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Cost-Based Access Pricing and Regulatory Challenges

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Abstract

The opening of the fixed telephony, mobile and data communications markets to competition, in conjunction with the subsequent reduction and elimination of entry barriers have allowed new telecommunications operators to launch their operations and develop. While traditional telecommunications business models required large amounts of money to be raised up-front in order to finance huge investment in network infrastructure, new business models are based on new entrants obtaining access to incumbents' "essential facilities" through interconnection and access agreements. In this paper, we analyze the costing methodologies adopted for pricing interconnection and access services in Brazil, and the regulatory challenges associated with setting cost-based access prices in telecommunications networks taking into account the technological uncertainty, demand uncertainty and the move to a full-service broadband (IP) network

Keywords: *Telecommunications, Costing, Interconnection, Access, LRIC*

Introduction

Regulators in different parts of the world have adopted cost-oriented prices for interconnection and access services in the effort of promoting service-based competition in telecommunications while also allowing for long term infrastructure competition. In line with international best practices, the Brazilian regulatory authority (Anatel; Agência Nacional de Telecomunicações) has recently adopted new regulations on cost-based access pricing targeting to ensure new entrants' access to existing network facilities on conditions that enable them to compete with incumbent operators.

Access or "essential facility" problems arise whenever the provision of a complete service to end-users requires the combination of two or more inputs, one of which is non-competitive (Armstrong, 2001; Laffont and Tirole, 2000; Valletti

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and Estache, 1999; Noam, 2002). The services that qualify as "essential facilities" to which access is mandated in the Brazilian regulatory framework are: (i) fixed call origination/termination service (local fixed interconnection); (ii) transit service (long distance fixed interconnection); (iii) mobile call origination/termination service (mobile interconnection); (iv) wholesale leased lines; (v) local loop unbundling. Anatel's regulations on cost-based access pricing determined that the access tariffs charged for the services that qualify as "essential facilities" will all be based on costs: either Long Run Incremental Cost (LRIC) or Fully Allocated Cost (FAC).

In this paper we analyze Anatel´s recent regulations on cost-based access pricing and point out regulatory challenges that need to be addressed so as to promote service-based (retail) competition without reducing incentives to build new networks or upgrade existing ones.

Cost-based Access Pricing

Anatel determined that two different costing methodologies should be used to measure the costs of access services: LRIC and FAC. The LRIC approach will be used for costing local fixed interconnection and transit services (Anatel, 2007), wholesale leased lines (Anatel, 2005a) and local loop unbundling (Presidency, 2003), while the FAC approach will be used for costing mobile interconnection services (Anatel, 2006).

The Fully Allocated Cost Model

Virtually all of a company's activities exist to support the production and delivery of "products/services". ABC systems (Cooper and Kaplan, 1991) first accumulate overhead costs for each of the activities of an organization, and then assign the costs of activities to the products, services, or other cost objects that caused that activity. This methodology uses as its basis the cause of costs (referred to here as cost drivers), allowing the tracing and allocation of costs through the activities performed.

In the FAC model (Anatel, 2005b), the revenue, costs and asset allocation process consists of a series of allocations to smaller and smaller groups (or cost pools) such that at the end of the process all revenues, costs and capital employed are allocated to "products/services". As shown in Figure 1, the cost allocation process includes intermediate stages of activities that enable a higher proportion of indirect costs to be allocated in an objective fashion to "products/services".

Following are the cost centers considered in the FAC model:

- Products and Services: cost center composed of the set of "products/ services" that are pooled into Product Lines and Business Areas.
- Primary Plant: cost center made up of elements that perform network functions that are vital for the provision of telecommunications services and the costs ascribable to it (e.g., switches).

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- Support Plant: cost center composed of infrastructure components that support the primary plant (e.g., electric power plant).
- Support Functions: cost center composed of costs and assets related to functions that are not directly linked to the provision of telecommunications services, but that are required for the operation of the company (e.g., maintenance).
- Common Costs: cost center made up of costs and assets related to functions that have no causality relation with the provision of “products/services”, but are required for the operation of the company, in respect to which one was unable to find a rule for allocating the cost to other cost centers.

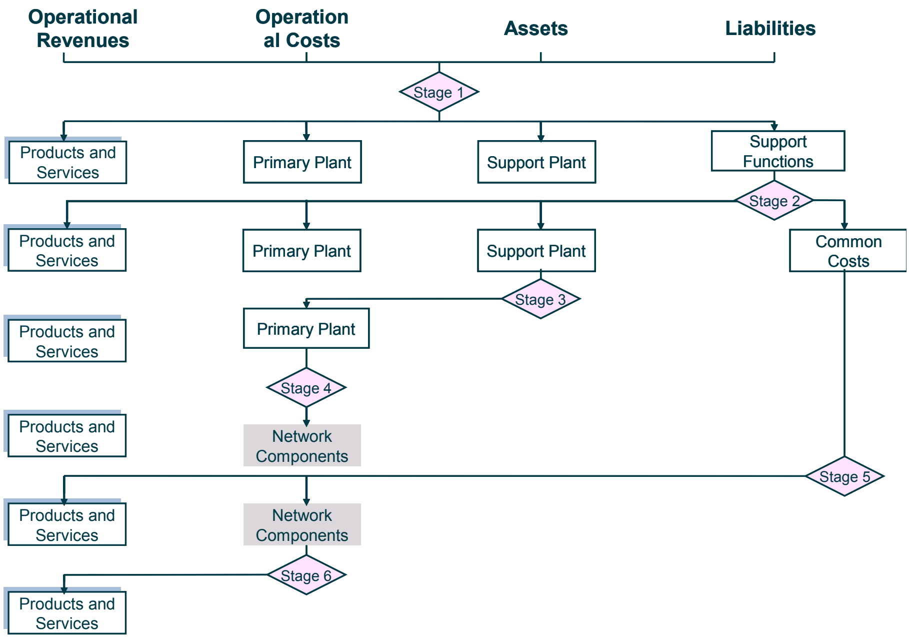

Figure 1 - Cost allocation process used in the FAC model

The costs of the various network elements should be allocated to network services according to the amount of network element resources used by each service. In accordance with this concept, the investments/costs associated with each network element (depreciation expenses, operating expenses and cost of capital) needs to be unitized according to the demand cost driver associated with the network element. For example, if the demand cost driver associated with the network element is “minutes of traffic”:

Unitary cost of network element = Network element costs / Total element traffic

Network costs are then assigned to network services on the basis of how

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much each service uses each network element (which can be measured in terms of "minutes of traffic", "number of calls", "number of subscribers", "capacity utilized", or other appropriate volume unit). In general:

Service unitary cost = Σ Usage of network element by the service * Unitary cost of network service

Common costs should be allocated to "products/services" and "network elements" on the basis of the EPMU (Equi-Proportionate Mark-Up) method, i.e., in proportion to the sum of the directly attributable costs, plus indirectly attributable costs that have been allocated to the "product/service" and "network element".

Transforming the HCA Cost Base to the CCA Cost Base

The CCA cost base should be built considering the efficient utilization of resources and taking as basis the real network of the telecommunications operator (Anatel, 2005c), so that excess capacity needs to be excluded from the CCA valuation. An asset is considered to have excess capacity if there is non-used capacity (above the acceptable safety margin) that is not expected to be used in a time horizon of three years.

Capital costs associated with a fixed asset is calculated by multiplying the asset's net current value by the company's weighted average cost of capital. Usually, the current value of an asset is equal to the net current replacement cost, which is often derived from the asset's gross replacement cost (equal to the current purchase price of an identical new asset, or the cost of a Modern Equivalent Asset (MEA) with the same service potential).

Depreciation expenses should be adjusted to reflect the current value of the assets, but the economic asset life and depreciation profile used for the HCA and CCA cost bases should be identical. The value of the depreciation expense under the CCA cost base is the difference between the net current value of the asset in the beginning of the period and the net current value of the asset at the end of the period.

The impact of MEA over operational costs, such as the maintenance, space and energy costs needs to be reflected in the CCA cost base, so that appropriate adjustments need to be made to the operational costs.

The LRIC Cost Model

The methodology used to calculate the LRIC considers the cost that would be avoided in the long run by not producing one unit of "increment" (e.g., a "product/service" or "network element"), given that costs may vary and some level of output already exists. In other words, incremental costs are those costs incurred in connection with the supply of a given "increment" in addition to the costs already incurred by the company for supplying the remaining "increments". With respect to the total cost of the company, the incremental cost of a given product is numerically equal to the savings that would be obtained had the product not been supplied. The total incremental cost

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of an “increment” is the sum of the costs that would be avoided by not producing the “increment” (the “pure LRIC”) and a mark-up in respect of common costs.

The LRIC model (Anatel, 2005d) uses costs and asset values adjusted to the current cost accounting basis and consolidated into cost and asset groups (or cost categories) of similar cost/asset types and identical cost drivers. The key component of the top-down LRIC analysis (and the main difference between FAC and LRIC) is the mapping and building of the Cost-Volume Relationships (CVRs).

The CVR is a curve that describes how the costs associated to a given cost category (y-axis) varies with the volume of its associated cost driver (x-axis). The appropriate cost measure is the long run cost, which includes all costs that are present in this cost category (capital costs, operating costs, allocated indirect costs, etc.) stated in a long run annualized cost basis. The cost that would be avoided in the long run by not producing one unit of “increment” should be computed with reference to the CVR of each cost category by analyzing the impact of the “increment” on the volume of the cost driver of each CVR (see Figure 2). The processing sequence should be determined by the CVRs calculation hierarchy, which reflects the dependency between cost categories in such a way that independent categories (where cost drivers are linked to exogenous factors) are processed first, and thereafter the cost categories with first order dependency, second order dependency, and so on (where cost drivers are linked to endogenous factors) are processed.

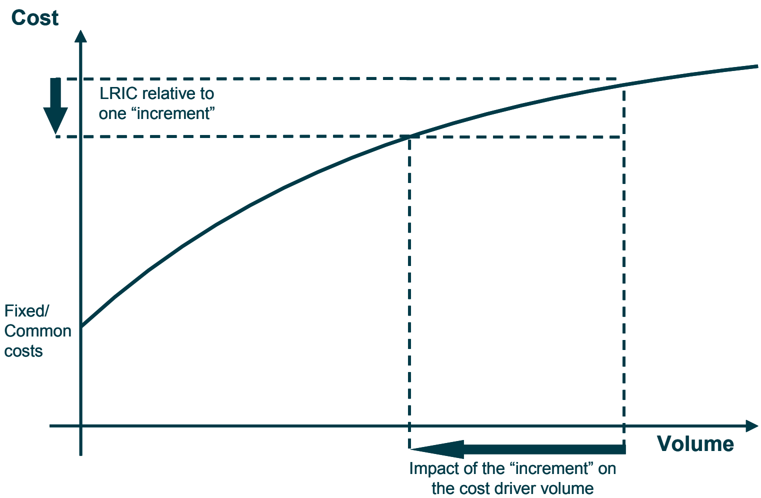

Figure 2 - Contribution of a cost category to the LRIC of an “increment”

Each cost category needs a CVR associated to it. The CVRs may be estimated using technical economic models, simulations produced by engineering experts (mostly used for network cost categories), regression and statistical analysis, or through the analysis of the processes which are at the basis of the activities. CVRs may be straight lines, convex curves or concave curves, depending on whether the

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cost category exhibits constant returns to scale, diseconomies of scale or economies of scale, respectively.

Common costs should be allocated to "products/services" and "network elements" on the basis of Equi-Proportionate Mark-Up (EPMU) method. Costs shared by more than one "increment" should also be distributed to "products/services" and "network elements" pursuant to the EPMU methodology.

Analysis of Current Regulations on Cost-based Access Pricing

The purpose of Anatel's current regulations on cost-based access pricing is to promote service-based competition by ensuring new entrants' access to existing network facilities on conditions that enable them to compete with incumbent and SMP operators. The key issue has been how to establish a pricing mechanism that ensures both optimal competition and investment in network facilities.

- Service-based entry has low investment requirements (as it relies on access to the incumbents' networks) and can help competitive service providers quickly build up a subscriber base, and then move them over to their own facilities.
- Facilities-based entry, on the other hand, is more expensive for new entrants, but leads to more vigorous competition because the competitors can provide their own innovative services (it only requires interconnection with incumbents).

Therefore, access tariffs should not be so high as to discourage service-based entry and/or increase the retail price charged to end-users, but it should not be so low as to discourage efficient investment in network facilities and/or delay facilities-based competition.

Comparison between FAC and LRIC

FAC is an accounting based approach that allocates total costs to services. It is usually based on audited costs of existing network (but can also be converted to current costs), and considers actual installed capacities and actual costs of operation (if current cost accounting is followed, then costs of operation are adjusted). The concept of fully allocated costs implies a top-down costing system where all costs incurred are attributed to services based on pure activity-based costing (ABC) rules, so that costs and assets should be grouped by activity and network element before they are "fully" allocated to products and services. When undertaking the FAC study, the number of cost categories used to derive services costs will depend upon the level of detail available in the company´s accounting and operational systems. Also, the level of detail and accuracy associated with the costs of each service is dependent upon the number of cost categories and the accuracy of the information they contain. This is of particular concern to Anatel, as they will need to evaluate and validate FAC and LRIC models of different incumbent fixed and SMP operators, which are based on different

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accounting systems and subject to different levels of detail and accuracy.

LRIC is an economic approach that measures the costs that would be avoided in the long run by not producing one unit of "increment" (e.g., network element, service, group of services) (British Telecom, 2007). LRIC is based on forward-looking costs of a network that is assumed to be efficient, and considers efficient levels of capacity and efficient costs of operation. For all these reasons, LRIC is the methodology that better mirrors the effect of efficient competition in the market. It can be calculated using two different approaches: top-down or bottom-up.

- The top-down approach is based on the costs actually incurred by a telecommunications operator and the data appearing on its accounting system. The entire network is costed (from accounting data), and then apportioned to individual network elements and services through the use of Cost-Volume Relationships curves (CVRs).
- The bottom-up approach establishes a number of assumptions on how an efficient operator would be structured to meet a given level of demand for services, and what kind of cost would it incur in. The network design is specified based on demand assumptions, individual network elements are costed, and then the full network is costed.

The LRIC study may use a similar set of cost categories (activity centers and network elements), but it differs from the FAC in the way it allocates these costs to products and services. First, the LRIC model allocates variable costs to services based on the impact of service removal on the cost driver volume of each cost category (see Figure 2). It starts from 100% of the cost driver volume and, after removing the service volume, it reads off the contribution of that cost category to the "incremental" costs (the "pure LRIC") associated to that service. It then continues with the next service that uses the cost category at hand, starting over from 100% of volume. Therefore, if the CVR curve is concave, the total amount of variable costs allocated to services (the sum of the pure LRIC of all services that use that cost category) will be lower than the total amount of variable costs in the cost category, what indicates the presence of fixed common and joint costs.

Joint costs are determined, for each cost category, by calculating the difference between the total amount of variable costs and the sum of the pure LRIC of all services that use that cost category. These costs are very significant in telecommunications networks, and they should allocated proportionally based on the pure LRIC of each service, so that the total amount of variable costs allocated to services (the "distributed LRIC") is exactly equal to the total amount of variable cost of that cost category. Common costs are then allocated proportionally based on the distributed LRIC of each product or service, so that at the end of the process the total amount of fixed and variable costs allocated to services (the "fully loaded LRIC") is exactly equal to the total amount of fixed and variable cost of all cost categories. However, since the LRIC model is developed using the CCA cost base (considering the efficient utilization of resources), excess capacity needs to be excluded from the

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cost categories prior to all these LRIC calculations.

Whatever the approach used for LRIC (top-down or bottom-up), the pricing and costing mechanism should take into account the possible evolution patterns of networks and services. The authors in Pannone (2001) proposed an approach towards the creation of dynamic scenarios to facilitate the assessment of alternative investment strategies in additional capacity/technology.

Cost-based Access Pricing Adopted in Brazil

Anatel adopted pricing and costing mechanisms that are in line with international best practices: the reconciliation of top-down and bottom-up LRIC for costing local fixed interconnection and transit services, wholesale leased lines, and local loop unbundling (areas where there are concerns about the efficiency of the incumbent/SMP operators), and the reconciliation of FAC-HCA and FAC-FLCCA for costing mobile interconnection services (where there is limited concern about efficiency). However, the implementation of such pricing/costing mechanisms in Brazil will require a significant level of effort from the regulatory agency.

There are a number of steps involved in completing a cost study, such as: (i) define the cost study methodology; (ii) define the cost model; (iii) gather base data; (iv) derive needed cost study data; (v) derive network component cost; (vi) derive service cost; (vii) validate service cost. It is necessary to decide how these activities should be distributed between the regulatory authority and the telecommunications operators.

- In many telecommunications markets, the operators develop the cost studies, and the regulatory agency just evaluates and validates the study.
- In Brazil, Anatel will evaluate and validate the cost studies prepared by the telecommunications operators, and – at the same time – it will develop the bottom-up LRIC and FAC-FLCCA cost models respectively for the incumbent fixed carriers and SMP mobile operators.

Regulatory Challenges

There are a number of regulatory challenges associated with setting cost-based access prices that deserve special consideration, particularly the challenges associated with technological uncertainty, demand uncertainty and the move to a full-service broadband network.

Technological Uncertainty

In telecommunications networks, capital investments tend to be high, so that a significant portion of the costs associated with "products/services" relates to capital costs. Such investments are in large part irreversible – they involve sunk costs (costs that cannot be recovered if the economic activity ceases). In other words, if the economic return of such investments falls below competitive levels, the firm cannot

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shift the investments to other uses. Incumbent carriers must share the use of their network facilities with rivals (competitive carriers) at the option of the rivals, who are free to utilize the network facilities they choose when and for how long they wish. New technologies will periodically arrive on the market and strand old technologies. In the fixed network, copper distribution cable and digital circuit switches will soon be replaced by fiber cable and Next Generation Network (NGN) switches. In the mobile network, 2G technology will soon be replaced by 3G technology. Any cost based approach to pricing access services leaves significant sensitivity of returns to subjective parameters such as economic asset lives and economic depreciation profiles (Hardin *et al.*, 1999; Davies *et al.*, 2004). Interconnection and access tariffs will be revised every three years on the basis of forward-looking costs. The incumbent/SMP operators cannot offer discounts based on the term of contract, volume of traffic, or total value of contract, and the competitive operators are under no obligation to financially support network investment (as they do not bear the risks associated with sunk investments). In order to provide the right incentives for efficient investment in infrastructure and allow the incumbent/SMP operators to properly recover their capital investments, access prices should reflect the risk associated with technological uncertainty and investment in sunk assets. Mathematically, real option models and technology survivor curves can be built to value the costs imposed by technology uncertainty in the presence of sunk costs (Hausman, 1998; Pindyck, 2004).

Demand Uncertainty

The annualized costs associated with each network element (depreciation expenses, operating expenses and cost of capital) need to be unitized according to the demand cost driver of the network element. Incumbent and SMP operators must develop traffic and demand forecasts based on their expectations on how the market should develop in the three years following the submission of the regulatory accounts to Anatel:

- In the top-down LRIC model, the demand forecasts will be used to eliminate the costs associated to spare network capacity (network capacity that is not planed to be used in the next three years) before calculating network element unit costs.
- In the bottom-up LRIC model, the demand forecast will be used to dimension the network according to network sizing rules, which are based on cost driver volumes.

Considerable uncertainty exists in the demand forecasts to be used in the LRIC model. Demand forecast should take into account the impact of Voice over Broadband (VoBB) and the effects of fixed-mobile substitution on fixed line and traffic demand volumes. Incumbent local carriers can expect a broad substitution of wireline narrowband access lines by wireless, mobile and broadband access. This will strand large quantities of network equipment, including switching, circuit, and outside plant equipment (e.g., copper cable). The authors in Garbacz and Herbert (2007) proposed a recent study on the demand for telecommunications services in developing countries.

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In order to allow the incumbent/SMP operators to properly recover their capital investments, access prices should reflect the risk associated with demand uncertainty. Real option models and competition survivor curves can be built to value the costs imposed by demand uncertainty in the presence of sunk costs (Hausman, 1998; Pindyck, 2004).

The Move to a Full-service broadband Network

In the long term, the incumbents' networks will transition from a primarily voice network to a full-service broadband (IP) network that provides a full range of communications services, including voice service and high-speed data service for Internet access. IP interconnection has always been governed by commercial negotiations between operators (not regulated). The form of interconnection that evolved is known as "peering", which involves a bilateral exchange of traffic between two similar operators. Peering enabled backbone providers to join together to create the Internet ("network of networks") and sell access to the Internet ("IP transit") to smaller providers, including the Internet Service Providers that provided access to end users.

Voice-over-IP (VoIP) service providers are able to offer voice services independently from ownership of the network. New entrant (competitive) service providers may consider it beneficial to interconnect with other service providers on a settlement-free basis for voice traffic, as is the case with IP peering today for data traffic. Mathematically, cooperation on network sharing leads to cooperative games, while the non cooperation on revenue maximization leads to non-cooperative games. There is a large literature on network games for access and interconnection pricing (Altman *et al.*, 2006; Kang *et al.*, 2007) and equilibrium modeling (Altman *et al.*, 2006; Orda *et al.*, 1993; Korilis, 1995; Altman and Azouzi, 2007).

The incumbent carriers, on the other hand, may not find it beneficial to interconnect with VoIP service providers on a settlement-free basis for voice traffic, and new interconnection arrangements will need to be developed based on the stochastic use of reserved capacities over time, as the costs of providing a service (voice, video, audio and data) depend on the Quality of Services (QoS) values assigned to that service. Different Class of Service (CoS) can be defined, each associated with its corresponding "Service Level Arrangement" and QoS specifications. Different applications will exhibit varying degrees of sensitivity to QoS parameters. For instance, real-time voice and video are very sensitive to delay and jitter, while traditional data applications are more sensitive to packet losses (DaSilva, 2000; Falkner *et al.,* 2000).

A key aspect of both the LRIC and FAC methodologies is the causal allocation of network elements to services. Network elements form the "building blocks" of any network cost model, and routing factors are used to allocate network costs onto services based on the extent to which each service causes the cost. For most network driven costs this is dependent upon two factors: (i) the relative capacity consumed by a unit of demand of each service; (ii) the path through the network that the demand takes. Cost and tariff schemes either based on connection time and

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distance (e.g., for voice service), or on a flat rate (e.g., for broadband access service) measure the usage time of a virtual channel under an assumed average information rate – or, in the case of flat rate, under an average utilization level among users. The evolution from circuit switched to packet switched technology, together with the introduction of new services using the IP protocol have made these types of tariffs inefficient, and require the study of new models. Pricing under QoS requirements has to consider the stochastic use of some reserved capacities over time and leads to more sophisticated models, as the costs of providing a service depend on the QoS values assigned to that service (Davies *et al.*, 2004).

Conclusion

The Brazilian telecommunications industry has been completely transformed by the introduction of competition. An industry which was once organized as a protected utility is now one of the more dynamic and innovative sectors in the Brazilian economy. However, the process of introducing competition has not been easy, and many issues have arisen in the last few years related to interconnection and access – that is, issues related to which facilities should be made available by the incumbent carriers, and on what terms and conditions. In this paper, we analyze the recent regulations on cost-based access pricing, noting that if a cost-based price is to be applied, the interconnect and access costs should be computed so as to promote service-based (retail) competition without reducing incentives to build new networks or upgrade existing ones.

In telecommunications networks, capital investment tends to be high, so that a significant portion of the costs associated with “products/services” relates to capital costs which are in large part sunk costs. Technology and demand uncertainty, together with the move to full-service broadband networks, pose a significant challenge to the task of setting pricing and costing mechanisms that take into account the possible evolution patterns of networks and services. We conclude the paper showing the regulatory challenges associated with setting cost-based access prices in telecommunications networks – taking into account the technological uncertainty, demand uncertainty and the move to a full-service broadband network – so as to promote service-based (retail) competition without reducing incentives to build new networks or upgrade existing ones.

Some research perspectives may be highlighted: (i) Real options models can be built in order to estimate the costs associated with technological and demand uncertainty in the presence of sunk costs; (ii) Mortality, technology and competition survivor curves can be developed for major network asset categories in order to produce depreciation profiles that reflect the asset’s expected loss of value over time; (iii) Sophisticated models can be built for pricing and costing IP-based services under QoS requirements (voice, video, audio and data) provided in a full-service broadband (IP) network.

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