



Competition, Interconnection and Price Regulation

Module 2

ICT Regulation Toolkit

EXECUTIVE SUMMARY

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The full module is available online at:

<http://www.ictregulationtoolkit.org/en/Section.1560.html>

For more information, please see:

<http://www.ictregulationtoolkit.org>.

ABBREVIATIONS AND ACRONYMS

COSITU	ITU model for the calculation of costs, tariffs, and rates for telephone services
CPP	Calling Party Pays
DSLAM	Digital subscriber line access multiplexer
EU	European Union
FCC	Federal Communications Commission
GSM	Global System for Mobile Communications
ICT	Information and Communication Technologies
IP	Internet Protocol
ISP	Internet Service Provider
IXP	Internet Exchange Point
LRIC	Long-run incremental cost
PBX	Private branch exchange
PSTN	Public Switched Telephone Network
TELRIC	Total Element Long Run Incremental Cost
TSLRIC	Total Service Long Run Incremental Cost
VoIP	Voice over Internet Protocol
WTO	World Trade Organization

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Introduction

This document summarizes the content of Module 2 of the ICT Regulation Toolkit on Competition, Interconnection and Price Regulation that was prepared by a consortium consisting of NERA Economic Consulting, Castalia Strategic Advisors, and Kalba International.

The web site for Module 2 of the ICT Regulation Toolkit is located at:

<http://www.ictregulationtoolkit.org/en/Section.1560.html>. The material on the web site is much more extensive than what could be included in this document. The reader is referred to the web site to read the full text of what has been prepared. This document is replete with references to sections of the web site (i.e., “see Section 3.2”), and it is to the web site that the reader is referred, not to other portions of this document.

I. OVERVIEW: PUTTING ICT REGULATION IN CONTEXT (Section 1)

This section discusses some key trends in the regulation of information and communication technologies (ICT). These trends provide important context for the specific issues of competition policy, interconnection, and pricing discussed in this Module.

Specifically, this section provides an overview of:

- key technological and market shifts (see section 1.1) taking place in the ICT sector; and
- recent trends in ICT regulation (see section 1.2), particularly the section concerning the shift from government-owned monopoly provision to a more competitive model.

A. Key Developments in the ICT Sector (Section 1.1)

The ICT sector is changing rapidly. The nature and pace of change create challenges for both regulators and regulated firms. This section provides an overview of key developments in the ICT sector across four categories:

- Technological changes.
- The emergence of new services.
- Changes in market structure and the level of competition.
- Financial forces that are affecting the sector.

B. Trends in ICT Regulation (Section 1.2)

This section draws on the ITU series “Trends in Telecommunication Reform.”

The way telecommunications services are provided is shifting. Many countries are replacing traditional, state-owned service provision with a competitive, market-based model.

The World Trade Organization (WTO) Basic Telecommunications Agreement (see section 3.5.4) has been an important catalyst for reform in the telecommunications sector. This agreement commits countries to put in place transparent regulatory structures, laws, and procedures for the sector. As of November 2006, nearly 90 governments had made commitments to liberalize their telecommunications markets to various degrees. At the time the agreement was reached in 1997, the signatories represented more than 90 percent of international telecommunications traffic.

This section summarizes some key trends in telecommunications reform, covering:

- ownership reform,
- legislative reform,
- liberalization and the introduction of competition, and
- regulatory reform.

II. COMPETITION POLICY AND THE ICT SECTOR (Section 2)

This section introduces key elements of competition policy, as it applies to the ICT sector. Information on the following topics is provided:

- What we mean by competition (see section 2.1), and why it is important (see section 2.2).
- The roles of competition policy and regulation (see section 2.3).
- Key concepts (see section 2.4) in competition policy.
- Common forms of anti-competitive conduct (see section 2.5).
- Remedies (see section 2.6) for anti-competitive conduct.
- Approaches to analyzing mergers, joint ventures, and acquisitions (see section 2.7).

A. Forms of Competition (Section 2.1)

There are many different forms of competition.

Many people think about competition in terms of the textbook model of perfect competition (see section 2.1.1). Perfect competition is an ideal model of a competitive market, but is unlikely to occur in practice.

Markets that are not perfectly competitive can still deliver significant benefits for buyers and sellers. A useful standard for analyzing real world markets is workable or effective competition (see section 2.1.2). The concept of contestability (see section 2.1.3) is also useful for analyzing markets in which there are few players but market power is constrained by the potential for entry.

B. Why Focus on Competition? (Section 2.2)

Competition policy and economic regulation are based on the premise that the “public interest” or “social good” is best served when markets work efficiently. This generally occurs in a competitive environment.

Competition is the most efficient and equitable mechanism available for organizing, operating, and disciplining economic markets. Competitive markets distribute resources efficiently and fairly without any need for a single, centralized controlling authority. Competition maximizes benefits to society at large by:

- ensuring that resources, products, and services are allocated to the person or persons who value them the most (allocative efficiency);
- forcing market participants to use scarce resources as productively as possible (productive efficiency); and
- encouraging market participants to innovate, and to invest in new technologies at the best time (dynamic efficiency).

There are numerous examples from all over the world of the benefits of competition in the ICT sector. For example, liberalization of the mobile phone sector in Jamaica led to large increases in the accessibility of telecommunications to consumers, and a jump in total teledensity. Similar results have been seen in other countries, including Morocco.

C. Competition Policy and Regulation (Section 2.3)

In practice, many markets do not exhibit all the conditions necessary for workable or effective competition (see section 2.1.2). *Market failures* occur in many forms. The two most associated with the need for regulation are:

- monopoly, including *natural monopoly*, and
- *externalities*.

When a market is not effectively competitive, it is important to ask if the problem is likely to correct itself. If not, then there may be a need for additional tools to encourage effective competition or to prevent socially unacceptable outcomes.

This section of the toolkit introduces two broad approaches to encouraging competition in the ICT sector – competition policy and regulation, both of which are not mutually exclusive. Many countries use a mix of both. However, care is required to ensure that sector regulation and anti-trust laws are developed and applied consistently.

This section discusses the following topics:

- Competition Policy (see section 2.3.1).
- Regulation (see section 2.3.2).
- Ex Ante and Ex Post Regulation (see section 2.3.3).
- Advantages and Disadvantages of Ex Ante versus Ex Post Regulation (see section 2.3.4).
- Regulatory Forbearance (see section 2.3.5).

1. Competition Policy (Section 2.3.1)

Competition policy provides a set of tools to promote sustainable competition (see section 2.1.4), and to preserve a market environment in which such competition can flourish. Competition policy may be implemented through general competition laws, or through competition-enhancing rules in specific sectors. In the ICT sector, such rules might include:

- general prohibitions of anti-competitive behavior, and mergers or acquisitions that would reduce competition (as in the case of Hong Kong); or
- specific rules designed to encourage competition in the sectors, such as interconnection requirements or unbundling policies.

Competition laws (or antitrust laws) aim to promote efficient competition by penalizing or undoing conduct that reduces competition in a market. Competition laws generally include provisions to:

- prevent competing firms from banding together (colluding) to increase prices or reduce quantities of goods and services, or to exclude other firms from a market;
- prevent firms with a dominant position, or “significant market power” (see section 2.4.2), from using their market power to exclude competitors from the market, or otherwise reduce competition; and
- stop mergers or acquisitions (see section 2.7) that would reduce competition.

With the exception of provisions for mergers and acquisitions, competition laws are generally *ex post* regulation (see section 2.3.3). They give the competition authority or the courts power to respond to anti-competitive behavior once it has occurred.

2. Regulation (Section 2.3.2)

Regulation is useful where the market by itself would produce undesirable or socially unacceptable outcomes.

Regulation attempts to prevent socially undesirable outcomes, and to direct market activity toward desired outcomes. For example, telecommunications regulation is widely used to promote prices that reflect efficient costs and promote universal access to basic services.

However, regulation has potentially high costs. The regulatory process is inherently time consuming to administer and requires considerable expenditure of resources. In addition, regulation can have unintended consequences that may be detrimental to customers and the public interest. No matter how capable and well intentioned regulators are, they will never be able to produce outcomes as efficient as a well-functioning market.

Accordingly, regulators should only focus on those parts of the ICT sector where there is a clear need for regulation (that is, where effective competition is not feasible – see section 2.1.2) and should only be a temporary measure. Over time, regulators should aim to establish or restore the conditions that provide for effective competition on a sustained (see section 2.1.4) basis. This entails removing or reducing barriers to entry and exit (see section 2.4.3), and enabling the market itself – for example, through the entry of additional competitors – to prevent the incumbent from exercising market power (see section 2.4.2).

D. Key Concepts in Competition Policy (Section 2.4)

This section introduces some key concepts that underpin competition policy and sector regulation.

The aim of competition policy (see section 2.3.1) is to promote sustainable competition (see section 2.1.4). Competition analysis generally asks the question: Will a given practice, transaction, or business acquisition reduce competition or increase market power in a given market?

Competition analysis follows the following steps:

- Define (see section 2.4.1) the relevant market or markets.
- Assess the level of competition in the market, without the behavior or act in question.
- Assess the level of competition in the market, with the behavior or act in question.

The level of competition in a market depends on the structure of the market, and whether it meets the conditions for effective competition (see section 2.1.2). Important considerations include:

- whether any firms in the market have market power (see section 2.4.2), and the impact of the trade practice or business acquisition in question on market power;
- whether any firms in the market have a dominant position or significant market power (see section 2.4.2) in the market;
- any barriers to entry or exit (see section 2.4.3) and the potential for competition from new entrants; and
- the role of any essential facilities (see section 2.4.4).

E. Common Forms of Anti-Competitive Conduct (Section 2.5)

Telecommunications firms with market power may try to use their position to reduce competition. This section gives an overview of some common forms of anticompetitive conduct:

- Abuse of dominance (see section 2.5.1).
- Refusal to supply (see section 2.5.2).
- Vertical price squeezes (see section 2.5.3).
- Cross-subsidization (see section 2.5.4).
- Misuse of information (see section 2.5.5).
- Customer lock-in and restrictive agreements (see section 2.5.6).
- Exclusionary and predatory pricing (see section 2.5.7).
- Tying and bundling of services (see section 2.5.8).

1. Abuse of Dominance (Section 2.5.1)

Abuse of dominance occurs when a dominant firm adopts predatory or exclusionary business practices with the aim of eliminating or substantially lessening competition and excluding competitors.

2. Refusal to Supply (Section 2.5.2)

Incumbent firms often control access to facilities that are essential inputs in the supply of services at the retail level. Competing retailers depend on the incumbent for access to the essential facility (see section 2.4.4).

In the telecommunications sector, for example, the local loop connecting end customers to the network is often regarded as an essential facility.

3. Vertical Price Squeeze (Section 2.5.3)

To implement a vertical price squeeze, a firm must be vertically integrated, and control an essential wholesale input (see section 2.4.4) to the retail service. A firm implementing a price

squeeze offers to supply this essential input to its retail competitors only at a price greatly in excess of its costs.

These are the key elements of a price squeeze:

- The firm demands a price for the essential facility that is so high that it is not possible for an equally efficient retail-stage competitor to operate profitably (or even survive), given the level of retail prices.
- The firm does not charge its own downstream operation this high price.

4. Cross-Subsidization (Section 2.5.4)

In the ICT sector, it is common for firms to supply a number of services. Network operators generally sell services in both competitive and non-competitive markets.

A firm with market power in one area may charge a high price for non-competitive services and use the proceeds to subsidize low prices for competitive services.

5. Misuse of Information (Section 2.5.5)

It is common for vertically integrated firms to sell wholesale products ("essential facilities") (see section 2.4.4) to other firms, while competing against those same firms in retail markets. In this situation, the vertically integrated firm can obtain sensitive commercial or business information through its wholesale transactions that gives it a competitive advantage in its retail activities.

6. Customer Lock-In (Section 2.5.6)

Service providers may attempt to “lock in” customers to prevent them from switching to alternative products, technologies, or suppliers. Customer lock-in involves raising customers’ **switching costs** to the point that the cost of switching outweighs the potential benefits from switching.

7. Exclusionary or Predatory Pricing (Section 2.5.7)

Predatory pricing is a pricing strategy used by an established firm to eliminate competition from equally efficient firms, and secure a monopoly position in a previously competitive market.

A firm practicing predatory pricing lowers its price below cost and maintains it there until equally efficient competitors are forced to incur unsustainable losses and exit the market. The firm then raises its price to a monopoly level in order to recoup its lost profits.

8. Tying and Bundling (Section 2.5.8)

Tying of services occurs where a service provider makes the purchase of one product or service over which it has market power (the "tying good") conditional on the purchase of a second, competitively supplied, product or service (the "tied good"). By tying services, a service provider can try to use market power in one market to give itself an advantage in another competitive market. Customers who opt to buy the tied good from a competitor cannot find a feasible substitute for the service provider's tying good.

Service **bundling** occurs where a service provider offers two or more services separately, but gives a discount to customers who purchase the services as a combined bundle. Bundling is typically pro-competitive and consumer friendly.

F. Remedies for Anti-Competitive Conduct (Section 2.6)

The section of this module on common forms of anti-competitive conduct (see section 2.5) discusses various forms of anti-competitive behavior that may arise in ICT markets. It provides an overview of the remedies available to governments and regulators for responding to:

- abuse of dominance (see section 2.6.1);
- refusal to supply and vertical price squeezes (see section 2.6.2);
- cross-subsidization (see section 2.6.3);
- misuse of information (see section 2.6.4);
- customer lock-in and restrictive agreements (see section 2.6.5);
- exclusionary and predatory pricing (see section 2.6.6); and
- tying and bundling of services (see section 2.6.7).

G. Mergers, Acquisitions, and Joint Ventures (Section 2.7)

Mergers, acquisitions, and joint ventures are all different ways for two or more firms to integrate or coordinate their operations:

- A merger (see section 2.7.1) is a structural fusion of two firms that results in a common ownership and management structure. Mergers usually happen through stock swaps.
- An acquisition is a type of merger in which a firm with more resources and greater market strength may acquire another firm. The acquiring firm usually uses some combination of stocks, debt, and cash to finance the transaction.
- A joint venture (see section 2.7.3) is a strategic alliance between two firms that share resources, equity, revenues, expenses, and management to pursue a common goal. Each firm usually retains its own corporate identity.

There are three types of mergers: horizontal, vertical, and conglomerate. Conglomerate mergers occur between firms operating in separate markets. As such they do not generally raise competition concerns and are not covered further in this section.

Mergers, acquisitions, and joint ventures are motivated by a range of factors, such as cost savings from synergies between the firms; economies of scale and scope; efficiencies from vertical integration; and geographical diversification or cross-selling of products.

This section discusses common approaches to analyzing:

- horizontal mergers (see section 2.7.1);
- vertical mergers (see section 2.7.2); and
- joint ventures (see section 2.7.3).

III. REGULATING FOR INTERCONNECTION (Section 3)

The purpose of this section is to set out the main issues related to interconnection. Topics covered include:

- a general overview of interconnection (see section 3.1) – what is meant by interconnection, why it is important, and why it needs to be regulated;
- key concepts (see section 3.2), such as one-way and two-way interconnection, unbundling, and asymmetric regulation;
- setting prices (see section 3.3) for interconnection;
- mobile interconnection (see section 3.4);
- challenges and opportunities (see section 3.5) for developing country regulators; and
- cross-border interconnection (see section 3.6).

Parts of this section are based on Timothy J. Tardiff, "The Economics of Access and Interconnection Charges in Telecommunications," in Michael Crew and David Parker, eds., *The International Handbook of Economic Regulation*, Cheltenham: Edward Elgar, 2006, Chapter 13.

A. Overview of Interconnection (Section 3.1)

There are many situations in the ICT industry in which networks must be linked with each other to provide services to customers. This section considers three questions:

- What is interconnection? (see section 3.1.1)
- Why is interconnection important? (see section 3.1.2)
- Why is regulation of interconnection sometimes necessary? (see section 3.1.3)

1. What is Interconnection? (Section 3.1.1)

The WTO defines interconnection as:

Linking with suppliers providing public telecommunications transport networks or services in order to allow the users of one supplier to communicate with users of another supplier and to access services provided by another supplier, where specific commitments are undertaken. [1]

Technological changes and increasing competition have led to the development of many forms of interconnection. All involve linking of networks to enable customers of one network to communicate with customers of another network, or to have access to services offered by another network operator.

2. Why is Interconnection Important? (Section 3.1.2)

ICT service providers need access to networks owned by others in order to provide services to their customers. Without interconnection, a customer cannot call subscribers on other networks, access Internet content located on another network, and so on.

Networks interconnect with each other to:

- provide a service that is not economically feasible without interconnection (for example, calls to customers on another operator's network);
- increase profitability. Where interconnection increases the value of telecommunications services, or the range of services operators can provide, it can be in the mutual interest of the operators to interconnect; and
- expand or improve services that are valuable to customers.

Interconnection has been important for telecommunications providers since the invention of the telephone. Even before competition emerged, adjacent carriers interconnected with each other so that their customers could make long distance and international calls.

With recent technological developments the range of services that depend on interconnection has increased. Interconnection is an essential input to local, long distance, and international fixed voice calls; mobile voice and data services; satellite services; Internet access; e-mail and message services; broadband data transmission; and a wide range of multi-media services.

3. Why Regulate Interconnection? (Section 3.1.3)

Telecommunications operators will interconnect voluntarily in some circumstances. If two operators are not in direct competition with each other, then generally they will have an incentive to interconnect. This is because interconnection increases the value of a network to its subscribers by increasing the number of people they can call and the range of ICT services they can access (*network externalities*).

Sometimes incumbent operators will have little incentive to allow access to their network, or to allow access on reasonable terms. Where the interconnection seeker is a potential competitor, an incumbent may seek to limit competition and preserve its market power by:

- refusing to interconnect;
- offering interconnection at a price, or on other terms, that make it difficult for an efficient entrant to compete; or
- seeking to “sabotage” the entrant by providing a lower quality interconnection service to the entrant than the incumbent provides itself.

In these cases, regulatory intervention can lead to a more efficient outcome. The motivation for regulating interconnection is that efficient competition in “downstream” markets would be difficult, or even impossible, unless entrants can access the incumbent’s network at appropriate prices, terms, and conditions.

For example, the interconnection directives of the European Union (EU) allow National Regulatory Authorities to impose interconnection or unbundling obligations on carriers that have significant market power (see section 2.4.2) in “situations where the national regulatory authority considers that denial of access or unreasonable terms and conditions having a similar effect would hinder the emergence of a sustainable competitive market at the retail level, or would not be in the end-users’ interest.”^[1]

In any market, regulation needs to be able to adapt to changing circumstances. This is especially important in the ICT industry, where outdated regulation risks stifling market growth and innovation.

B. Key Concepts (Section 3.2)

This section introduces several key concepts in interconnection:

- One-way and two-way interconnection (see section 3.2.1).
- Unbundling (see section 3.2.2), facilities sharing, and co-location.
- Asymmetric interconnection regulation (see section 3.2.3).
- Other issues dealt with in interconnection agreements (see section 3.2.4).

1. Forms of Interconnection (Section 3.2.1)

There are two broad forms of interconnection: one-way interconnection and two-way interconnection.

One-way and two-way interconnections can co-exist. For example, new entrants often obtain parts of their networks from the incumbent carrier (one-way interconnection), and then exchange traffic with the incumbent (two-way interconnection).

2. Unbundling (Section 3.2.2)

This section addresses the following questions:

- What is unbundling?
- Why should regulators require unbundling?
- How much unbundling should be mandated?
- What are the costs and benefits of unbundling?

What is Unbundling?

Unbundling is the mandatory offering by network operators of specific elements of their network to other operators, on terms approved by a regulator or sanctioned by a court.

Why Require Unbundling?

The rationale for unbundling is similar to that for interconnection regulation (see section 3.1.3) more generally.

Some inputs are available only from certain network operators, and cannot easily be duplicated. Unless those inputs are available at appropriate prices, competition in downstream telecommunications markets would be difficult or impossible.

How Much Unbundling?

There are a range of options for unbundling interconnection services.

Under **full unbundling**, the incumbent must offer a separate, fully unconditioned local loop service. This provides access to *raw copper local loops*, and *subloops*.

Under **shared access**, the incumbent must provide access to the non-voice frequencies of a local loop and/or access to space within a main distribution frame where digital subscriber line access multiplexers (*DSLAMs*) and similar types of equipment can be interconnected to the local loop.

Under **bitstream access for high-speed access services**, the incumbent must furnish and lease to other carriers links capable of providing high-speed services.

Costs and Benefits of Unbundling

There is considerable debate over the costs and benefits of unbundling. The magnitude of these costs and benefits will vary depending on:

- the form of unbundling; and
- whether regulated prices for unbundled network elements reflect economic costs.

3. Asymmetric Interconnection Regulation (Section 3.2.3)

Interconnection regulation can apply equally to all telecommunications carriers (symmetric regulation) or to incumbent carriers only (asymmetric regulation).

Asymmetric interconnection regulation is very common. The rationale for asymmetric regulation is to redress the consequences of market power (see section 2.4.2). Asymmetric regulation does this by placing additional requirements on incumbent or dominant operators that might otherwise be able to prevent or deter competition (see section 2.5).

4. Issues Addressed in Interconnection Agreements (Section 3.2.4)

To have a successful interconnection, the following issues should be dealt with in the interconnection agreement or by rule or order from the regulatory authority:

Prices and adjustment of prices over time. This includes the initial level of interconnection charges; a definition of the currency in which interconnection charges are to be paid (this is especially complicated when retail prices are set in a local currency and interconnection is set in another currency); and how prices will adjust over the term of the agreement to account for exchange rate changes and inflation. The "ownership" of the call must be defined. For example, in mobile-to-fixed interconnection, one possible mode is for the call to be "owned" by the mobile operator, who sets the retail price, undertakes billing and collection, and pays for interconnection to the fixed operator. Another mode would be for the call to be "owned" by the fixed operator, who would set the retail rate and pay the mobile operator an origination charge. Liability for bad debt and uncollectible bills should be defined.

Points of interconnection. The physical locations where interconnection will take place and the technical standards to be employed in the interconnection are defined. A process for requesting and obtaining additional points of interconnection should be established. This is closely related to the issue of transport charges and traffic routing.

Transport (conveyance) charges and traffic routing. Specific methods for routing calls must be defined. In other words, if there are multiple interconnection points defined, what is the proper routing and hand-off point for each type of call? Otherwise, higher charges may apply to misrouted calls. The applicability of transport charges in the receiving network for calls that must be carried beyond the area local to the point of interconnection must be defined. If one

carrier requests interconnection in a particular area to avoid paying the receiving network for transport charges, and the interconnection point is not made available, a virtual point of interconnection is defined for that location whereby transport charges are not collected to bring calls to that area.

Frequently, incumbent operators want to offer the fewest possible points of interconnection to maximize transport revenues. However, over time, entrants usually wish to build out their own networks and interconnect in more places to avoid paying the incumbent's transport charges.

Quality-of-service standards. Quality standards are defined, particularly for time to provision circuits and for call blocking levels, and remedies are defined for when those standards are not met. Often, an incumbent provider is required to provide at least as high a level of quality to interconnecting carriers as he provides to his own retail customers. Testing opportunities should be provided to each party.

Billing and collection. When and how to collect traffic data, exchange bills, and make payment should be specified. A process should also be developed for reconciling traffic data and making inquiries to the other party, as well as for handling claims. A procedure for resolving discrepancies is useful, which often involves seeking recourse to arbitration, the regulator, or to the courts.

Traffic measurement and settlement. Sometimes, specific trunk groups are identified to carry different types of traffic so that each type of traffic can be billed for separately. However, these arrangements can be defeated and traffic will thus end up disguised as the cheapest type of traffic. The responsibilities of each interconnecting operator to measure traffic are defined, as are settlement procedures for when there are discrepancies in the amount of traffic measured. Obligations to cooperate in fraud detection and enforcement activities should be specified.

Numbering resources. Access of each operator to the country's numbering plan and numbering resources must be defined. It is particularly important that numbers be provided in a timely manner so that potential sales are not blocked. If number portability may be part of the local regulatory regime, the terms of participation should be defined.

Forecasting network needs. Part of providing interconnection is having the available capacity to deliver and receive the traffic that flows between the interconnecting networks. To do so, a planning process must be followed between the interconnecting operators so that investment for additional capacity can be agreed, budgeted, and installed in time to meet the forecasted demand. Procedures to resolve differences over forecasts also must be defined, as well as what constitutes a bona fide request for additional interconnection capacity. At a minimum, a mutual obligation to notify the other party well in advance of network changes and upgrades is needed to avoid disadvantaging one competitor over another.

Access to customer information. By necessity, when completing calls and billing for them, interconnecting operators pass back and forth considerable information about each other's clients. Limits on the permitted uses of this information should be defined, particularly regarding the temptation to engage in marketing activities in approaching another operator's

clients based on information obtained through interconnection activities. Safeguards are also necessary to protect customers' privacy.

C. Setting Interconnection Prices (Section 3.3)

This section of the module covers the following:

- Broad objectives and pricing principles for interconnection (see section 3.3.1).
- Specific pricing principles for one-way and two-way interconnection (see section 3.3.1).
- Long-run incremental cost modeling, including “bottom-up” and “top-down” modeling methods (see section 3.3.2).
- Commonly used cost models (see section 3.3.3).
- Benchmarking (see section 3.3.4) of interconnection charges.

Why is the Interconnection Price Important?

There is a consensus among economists and regulators that interconnection prices based on cost are most likely to lead to desirable outcomes. Measuring cost is challenging – there is no single correct interconnection price. However, if the interconnection price is set too low, the following may occur:

- Inefficient competitors may enter the market.
- Entrants may look for opportunities to profit by purchasing services at low regulated prices and simply re-selling them, instead of developing innovative new product offerings.
- Incumbent operators may not invest in the network or maintain its quality.

For many new entrants, interconnection is one of their largest costs. If the interconnection price is set too high it will:

- deter entry by efficient competitors;
- cause carriers, in the case of two-way interconnection, to concentrate on maximizing payments from other carriers, instead of focusing on providing services to retail customers; and
- force customers to pay more than they need to.

1. Pricing Principles (Section 3.3.1)

This section of the module discusses:

- general objectives and principles for interconnection pricing.
- specific principles for one-way and two-way interconnection, and
- key trade-offs for regulators in determining their approach for regulating interconnection prices.

2. Long-Run Incremental Cost Modeling (Section 3.3.2)

The economic cost of interconnection is generally the starting point in establishing economically efficient interconnection prices.

In many jurisdictions, regulators set interconnection prices based on long-run incremental costs (LRIC) – for example, New Zealand, Australia, the United Kingdom, the European Community, and the United States. The most common form of LRIC is Total Service Long Run Incremental Cost (TSLRIC), known as Total Element Long Run Incremental Cost (TELRIC) in the United States.

There are numerous methods of estimating LRIC. Approaches to modeling LRIC can be broadly categorized as bottom-up and top-down modeling approaches. Bottom-up models include scorched earth or scorched node methods. See below for a comparison of bottom-up and top-down modeling approaches.

3. Commonly Used Cost Models (Section 3.3.3)

This section provides an overview of three commonly used cost approaches. The FCC Synthesis Model and World Bank Group Model are both bottom-up TSLRIC models. The COSITU model (ITU model for the calculation of costs, tariffs, and rates for telephone services) is an example of a top-down cost model.

4. Benchmarking Interconnection Rates (Section 3.3.4)

Benchmarking is the process of establishing interconnection rates based on rates in other jurisdictions. For example, the rate charged to long distance carriers for terminating calls on a local network might be based on rates for this function in other jurisdictions.

Benchmarking has two main purposes in interconnection pricing. In situations where detailed cost models can be estimated, benchmarking can be used as a common sense check on the results of the modeling. Alternatively, benchmarking can be used directly to set interconnection prices.

Benchmarking can be very useful to regulators if undertaken carefully. Undertaking a full forward-looking cost modeling (see section 3.3.2) exercise is challenging and time-consuming. In some markets the detailed information required may not be available. Regulators in many jurisdictions have used benchmarking to set initial interconnection rates (for example, Botswana and New Zealand).

Rates based on benchmarking may be used for extended periods if they allow competition to develop in a satisfactory manner.

In a benchmarking exercise, adjustments need to be made for differences among jurisdictions, for example, exchange rates, traffic patterns, or the cost of shipping network equipment.

For a discussion of practical issues in benchmarking prices, see section 5.7.

D. Mobile Interconnection (Section 3.4)

The principles underpinning interconnection are broadly the same for mobile networks as for fixed networks. However, there are some important technical, commercial, and regulatory differences between mobile and fixed networks that affect interconnection arrangements. This section covers:

- key forms of mobile interconnection (see section 3.4.1);
- issues in setting mobile termination rates, and retentions for fixed-to-mobile calls (see section 3.4.2);
- additional considerations in modeling mobile network costs (see section 3.4.4);
- mobile roaming (see section 3.4.5); and
- the role of mobile networks in achieving social goals (see section 3.4.6), and implications for regulators.

1. Forms of Mobile Interconnection (Section 3.4.1)

In many countries, mobile interconnection is regulated and priced differently, depending on the form of interconnection. There are three broad forms of mobile interconnection:

- **Fixed-to-mobile interconnection.** A mobile network terminates a call from a fixed network. The call might originate from a local fixed operator, a domestic long-distance operator, or an international operator.
- **Mobile-to-fixed interconnection.** A mobile operator interconnects with a fixed network to complete calls for the mobile operator's customers. Again, the fixed network might be owned by a local fixed operator, a domestic long-distance operator, or an international operator.
- **Mobile-to-mobile interconnection.** A mobile operator interconnects with another mobile operator.

2. Mobile Termination Rates (Section 3.4.2)

There is no unique treatment of mobile termination charges among countries. Some countries only regulate mobile termination charges for fixed-to-mobile calls. In other countries, mobile networks are required to apply a single regulated termination charge, regardless of where the call originates.

This section discusses the following topics:

- Calling Party Pays (CPP).
- Regulation of mobile termination rates.
- Other pressures on operators to reduce mobile termination rates.

3. Retentions for Fixed-to-Mobile Calls (Section 3.4.3)

Under CPP for fixed-to-mobile calls, the fixed operator deducts specified charges from the fixed-to-mobile rate and passes the balance of the call revenue to the mobile operator.

The fixed operator may retain charges for the following items:

- **Call origination.** Call origination charges reflect the cost of the fixed network used to originate the call.
- **Billing and collection.** The fixed operator may levy a contribution to the cost of collecting call revenue from its customers. This fee may be expressed as a percentage of the fixed-to-mobile tariff, or as an absolute charge per minute, per call or per bill.
- **Bad debts.** The fixed operator may levy a fee for bad debts, on the basis that fixed-to-mobile calls may make up a significant proportion of customers' total bills.

- **Other fees.** In some countries, fixed operator charge fees for managing complaints related to fixed-to-mobile calls.

4. Modeling Mobile Network Costs (Section 3.4.4)

The basic economic principles of forward-looking cost models apply to both fixed and mobile networks.

However, the importance and types of *cost drivers* in a mobile network differ from traditional fixed networks.

The costs of both fixed and mobile networks rise with increases in:

- the number of subscribers, and
- the traffic produced by those subscribers.

The costs of a mobile network also increase with coverage – the geographic size of the network. Coverage costs are an example of common costs. They do not increase with the volume units usually considered in wholesale or retail price structures (such as access connections and usage). Accordingly, retail and interconnection prices for mobile usage need to contain mark-ups to recover coverage costs.

5. Mobile Roaming (Section 3.4.5)

Roaming is the term used when a subscriber of one mobile operator's service travels outside that service area and obtains connectivity and service from another operator. Roaming can take place within a country or between countries, as long as it involves a customer of one operator being connected to the mobile network of another operator.

For example, roaming enables a subscriber of Cabo Verde Telecom in Cape Verde (which operates using GSM technology) to travel to Angola and obtain services from a GSM operator there.

Conceptually, roaming is similar to a call forwarding arrangement. Callers use the customer's usual mobile phone number. The home network hands the call over to the host network, which passes the call to the customer's mobile phone.

6. Social Issues and Universal Service (Section 3.4.6)

In many developing countries, mobile networks play an important role in meeting universal access goals. Mobile or wireless networks may be more economic than conventional landline networks, particularly in remote or rural areas.

In many developing countries, there is a tension between ensuring low fixed-to-mobile rates, and encouraging greater penetration of mobile services.

In markets with low mobile penetration there may be theoretical and practical justifications for above-cost mobile termination charges. Revenue from high termination charges may enable mobile operators to subsidize:

- access to the service, for example by subsidizing the cost of handsets, and
- usage charges (mobile-to-mobile and mobile-to-fixed calls).

Before intervening to reduce mobile termination charges, developing country regulators should weigh the potential effect on access to the network for poorer segments of the population, against the purported benefits from reduced termination charges.

E. Challenges and Opportunities for Developing Countries (Section 3.5)

Establishing a regime to develop and implement interconnection rates, terms and conditions, and other provisions can place significant demands on a developing country's legal and administrative infrastructure. This section considers particular challenges that may be significant for developing country regulators.

Many of these challenges apply to all countries, but are more difficult in countries with weak legal systems or no tradition of decision-making by independent regulators.

Key challenges include:

- the physical state of telecommunications networks (see section 3.5.1) in developing countries;
- transparency and access to information (see section 3.5.2);
- when state-owned operators (see section 3.5.3) are part of the industry;
- free trade negotiations (see section 3.5.4); and
- dispute resolution (see section 3.5.5).

1. Infrastructure Challenges (Section 3.5.1)

Compared to developed countries, telecommunications infrastructures in developing countries have a number of features that create both challenges and opportunities. Here are some examples:

- Developing countries may not have extensive telephone network coverage, particularly outside main population centers.
- Wireless and mobile operators often play a significant role, particularly in rural and remote areas. Typically, wireless demand in developing countries exceeds wireline demand, sometimes by significant amounts.
- Fiber-optic systems are often not widely rolled out (or not all fiber is “lit” with the necessary electronics). Customers may have limited or no access to broadband services, particularly in rural areas.
- The technology in use, and network architecture, are often outdated.

2. Transparency and Access to Information (Section 3.5.2)

In many developing countries, transparency of interconnection and access to information are key challenges.

Transparency

Many countries require dominant operators to make the terms and conditions of interconnection transparent. In addition, the WTO (see section 3.5.4) requires members to ensure that agreements or model interconnection offers of major suppliers are made public.

Access to Information

In order to regulate effectively, a regulator needs access to detailed information about the regulated firm. For example, regulators often require detailed cost information, such as the regulated firm’s cost of capital.

3. Regulating State-Owned Operators (Section 3.5.3)

In countries where the incumbent telecommunications operator is government owned, it may be challenging for the regulator to be independent, or to be perceived as independent. Entrants may have little confidence that their interests and those of their customers will be given due weight.

4. Free Trade Negotiations (Section 3.5.4)

The WTO *Agreement on Basic Telecommunications* came into force in 1998. The agreement includes obligations relating to interconnection. WTO Members, or countries seeking to join the WTO, must comply with these rules. If a member country fails to comply with its WTO obligations, other member countries may take a dispute to the WTO.

Key WTO obligations for interconnection are as follows:

- Interconnection with “Major Suppliers” must be assured:
 - at any technically feasible point in the network;
 - in a timely fashion;
 - on non-discriminatory and transparent terms (including quality and rates);
 - sufficiently unbundled to avoid charges for unnecessary components; and
 - at non-traditional interconnection points if the requestor pays charges.
- Procedures for interconnection to major suppliers must be made public.
- Agreements or the model interconnection offer of major suppliers must be made public.

5. Dispute Resolution (Section 3.5.5)

Disputes pertaining to access, interconnection, and other aspects of regulation are common in the telecommunications sector. This section covers:

- why interconnection dispute resolution is important;
- the role of the regulator in resolving disputes;
- challenges for regulators; and
- ways to strengthen dispute resolution processes.

F. Cross-Border Interconnection (Section 3.6)

This section covers issues related to cross-border interconnection, specifically:

- the accounting rate system (see section 3.6.1) and cross-border interconnection; and
- regional interconnection clearing houses (see section 3.6.2).

1. The Accounting Rate System (Section 3.6.1)

The **accounting rate system** was developed as a way to allocate revenue for international telephone services. The system is a series of arrangements among national operators in which the operators jointly provide international calls and divide the revenues from such calls among them.

The accounting rate system provides a set of agreed prices for interconnection of international calls. The originating carrier charges the customer making the call a retail rate, and is charged the accounting rate for terminating the international call. As their name suggests, accounting rates do not always reflect costs.

Moving Away From Accounting Rates

The accounting rate system has now been largely replaced by cross-border interconnection. Carriers directly negotiate rates to terminate traffic, in some cases with long-term contracts, and in other cases on a short-term or spot basis. Electronic exchanges have emerged that enable trading of international voice, data, and mobile capacity. Arbinet (<http://www.arbinet.com/>) is an example of such an exchange. Arbinet claims that more than 10.4 billion minutes of traffic were transacted through its trading platform in 2004.

2. Regional Interconnection Clearing Houses (Section 3.6.2)

A promising area of activity in the exchange of international traffic is the development of regional interconnection clearing houses.

The idea of a clearing house is that multiple carriers connect to the same hub to facilitate international interconnection. This differs with the traditional approach where each carrier must have interconnection arrangements in place with all other carriers, in order to complete international calls.

IV. NEW PARADIGMS: VOICE OVER IP AND IXPS (Section 4)

The ICT sector is developing rapidly. Technological advances are making new services and new modes of service delivery possible. In the future, the Internet will be the primary medium through which converging voice and data services will flow. As a result, market structure, business models, and commercial arrangements for interconnection are changing.

This section focuses on the implications of the Internet for interconnection, specifically on:

- background to the Internet (see section 4.1) and its development;
- an overview of Voice over the Internet Protocol (VoIP) (see section 4.2);
- opportunities for arbitrage (see section 4.3) that are creating pressures for change to existing regulatory and commercial models;
- implications of VoIP for regulators (see section 4.4), and for interconnection (see section 4.5);
- VoIP over wireless (see section 4.6) technologies;
- international benchmarking (see section 4.7) of charges for network access; and
- Internet Exchange Points (IXPs) (see section 4.8).

A. About the Internet (Section 4.1)

This page provides an overview of the Internet and its development, as background to other material in this section of the module. This page covers:

- an overview of the Internet (see section 4.1.1);
- different layers of the Internet (see section 4.1.2);
- the evolution of the Internet (see section 4.1.3); and
- current trends in the development of the Internet (see section 4.1.4) that are acting to constrain the market power of Tier-1 ISPs.

The Internet is a worldwide collection of interconnected networks. It is capable of switching, routing, and transmitting digital packets of information corresponding to a variety of voice, data, text, audio, and video services. The Internet allows any computer (or other device) with an Internet connection to communicate with any other device that is connected to the Internet.

The Internet is continuing to develop. A number of trends appear to be shifting the geographic focus of the Internet (with respect to content, servers, peering points and carriers) away from just North America and Europe. These factors are acting to constrain the market power of Tier-1 ISPs.

B. About VoIP (Section 4.2)

Internet telephony, or Voice over Internet Protocol (VoIP), is a category of services that enables users to make real time voice calls, transmitted over the Internet (rather than using traditional circuit-switched telephone networks).

VoIP enables network operators, service providers, and consumers to make significant savings by:

- reducing the underlying costs of a telephone call. VoIP uses network resources much more efficiently than conventional telephone service, reducing the costs of providing a call (albeit with the loss of some call quality and service features); and
- creating opportunities for regulatory arbitrage (see section 4.3) that enable service providers and consumers to reduce or avoid call charges and/or regulatory fees.

The volume of voice telephony traffic is small compared to traditional, dial-up, circuit-switched telephone services. However, the very real potential exists for packet-switched, Internet Protocol (IP) networking to become the primary medium for most voice and data services. Should this occur, information services (including VoIP) will become the primary end-user service provided by telecommunications networks.

This section discusses:

- different types of VoIP (see section 4.2.1);
- similarities and differences (see section 4.2.2) between VoIP and conventional telephony; and
- some key protocols (see section 4.2.3) that support VoIP.

1. Types of VoIP (Section 4.2.1)

VoIP services differ depending on whether:

- the service provides a competitive alternative to conventional telephone services;
- a conventional telephone can transmit and receive calls;

- subscribers need to acquire and install additional equipment on their premises;
- traffic routes into or from the public switched telephone network (PSTN); and
- users pay for service.

2. Comparison of VoIP and Conventional Telephony (Section 4.2.2)

This section compares the similarities and differences between VoIP and conventional dial-up telephony.

A number of factors indicate that consumers increasingly view VoIP as “functionally equivalent” to conventional telephone service. Consider the following:

- Increasing numbers of consumers use VoIP as an alternative to conventional service. In making this choice, consumers are trading off a reduction in quality and some loss of features, for a lower price.
- Improvements in VoIP service have reduced the difference in quality between VoIP and conventional service.
- Many carriers partially route calls over the Internet without their customers’ knowledge. In many cases, consumers are unable to detect differences in quality between VoIP and conventional service.
- VoIP customers can now obtain a telephone number and receive calls originated on the PSTN.
- There is evidence that local exchange telephony subscriptions, total switched long distance minutes, and revenues for conventional dial-up services are declining. This suggests that many consumers are switching to VoIP. A number of other factors may also contribute to this trend, such as migration from wireline to wireless services; the proliferation of private-line and virtual private-line services that can access the PSTN; and the commingling of voice and data services on the same telecommunications link.

3. Protocols that Support VoIP (Section 4.2.3)

VoIP uses a number of protocols to transmit voice calls using packet switching.

The **IP** is one of several processing standards for routing Internet traffic. IP ensures that traffic can reach the intended recipient even though it traverses different networks using different equipment.

Compression algorithms reduce the number of packets that must be transmitted by sampling the voice traffic and reconstructing a digital replica.

The **Real Time Transport Protocol** provides procedures for loading packet headers with routing, signaling, and identification information so that, for example, packets that arrive out of sequence can be rearranged.

The **Session Initiation Protocol** provides standardized call processing formats. This enables VoIP ventures to offer telephone service features from ringing and busy tones to call forwarding.

The **Transmission Control Protocol** manages the complete link of sender and recipient through different networks.

C. Arbitrage Opportunities in the ICT Sector (Section 4.3)

Traditional network operators often charge different interconnection rates, depending on the type of call or type of service provider involved. Often this reflects differences in regulatory treatment between service providers. This creates opportunities for service providers to engage in *arbitrage* (either legally or illegally).

Arbitrage can cause marketplace distortions and reduce the effectiveness of regulation. If legislatures and regulators do not promptly adjust the regulatory policy that triggered such arbitrage, the impact on the market can be substantial. Some common arbitrage strategies are discussed in section 4.3.1.

Not all regulatory arbitrage strategies violate laws and regulations even though they deviate from regulatory intent, or exploit loopholes. Also, when network operators create arbitrage opportunities in the absence of a regulatory obligation, or if they fail to close a loophole quickly once it is detected, this may indicate that they themselves expect to benefit. Operators will tolerate some loss of revenue if it is outweighed by other benefits, such as regulatory relief or compensation.

Certain features of VoIP traffic create additional arbitrage opportunities. VoIP traffic can readily enter the Internet without traversing the PSTN. Opportunities also exist for terminating VoIP traffic without traversing the PSTN, or through undetected transit of the PSTN. Even when a PSTN operator is able to detect VoIP traffic, it may not be able to differentiate between local, domestic, and international VoIP calls for billing purposes.

Arbitrage may involve:

- qualifying services as long-haul transmission in order to avoid universal service surcharges;
- obscuring the origin of traffic to making international traffic appear domestic and long distance traffic appear local, in order to obtain the most favorable access price;

- characterizing traffic as local instead of long haul, to generate a reciprocal payment obligation (instead of a one-way access charge);
- distorting or obscuring the origin of traffic and the method of transmission to reduce or avoid charges imposed by another carrier for delivering the traffic to the intended recipient; and
- offering telecommunications services as ancillary to, or a minor transport element for, an enhanced information service.

A number of arbitrage strategies are sufficiently common that they warrant specific mention. These are:

- grey market strategies;
- leaky private branch exchanges (PBXs);
- resale of private lines;
- international call reorigination (or "call-back");
- refiling; and
- routing calls over the Internet.

D. VoIP and Regulation (Section 4.4)

Technological innovations are continuing to make Internet telephony functionally closer to dial-up telephone service. For example, it is now possible to access Internet telephony services using an ordinary telephone handset. As VoIP becomes more similar to conventional telephony, VoIP providers will compete more directly with incumbent telecommunications operators.

National legislatures and regulators will eventually have to decide what aspects of conventional telephony regulation should apply to VoIP service. Once a significant volume of telephone traffic is carried over Internet networks, the differences between VoIP and conventional traffic will have implications for universal service arrangements, telephone number management, public safety, and national security. For example, VoIP services are not available on a public, ubiquitous basis. In addition, they are generally unable to provide access to emergency service, or give location information in case of emergency.

This section reviews:

- key implications of VoIP for regulators (see section 4.4.1);
- trends in the regulation of VoIP services (see section 4.4.2); and

- the effect of differential regulation (see section 4.4.3) of VoIP and conventional telephony.

1. Implications of VoIP for Regulators (Section 4.4.1)

VoIP presents a particularly compelling challenge to regulators. Decisions on the regulatory status, availability, and price of VoIP services will directly affect the economic viability and future regulatory status of incumbent operators.

VoIP has the potential to erode the market share and profitability of incumbents. VoIP services can traverse the telephone network without detection. Thus, even where regulators permit only limited or no VoIP services, incumbent operators will still face competition from this source. Incumbent operators may no longer be able to expect voice traffic to generate lucrative revenues and profits.

In response to this competitive pressure, incumbents may seek regulatory relief. For example, incumbent operators may approach regulators seeking:

- regulatory parity with new entrants, for example by removing asymmetric regulation (see section 3.2.3) not imposed on other operators; or
- protection from competition, for example, by banning or seeking to limit VoIP services.

Finally, regulators will have to consider how best to encourage incumbent operators to retrofit their existing networks and install new digital plant, optimized for switching and routing data (of which VoIP will be a significant component in the future).

2. Trends in VoIP Regulation (Section 4.4.2)

In many countries Internet telephony qualifies for streamlined regulation on grounds that it is an “enhanced,” “value added,” or information service (generally consistent with regulatory treatment of the Internet).

As VoIP becomes a closer substitute for conventional voice telephony, regulators may be less inclined to eliminate regulatory requirements. This is particularly the case where VoIP services are close substitutes for traditional telephony, for example where VoIP operators seek telephone number assignments and *number portability*.

Most countries that have developed a VoIP regulatory policy have adopted a light handed approach in general, and have targeted regulatory interventions to specific matters, such as access to telephone numbers, number portability, access to emergency services, universal service, and national security.

3. Differential Regulation of VoIP and Conventional Telephony (Section 4.4.3)

Many countries regulate information services and traditional telecommunications services differently.

Differential regulatory treatment creates opportunities for arbitrage (see section 4.3). It also encourages incumbent network operators to:

- focus new investment on unregulated broadband networks, and
- migrate services (including voice telephony using VoIP) onto those new networks wherever possible.

This behavior achieves operational savings, and also qualifies voice telephony traffic for a lower level of regulation.

The result will be an increase in the volume of information services, and a reduction in the volume of voice telephony minutes of use that are subject to interconnection charges, or international accounting rate settlements. Network operators' traditional sources of revenues will erode, forcing regulators to rethink how network operators should be permitted to recover their costs.

E. Interconnection Pricing for VoIP (Section 4.5)

As network operators migrate to digital networks, voice services will become simply software applications riding over the network. Converging technologies and markets make conventional approaches to interconnection charging unsustainable.

Many technology forecasters predict that in the future voice telephony will migrate completely from circuit-switched telephony to VoIP. Once this happens, Internet interconnection and pricing models may replace the current arrangements. In the interim, VoIP network operators will need to interconnect with incumbent network operators' PSTNs. This section addresses:

- differences in cost recovery (see section 4.5.1) between the Internet and conventional telephony;
- interconnection models (see section 4.5.2) by Internet Service Providers (ISPs), namely peering and transit;
- implications of VoIP (see section 4.5.3) for interconnection pricing;
- pricing mechanisms (see section 4.5.4) for VoIP interconnection; and

- criteria (see section 4.5.5) for a new interconnection pricing regime.

1. A Comparison of Telecommunications and Internet Cost Recovery (Section 4.5.1)

Cost recovery models in telecommunications and for the Internet differ substantially. As technologies and markets converge, these differences are creating opportunities for arbitrage (see section 4.3). This section compares the cost recovery models for telecommunications and Internet interconnection.

2. Models for Internet Interconnection (Section 4.5.2)

ISPs use different models for interconnection pricing, depending on the specific characteristics of the ISPs concerned. Broadly, ISPs can either:

- enter into “peering” arrangements; or
- enter into a transit arrangement.

3. Implications of VoIP for Interconnection Pricing (Section 4.5.3)

Changes in how telecommunications services are delivered, including the emergence of VoIP, will have significant implications for interconnection pricing. In particular, the opportunities VoIP creates for arbitrage create pressures to:

- move toward cost-based pricing for interconnection (and other telecommunications services); and
- adopt uniform charges for access, regardless of the type of call, type of service providers, or other call characteristics.

Cost-based Pricing

Traditionally, telecommunications prices have been designed to keep prices for access and “basic” local service low, at the expense of long-distance users. The resulting high long-distance prices have created numerous opportunities for arbitrage (see section 4.3), which have placed downward pressure on prices.

Recognizing that the traditional model is unsustainable and inefficient, many regulators are now moving towards a more cost-based model. This shift often involves a long transition period, to avoid significant immediate jumps in prices for basic service.

Generally, pricing reforms are accompanied by a shift to transparent funding of universal service obligations, through explicit charges to interconnecting service providers, or directly to end users.

Uniform Access Charges

It is common for network operators to charge different access prices depending on the type of call, the type of service providers, or the distance involved. This creates opportunities for arbitrage (see section 4.3).

In many cases it makes more sense to move to a uniform charging regime. For example:

- Network operators, especially long-distance, average long- and short-haul traffic costs and charge a flat rate for calls (for example, a single per-minute rate for all calls in a wide geographic area – say, nationwide).
- “All You Can Eat” pricing – a flat monthly rate for unlimited local and long distance calls. This form of pricing is already standard for Internet access in many countries.
- If the cost of measuring the distance between the call originator and call recipient exceeds the cost difference in handling traffic of different distance, then network operators should not bother to do so. In this case, charges should not differ based on distance.

To move to a more sustainable charging regime, regulators will need to:

- eliminate regulatory asymmetries that treat similar services differently based on the technology used to provide the services (for example, VoIP or conventional voice service), or the type of provider;
- decide whether VoIP providers offering equivalent service to conventional voice telephony should pay the same charges and regulatory fees as other network operators.

Changes in technology and telecommunications network cost structures mean that per-minute pricing may become an inefficient cost recovery mechanism. As more services are delivered as packets over digital networks, minutes of use are no longer an important cost driver.

Technical developments are improving the ability of consumers to manage their own telecommunications services. As a result, the premise that the calling party is the sole cost causer may no longer be valid. The Calling Party Pays (see section 3.3.1) approach to call pricing (and interconnection charges) may no longer reflect actual cost causation.

4. Pricing Mechanisms for VoIP Interconnection (Section 4.5.4)

This section discusses:

- the application of origination and termination payments to VoIP interconnection;

- cost drivers for VoIP;
- setting cost-based charges for VoIP interconnection; and
- reciprocal payment obligations between VoIP providers and conventional operators.

Application of Origination and Termination Payments to VoIP

VoIP providers require access to the PSTN to terminate calls to recipients who do not subscribe to the VoIP provider's service, and for some types of call originations. Such interconnection typically occurs between a VoIP operator's gateway and the PSTN operator's Tandem Switch closest to the call originator or recipient.

Cost Drivers for VoIP

Per-minute cost recovery has a number of weaknesses in a VoIP world. Call duration has no meaningful relationship to the costs of a VoIP call. Charging on a per-minute basis creates opportunities for VoIP operators to engage in regulatory arbitrage (see section 4.3), or to avoid interconnection charges.

As VoIP traffic increases, interconnection charges based on bandwidth used would better reflect underlying cost drivers, and would be more consistent with economic efficiency.

Setting Cost-Based Charges for VoIP Interconnection

An interconnection pricing mechanism for VoIP services should reflect the costs of the local network assets used to provide VoIP. If interconnection prices reflect underlying costs and appropriate *cost drivers*, opportunities for arbitrage will decline. Similarly, where VoIP operators provide a service that is functionally equivalent to conventional telephony, treating VoIP providers in the same way as conventional service providers will remove arbitrage opportunities.

Reciprocal Payment Obligations

VoIP operators currently do not receive any compensation from PSTN operators for terminating calls that originate on the PSTN. If VoIP operators are treated in the same way as other service providers with respect to interconnection payments, then they should also have the same rights to compensation. That is, VoIP providers should also be entitled to reciprocal compensation for terminating calls that originate on the PSTN.

5. Criteria for a New Interconnection Regime (Section 4.5.5)

As more traffic migrates to VoIP, we will need a new approach to interconnection pricing. Any new approach to interconnection pricing should:

- encourage efficient competition and the efficient use of, and investment in, telecommunications networks;

- preserve the financial viability of universal service mechanisms (thus any proposal that would result in significant reductions in intercarrier payments should include a proposal to address the shortfall);
- treat technologies and competitors neutrally;
- allow innovation; and
- minimize regulatory intervention (see section 2.3.5) and enforcement, consistent with the general trend toward less regulation wherever possible.

This implies treating VoIP providers that provide service over the PSTN in the same way as other telecommunications service providers, with respect to the following:

- Interconnection charges. VoIP providers should face the same payment obligations as other service providers that use equivalent facilities and services. Similarly, VoIP providers should be entitled to the same reciprocal termination payments from PSTN operators.
- Regulatory fees. Technology neutrality suggests that all providers (including VoIP providers) whose service accesses the PSTN should be subject to the same regulatory fees, including universal service contributions.
- Other regulatory requirements. Where feasible, VoIP providers should have similar obligations to other service providers that offer a functionally equivalent service (for example with respect to emergency services, or obligations to support law enforcement call intercepts).

F. VoIP Over Wireless Networks (Section 4.6)

Wireless networks will have a substantial impact on VoIP service development, particularly in developing countries.

As wireless and VoIP traffic increase, differences in the terms and conditions under which wireline, wireless and VoIP operators interconnect networks will create opportunities for arbitrage, and distort markets. Differences in call termination rates and interconnection arrangements can cause operators to adjust traffic flows to obtain the lowest possible rate, and to minimize regulatory fees.

G. Benchmarking Rates for Network Access (Section 4.7)

This section provides international benchmarks of voice telephony call rates and broadband data rates.

H. Internet Exchange Points (Section 4.8)

Regional IXPs play an important role in reducing the costs of ISPs and encourage development of the Internet in developing countries. This section discusses:

- the role of regional IXPs (see section 4.8.1);
- ways to support the development of IXPs (see section 4.8.2) in developing countries; and
- the development of IXPs in Africa (see section 4.8.3).

1. The Role of Internet Exchange Points (Section 4.8.1)

Because the Internet offers access to content and users anywhere, each ISP has to secure network connections to all potential senders and recipients of content, or suffer competitively for the lack of global reach. Reciprocal interconnection – whether freely provisioned or provided for a fee – makes it possible for an ISP to access the entire global Internet “cloud” for its subscribers.

The Internet operates almost free of regulation, so Tier-1 ISPs can largely dictate interconnection terms and conditions. ISPs in remote areas (including most developing countries) must meet the entire cost of accessing larger “Tier-1” ISP networks, using expensive international satellite links or submarine cables.

In some cases, where there is no local or regional facility for the exchange of Internet traffic, developing country ISPs must pay for international transit facilities to deliver local traffic. This practice is known as “tromboning.”

A key way to reduce Internet traffic costs for developing country ISPs is through the development of regional IXPs.

2. Supporting IXPs in Developing Countries (Section 4.8.2)

IXPs in developing countries are important for a number of reasons. They:

- enable efficient, cost effective management of Internet traffic;
- provide an interface between multiple ISPs, which enables them to avoid tromboning local and regional traffic; and
- should help stimulate market entry by new ISPs, web hosting and equipment co-location developers, and content creators.

This section reviews key challenges in establishing IXPs in developing countries, and suggests some elements of “best practice.”

3. Internet Exchange Points in Africa (Section 4.8.3)

Until recently, Africa was especially disadvantaged by the absence of IXPs.

Compared to other continents, Africa had limited connectivity options and low initial traffic volumes. As a result, African ISPs often faced high transmission costs, even when routing local and regional traffic, due to the need to “trombone” traffic. Tromboning increases delays and can reduce the quality of the transmission.

In addition, African ISPs pay a substantial premium for overseas connections. International connectivity charges can be between 15 and 26 times greater than their equivalent local costs.^[1]

In response to these pressures, IXPs are now emerging in Africa.

V. REGULATING PRICES (Section 5)

If effective competition is not possible in wholesale or retail markets, it may be necessary to regulate the prices dominant firms can charge. Without price regulation, dominant firms can increase prices above competitive levels, harming their customers.

This section of the toolkit covers key issues in regulating prices:

- The justification for *ex ante* price regulation – why regulate prices? (see section 5.1).
- Economic and accounting approaches to measuring costs (see section 5.2).
- Determining the structure and level of regulated prices (see section 5.5).
- Benchmarking prices (see section 5.7).
- Methods of price regulation, specifically rate of return regulation (see section 5.8) and incentive regulation (see section 5.9).
- The relative merits of rate of return regulation versus price caps (see section 5.8).
- Issues in implementing price caps (see section 5.11), including defining the basket(s), assessing price variations, calculating the efficiency factor, and incorporating service quality and exogenous costs.
- Double price caps (see section 5.11).

In addition, this section provides an overview of economic concepts (see section 5.3) that are particularly relevant to price regulation, and key pricing principles (see section 5.4).

A. Why Regulate Prices? (Section 5.1)

Regulation (see section 2.3.2) has potentially high costs. Among other things, it substitutes the regulator's judgment for market interactions. No matter how capable and well intentioned regulators are, they will never be able to produce outcomes as efficient as a well-functioning market.

Regulators should therefore forebear from interfering in pricing decisions unless the expected benefits from regulating prices outweigh the expected costs from doing so. This requires that, without regulation, prices will either be:

- too high overall – if an operator or service provider has market power it may increase prices above competitive levels, suppressing demand for the service and leading to a loss of social welfare, or;

- anti-competitive – an operator or service provider with market power may engage in pricing practices that hinder competition in a market. Three important anti-competitive pricing practices are cross subsidization (see section 2.5.4), price squeezes (see section 2.5.3), and predatory pricing (see section 2.5.7).

Regulatory Options

If there is a case for price regulation, a number of regulatory options exist. These include:

- Rate-of-return regulation (see section 5.8).
- Incentive regulation (see section 5.9).
- International benchmarking of prices (see section 5.7).

Regulatory Criteria

The list below sets out common regulatory goals, which provide useful criteria for assessing regulatory options:

- **Prevent the exercise of market power.** An important goal of regulation is to ensure that prices are fair and reasonable, where competitive forces are insufficient. Any regulatory price control mechanism should encourage prices that reflect what one would observe in a competitive environment.
- **Achieve economic efficiency.** The regulatory mechanism chosen should improve economic efficiency. There are several measures of economic efficiency:
 - **Technical efficiency** (or “productive efficiency”) requires that goods and resources produced in the telecommunications industry should be produced at the lowest possible cost. This ensures that society’s scarce resources are used efficiently and are not wasted.
 - **Allocative efficiency** requires that the prices one observes in a market are based upon and equal to the underlying costs that society incurs to produce those services (generally the long run incremental cost of producing the service). This will ensure that customers whose valuation of the service exceeds the cost of producing the service will purchase the service. Customers who place a lower valuation on the service will forgo it. This ensures that the “optimal” amount of the service is consumed, given cost and demand conditions. In the ICT sector, prices must include some mark-up to recover shared and common costs. Mark-ups (see section 5.5.2) should be set so as to minimize the impact on allocative efficiency.
 - **Dynamic efficiency** requires that firms should have the proper incentives to invest in new technologies and deploy new services.

- **Promote competition.** Many regulators operate under a legal framework where the goal is to permit and promote competition in telecommunications markets. Where the legal framework permits competition, it is important that regulation (at a minimum) does no harm to competition.
- **Minimize regulatory cost.** All else being equal, regulators should choose a regulatory mechanism that is less costly to implement over one that is costlier to implement.
- **Ensure high service quality.** In addition to ensuring that the prices of telecommunications services are fair, regulators are also concerned that consumers should receive a high quality service. In ranking alternative regulatory options, regulators should give preference to mechanisms that result in higher quality service, all else being equal.
- **Ensure telephone prices are competitive with other jurisdictions.** This is a relevant objective in countries, such as Singapore, that use telecommunications infrastructure as a tool for competitive advantage. In these countries, telecommunications infrastructure plays an important role in attracting foreign investment. It is therefore important that telecommunications prices are competitive with other possible destinations for foreign investment.
- **Generate compensatory earnings.** Any regulatory mechanism should provide the regulated company with the opportunity to earn a reasonable profit and to achieve compensatory earnings. If not, the firm may be forced to reduce investment and quality of service may decline.

B. Economic and Accounting Measures of Cost (Section 5.2)

Different cost concepts are useful for answering different questions about a firm and its activities. This section provides an overview of cost measures that are particularly relevant to price regulation:

- Historic costs.
- Sunk costs.
- Forward-looking costs.
- Fixed costs (service specific, shared and common costs).
- Variable costs: marginal costs, incremental cost (including LRIC and TSLRIC).
- Stand-alone costs.
- Short- and long-run cost concepts.

C. Useful Economic Concepts (Section 5.3)

This section introduces some economic concepts that are particularly relevant to the task of price setting:

- Economic efficiency (see section 5.3.1).
- Economies of scale and scope (see section 5.3.2).
- Single and multiple-service firms (see section 5.3.3).

1. Economic Efficiency and Pricing (Section 5.3.1)

In economics, the ideal of **efficient pricing** is often held up as a desirable social goal. Only efficient pricing can ensure that consumers pay the true economic value of products they buy, and that society's scarce resources find their best possible uses.

The following are two general principles pertaining to efficient pricing:

- The economically efficient price of any increment of service is the price that exactly recovers the full economic cost incurred to provide that increment of service.
- In a perfectly competitive market, the price of any increment of service will be driven to the full economic cost of that increment of service, and will therefore be economically efficient.

2. Economies of Scale and Scope (Section 5.3.2)

The production process for telecommunications operators is characterized by economies of scale and scope. This is because telecommunications operators generally have high fixed costs and high shared and common (see section 5.2) costs.

3. Single- and Multiple-Service Firms (Section 5.3.3)

A **single-service firm** provides only one service to customers. A **multiple-service firm** provides several services to customers.

In a single-service firm there are no shared or common (see section 5.2) costs, and no need to attribute costs between services in order to calculate prices.

D. Pricing Principles for the ICT Sector (Section 5.4)

Most firms in the ICT sector provide multiple services and operate in markets that are very different from a standard model of a perfectly competitive market (see section 2.1.1). When pricing services provided by multiple-service network operators, an alternative set of pricing principles applies:

Pricing Principle 1: In a competitive market, the efficient price of a service provided by a multiple-service operator need not be equal to its TSLRIC (see section 5.2). Instead, the efficient price must be equal to the full economic cost of the service which exceeds the TSLRIC.

In perfectly competitive markets, the efficient price is equal to the underlying incremental or marginal cost of producing a service. Pricing Principle 1 recognizes that telecommunications firms are multiple services with substantial shared and common costs. Full economic costs include incremental costs, and an appropriate contribution (see section 5.5.2) towards shared and common costs.

Pricing Principle 2: The TSLRIC of each service provided by a multiple-service operator is the price floor for that service. Incremental revenue from each service must cover the TSLRIC of that service. However, a price that is equal to the full economic cost of a service will be efficient even if that price is above the TSLRIC.

In perfectly competitive markets, any price above incremental cost is inefficient. Pricing Principle 2 emphasizes that, for network operators, a price that is above incremental cost is not necessarily inefficient.

Pricing Principle 3: The LRIC (see section 5.2) shall be the price floor for any additional increment of service provided by a multiple-service operator. Revenue from each increment of service must at least cover its LRIC.

LRIC is the appropriate price floor because the planned increment of service for which a price is set need not be the entire quantity of the service. However, regulators increasingly use the (average) TSLRIC as the price floor in place of LRIC. The difference between LRIC and TSLRIC is that TSLRIC includes service-specific fixed costs, while LRIC does not. As a result, TSLRIC usually results in a higher price floor.

In the United States, some regulators have established (average) TSLRIC as the price floor for the service as a whole so that the total revenues received from the service must at least equal the service's TSLRIC. Yet for the price floor for an additional unit of output, regulators have accepted LRIC as the proper price floor.

E. Setting the Level and Structure of Prices (Section 5.5)

This section discusses the task of setting prices for network operators and service providers. It addresses:

- the relationship between fixed and variable costs and efficient prices (see section 5.5.1);
- methods for determining mark-ups over TSLRIC (see section 5.5.2); and
- tariff rebalancing (see section 5.6).

1. Fixed and Variable Costs and Price Setting (Section 5.5.1)

Efficient prices typically consist of:

- recovery of the variable (or incremental) costs for the product;
- a mark-up to recover that product's fixed costs;
- an additional mark-up to recover any costs shared with other products; and
- another mark-up to recover the firm's common costs.

2. Determining Mark-Ups over TSLRIC (Section 5.5.2)

A multiple-service firm (see section 5.3.3) that has economies of scale or scope (see section 5.3.2) cannot recover all of its costs if it prices services at exactly their respective TSLRICs (see section 5.2). In order to recover legitimate total costs, multiple-service operators must mark up prices above TSLRIC. If the mark-ups are done right, the contributions from each service should enable the operator to fully recover its shared and common (see section 5.2) costs.

Although operators need to mark up prices above TSLRIC in order to recover their costs, such mark-ups can reduce social welfare below its **theoretical** maximum. Mark-ups must be set with care, to minimize this distortion. This is known as *second-best optimality*. Two approaches for second-best optimal pricing are value of service pricing and non-linear tariffs.

F. Tariff Rebalancing (Section 5.6)

Historically, telecommunications operators and regulators have set prices for network access as low as possible. Prices for other services, such as long distance calls, have been kept high to subsidize low access prices.

The rationale behind such policies was to encourage customers to join the network, to realize network externalities. In practice, however, subscribership in many developing economies has been extremely low. It is questionable whether low network access prices have in fact led to economic gains. Whatever the benefits from subsidizing access prices, economists agree that rebalancing tariffs can produce significant economic gains.

A policy of rebalancing seeks to increase access prices, and reduce prices for services that have traditionally subsidized low access prices. The objective is to ensure that the price for each service reflects the underlying cost of providing that service.

Tariff rebalancing can improve social welfare by:

- stimulating demand for services such as long distance calling;
- providing improved signals to actual and potential service providers to invest in network access technologies; and
- improving incentives for competitors to compete for a broad range of customers.

G. International Benchmarking of Prices (Section 5.7)

International benchmarking is the process of establishing the price of a service based on prices in other jurisdictions. Benchmarking can be used as a common-sense check on the results of cost models. Alternatively, it can be used directly to set prices.

H. Rate of Return Regulation (Section 5.8)

This section covers the following topics:

- An overview of rate of return regulation.
- Calculating the revenue requirement for regulated services.
- Setting prices for regulated services.

For an assessment of the advantages and pitfalls of rate of return regulation, compared to price caps, see section 5.10.

I. Incentive Regulation (Section 5.9)

The term “incentive regulation” refers to types of regulatory mechanism that seek to improve on the weak incentives for efficiency in traditional rate-of-return regulation (see section 5.8).

Incentive regulation includes:

- banded rate-of-return regulation;
- earnings sharing;
- revenue sharing;
- price freezes;
- rate case moratoriums;
- pure price caps; and
- hybrid price caps.

J. Implementing Price Caps (Section 5.11)

This section discusses key issues in implementing a price cap regime. The key features of a price cap regime include the following:

- The regulator controls the average price of a basket (or baskets) of services (see section 5.11.1). The firm has the flexibility to set prices for individual services, provided that the average price for the basket does not exceed the cap. On an annual basis, the firm and the regulator assess price variations (see section 5.11.2) to ensure that they conform to the price cap.
- The price cap includes an efficiency factor, or “X-factor” (see section 5.11.3). Usually, the efficiency factor requires *real prices* to reduce over time to reflect expected efficiency improvements for the regulated firm.
- The price cap formula may also include factors to account for other variables, such as service quality (see section 5.11.4) and exogenous changes in costs (see section 5.11.5).

The X-factor in the price cap formula (see section 5.9) is an efficiency target chosen to reflect the productivity growth potential of the regulated firm over the (forward-looking) term of the price cap.

The inclusion of the X-factor ensures that prices change over time to reflect productivity gains. If the regulated firm's actual cost reductions exceed the X-factor, the firm is rewarded. On the other hand, if the firm's actual cost reductions are not as great as required by the X-factor, then the firm is penalized.

Care is required in setting the X-factor. The firm's financial success will depend on its ability to reduce unit costs while there is a price cap. This, therefore, should be taken into account in setting the X-factor.

The X-factor can be calculated by:

- using a forward looking financial model of the firm; or
- comparing the rate of increase in the firm's (or industry's) total factor productivity to the economy-wide rate.

In addition, some regulators include an additional component in the X-factor, to provide a consumer productivity dividend, or "stretch factor."

A theoretical weakness of price cap regulation (see section 5.10) is that it could lead to a deterioration of service quality. Some price cap plans therefore include a service quality component to ensure that service quality will not suffer under price cap regulation.

Regulators can set a service quality component by:

- selecting key service quality measures, and
- monitoring the regulated firm's performance against these measures.

If performance falls below the required standards the firm is penalized, for example through an increase in the X-factor. Conversely, the firm should be rewarded for exceeding service standards.

Many regulators include an exogenous cost component, or Z-factor, in the price cap formula (see section 5.9). This allows the regulated firm to adjust for changes in costs that are beyond its control.

By including a Z-factor in the price cap, regulators can allow changes in certain types of costs to flow directly through to the price cap index (see section 5.11.2), without affecting the regulated firm's incentives to control its costs. Thus changes in the firm's prices (or at least in the price cap index) can more closely track changes in costs.

When establishing a Z-factor it is crucial that regulators treat only those events over which the firm has no control as exogenous. Some exogenous factors are easy to identify, for example changes in taxation or in regulatory rules. However, other exogenous factors changes are difficult to isolate.

There are significant technological and competitive changes occurring in the telecommunications industry such as the advancement and rapid growth of wireless services, the rapid development of packet-based communications, (VoIP), the emergence of cable companies as strong competitors to traditional phone companies, and the potential for convergence to obliterate remaining distinctions between fixed and wireless communications.

As a result, regulators have begun the process of evaluating whether current price regulations still remain necessary for traditional telecommunications carriers. While certain form of regulatory intervention will likely remain for the long run, such as numbering resources, interconnection oversight, spectrum allocation, etc., some regulators have already decided that traditional telecommunications firms no longer possess market power and have begun the process of deregulating telecommunications carriers.