Singapore had resulted in operators staying at Node C in Figure 1 backed up by access regulation and making lower level of investment on network facilities. Even at Node C, the access seekers sought the governance structure that gave the lowest transaction costs. The availability of wholesale services provided over SingTel and StarHub networks at regulated rates had attracted the access seekers to adopt the services-based mode of competition instead of access to the unbundled local loops which involved higher level of transaction costs.

It would be an over-simplification to attribute the choice of governance structures to the minimisation of transaction costs alone. The level of production costs is also a relevant consideration as recognised by Williamson (1985).¹⁸⁶ If the level of production costs associated with a particular governance structure is too high, such costs may more than offset the reduction in transaction costs. In the case of Hong Kong, the production costs associated with self-built access networks would be higher in the short-term compared with using Type II interconnection. Therefore for an operator without long-term plan to invest in its own access networks, it may be attracted to stay in Node C, relying on access regulation to gain access to the local loops of the incumbent. In Singapore, the production costs for access to unbundled local loops would be higher than using wholesale access services because of the substantial fixed costs involved in the investment for co-location at the access provider's telephone exchanges. If the market share expected to be captured is small due to, for example, the need to compete against two established incumbents, the approach using the regulated wholesale access services would involve lower production costs per acquired customer. Therefore the access seekers are likely to adopt the governance structure that can minimise the sum of transaction costs and production costs.

Choice of governance structures by policymakers and regulators

In designing the regulatory models for the NGA networks, the objectives of the policymakers and regulators are to ensure that investment is made to roll out the NGA networks with the required speeds and capacity and at the same time promote competition in the provision of access services to the end-users. The reasoning of the policymakers and regulators was usually not formulated in transaction cost terms, but obviously, it is necessary to minimise the transaction costs to achieve the desired public policy objectives. The experience in the first generation access networks must have impact on the choice of governance structures for the NGA networks, as

¹⁸⁶ Williamson, *The Economic Institutions of Capitalism*, pp. 92 – 93.

policymakers and regulators would wish to avoid the transaction costs encountered in the first generation access networks.

Where multiple NGA networks have been rolled out, the obvious approach to minimise transaction costs would be to deregulate, allowing vertical integration between the infrastructure operators and the service providers so that the dealings between the access provider and the access seeker become internal relations within the same firm and transaction costs can be minimised without affecting the incentive to invest in infrastructure. This however means that the transaction costs for those access seekers without their own network infrastructure will be very high as the access will not be backed up by access regulation. Hong Kong has adopted this deregulatory approach.

Where multiple NGA networks have not been, or are not expected to be, rolled out, deregulation would lead to exit of competitors and re-emergence of dominance or monopoly. Access regulation needs to be applied and may need to be strengthened to avoid the transaction costs encountered in the first generation access network environment. Singapore has strengthened the access regulation, for example, by introducing structural/operational separations and strict non-discrimination requirements that were not present in the regulation on the first generation access networks. Merely strengthening the access regulation may not deliver the policy objectives, as the stringent regulation may dampen investment incentives and the NGA networks may not be built. Singapore government has to provide subsidy and use the approach of awarding a franchise in order to ensure that the government objectives of rolling out a nationwide NGA network are met.

The above shows that policymakers and regulators have chosen the governance structure with the purpose of minimising transaction costs. However, transaction cost minimisation between the access seekers and the access providers is not the only concern of policymakers and regulators. As policymakers and regulators, they have to take a broad view of all types of transaction costs as well as other types of economic costs and social costs. One type of economic costs would be adverse impact on investment incentives to roll out the NGA networks. The policymakers in Hong Kong had emphasised on the need to invest in advanced infrastructure. The objective of the policymakers in Singapore was also to roll out the infrastructure. Other economic and social costs would include inefficiencies due to duplication of infrastructure, inefficiencies due to vertical separation, displacement of private capital, distortion of competition, impediments to the delivery of universal service, and so on.

The policymakers and regulators would choose the governance structure that can minimise the sum of the transaction costs, other economic costs and social costs in the particular environment in which they are operating.

The choice of governance structure was affected by the institutional environment

Although the governance structures adopted in Hong Kong and Singapore are different, they belong to the group of governance structures that can deal with the high level of contractual hazards more effectively. This supports the predictions of the “discriminating alignment hypothesis” that transactions with different attributes will align with governance structures with different capabilities so as to minimise transaction costs. However, different governance structures have been adopted in Hong Kong and Singapore for the similar transactions of access to the final access links of NGA networks. What explains the different choices of governance structure?

The implementation of the Next Gen NBN project in Singapore was the decision of the government. The Next Gen NBN is just a component of the iN2015 master plan formulated at the top level of the government. No public consultation documents were available. The decision of the government to launch the project of the Next Gen NBN was announced by the Prime Minister and Minister for Finance in his 2006 budget speech¹⁸⁷ and the details were subsequently elaborated upon by the Minister of Information, Communications and the Arts in the Committee of Supply.¹⁸⁸

From presentations given by IDA after the announcement was made, it was apparent that the decision was taken after consideration of the status of the Singapore information communications infrastructure and IDA’s vision of the next generation information communications infrastructure in 2015.¹⁸⁹ In 2006, Singapore was served by ADSL and cable modem broadband services with speeds up to 25 Mbps and 30 Mbps respectively with expectation that the cable modem speed would be upgraded to 100 Mbps by the end of 2006.¹⁹⁰ Singapore was conscious of the ranking in widely recognised international indices concerning ICT development. Although Singapore

¹⁸⁷ Singapore Government, "Budget Statement 2006: Building on Our Strengths, Creating Our Best Home" (2006), delivered by Prime Minister and Minister for Finance Lee Hsien Loong on 17 February 2006, para. 2.16.

¹⁸⁸ Singapore Government, "Singapore, Totally Connected, Wired and Wireless" (2006), Statement by Dr Lee Boon Yang, Minister for Information, Communications and the Arts in Parliament during Committee of Supply Debate on 3 March 2006.

¹⁸⁹ Info-Communications Development Authority of Singapore, "Infocomm Infrastructure and Manpower Development" (2006), Presentation by Mr Leong Keng Thai, Deputy Chief Executive Officer and Director-General (Telecoms), Infocomm Development Authority of Singapore, 21 June 2006.

¹⁹⁰ Id., Slide 4.

was consistently among the top economies, it was not always at the top.¹⁹¹ The vision for 2015 was to have “an ultra-high speed, pervasive, intelligent and trusted infocomm infrastructure”.¹⁹² This project was part of the initiatives to enable Singapore “to become a knowledge hub in Asia”.¹⁹³ The government has concluded that a NGNII is necessary “to transform Singapore into an innovative and creative economy”.¹⁹⁴

Therefore regulation is but a tool to implement an industrial policy in Singapore. The approach in the Next Gen NBN is not the first time the government had invested in network infrastructure. Since 1981, Singapore has launched a number of national IT plans aimed at raising the ICT capabilities and competitiveness of the nation.¹⁹⁵ For example, as part of the plan known as “IT2000” implemented during 1992 – 1999, the nation-wide broadband network Singapore ONE was implemented under the leadership of the government.¹⁹⁶

The approach in Singapore would not have been politically feasible in Hong Kong. The Singapore government is well known for its economic intervention which has delivered success in high technology, capital-intensive industries, and value-added services¹⁹⁷, while the Hong Kong government is equally well known for its free-market approach which has also achieved remarkable economic success.¹⁹⁸ Although Hong Kong has also intervened in some sectors of the economy¹⁹⁹, such policy had not been applied to the telecommunications sector particularly during the review of the access regulation in 2004. The prevailing government policy then was, and probably still is, “big market and small government”²⁰⁰ and “market leads,

¹⁹¹ Id., Slide 10. The indices were the World Economic Forum IT Report, EIU e-Readiness Rankings and Accenture Annual e-Government Rankings.

¹⁹² Id., Slide 12.

¹⁹³ Singapore Government, "Budget Statement 2006: Building on Our Strengths, Creating Our Best Home", para. 2.16.

¹⁹⁴ Singapore Government, "Singapore, Totally Connected, Wired and Wireless", paras. 8 – 11.

¹⁹⁵ John Ure (ed.) *Telecommunications Development in Asia* (Hong Kong: Hong Kong University Press, 2008), Chapter 11, Table 1: Singapore's national IT plans, p. 249.

¹⁹⁶ Initially, IDA, through a wholly owned subsidiary, Singapore Communications Investments Pte. Ltd. (SingCom), had 40% stake in the operating company of Singapore ONE, 1-Net. The other shareholders of 1-Net were Singapore Telecom and Singapore Cable Vision, each with 30% stake. SingCom subsequently divested 30% equity in 1-Net to Pacific Internet (holding 15%) and StarHub Internet (holding 15%). The operating company 1-Net has subsequently been sold to MediaCorp in September 2000. See Info-Communications Development Authority of Singapore, "Industry Players Divest 1-Net Shares to MediaCorp" (2000), Media Release issued on 18 September 2000.

¹⁹⁷ Newman M. K. Lam, "Government Intervention in the Economy: A Comparative Analysis of Singapore and Hong Kong" (2000) 20 *Public Administration and Development* 397, p. 402.

¹⁹⁸ Id., p. 397.

¹⁹⁹ Id., pp. 402 – 403.

²⁰⁰ Chief Executive of Hong Kong SAR, "Big Market, Small Government", press release, 18 September 2006. In the colonial period, the Financial Secretary Sir Philip Haddon-Cave referred to

government facilitates”.²⁰¹ As facilities-based competition had materialised in the sector, the *ex ante* regulation introduced in the initial phase of market liberalisation had been progressively withdrawn and post-2008, all access to telecommunications infrastructure is made through commercial arrangements rather than regulation.

Williamson (1991) has treated the institutional environment “as a set of parameters, changes in which elicit shifts in the comparative costs of governance”.²⁰² Therefore different institutional environments in Hong Kong and Singapore would have affected the relative transaction costs associated with the governance structures represented in the extension of “simple contracting schema” shown in Figure 1. In the political environment of Hong Kong, the transaction costs of adopting the governance structure in Singapore would be exceedingly high. For example, the enactment costs would be extremely high as any proposal to use public fund to subsidise the rollout of network infrastructure in areas where commercial investment is viable would likely be vehemently opposed to by the industry players and the legislature. The transaction costs at Node D in the Hong Kong environment are lower as multiple access networks have been rolled out. On the other hand, in Singapore, the transaction costs of adopting the governance structure at Node D would be higher. Given the lack of rollout of access networks in competition with the incumbents since the initiation of market liberalisation in 2000, there is uncertainty as to whether the competing infrastructures would be constructed following deregulation. The resulting industry structure based on facilities-based competition may also not be in accord with the government’s vision of having the infrastructure operated on an “open access” basis.

5.3 Effect of the Governance Structures

According to the foregoing analysis, the regulatory models have been chosen to minimise the transaction costs, other economic costs and social costs. It may be difficult to measure these costs directly in a comparison of the governance structures adopted in different jurisdictions. However, these costs should be reflected in the extent to which the governance structures have delivered end-users’ interests. Therefore the impact of the governance structures on the end-users’ interests may be compared. In this section, end-users’ interests delivered by the regulatory models adopted in Hong Kong and Singapore so far are compared in the dimensions of

the “positive non-interventionism” policy. The Chief Executive remarked that this term had been used many years ago and the current style of capitalism in Hong Kong should be described as “big market, small government”.

²⁰¹ Financial Secretary of Hong Kong SAR, “Budget Speech 2010 – 11”, 24 February 2010, para. 36.

²⁰² Oliver E. Williamson, “Comparative Economic Organization: The Analysis of Discrete Structural Alternatives” (1991) 36(2) *Administrative Science Quarterly* 269, p. 287.

network coverage, penetration, price, choice, quality, product differentiation and access to content and applications.

Network coverage

The strength of the Singapore approach is that through the competitive bidding exercises for the selection of the NetCo and OpCo, and binding each of the successful proposers by a contract as well as a licence, the government is able to ensure that the rollout and coverage of the next generation broadband infrastructure would proceed in accordance with the targets of the government. Although some teething problems have been encountered in the rollout, the deployment in Singapore has been on schedule, achieving 95% national coverage by July 2012.²⁰³ From January 2013, the operators of the passive and active infrastructures will have universal service obligation for NGA services.

In Hong Kong, the rollout is relying on market forces and therefore would not be under the direct control of the government. Four fixed broadband networks connected to domestic premises have been upgraded to NGA networks.²⁰⁴ They are based on fibre-to-the-building (FTTB), fibre-to-the-home (FTTH) and cable modem technologies, providing domestic customers with a wide choice of downloading and uploading speeds, up to 1 Gbps, symmetrical or unsymmetrical.²⁰⁵ The regulator has not published data on the coverage of NGA networks. Only the data on the aggregate coverage of all first generation access networks and NGA networks is available.²⁰⁶ However, according to data published by infrastructure operators and industry reports, HKBN's fibre-based network currently covers over 2 million households (or 85% of all households)²⁰⁷, Hutchison's fibre-based network covers 1.5 million households²⁰⁸, while the incumbent (PCCW)'s fibre-based network covers "some two-thirds of Hong

²⁰³ The teething problems included building access problems and delays in the installation by OpenNet. OpenNet Pte. Ltd., "Ninety Percentage Coverage Today Due to Aggressive Rollout" (2012), Media Release, 8 May 2012.

²⁰⁴ Operated by PCCW, Hutchison, Hong Kong Broadband Network (HKBN) and i-Cable.

²⁰⁵ Data from the websites of PCCW Netvigator at <http://www.netvigator.com/> (last visited 8 April 2011), Hutchison Broadband at <http://www.hgcbroadband.com/home.html> (last visited 8 April 2011), Hong Kong Broadband Network at <http://www.hkbn.net/bb1000/> (last visited 8 April 2011) and i-Cable at <http://www.i-cable.com/> (last visited 8 April 2011).

²⁰⁶ According to the data from the regulator, 86% and 75% of domestic households had choice of at least two and three access networks respectively by the end of 2011. See Office of the Telecommunications Authority (Hong Kong), "Overview of Developments in the Telecommunications Market in 2011" (2012), Presentation by the Director-General of Telecommunications on 9 February 2012, Slide 4.

²⁰⁷ The data was published on HKBN's website at <http://www.hkbn.net/new/en/about-us-company-profile.shtml> (last visited 6 September 2012).

²⁰⁸ Business Monitor International, "Hong Kong Telecommunications Report Q2 2012" (2012), Industry report, May 2012, p. 56.

Kong's households".²⁰⁹

However commercial forces in Hong Kong would unlikely drive the network operators to extend the coverage of the NGA networks to provide universal coverage. The NGA networks are likely to be extended to the newer high-rise buildings with a larger number of households per building and with adequate equipment room space and cabling facilities for the installation of fibre termination equipment and in-building wiring systems. The low-rise buildings with fewer number of households and less well provisioned with equipment room space and cabling facilities may not be connected for some years to come.

Penetration

Coverage of the NGA networks is not equivalent to penetration. Singapore fibre penetration is still lower than Hong Kong, but since the commencement of operation of the Next Gen NBN, the number of homes connected by fibre has increased steadily. In Singapore, about 15% of Singapore homes were connected by FTTH technology in June 2012.²¹⁰ On the other hand, according to Fibre-to-the-Home Council statistics, fibre-based networks served 45% of households in December 2011 in Hong Kong, the majority of which is by FTTB technology. Only 10% of households were served by FTTH technology.²¹¹

Price

Competition in Hong Kong tends to be more vigorous with frequent changes in price. In Singapore, there are price floors imposed by the access prices charged by the active infrastructure operator which in turn is constrained by the price floors imposed by the passive infrastructure operator. In Hong Kong, there are no such price floors, and the market prices tend to be set by the most efficient operator. As of September 2012, the prices for a residential broadband connection with advertised 100 Mbps download speed in Hong Kong were HK\$159 – 298 (US\$20 – 38) per month, while the

²⁰⁹ The data was obtained from PCCW's website at http://www.pccw.com/Consumer/Broadband+Services?language=en_US (last visited 6 September 2012).

²¹⁰ According to statistics published by IDA, the number of fibre-based connections at the end of June 2012 was 180,200. This figure has included residential and business connections. The majority of these connections should be residential connections. With total number of households of around 1.2 million, the % of households connected by fibre is estimated to be about around 15%.

²¹¹ Fibre-to-the-Home Council, "Economies with the Highest Penetration of Fibre-to-the-Home/Building + LAN" (2012), Data chart, published in February 2012, available at http://s.ftthcouncil.org/files/2012_global_ranking_ftth_all_countries_0.pdf (last visited 6 September 2012).

corresponding prices in Singapore were S\$53.5 – 68.27 (US\$43 – 55) per month. 1 Gbps connections were offered by Hong Kong operators at prices of HK\$199 – 498 (US\$26 – 64) per month while similar connections were offered at S\$395.9 – S\$399 (US\$317 – 319) per month in Singapore, reflecting the price floors imposed by the access prices. The costs of rolling out and operating NGA networks in Singapore are higher than those in Hong Kong. The building and population densities in Singapore are lower than those in Hong Kong and the wage level in Singapore is higher than in Hong Kong. In mid-2011, the median monthly income from main employment in Hong Kong was HK\$11,000 (US\$1,410)²¹² and the median monthly income per household member in Singapore was S\$1,990 (US\$1,592)²¹³. The median monthly income of domestic households in Hong Kong was HK\$20,500 (US\$2,628)²¹⁴, while the corresponding figure in Singapore was S\$6,307 (US\$5,046).²¹⁵ Expressed as a percentage of the median monthly income of domestic households (reflecting the fact that typically one household subscribes to one broadband connection), the prices for an NGA connection with an advertised 100 Mbps download speed are 0.8% – 1.5% in Hong Kong and 0.9% – 1.1% in Singapore. The prices in the two jurisdictions relative to the household income levels are similar.

Choice

The services-based approach in Singapore theoretically can result in a large number of choices in the market. As of September 2012, the OpCo has signed up 12 retail service providers.²¹⁶ However, to the residential households, the number of choices was five, compared with four choices in Hong Kong. This means that the other retail service providers in Singapore serve the business sector only. The markets for broadband access services in both Hong Kong and Singapore remain fairly concentrated. According to industry reports, the largest service provider in Hong Kong had 65% of the broadband access service market at the end of 2011 while the remainder of the market was shared by the other service providers.²¹⁷ In Singapore the largest three service providers (SingTel, StarHub and M1) nearly captured the

²¹² Census and Statistics Department (Hong Kong), "2011 Population Census Summary Results" (2012), Issued in February 2012, p. 61.

²¹³ Department of Statistics (Singapore), "Key Household Characteristics and Household Income Trends, 2011" (2012), para. 2, p. 1.

²¹⁴ Census and Statistics Department (Hong Kong), "2011 Population Census Summary Results", p. 68.

²¹⁵ Department of Statistics (Singapore), "Key Household Characteristics and Household Income Trends, 2011", Table 5, p. 6. The figure was for the median monthly household income from work among resident households, rather than resident employed households or retiree households.

²¹⁶ Information from the list of Retail Service Providers for the Next Gen NBN published on IDA's website at <http://www.ida.gov.sg/Infrastructure/20110512105350.aspx> (last visited 12 September 2012).

²¹⁷ Business Monitor International, "Hong Kong Telecommunications Report Q2 2012", pp. 54 – 55.

entire market of NGA services at the end of 2011.²¹⁸ So far there is therefore lack of evidence showing that the services-based competition model in Singapore has given rise to less concentrated market compared to Hong Kong.

Quality

There is no evidence that there are significant differences in the quality of the NGA services in terms of the advertised peak data speeds in Hong Kong and Singapore. As of September 2012, download speeds of up to 1 Gbps symmetrical have been offered by Hong Kong operators. In Singapore, the commonest speeds for fibre-based broadband are 100 – 200 Mbps download and 50 – 100 Mbps upload. StarHub and M1 have offered download speeds of up to 1 Gbps and upload speeds of 500 Mbps. The speed asymmetry in Singapore reflects the characteristics of the wholesale product from Nucleus Connect.²¹⁹ The active infrastructure employs two technologies – Gigabits Passive Optical Network (GPON) and Active Ethernet/Optical Ethernet (OE). Active Ethernet provides symmetrical bandwidth and is expected to serve mainly non-residential customers.

As regards the speeds achieved in practice, a report for the first quarter of 2012 by Akamai based on the huge number of requests for Internet content stored in Akamai servers connected to access networks around the world found that the speeds of end-users connections in Hong Kong are higher than those in Singapore.²²⁰ The report has however noted that the speeds in the Singapore has increased fast in the past year with year-to-year increase of 47%, presumably due to the migration of more end-users to the Next Gen NBN.

Product differentiation

For broadband access services, the services are differentiated in terms of the speeds and symmetry between download and upload transmissions. As of September 2012, providers of NGA services offer a choice of speeds between 1000 Mbps/1000 Mbps

²¹⁸ Business Monitor International, "Singapore Telecommunications Report Q2 2012" (2012), Industry report, May 2012, pp. 50 – 51.

²¹⁹ Nucleus Connect Pte. Ltd., "Interconnection Offer (ICO) Agreement Service Schedule - Residential Per-End-User Connection" , para. 4.2(a).

²²⁰ Akamai Technologies Inc., "The State of the Internet: 1st Quarter, 2012 Report" (2012), Volume 5, Number 1, 9 August 2012, pp. 14 – 16 and 21 – 23. According to this report, for average connection speed, Hong Kong ranked 3rd in the world, at 9.3 Mbps while Singapore was not within top ten countries in the world ranking, at 5.3 Mbps. For average peak connection speed, Hong Kong ranked 1st in the world, at 49.3 Mbps, with year-to-year change of 25%, while Singapore ranked 10th in the world, at 28.6 Mbps, with year-to-year change of 47%. For percentage of connections with speeds >10 Mbps, Hong Kong ranked 3rd, at 28%, while Singapore was not within top ten countries, at 7.9%.

and 100 Mbps/100 Mbps in Hong Kong and between 1000 Mbps/500 Mbps and 100 Mbps/50 Mbps in Singapore. There is no apparent difference in product differentiation among service providers in the two jurisdictions. Normally, in a jurisdiction relying on services-based competition, product differentiation is restricted by the parameters of the underlying wholesale products. In Singapore, the wholesale services offered by Nucleus Connect allow some product differentiation in terms of service performance. The retail service providers may select different speeds in the end-users' connections.²²¹ In addition to the "End-to-End" service model, Nucleus Connect also offers the "Segment-by-Segment" approach. The latter allows the retail service providers to specify the bandwidth and QoS requirements of the virtual circuits over the core and aggregation networks in accordance with the service providers' service performance requirement and traffic engineering policy.²²²

Access to content and applications

Public interests in the NGA network environment should include not only the price, quality and choice of NGA services available to end-users in the market, but also the capability of the end-users to access content and applications of their choice over the NGA network infrastructure. Openness of the infrastructure would therefore be a significant factor in delivering end-users interests.

In this regard, the "open access" model in Singapore may deliver a higher level of openness to the infrastructure compared to the end-to-end facilities-based competition model in Hong Kong. First, the entry barriers in Hong Kong are higher because investment has to be made for independent infrastructure connecting the end-users' premises. Although services-based competition could be supported by facilities-based operators offering open access on a commercial basis, it has proved difficult for significant services-based competition to develop in an environment where facilities-based competition has materialised. The fact that services-based competition is able to operate side by side with facilities-based competition is due to the existence of operating margins between the retail prices and the wholesale prices. As the level of competition intensifies, such margins would gradually be eroded, leading to the exit of the services-based operators.

²²¹ Increments of downlink or uplink speeds in blocks of 5 Mbps may be specified above a minimum speed – 25 Mbps downlink in the case of a Fast Ethernet service port and 25 Mbps downlink and 10 Mbps uplink in the case of a Gigabit Ethernet service port. See Nucleus Connect Pte. Ltd., "Interconnection Offer (ICO) Agreement Service Schedule - Residential Per-End-User Connection", para. 4.2(c).

²²² Nucleus Connect Pte. Ltd., "Guidance Notes", pp. 4 – 5.

Second, the switching barriers for certain end-users in Hong Kong are higher than in Singapore. In Singapore, alternative suppliers can reach all households when connected to the Next Gen NBN and switching takes place in central exchanges, a relatively simple operation. In Hong Kong switching to alternative suppliers may be impeded by the difficulties with laying the final access links to the end-users' premises.

Switching between alternative suppliers in the FTTB configuration should be less of a problem as the copper wires in the final access links to the end-users can be connected to the optical fibre cables of any of the facilities-based operators.²²³ However, sooner or later, upgrading of the FTTB access networks to the full FTTH configuration would need to be considered.²²⁴ At the time of review of the Type II interconnection policy, the Hong Kong regulator had not extended Type II interconnection within buildings to fibre-based systems.²²⁵ In-building optical fibres have therefore been installed without the requirement of unbundling in mind. It may be difficult for the operators owning the in-building fibres to offer other operators access to these fibres. So doing would require retrofitting optical distribution frames to facilitate the patching of terminating optical fibres to the optical fibres or splitters of different operators.²²⁶ In the FTTH configuration, if the end-user in a particular premises wishes to switch to another service provider, the new service provider will need to find a route to lay a fibre into the end-user's premises. If the conduit (or a section of it) leading into the end-user's premises is congested due to occupation by existing copper cables and the optical fibre cable of the service provider serving the end-user before the intended switch, laying another fibre cable through this route could be challenging or time-consuming. Thus the operator that first reaches an end-user with its optical fibre cable commands a strategic advantage compared with the subsequent

²²³ In the FTTB configuration, the final sections of the access links to the end-users' premises are copper wires. Such copper wires are usually part of the in-building wiring systems. A copper-based in-building wiring system can be shared among a number of facilities-based network operators. When the fibres of the network operators are brought into and terminated in the equipment room of a building, connections can be made to the in-building wiring systems for access to the end-users. In the decision of 2004 concerning Type II interconnection, OFTA confirmed that mandatory Type II interconnection to copper wires of in-building systems (including blockwiring systems and in-building coaxial cable distribution systems) will be maintained to address the potential physical and economic constraints in duplicating wiring systems within building. See Office of the Telecommunications Authority (Hong Kong), "Review of Type II Interconnection Policy", paras. 10 and 27.

²²⁴ FTTB can provide speed up to 100 Mbps using the very-high speed digital subscriber line 2 (VDSL2) technology if the length of the copper wires in the final segment of the access networks is sufficiently short. Speeds beyond that require FTTH technology.

²²⁵ Office of the Telecommunications Authority (Hong Kong), "Review of the Regulatory Policy for Type II Interconnection: Analysis of Comments Received, Preliminary Conclusions and Further Consultation", para. 29.

²²⁶ For example, see Analysys Mason, "GPON Market Review - Competitive Models in GPON: Initial Phase" (2009), Report for Ofcom, 26 October 2009, Figure 3.15, p. 24.

suppliers. One of the Hong Kong operators in its presentation to analysts made the comment that the “last mile is very congested, forming a bottleneck to copy-cat operators”.²²⁷

The combination of high entry barriers for new entrants and high switching barriers between alternative suppliers may cause concerns about potential ability of the infrastructure operators to act as “gatekeepers” controlling the access to content and applications by the end-users.

At present, there is little evidence to show that infrastructure operators are not open to content and applications providers on the Internet. Competition is intense and each competes on the basis of better bandwidth for access to the Internet. Bandwidth cost over the Internet is on the decline and congestion over the best-effort channels does not appear to be a problem yet. However, as more bandwidth intensive content and applications are developed over the Internet, and some of these “over-the-top” products may well threaten the revenue stream of the content and applications operated by, or affiliated with, the infrastructure operators, it is uncertain as to what policy the infrastructure operators will adopt. At present, the infrastructure operators offer “managed services” with Quality of Service (QoS) assurances to content and applications that need QoS better than the best-effort channels. The QoS channels provide more opportunities for the infrastructure operators to control which content and applications providers can have access to the infrastructure. The best-effort channels are operated without the need for the content and applications providers on the Internet to seek commercial relationships with the infrastructure operators. However, it is uncertain whether the best-effort channels will remain adequate to satisfy the needs of the end-users in the future knowledge economy.

In the US, the majority of the end-users face a duopoly in the supply of broadband wireline access services. That is the reason why the US regulator has to enact the net neutrality regulation²²⁸ to deal with transactions costs arising from potential discriminatory practices of the infrastructure operators against third-party content and applications on the Internet.

The US net neutrality regulation has been criticised by economists as restricting the

²²⁷ City Telecom (H.K.) Limited, "Business Case for "Fattest Dumbest Pipes"" (2010), Presentation at JP Morgan Conference Call, 29 November 2010, Slide 22.

²²⁸ Federal Communications Commission, "Report and Order in the Matter of Preserving the Open Internet and Broadband Industry Practices" (2010), FCC 10-201 adopted on 21 December 2010 and issued on 23 December 2010.

business models for the relationships between infrastructure operators and content and applications providers.²²⁹ The next generation ICT environment is becoming much more complicated than the conventional network environment. The environment consists of layers above and below the network infrastructure. Content and applications are increasingly clustered around platforms such as portals, content aggregators, end-user devices or operating systems. Any platform in any layer of the ICT environment can act as a “gatekeeper” controlling what content or applications are accessible to end-users. There exist complex and diverse relationships among the players in different layers of the environment. Restricting business models between content and applications providers and the infrastructure operators as the US regulator has done in its net neutrality regulation has many unintentional and undesirable side effects.

The better approach is to constrain the incentives and ability of the access service providers in discriminating against unaffiliated content and applications providers by lowering the barriers to the end-users to switch service providers and to the new players to enter the market. If there is a sufficient number of access services in the market and end-users can readily switch among them, discriminatory behaviours of any particular access service provider should not be a public interest concern. In this regard, the services-based and access-based competition model adopted in Singapore associated with low entry barriers and low switching barriers may be more effective than end-to-end facilities-based competition in Hong Kong in promoting openness of the infrastructure to content and applications.

This higher degree of infrastructure openness in Singapore may however be theoretical rather than empirical. It could be argued that even though switching barriers may be higher for some end-users in Hong Kong, as the access service providers would apply the same policy on access to content and applications to the whole network, the practices of the access service providers are likely to be influenced by the readiness of the end-users to switch in areas where the switching barriers are reasonably low.

In Singapore, only retail service providers are entitled to seek “open access” to the Next Gen NBN. A content or applications provider could become a retail service provider to acquire the access products to reach the end-users, but it would need to pay for the separate access link, the cost of which is likely to be passed on to the end-

²²⁹ For example, see Thomas W. Hazlett & Joshua D. Wright, "The Law and Economics of Network Neutrality" (2011), George Mason Law & Economics Research Paper No. 11-36, 15 August 2011.

user. Thus unless the end-user is prepared to pay for a separate access link to reach the content or applications, the access link must also be used as a general purpose access connection. In other words, the content or application provider needs to enter the market as a general purpose access service provider and compete with established service providers in the access service market. If this is not the business intention of the content or applications provider, the content and applications provider is likely to seek access to the retail service providers providing the access connections to the end-users in order to reach the end-users – same arrangements as for reaching end-users in Hong Kong. Discriminatory practices, if any, of these access service providers would affect content and applications providers in Singapore as in Hong Kong.

5.4 The Optimal Governance Structure

The long-term impact of the different regulatory models adopted in Hong Kong and Singapore for access to NGA networks on investment, competition, innovation, and consumer welfare has yet to be assessed as it is still a rather early stage in the rollout and adoption of the fibre-based infrastructure. Only time will tell which regulatory model will better deliver the long-term interests of the end-users and the economy as a whole.

The comparison relating to infrastructure openness suggests that in jurisdictions committed to end-to-end facilities-based competition, more attention should be paid to the higher level of entry barriers and switching barriers. Through the lens of TCE, such barriers result in higher level of asset specificity that may lead to high potential of contractual hazards and transaction costs. Although vertical integration between the access seekers and access providers in a facilities-based competition model has diminished the costs of transactions within firms operating the broadband infrastructure, higher levels of transaction costs may be experienced at the edge of the infrastructure, in the relationships between the end-users and the infrastructure operators, and those between the infrastructure operators and content/applications providers.

In an environment that relies on facilities-based competition up the end-users' premises, the end-user and the infrastructure operator that has laid the cable to the particular premises would both face high level of asset specificity. The end-user, by allowing the operator to occupy the limited resource of space in conduit leading to the end-user's premises, has entered into a relationship of dealing with that particular operator and it could be quite time-consuming and inconvenient to switch to another

operator. The operator that has laid the cable into the end-user's premises has also made an investment that is of little value in serving other end-users. Both parties are therefore locked into a position of dealing with each other, at least until the end-user has managed to switch to another operator.

In the theories of TCE, contracting parties are compelled to deal with each other not necessarily because either party has substantial market power in the market it is operating in, but because of investment in specific assets which would have higher value within a particular contractual relationship than outside it. In other words, switching to other contracting parties would involve substantial transaction costs, represented by the loss of value of the assets concerned. High level of transaction costs may exist despite absence of substantial market power. The problems of access to the NGA network infrastructure will be brought into a better focus in the theories of TCE as the problems are more likely to be due to asset specificity in the relationship between the contracting parties instead of substantial market power in the larger neoclassical market. This suggests that regulation should be dealing with asset specificity, rather than market power in traditional theories of law and economics.

According to traditional theories of law and economics, regulation may be considered to address failures of the market to deploy resources efficiently. After a *prima facie* case for regulation is established based on the existence of "market failure", regulation is compared with leaving the market alone, and regulation is applied only if it can deliver net benefits (benefits outweighing its costs) compared with the market. Such an approach has been incorporated into the best practices for regulation in many developed economies.²³⁰

The problem with a strict application of this approach is that if the state of affairs in the market has not crossed the threshold of "market failure", regulation will not be considered and the comparison with the market will not be performed. For example, under the EU regulatory framework for electronic communications networks and services, *ex ante* regulation may not be applied unless there exists in the relevant market an operator with significant market power.²³¹ In the absence of significant market power, the market approach will continue to be adopted. This approach reflects the philosophy of bias against state intervention in economic affairs, but could

²³⁰ OECD, "Regulatory Impact Analysis: A Tool for Policy Coherence" (2009), Report published on 11 September 2009, pp. 66 – 68, 74.

²³¹ Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive) as amended by Directive 2009/140/EC, Article 8.

leave some problems due to transaction costs unresolved simply because the threshold of “market failure” has not been crossed.²³²

Scholars have recognised the difference between the larger neoclassical market and the narrower market in the relationship between the end-users and the infrastructure operators. The latter market is called “Coasean market” after Coase (1960)’s famous paper *The Problem of Social Cost*. This paper referred to the 1879 case *Sturges v Bridgman* in the Court of Appeal of England and Wales.²³³ Another paper by Hovenkamp (2010)²³⁴ referred to the 1992 *Kodak* case²³⁵ in the US Supreme Court. The doctor Sturges and the confectioner Bridgman in the former case, and the photocopier producer Eastman Kodak and the independent service organisations Image Technical Services in the latter case were forced to deal with each other in a “bilateral monopoly” situation because of transaction costs, but they all did not possess market power in the markets that they operated in. As Hovenkamp (2010) points out, TCE examines conduct in the “Coasean market” while market power is assessed with reference to the larger neoclassical market.²³⁶ Traditional law and economics look at market power in the broad product and geographic markets and caution against defining the market too narrowly. The Coasean markets would be too narrow to be analysed under traditional law and economics. Behaviours in the Coasean market would not affect prices and output in the neoclassical markets²³⁷, but would have an impact on the interests of the contracting parties. The problems of access to the NGA infrastructure will be brought into a better focus in the theories of TCE as the problems are more likely to be due to asset specificity in the Coasean markets instead of substantial market power in the larger neoclassical market.

There are reasons why problems due to transaction costs in the Coasean markets would still arise even though the larger neoclassical market is competitive. Service providers compete on the basis of parameters that are readily recognisable by the potential customers, such as prices and advertised speeds of the services. The potential customers typically have little information about the service quality and the policies of the service providers in traffic management and openness towards third-

²³² For this reason, the EU regulatory framework contains a separate provision to deal with problems, for example, those of access to content and applications over communications networks, in a market without significant market power. See *id.*, Article 5.

²³³ *Sturges v Bridgman*, (1879) 11 Ch. D. 852. See R. H. Coase, "The Problem of Social Cost" (1960) 3 *The Journal of Law and Economics* 1, p.8.

²³⁴ Herbert J. Hovenkamp, "Harvard, Chicago, and Transaction Cost Economics in Antitrust Analysis" (2010), University of Iowa Legal Studies Legal Research Paper No. 10-35, December 2010, p. 14.

²³⁵ *Eastman Kodak Co. v Image Technical Services*, 504 US 451 (1992) (US Supreme Court, 8 June 1992).

²³⁶ Hovenkamp, "Harvard, Chicago, and Transaction Cost Economics in Antitrust Analysis", p. 10.

²³⁷ *Id.*, p. 15.

party content and applications. By the time the potential customers become actual customers and these other parameters become known, the customers may have already entered into term contracts with the service providers. At that point, the customers may be reluctant to switch even though they may not gain access to certain content or applications. For example, the customers may find certain other features of their existing services to be more preferable, be accustomed to certain content and applications available only from the current service providers, be deterred from switching by the service disruption or inconvenience of changing service providers or be obstructed from switching by some unfair arrangements on automatic renewal of contracts.

There is evidence showing that asset specificity reflects better the regulatory concerns in an environment relying on facilities-based competition. In Hong Kong, the broadband market has often been described as intensely competitive. This means that there is absence of any market failure or any operator with significant market power. Therefore the broadband market would need no regulatory attention. This obscures the potential problem associated with a higher level of asset specificity in the relationships between the end-users and the infrastructure operators and in those between the content/applications providers and the infrastructure operators, particularly when the NGA networks migrate to the FTTH configuration.

The EU regulatory framework for electronic communications networks and services has included a provision whereby national regulatory authorities may impose obligations on “undertakings that control access to end-users” to ensure end-to-end connectivity.²³⁸ Control of access to end-users may entail ownership or control of the physical link to the end-users and end-to-end connectivity may be impaired if network operators should restrict unreasonably end-user’s access of Internet portals and services of their choice.²³⁹ This imposition of obligations is separate from that of imposing regulatory obligations on operators found to have significant market power.

6. Conclusions

Hong Kong and Singapore have adopted two different models for governance structure applied to NGA networks. Up to now, there is no predominant case that one model is better than the other. Despite the divergence, the approaches in the two

²³⁸ Directive 2002/19/EC of the European Parliament and of the Council of 7 March 2002 on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive) as amended by Directive 2009/140/EC, Article 5.

²³⁹ Id., recital (6).

jurisdictions have achieved significant rollout of the NGA networks and a competitive market in the provision of access services to end-users. The penetration of fibre-based services in Hong Kong is still higher than in Singapore, but the penetration in Singapore is increasing steadily since the commencement of operation of the Next Gen NGN and is likely to approach the same level of Hong Kong. The fibre-based services in Hong Kong are based on FTTB and FTTH, but the fibre-based services in Singapore are all based on FTTH which will have more potential for upgrading. Universal service will also be achieved in Singapore. Hong Kong price competition tends to be more robust, without constraints by price floors. There is no significant difference in the choice, quality and product differentiation of NGA services in Hong Kong and Singapore. Both markets remain concentrated. The Singapore model potentially lowers barriers to entry and switching barriers between service providers, with higher degree of openness to content and applications, but the benefits are so far theoretical rather than empirical. The problems, if any, faced by content and applications providers in reaching the end-users are essentially the same in the two jurisdictions.

Once adopted, it is not easy for either jurisdiction to change to another regulatory model. The Hong Kong model appears to be working well, giving end-users very good deals. There is no reason to consider alternative models. In any case, the Singapore model is not politically feasible in Hong Kong. However, this does not mean that the current model does not need a review after the decision to deregulate taken some ten years ago. This study has identified the potential transaction costs due to high level of asset specificity associated with a market-driven and facilities-based competition model.

Compared with a jurisdiction like Singapore where the NGA network is operated on an “open access” basis, the reliance on end-to-end facilities-based competition has the potential of higher asset specificity at the level between the end-users and the infrastructure operators and between the content/applications providers and the infrastructure operators. Hong Kong needs to review its regulation to see if such asset specificity can be adequately dealt with. For example, the regulator needs to review whether consumer protection measures are adequate to enhance the transparency about the quality of service and the policies of the infrastructure operators in traffic management and openness towards third-party content and applications on the Internet. Such transparency will enhance the end-users’ ability to choose the services in the market, thus lowering switching barriers and asset specificity. The regulator should review the problems of installing optical fibre cables to the end-users’

premises, when the existing FTTB access networks are upgraded to FTTH in the future. The regulator should consider if the problems can be ameliorated by expanding the facilities (e.g. conduits and ducts) for optical fibre cables within buildings, commercial collaboration between the infrastructure operators and whether any regulatory intervention is warranted. Asset specificity problems can be reduced if content and applications can reach end-users through multiple routes, by interconnection between access networks, and by interconnection between access networks and multiple backbone networks. The existing regulation on interconnection should be reviewed to see if it is adequate to deal with the delivery of content and applications over the interconnection rather than just “telecommunications services”²⁴⁰ licensed in Hong Kong. The government should also consider a declaration of policy of maintaining an open Internet and such policy objective should be incorporated into the telecommunications law as one of the factors to be considered by the regulator in the enforcement of regulation on interconnection and access.

The theories of TCE provide useful tools for the analysis of access regulation in the NGA network environment. The “discriminating alignment hypothesis” has been found to be generally true. The transactions of access to the final access links to the end-users are associated with high levels of contractual hazards. Therefore these transactions are aligned with the governance structures that can address the contractual hazards more effectively. These governance structures are the vertical integration between the access providers and the access seekers in Hong Kong or the stronger form of access regulation (incorporating obligations to make standard interconnection offers, structural and operational separations, strict non-discrimination, etc.) in Singapore. The transactions have not been aligned with the more market-oriented governance structures such as the market (in the sense that the access seekers freely contract with the access providers in the market) or a weaker form of access regulation based on the “negotiate-arbitrate” model. The economic agents have therefore chosen the governance structures to minimise transaction costs, and a mismatch between the transactions and the governance structures is unlikely to minimise transaction costs, as predicted by the “discriminating alignment hypothesis”. However, this hypothesis needs some further elaborations. First, the economic agents have considered more than transaction costs in the choice of governance structures.

²⁴⁰ At present, under section 36A(3D) of the Telecommunications Ordinance, the regulator is empowered to determine the terms and conditions of “interconnection” which includes “an arrangement among 2 or more parties for interconnection to and between telecommunication systems or services” licensed under the Ordinance.

The agents have chosen the governance structures that can minimise the sum of transaction costs, production costs, other economic costs and social costs. Second, transactions with similar attributes may be aligned with different governance structures as in Hong Kong and Singapore. The choice of governance structures has been affected by the institutional environment.

Finally, the TCE theories have not provided definitive answers to the question of what should be the optimal choice of governance structure. The optimal governance structure should be the one that can minimise the sum of transaction costs, production costs, other economic costs and social costs in a given institutional environment. However, the determination of the regulatory model that can deliver this cost minimisation requires much fact-finding, analysis and foresight of the policymakers and the regulators. This study has found that consideration of only “market failure” or “significant market power” in the larger neoclassical market may not adequately protect end-users’ interests in the NGA network environment. “Asset specificity” should also be considered in deciding the optimal form of governance structure.

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