III. ANALYTICAL FRAMEWORK

III.1 Objectives and definitions

The objectives for this project anticipate the development of an in-depth information and data collection, analysis, and modeling exercise, across 19 member countries of Regulatel, to review and assess current and planned universal access programs in these countries, to assess their impact and effectiveness, to assess the demand and supply for telecommunications services in unserved and underserved rural and urban areas, to evaluate the scope of the "gaps" in access to communications and to propose innovative models for meeting the requirements of universal access. To underpin this research, it was necessary to develop a coherent analytical framework through which the analysis and findings could be structured and compared. This includes defining the scope and limits of the factors that we are analyzing, as well as specific terminology and questions that arise any time "universal access" policies in telecommunications are raised.

It is important here to distinguish between the concepts of universal access and universal service. While different countries' legislation and regulations define these terms in varying ways, the general concepts, and the definitions that we apply throughout this report, can be summarized as follows:

> <u>Universal access</u> to telecommunications implies the reasonable availability of network facilities and services, in terms of geographic coverage and public access points, such that citizens and institutions, can obtain and the services within their local communities, either on a private or a shared, public basis. To achieve true "universal access" therefore implies that 100% of a designated population can obtain, at a minimum, public access to a defined service, through reasonably available and affordable public or community facilities, and those who are willing and able to pay full cost-based prices can obtain individual or household service on demand.
>
> <u>Universal service</u> in telecommunications intends a more absolute condition, in which telecommunications services are delivered ubiquitously to households or individuals throughout an area, and thus are both accessible <u>and</u> affordable, with

no practical impediments to subscription and usage. To achieve true "universal service" thus implies that 100% of a designated population is reasonably able to subscribe to and use a defined service on an individual, household or institutional basis.

As explained below, the emphasis in this study is on universal access, namely, expansion of basic telecommunications network facilities to geographic locations and populations which do not yet have access to those networks, either on a public or private basis. We discuss universal service considerations, including affordability and related factors, as further concerns of these policies, but with basic geographic coverage and access as the priority objective,

Other important terms used in this report are defined here in order to ensure a common at least for this present study.

A universal access fund is a mechanism and a fund established to create an extra level of economic incentives necessary to spur private investment in network expansion and service delivery while maintaining market conditions, defined through a legislative instrument (law, regulation, decree, etc.) which describes its objectives, operation, administration and internal organization, and method of collecting and disbursing funds. Universal access funds fall within the definition of the World Bank's Output Based Aid (OBA) concept defined as "the use of explicit, performance-based subsidies to complement or replace user fees involving the contracting out of basic service provision (e.g., infrastructure, health, education) to a third party—such as private companies, non-governmental organizations (NGOs), community-based organizations, and possibly even a public service provider — with subsidy payment tied to the delivery of previously specified outputs (e.g., per network connection, or per kilometer of road constructed or maintained)"[1].

[1] The prime purpose of the World Bank's OBA approach up to now has been to improve the delivery of and access to basic services mainly in relatively small, rural Greenfield operations. The World Bank would now like now to scale up projects from small rural communities to larger rural as well as urban and peri-urban areas. Structuring Output-Based Aid (OBA) Approaches in World Bank Group Operations

Broadband refers to a high-capacity, two-way link between an end user and access network suppliers capable of supporting applications beyond simple voice and messaging. While there is no common definition of what constitutes broadband in a data communications network, generally speaking any speed which is higher than that which can be obtained through source encoding and modulating a common voice channel (usually 64 kilobits per second or Kbps using for example pulse code modulation) can be considered to be broadband.

The first questions to ask in the context of a policy and market analysis of this kind must address the basic definitions of "access", in terms of technical and service parameters as well as the specific objectives that policymakers are seeking to achieve through universal access programs. These questions present an analytical challenge from the outset, because the answers imply a set of priorities for access development before the market structure is fully understood. In the context of rapidly changing technological and market conditions, it is important to frame the issue from a forward-looking perspective: i.e., to consider what services are, and will be, most in demand and most realistic for operators to provide on a cost-effective basis.

Table III.1 presents a schematic hierarchy of various types of telecommunications/ICT "access" that can be envisioned for different locations and different types of users. In any given location, and for each type of service, there are generally three types of possible access: public, institutional, and private. Public access implies shared community-based facilities open to all users. Examples include public telecenters, cyber cafés, libraries, and other commercial or non-profit public access points. Institutional access includes connections within public as well as business organizations, which may be utilized by the members or employees of such institutions. Examples can include schools and universities, community service groups, business networks available to employees, and the like. Private or individual access implies that each household or individual user can have unique, personal access to a service. (Note again that the availability of access is a supply-side consideration and not the same thing as actual subscription to and use of a service, which is a function of demand-side factors such as affordability and interest.)

The service types in the table represent generally increasing degrees of flexibility and functionality. In most cases, the next level of service development can (and must) be built upon the previous level, although there are exceptions. This range of options has formed the broad basis for the analysis of access conditions and policies in this study, although precise definitions vary greatly from country to country. Chapter VII and Appendix 5 discuss the various wireline and wireless technologies available to provide these services.

Not all of these service configurations have been the focus of universal access policies, and the most advanced options may be more appropriate for consideration only after basic access policies have been implemented in many countries. But the schematic allows for a clear perspective on the range, scope, and direction of universal access objectives, especially in the rapidly changing telecommunications and ICT environment.

Table III.1 Hierarchy of various types of telecommunications/ICT "access"

Service	Public access	Institutional access	Private subscriber
Basic voice telephone	Public pay telephone, simple telecenter	Telephone service connection (single or multiple lines)	Household telephone service connection.
Mobile telephone	Public resale of mobile service (e.g., Chalequeros, Grameen Phone)	Mobile service account(s) for administrators, employees	Individual mobile subscriptions with post- and pre-paid payment plans
Basic dial-up Internet	Telecenter, Internet café, cabine (single or multiple access lines); public IT, training support; local or national ISP	Institutional dial-up account (single or multiple access lines); in-house IT support, PCs; local or national ISP	Home dial-up accounts (and access lines), local commercial PC supply, IT support; local or national ISP
High-speed Internet, data services	Same as above, with high-speed access line enhanced applications, local Web hosting, VOIP option	Institutional high-speed access line; enhanced applications, in-house Web and e-mail server hosting; VOIP option; uploading of local content; institutional data networking	Home high-speed Internet access; enhanced applications, VOIP option (using DSL, cable modem or wireline access technologies)[2]
Mobile data	Public WiFi/WiMax hot spots	Institutional WiFi/WiMax, also 2.5G/3G mobile service	Individual 2.5G/3G mobile voice/data service accounts
Broadcasting	Public radio reception, retransmission; local community radio production & broadcast; public TV viewing, recording	Institutional radio and TV reception; local content creation, distribution; commercial advertising	In-home radio & TV reception; requires electricity, local market for equipment, service
Broadband multimedia	Public/community (telecenter) access to public and private multimedia services, applications (audio, visual, graphic, interactive); public content creation, upload	Institutional access to multimedia services, applications; content creation, upload; interactive networking (e-learning, e-health, etc.)	Home-based multimedia access: cable TV, digital audio, etc.; in addition to full-service Internet, VOIP, personal networking, etc.

[2] Table VII.2 (Chapter VII) summarizes the local access technologies deployed to provide high speed Internet access in each of the Regulatel member countries.

III.2 Policy and program analysis

This section outlines the analytical framework we have used in this study for evaluating universal access policies and programs in Latin America, in the context of the market gaps perspective and the overall goals for telecommunications and ICT access expressed within each country.

Current universal access programs in Latin America including their overall impact, cost effectiveness, sustainability, and the types of networks and services being provided, have been analyzed according to four general policy approaches, which Regulatel member countries have used individually and in combination to expand networks, improve telecommunications services and promote universal access and universal service. These four approaches are:

a. Market liberalization combined with regulatory initiatives including universal access obligations and special regulations and conditions which favour projects and operations in uneconomic areas (almost all countries have adopted aspects of this approach);
b. Universal access programs/funds;
c. Other financing methods and project initiatives by national, state and local governments, cooperatives, NGOs and others;
d. State-mandated and controlled approaches using cross subsidies and other financing sources.

We review how each of these approaches has been adopted in Regulatel member countries (Chapter V) and present the results and systematically analyze each (Chapter VI) in terms of the following key criteria and metrics:

- What have been the general results with respect to access growth and other indicators? Relevant indicators for the results of universal access approaches which have been considered throughout the evaluation include:

- Effectiveness of programs in terms of numbers of persons, households, and communities obtaining new access to network coverage, as well as growth in subscribership and penetration of services;
- Efficiency of projects in relation to the level of funding (subsidy) required (cost-benefit indicators);
- Sustainability of projects over time, as demonstrated by continued operation, maintenance, and growth after subsidy and other public support is depleted;
- Impact of projects on larger socio-economic development goals within communities or the country as a whole.

- What has worked well, and why? Which programs and policies have produced positive results according to the above metrics? To what can we attribute these successes?
- What are the key features and activities (including specific implementation details) that have produced the most promising results? Among the most effective policies and programs, what terms and conditions have appeared to contribute most to the favorable outcomes? Can these be replicated easily? What general lessons can be taken from the experiences?
- What problems have been encountered, and what has caused them? What are examples of projects or programs that have failed to live up to expectations, whether in terms of meeting stated network expansion goals, or through encountering unexpected barriers and difficulties along the way? Are the problems political, bureaucratic, economic, technical, or human in nature?
- What responses have been tried to overcome problems or barriers? Have there been successful (or partially successful) strategies for dealing with the setbacks that have occurred? Have there been lessons as to tactics or approaches that should not be repeated, or other key mistakes to be avoided? Are there obvious ways around some of the more basic problems?
- What are the key overall lessons learned, and how can they be applied going forward? In looking at the “big picture”, what can regulators, investors, governments, and others learn from the experience of universal access programs in Latin America, and what new strategies should they consider in the future?

III.3 The "market gap" and "access gap" concepts

Among the key theoretical and economic foundations for the analysis of this study, and particularly for the spreadsheet model used to assess levels of telecommunications development and impacts of universal access policies, are the concepts of "market efficiency" and "market gaps" and "access gaps". These notions have been gaining wide acceptance within the telecommunications policy and economics field as the best framework for understanding the interplay of market forces, regulatory decisions, and financial constraints on the development of telecommunications markets, especially among lower income and higher cost areas and populations.

The following diagram illustrates in detail the relationships and terms that define this "gap" theory, with explanations of the key concepts and principles below.

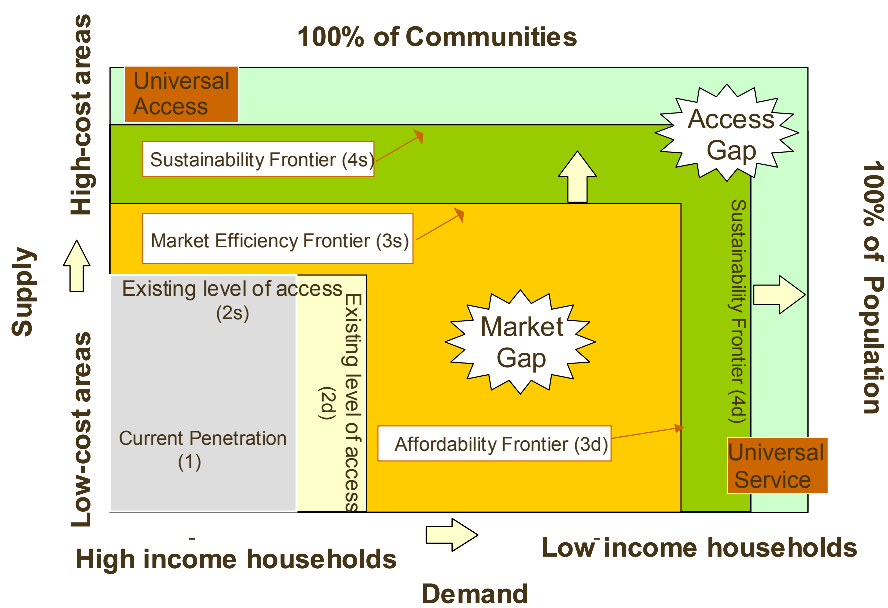

Figure III.1
The Gaps Model

Basic framework: The diagram represents any market, for any telecommunications service. The y-axis is the supply side, and the x-axis is the demand side, with the top border representing 100% of communities (i.e., geographic population centers) within the region or country being examined, and the right border representing 100% of the population, typically expressed as households. The gray box (1) showing "current penetration" represents the degree of actual subscribership or usage of the service in question at present. The light yellow border (2) represents the existing level of "access" to the service. (On the supply axis, access and penetration are the same, as this axis measures geographic availability; whereas on the demand axis, penetration is unlikely to equal availability, as there are households that may be covered, but may not purchase the service – see below). Thus, for example, if a given service were available to 30% of the population, the "current penetration" box would reach 30% along each axis.

As indicated in the diagram, the direction of decreasing supply tends to correlate with higher costs of providing service, while the direction of decreasing demand tends to correlate with lower incomes. (There may be exceptions to these general trends.) Note that the bulk of this study, and of most research and policy analysis regarding universal "access", focuses on the y-axis; i.e., supply-side availability of network and service coverage to geographic areas; however, increasing attention is beginning to be paid to demand-side questions, affordability, and the notion of true universal "service," at least for some basic services, and we will address these as well.

Market efficiency frontier: The concept of the market efficiency frontier is central to this theory, and is the critical idea driving market-oriented telecommunications development policy as well as universal access policies. The notion is that there is some theoretical size of the "efficient" market for any given service, which profit-motivated, competitive operators would be prepared to deliver without any subsidy or other outside intervention, as long as artificial (non-economic) barriers to entry and expansion were eliminated. The principle at work here is the recognition that most telecommunications markets in developing countries are in a stage of transition, from formerly monopoly, state-run operations to more competitive and open markets, in which a variety of investors and entrepreneurs can pursue customers, with different technical and market strategies. In moving toward this market-driven model, most countries' regulatory frameworks and legacy industry structures tend to exhibit residual impediments to the full functioning of market forces. At the same time, the rapidly changing technological and economic conditions of the telecommunications industry ensure that investments and operating decisions and efficiencies are in constant flux, so that nearly any service provider is not likely to be operating in the most cost-effective manner at any given time.

The location of this market efficiency frontier is determined primarily by supply-side factors. Note that the term “location” here is an economic concept, although it does have geographic dimensions. In fact, geographic factors are typically the most prominent determinants of the ultimate limitations on market deployment of services. For most telecommunications networks and services, the location of network access points, in terms of distance from backbone facilities, topographic conditions such as mountains or jungles, and similar geographic factors, are the most significant elements driving capital investment costs. Thus, the locations most often lacking in basic network access are the most remote and rural areas, and those isolated by the landscape and other natural barriers. Other supply side factors that can strongly influence the economic “location” of the market efficiency frontier include:

- basic costs of network infrastructure and equipment, including costs that may be associated with the import of foreign-manufactured facilities, as well as the labor costs for their installation;
- acquisition and/or license costs for frequency spectrum, support structures, rights of way, and similar legal or contractual obligations;
- impact and availability of other forms of essential infrastructure, such as roads and electricity, to support the construction and operation of telecommunications networks in remote locations;
- costs and availability of human resource capacity, from technicians and construction workers to salespersons and customer support personnel needed to promote the effective deliver of services to end user customers;
- costs, expertise, and accessibility of software platforms and applications of all kinds, particularly with respect to deployment of more advanced ICT services and capabilities, where both market demand and the effective functioning of services depends upon not only network connectivity but the provision of useful and reliable features, functions, and information content;
- tax and tariff policies of the national and local governments with respect to revenues earned from services, as well as import tariffs and other fees, which directly affect the economic viability of any business model. (As noted below, however, it is debatable whether this factor is legitimately an element of the market efficiency frontier, or represents a non-economic barrier that contributes to the market gap.)

Market gap: The concept of the market efficiency frontier directly leads to the companion notion of the market efficiency "gap", or simply "market gap". As explained, the theory holds that the likely size and scope of a fully "efficient" market for any service is potentially significantly greater than the present degree of access. The market gap represents the difference between the size of this perfectly efficient market and the extent of present real-world market access for the service in question. As service demand grows, regulations are streamlined, and investment is able to flow to identifiably attractive market segments, the size of the market gap tends to shrink, as the current access line moves toward the market efficiency frontier. (On the other hand, the gap can also become larger, if supply factors independently reduce costs to deliver services, but the market is prevented from expanding commensurately.)

The size of the market gap is essentially due to non-economic limitations, restrictions, and barriers to the efficient expansion of services by profit-oriented competitive investors and operators. Since in principle all service provision within the gap would be of economic value to one or more suppliers, the fact that market players have not yet entered these areas must generally be a result of non-economic factors. Some of the most notable impediments to this type of market-driven development include:

- Barriers to entry and licensing restrictions that prevent or make it excessively difficult for new, especially smaller entrepreneurs to establish operations targeting unserved customer groups and locations;
- Local government restrictions on rights of way, disproportionate taxes and fees on infrastructure, business establishment charges and procedures, and other costly disincentives. Taxes can also represent a key impediment to market expansion, especially business income taxes which directly reduce the level of retained revenues for an operator, and hence the potential profitability of a project. Such taxes and other fees may be seen as "appropriate" economic costs of doing business, for example if they are comparable to tax rates paid by all enterprises in all sectors, but disproportionate taxes on telecommunications operations could be considered non-economic barriers to expansion. Naturally, reduced taxes can help form incentives for new investment as well;

- Import duties on foreign equipment that cannot be obtained domestically, which can drive up costs dramatically, especially for smaller operators;
- Difficulties accessing start-up financing from domestic or international sources, due to a variety of factors, including general inefficiencies in capital markets, especially for micro-finance;
- Human resource limitations, such as the lack of trained technicians, management personnel, and others needed to initiate and maintain services, especially in remote areas;
- Demand side considerations, including customers' inability to access cash or to obtain adequate credit to pay for services.

The most appropriate and effective methods for addressing the market gap should involve reduction and elimination of as many of these types of barriers as possible, so that the market can function more effectively. Using public subsidy funding, on the other hand, to help improve the financial incentives of an under-performing, insufficiently competitive market, would tend to distort that market and ultimately hurt the prospects for longer term competitive growth.

Sustainability frontier: The sustainability frontier is beyond the market efficiency frontier, and indicates another theoretical boundary in the potential of market-oriented service development. In sum, this frontier – and the area beneath it – represents areas in which telecommunications services could be operated on an economically viable basis, if some degree of initial start-up investment costs could be supported by outside sources. In other words, the services themselves would generate enough revenue, month-to-month and year-to-year, to pay the ongoing operating costs of the network at a reasonable margin of profit, but the initial investment necessary to construct the network and introduce the services could not, in this region of the graph, be justified by that future net revenue stream. Locations, services, and market segments that fall outside of the market efficiency frontier, but within the sustainability frontier, are the most attractive candidates for public subsidy financing, joint ventures, public-private partnerships, and the like, as these are operations which in principle should be able to provide services on a long-term basis with only one-time intervention to support start-up costs. The amount of such subsidy support that may be required, whether all or part of the capital investment in a particular project, will depend in essence upon how close to the sustainability frontier a given location may be – and consequently how far away from the market efficiency frontier, wherein no subsidy at all would be required.

Note that again tax policy can have a significant impact upon the location of the sustainability frontier. Where profit margins are very thin, even if initial capital costs are subsidized, ongoing tax payments can make the difference between viability and unsustainable business prospects.

Access gap: The term “access gap” is often used to define two related sections of the diagram: that within the sustainability frontier and the area beyond that frontier, both of which are outside the market efficiency frontier and the market gap. In both areas, access to telecommunications cannot be achieved by the market alone; the principal difference is that described above, in which sustainable service can be provided following one-time capital subsidies. Outside of the sustainability frontier, which typically involves the most remote and lowest income regions of countries, the theory indicates that there are locations which could not generate sustainable telecommunications markets regardless of the degree of capital subsidy, and hence these locations would require “permanent” subsidies to ensure access to services. These latter areas are sometimes referred to as the “unsustainable access gap”. In both cases, the distinction between the “access gap” and the “market gap” is critical to policy development and market analysis, as it separates the areas where the main focus of concern should be elimination of barriers, versus those where direct financial intervention is justified. Given the fact that the market efficiency frontiers themselves tend to be moving outward, with the decreasing costs and increasing benefits of telecommunications technologies and services, the size of the access gaps should generally be diminishing in most countries.

Affordability/Adoption frontier: On the demand side of the graph, the frontier that forms the edge of the market gap boundary in sometimes called the “affordability” or “adoption” frontier. This boundary identifies the limits at which households can afford to pay for market-based services (i.e., with cost-oriented prices). Because this axis represents the total potential market population, this frontier designates the limit of affordability of service, primarily based upon income distributions. Alternatively, it can also be seen as the “adoption” frontier, for potential customers that can afford to pay for service, but choose not to, for example because they don’t consider the service of sufficient value. This is most likely the case with more advanced services, including Internet and broadband access, whereas basic telephone service (fixed or mobile) is typically regarded as a necessity, and hence will be adopted by virtually all who can afford it. The gaps beyond the affordability frontier can be addressed through various demand-management policies, including price subsidies and the like, to help promote universal service where universal (or near-universal) access has already been achieved.

Focus of this Report: As mentioned above, the primary focus of this study and report is upon the supply-side, universal "access" aspect of telecommunications development policy in Latin America. This is because, in most countries, there still remain significant gaps, both market gaps and access gaps, which prevent many populations and geographic regions from obtaining simple access to telephone and Internet services, even on a shared community basis. While the affordability of services for those within reach of networks (and hence concerns about universal "service") is also an issue, and is becoming a higher priority for many countries, this primary focus upon initial access has generally taken precedence in the policies and initiatives of countries throughout the region. Where appropriate, however, we have also addressed questions of affordability, and how regulators may ultimately shift their focus toward full universal service approaches as the market and access gaps narrow.

III.4 The Regulatel gaps model

Based upon the above theoretical framework, and in accordance with the Terms of Reference for this study, the consultants undertook to develop an in-depth computer simulation model, for the purpose of estimating the size and location of the market and access frontiers and gaps within Latin American telecommunications markets. The purpose of this modeling exercise is to provide Regulatel member regulators with both an indication of the scope of the existing gaps within their countries at a "macro" level, and a tool for further examining and addressing those gaps on a "micro" level. In conducting the "macro" comparative analysis across countries in the region, we have also sought to illuminate and understand the different gaps that have resulted from different market conditions and telecommunications sector policies throughout Latin America.

A complete description of the Regulatel Gaps Model's structure, algorithms, data inputs, and applications is provided in Appendix 3 of this report. The following discussion summarizes the key elements of the model's development and functions. Chapter IV provides the findings and analysis that result from applying the model to Regulatel member countries.

Objectives: In sum, we can characterize the questions that the model is attempting to answer as including the following:

- What is the approximate size of the "market gap" (in terms of geographic coverage or network access) for different types of telecommunications services in each country? (Specifically, we looked at voice telephone service delivered by mobile networks; basic public Internet access via community telecenters; and access to broadband network connectivity.)
- What are the variations in telecommunications network cost structures, revenue opportunities, and market conditions throughout the Latin America region, which influence countries' ability to promote Universal Access?
- What amount of subsidy or other funding support would be required to close the "true access gap" for the different services in each country and/or region?
- What are the business case options and opportunities for operators, investors, small and medium enterprises, and communities to establish financially sustainable telecommunications capabilities within different regions and localities?
- What mix of technical capabilities and services is most cost effective, at the local, regional, and national levels?

Model Structure and Approach

As further explained in Annex 3, the model consists of several main components, or modules:

- Data Inputs: Detailed data describing the current state of the telecommunications market in the country, including geographic and population distribution, and current access levels for all services. The model depends upon accurate and detailed data to be able to produce realistic results. In cases where adequate data in the necessary format of level of precision are not available, some estimates or assumptions can be made to obtain approximate results and compare trends.

- Cost Assumptions: Assumptions regarding the ranges of unit costs for the various types of technology and network components involved in establishing access to telecommunications networks and services. Elements include both capital and operating costs for major network components, namely backbone transport, the local access network, network management and operating costs (expressed in relation to market size or demand), interconnection, and human resource costs for different types of networks and different scales of operations.

- Network Development: Calculations which define the estimated layout of network facilities required to provide service within each defined geographic area, according to the input data and the cost assumption characteristics. This segment in essence creates a hypothetical network (or set of networks) based upon the parameters given, and determines its approximate cost.

- Revenue Assumptions: Basic assumptions regarding the level and distribution of potential revenues for each category of service and each user group. Assumptions are simplified to be based upon allocations of average national income levels, and can be adjusted to test for different degrees of demand.

- Net Revenue Calculations: Calculation of the difference between the total cost and projected revenues for each service within each geographic area. These net costs (deficit) or net revenues (profit) are expressed in annual, per-location terms (i.e., annual cost per town or site). From this, the model calculates the potential profit or loss to a market-based operator associated with providing service in each such location. Locations that incur net profits are considered to be within the “market gap”, which those which incur losses are part of the “access gap”.

- Results: Summary of the key results, showing the current level of access and the size of the market and access gaps for each region, and for the country as a whole. These access and gap results are expressed as a percentage of the total population (for example: 50% currently have access, the market gap is 30% and the access gap is 20% of the population.) Finally, the model calculates the estimated total subsidy cost that would be required under current conditions to eliminate the access gap (assuming the market gap is overcome via policy measures).

The assumptions and algorithms contained in each of these modules have been tested and revised several times during the course of the model's development.

As mentioned, the model as ultimately completed concentrates on examining market structure and access conditions in relation to three categories of networks and services:

- Voice telephone (as represented by cellular mobile service);
- Public Internet access (through community telecenters); and
- Broadband connectivity (as an upgrade of existing networks, using appropriate technology)

The following chapter presents the results, findings, and analysis of the applications of the gaps model to Regulatel member countries.