IV. Regulatel Gaps Model Results and Analysis

IV.1 Overview

This chapter provides an extended discussion of the findings resulting from application of the Regulatel Gaps Model to evaluate telecommunications industry conditions in Latin America. As explained in the previous chapter, the model's purpose is to examine the size and characteristics of the existing gaps in access to telecommunications network coverage and mobile telephone, public Internet, and broadband-based services, and the potential for further expansion of those networks and services, whether by the market itself or with subsidy funding support. The analysis here offers first a "macro" comparison of the gap results for all countries for which sufficient market data have been provided. Second, it provides more "micro" level findings for a selection of countries for which detailed sub-national data are available. Finally, the discussion presents some overall findings and observations about the implications of the modeling exercise for universal access and market policies in Latin America, as a springboard for further discussion of these policy issues in the subsequent chapters.

Interpretation of Results: Recall that the Model examines primarily supply-side conditions with respect to availability and gaps in access to telecommunications networks and services, specifically cellular voice telephone, public Internet, and broadband transmission. This means that the results presented here primarily address the geographic coverage of these networks, and hence their accessibility to potential users within defined population centers (towns, villages, cities, etc.). Specifically, the proportions indicated by the model identify the percentage of the population of such population centers in a country or region that is within reach of these networks, and hence could obtain service.[1]

It is important to distinguish between this classification of network access and indicators of service penetration or subscribership within any given area. "Access" measures the presence of the network within reasonable reach and adequate

[1] (Note that there are invariably other populations in most countries living in dispersed rural areas not affiliated with towns and villages; in general this study did not have any data to include these populations in the analysis, although the model does estimate their levels in calculating current access proportions, as discussed previously.)

quality, such that users may obtain services; "penetration" measures actual take-up of the services, whether in terms of individual subscriptions or public usage patterns. In terms of Universal Access policies, it is the first concept, geographic coverage that is of primary concern, since access is a pre-requisite for usage. Actual penetration patterns are influenced by many factors, especially price and affordability, as well as substitutability of services, customer awareness, and other market and demographic conditions.

Hence, the findings indicated by the Model results provide a baseline for understanding the scope of current and potential network and service access within countries and regions. The gaps that are revealed address the size and scope of areas (i.e., towns and villages) where such network access is not available, and the underlying economic conditions influencing the market for further expanding those networks. For further clarity, we have added a graph showing relative penetration levels for current cellular mobile service, which helps illustrate this important distinction. In the case of Internet telecenters and broadband network access, "penetration" figures are more difficult to obtain.

IV.2 "Macro" Comparative Analysis of Market Efficiency and Access Gaps in Latin America

The project team and local consultants collected data from most Latin American countries to utilize with the Gaps Model to generate comparative estimates of the current gaps in access to different telecommunications networks and services, and the resources that would be required to close those gaps. The robustness and reliability of the data gathered varied considerably, so that the results can only be viewed as tentative and general estimates, in keeping with the broad purposes of the macro model analysis, and comparisons across countries may not always be appropriate, given the different sources and context of the data provided. Nevertheless, there are useful findings in this initial review of the scope of the various gaps in the region.

The following table provides the full summary macro model results for all countries modeled. Further detail and explanations are included in the sections that follow.

Summary Country Results

Country	Cellular Telephone			Telecenter/Internet			Broadband		
	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost
Bolivia	68%	71%	$2,568,998,372	67%	69%	$3,155,825,673	34%	36%	$1,510,372,758
Brazil	63%	75%	$27,387,905,988	56%	72%	$10,065,531,371	30%	44%	$10,965,166,261
Chile	72%	85%	$920,427,719	71%	75%	$1,098,339,401	27%	30%	$633,786,404
Colombia	63%	86%	$1,308,748,298	66%	72%	$3,319,005,652	38%	45%	$1,255,932,541
Dominican	55%	83%	$170,943,505	36%	68%	$573,460,102	44%	66%	$149,122,518
Ecuador	58%	73%	$898,179,569	43%	68%	$731,679,204	28%	56%	$631,379,386
Mexico	71%	83%	$3,647,571,211	70%	75%	$5,605,172,056	31%	36%	$2,700,992,654
Nicaragua	57%	64%	$548,395,203	46%	50%	$768,738,690	31%	31%	$312,938,076
Paraguay	68%	68%	$886,779,088	64%	73%	$250,259,179	21%	38%	$383,342,869
Peru	58%	63%	$5,627,102,387	60%	62%	$5,363,022,575	55%	59%	$3,316,728,560
Uruguay	97%	98%	$19,382,092	95%	97%	$6,067,187	77%	80%	$35,654,430
Totals			$43,984,433,431			$30,937,101,089			$21,895,416,457

IV.2.1 Cellular mobile telephone service

Perhaps the most significant results relate to the extent of access to cellular mobile telephone service, as this service has become the de facto option for achieving voice telephone access throughout the region. The following graphs illustrate the degrees of access, and the remaining gaps, for this service. Figure IV.1 presents the Model results for geographic network access; in essence, this represents the degree of signal coverage by cellular networks, relative to the population centers (towns and villages, not the entire geographic territory) of the countries studied. For example, the finding of 68% cellular access for Bolivia, means that approximately 68% of the population of Bolivia lives in towns or villages that have at least some reasonable access to cellular telephone signals studied.

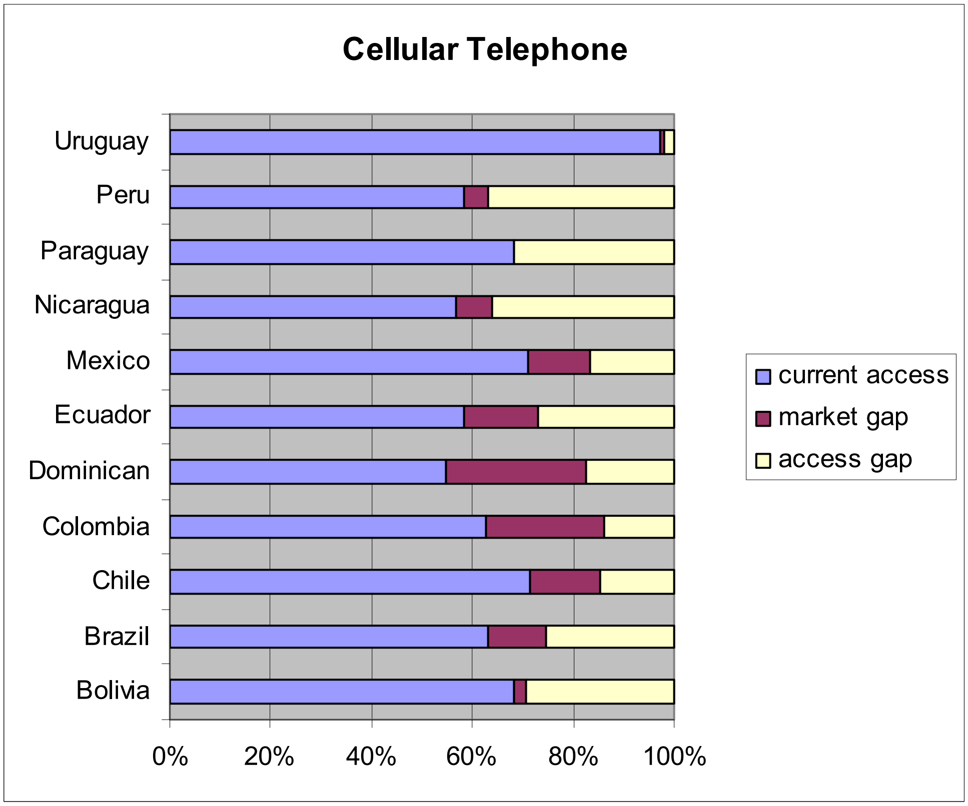

Figure IV.1
Gaps Model Results for Cellular Telephone Access (Coverage)

For comparison, this Figure IV.2 shows estimated cellular service penetration in each of these countries, i.e., the proportion of the population that actually subscribes to or utilizes cellular telephone service.

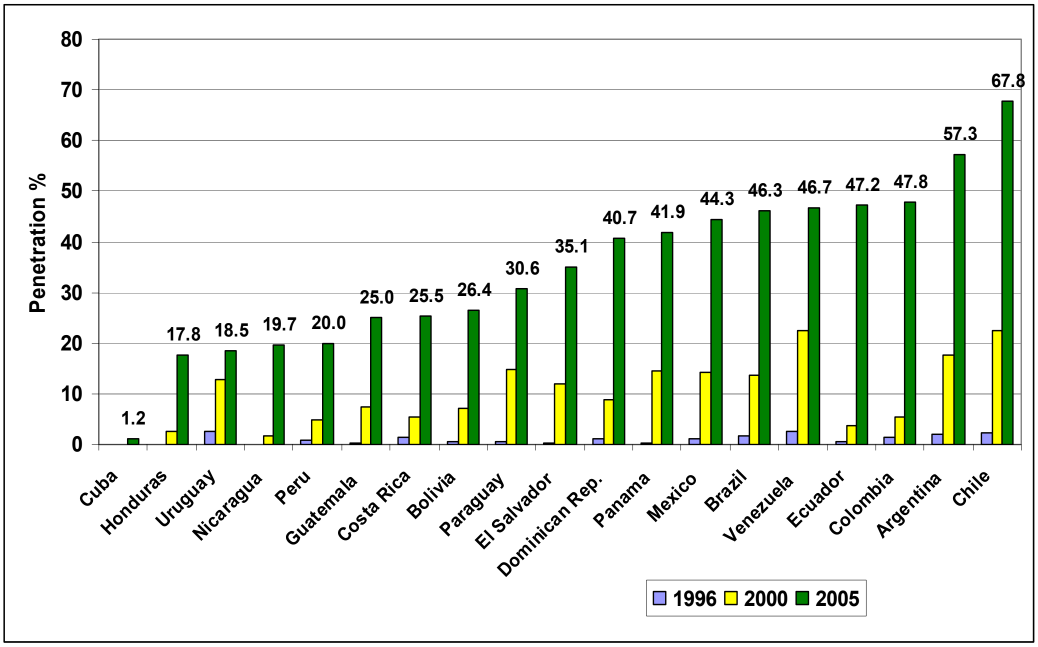

Figure IV.2
Estimated cellular service <u>penetration</u> in Latin America

Cellular mobile networks have expanded rapidly throughout Latin America in recent years, and these trends are reflected in the data. (See also Chapter VI, Figures VI.2 VI.3 and VI.4). On average, over 60% of the populations of the countries studied are now covered by cellular network signals. The average penetration rate for the 19 countries is 45 cell phone users per 100 population. It is evident from these trends that there are still many areas where prices may be unaffordable to large segments of the population. Also, in some cases the mere availability of cellular network signals may not easily translate into widespread service usage, due to constraints on access to other resources, including electricity, and the means to recharge and repair phones and phone cards, for example. Obviously the largest portion of users are in the urban and peri-urban areas, where penetration may exceed 60% of households, but even in smaller towns and villages, the data suggest that cellular penetration in most Latin American countries is in the range of at least 10%, and growing steadily.

Nevertheless, it is the degree of access to cellular voice networks that primarily concerns us here – as access is the pre-requisite for potential usage – and this is what the Gaps model examines. As stated, the current range of existing network access averages over 60%, with several countries indeed indicating that network signal coverage already encompasses over 70% of their population centers. The lowest access coverage figures in the region are in the Dominican Republic, Ecuador, Peru, and Nicaragua, which exhibit only about 55% to 58% town population coverage. For these and the other countries where significant gaps remain, the model asks: what portion of these areas area likely to be covered by market forces alone, given the underlying economic conditions revealed by the data?

The answers here are also encouraging. In many countries, an additional 10% or more of the remaining gap for cellular service access appears to be within the market efficiency frontier, as evidenced by the size of the purple yellow portion of bar. In Colombia, the data indicate that another 23% of the country can be efficiently served by market-driven cellular networks. In a few countries, on the other hand, such as Paraguay, Bolivia, and Peru, the results which suggest that the market frontier has already been nearly reached at current levels of coverage.

Given that many of the cellular networks in most Latin American countries have only been operating for a few years, and have generally been continuing to expand on their own initiative, there is every reason to expect that cellular coverage will increase in the near term to fill much of these economically viable market gaps. In some cases further licensing or other regulatory measures to reduce barriers to such expansion may be required to reach the market efficiency frontier. As for the access gaps, these are in the range of about 20% to 25% in most countries, although the populations that they include are typically in the smallest, most isolated towns. About 25% of Brazil's town populations, and 30% of those in Bolivia, are unlikely to be covered by cellular networks without some form of intervention. The proportions in Nicaragua and Peru are even higher, around 35% to 40% based upon the data. The source of these cellular access gaps is typically the higher costs of deploying both backbone and local transmission facilities in the remote, mountainous, and jungle regions of these countries, where sparse populations have little income, and other hindrances prevent the cost-effective establishment of network services. It is noteworthy, however, that many such areas are indeed included within the market frontier of these and other countries. Still, the model's estimates show that the potential subsidy cost to reach the last, most remote segments of the populations of many countries with cellular service could be quite considerable: an aggregate US$ 43 billion to cover virtually 100% of the unserved Access Gap throughout the region (more than half of that amount is for Brazil).

(See the micro-level discussion of selected countries in Section IV.3 below.)

Naturally, the results shown in the Figure IV.1 are approximate, and based upon a variety of assumptions and estimates concerning the input data along with other uncertainties, as explained in Chapter III. Testing these model runs for sensitivity to differing ranges of the inputs and assumptions yields relatively small variations in the overall results, generally in proportion to the initial findings. That is, only with highly unrealistic assumptions regarding higher costs or lower revenues does the net cost to achieve close to 100% access to cellular service increase more than a few percent outside of the range indicated in the baseline model results.

In sum, this analysis suggests quite strongly that the liberalization of cellular telephone markets in Latin America has had the expected and desired effect of spreading access to these services, and hence to voice telephony, quite widely throughout the region, to date without significant need for public financing intervention. Voice telephone service is now realistically within the reach of the majority of the populations of Latin America, at least in terms of network deployment and the basic availability of service. With the continuing rapid expansion of calling party pays (CPP) and pre-paid subscriptions, these services are reaching further and further into lower income strata in particular, and also into remote and rural regions, all due to the market incentives driving competing cellular operators. Significant access gaps certainly remain, both in terms of network accessibility for isolated areas, and in terms of affordability for the most disadvantaged populations (which often live in such isolated areas). These gaps can be (and are increasingly) the focus of public universal access strategies, which can concentrate resources upon these narrowly defined and targeted constituents, with the confidence that the continued reach of the market, given the opportunity, will take care of the rest.

IV.2.2 Internet and Telecenters

The rapid growth of cellular voice services is beginning to be mirrored across Latin America by expanding interest in access to Internet connectivity, and the market results are reflecting this trend as well.

Here the definition of "access" is more ambiguous, as most Internet services still depend upon fixed, wireline-based networks for dial-up connections to end users, although this situation is also changing. Also, whereas cellular phone service is now most typically an individual, private subscription/pre-paid service, Internet access for a large proportion of users – probably a majority in most Latin American countries – is more often a public access phenomenon. Use of computers and Internet connections is thus today more akin to the role of public pay telephones for voice service in the recent past, a role that was the primary emphasis of universal service programs, but which has been largely supplanted by private cell phones. One key question of this overall area of study concerns whether it is likely that public Internet access will itself rapidly migrate toward private, household-based usage models, given trends in technology, costs, and demand. But for the present and immediate future, the model of Internet service for the bulk of potential users, particularly those outside of major urban areas but also many in the cities as well, involves one form or another of public access, from cyber cafés (cabinas públicas) to telecenters, to connections in schools and universities and the workplace.

In collecting data for the study, we asked about current levels of access both to Internet connectivity in general (i.e., presence of the network itself) as well as to publicly available Internet centers, particularly telecenters. It turns out that there is often little substantial difference between the two measures of Internet access, as the presence of a network capable of allowing Internet connectivity in many cases appears to correlate closely with the introduction of some type of public access facility, at least according to the data provided.

The baseline results for Internet/telecenter access in the countries studied are shown in Figure IV.3:

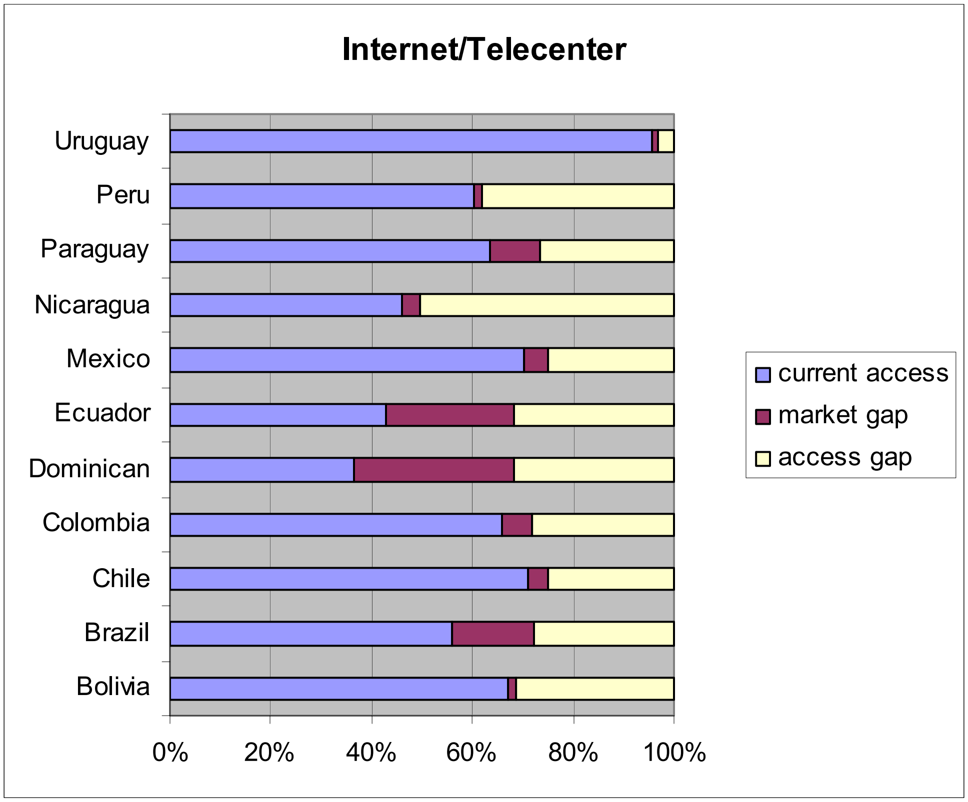

Figure IV.3
Gaps Model Results for Internet/Telecenter Access

Again it is important to understand the proper interpretation of the data and the Model's analysis for this market. Given that we are examining public access to Internet capabilities, via telecenters or the equivalent, the coverage proportions identified indicated the percentage of the population living in towns or villages that are (or can be) within reasonable geographic reach of such public Internet access. We asked local researchers and regulatory authorities to identify the proportion of communities, by population size, which have access to Internet connections and (at least) public telecenters. The "current access" figures therefore reflect these market input data for each country (adjusted for our assumptions concerning smaller towns in many countries) whereas the market and access gap calculations are determined by the model's algorithms.

The degrees of public access to Internet capabilities indicated by these measures vary quite widely among Regulatel member states, and within different regions of these countries. Aside from Uruguay, which claims nearly complete Internet coverage, the highest levels of estimated current access are in the range of 65% to 70% (Chile, Colombia, Mexico, Bolivia, Paraguay). Yet in most countries there are many regions where Internet access is not at all available, or only sparsely. Countries that have made the least progress, according to the data, in public Internet availability, include Nicaragua, the Dominican Republic, Ecuador, and Peru. As expected the trend is that such access is greatest in larger cities, and in fact nearly all cities throughout the region with populations above 100,000 now offer Internet access, a situation which was not so widely the case even a few years ago. Among medium sized cities and towns of 20,000 to 100,000 inhabitants, Internet access is less common, averaging in the range of 25% to 100% across different Regulatel countries. A much smaller proportion of towns smaller than 20,000 in most countries currently include Internet connectivity or telecenters, although these numbers appear to be increasing across the region as well.

As for the size of the market and access gaps, the model indicates significant disparities in the scope and potential of market efficiency coverage. For example, both the Dominican Republic and Ecuador could achieve about 68% access to Internet services within the scope of the market's potential, even though current access is below 45% in both countries. The results for Brazil and Paraguay indicate that 70% to 75% Internet coverage should be achievable by the market.

The size of the true access gap for Internet access in most countries is quite significant, particularly in Nicaragua and Peru, which exhibit gaps of 50% and 38%, respectively. These gaps encompass a large majority of the smallest towns and villages throughout these countries, where public Internet telecenters are not typically available. On the other hand, the subsidy cost to fill these gaps is somewhat smaller than for cellular service in most cases, with an aggregate estimate of some US$ 31 billion to reach 100% of the population. The full subsidy cost for several countries, however, is greater for Internet service than for cellular telephony; the lower overall total results largely from the much lower subsidy cost in Brazil for Internet (US$ 10 billion) than for cellular (US$ 27 billion).

These results for Internet and Telecenter access are driven substantially by the underlying assumptions within the model concerning the availability and cost of technology to achieve local Internet access. A system that is based on a VSAT backbone connected to a WiFi can typically be provided for the equivalent of under US$ 40,000 per year in most smaller locations. For such a market model to be sustainable thus requires that it be capable of generating at least that much in annual revenues, or about US$ 4,000 per month. In medium sized towns of 5,000 to 10,000 population, this requires average net spending (after interconnection charges) of less than US$ 1.00 per capita per year on public Internet services to produce a viable business; even in smaller towns of 1,000 population, the profitability threshold is only about US$ 5.00 net revenue per capita per year, which is usually well within the income allocation assumptions of the model. For these reasons, the model shows very wide market efficiency frontiers for this type of Telecenter-based Internet access in most countries.

Another factor that can affect the viability of Internet connectivity in many communities is the prospect of sharing backbone network transmission infrastructure with existing networks, especially cellular networks. For areas that are within adequate reach of those networks, it can be more cost-effective to lease backbone capacity than to use a VSAT connection. To test this option, we built a variable into the model's backbone cost calculations which assigns a range of infrastructure sharing between 0% and 100%. The maximum backbone cost is always the cost of a stand-alone connection, i.e., via satellite, where the cost to link to an existing terrestrial backbone would be prohibitively high; but where such capacity sharing would be more efficient, the model utilizes the lower shared cost. Evaluating the results of the two extremes, 100% shared infrastructure versus satellite connections for Internet service, produces only minor differences in most results for the size and cost of the access gap. This is because in many locations the default VSAT solution turns out to be more cost-effective than terrestrial backbone transport, even where the network can be fully shared, especially where the node is significantly distant from the existing network.

IV.2.3 Broadband

The third major market segment examined by the model is broadband network access. In this case, the services available to end users are not necessarily distinct from the services under the Internet market segment, but the capacity and quality of transmissions is based upon substantially higher bandwidth. The actual throughput capacity delivered to end users depends upon a variety of factors, especially the levels of local utilization, but in general the model assumes a minimum combined capacity (downstream and upstream) of 8 to 32 Mbps, up to 155 Mbps, at the backbone level and combined 4 Mbps at the access level as the standard range for "broadband" connectivity.

There are a number of important caveats and assumptions involved with the modeling of the actual and potential broadband access markets in Latin America. For the most part, broadband networks and services are quite new and not widespread in the region, especially beyond major urban centers. Even where some degree of broadband deployment is in place, many countries have not collected meaningful data on such facilities, so that inputs regarding current levels of broadband access were either not available or highly estimated. Within a given community, it is generally assumed that if broadband networks are in-place, then broadband service is "accessible" to the entire community, even if this may be an overly simplistic assumption in practice. Thus, an entire city may be identified as having 100% broadband access, even if only certain segments of the city have to date been wired for local broadband connectivity. This simplified assumption is again a function of the limited scope of available data on broadband deployments.

Another important set of assumptions utilized for this model exercise involved the type of broadband access technologies that <u>could be</u> deployed in the near future in most markets. While present broadband connectivity is typically provided over terrestrial DSL circuits linked to the switched landline telephone network, or over cable TV networks – which are often extremely expensive to deploy outside of high-density settings where such networks are already available – key developments in the area of <u>broadband wireless access</u> (BWA) are creating the strong potential to shift the economics of this segment dramatically. For the purposes of modeling forward-looking prospects for broadband access, therefore, we have chosen to utilize consensus industry forecast assumptions about the anticipated costs of these new wireless broadband technologies, rather than costs for traditional DSL- or cable-based networks, which cursory study indicates would be prohibitive for the vast majority of rural and underdeveloped areas for the foreseeable future.

The assumptions, calculations, and results for broadband network access within the Gaps Model, therefore, are somewhat more theoretical than those for cellular telephone and Internet services, in that they are based upon these newer and relatively untested technology scenarios. Nevertheless, by conducting this exercise using reasonable assumptions about prospective trends in this field, we can establish a view of the potential market opportunities that are beginning to present themselves, and the locations and characteristics of communities where they may be most viable in the near term.

This combination of uncertain inputs and generalized assumptions leads to rather widely varying results from the Model's assessment of broadband markets in Latin America:

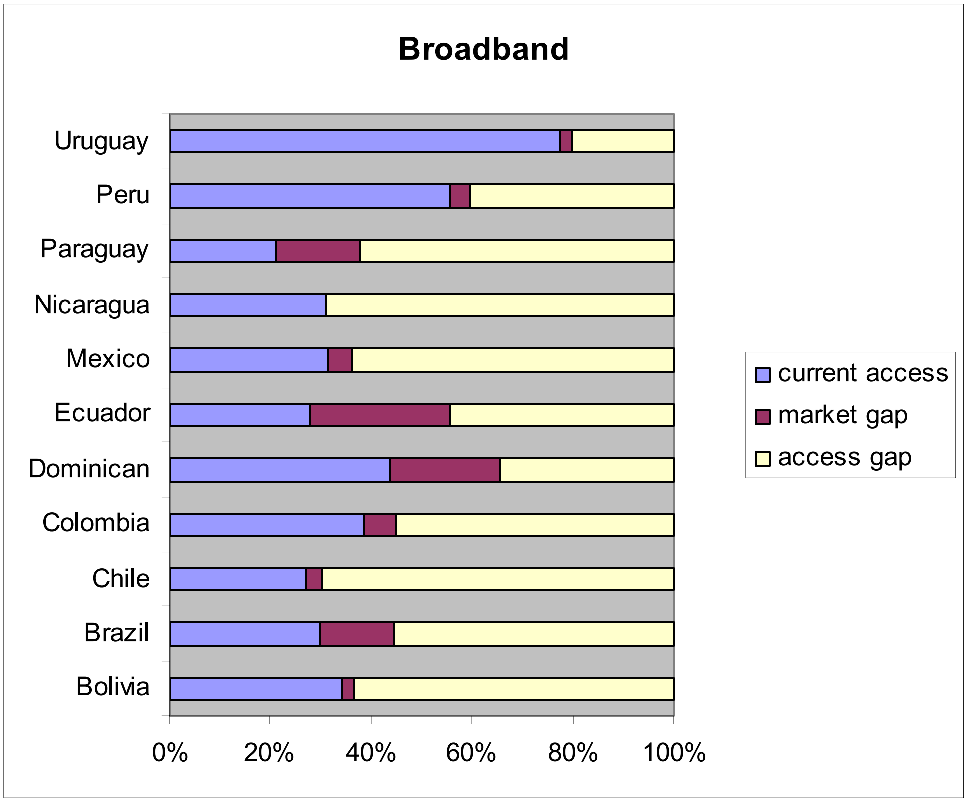

Figure IV.4
Gaps Model Results for Broadband Access

As the data show, the status of broadband markets, actual and potential, is much more uncertain in Latin America, as one would expect given the relatively new technologies and market interest in this area. For most countries, the access gap is greater than 50% to reach all localities. Again, it is important to keep in mind that the "current access" indications are based upon general geographic availability of broadband networks within designated cities or towns, as well as estimated assumptions concerning input data for many countries. These results do not indicate actual penetration or usage levels for broadband services, data which have not been available in most countries.

There do appear to be large potential opportunities in several countries for market-driven expansion; in all likelihood, this type of growth will begin to be seen as soon as viable pilot projects and public-private undertakings to deploy new broadband access technologies begin to show promise (See Chapter VII). This is clearly a field that deserves more study, and should be updated as new projects and investments come on-line throughout the region.

The key area of sensitivity of these calculations involves the revenue assumptions, since the default approach is to assume that only “surplus” Internet market revenues will be available to support broadband upgrades. If revenues from other sources become available to add to this base – for example, payments from government and institutional customers, or shifts in demand from voice applications toward broadband due to availability of Voice-over-IP service – then the market prospects for broadband services become commensurately more attractive. (See Section IV.4 below).

IV.3 “Micro” Detail Analysis of Selected Country Results

The usefulness of the Regulatel Gaps Model extends beyond the type of macro comparisons and analysis discussed above, to allow much more detailed assessment of the conditions within individual countries and regions with respect to the location, size, cost, and characteristics of the market and access gaps for telecommunications services. This level of micro analysis depends upon a substantial level of detailed input data on each district or division within the country being studied, such as geographic, demographic, and network statistics that may be unique to each location. The study team sought such levels of detail from the member Regulators and received extensive inputs from five countries. This section describes the results of applying the Model at the micro level to study the telecommunications sectors and gaps of each of these countries. (Full model runs for all countries studied are provided in electronic form along with this report.)

IV.3.1 Brazil

Brazil, the largest country in Latin America, consists of 26 states and the capital region, ranging in population from 500,000 to nearly 40 million. In this respect, many regions in Brazil are comparable in size and socio-demographic characteristics to several entire countries elsewhere in the region; hence, running the Gaps Model at the “micro” level for each of these regions is akin to running it at a “macro” level for other countries. Nevertheless, the analysis of market status and potential on a region-by-region basis provides interesting insights into the diversity of the country, and the areas where market and access gaps are most pronounced.

Summary Results **BRAZIL**

Infrastructure shared % 0%

Region	Cellular Telephone			Telecenter/Internet			Broadband		
	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost
National	**63%**	**75%**	**$27,387,905,988**	**56%**	**72%**	**$10,065,531,371**	**30%**	**44%**	**$10,965,166,261**
ACRE	62%	75%	$87,533,950	51%	70.99%	$33,382,868	22%	44%	$35,841,291
ALAGOAS	60%	75%	$445,086,581	38%	68.71%	$169,742,900	26%	52%	$180,034,500
AMAZONAS	52%	74%	$441,583,193	46%	70.39%	$168,406,811	33%	53%	$178,586,672
AMAPA	61%	74%	$74,896,123	63%	73.27%	$28,563,173	26%	33%	$31,646,113
BAHIA	49%	74%	$2,057,172,189	22%	65.56%	$784,544,824	25%	53%	$831,178,639
CEARA	58%	75%	$1,166,645,978	40%	69.11%	$444,924,381	28%	51%	$472,961,922
Distrito Federal	100%	100%	$0	100%	100.00%	$0	75%	75%	$3,127,451
ESPIRITO SANTO	71%	75%	$509,677,107	60%	73.19%	$186,010,002	25%	43%	$200,631,918
GOIAS	67%	74%	$822,646,790	67%	73.70%	$300,230,340	27%	35%	$335,326,919
MARANHAO	41%	72%	$927,212,131	26%	66.26%	$338,392,147	22%	54%	$356,667,428
MINAS GERAIS	62%	74%	$2,935,377,931	55%	71.60%	$1,071,285,422	25%	48%	$1,143,772,499
MATO GROSSO DO SUL	69%	75%	$340,928,585	68%	74.45%	$124,424,122	28%	39%	$139,121,893
MATO GROSSO	65%	74%	$420,332,610	60%	72.47%	$153,403,142	23%	49%	$163,182,040
PARA	56%	74%	$1,015,944,293	39%	68.83%	$370,775,531	27%	55%	$391,092,440
PARAIBA	51%	72%	$565,013,528	40%	68.18%	$206,205,391	21%	49%	$218,978,542
PERNAMBUCO	58%	74%	$1,299,127,862	44%	69.83%	$474,125,231	28%	49%	$505,999,013
PIAUI	53%	72%	$466,526,912	37%	66.92%	$170,262,055	22%	49%	$180,394,141
PARANA	63%	74%	$1,569,035,692	68%	74.29%	$572,629,863	25%	36%	$638,372,874
RIO DE JANEIRO	72%	75%	$2,389,034,986	68%	74.64%	$871,893,982	42%	48%	$938,284,101
RIO GRANDE DO NORTE	55%	73%	$456,067,889	40%	68.18%	$166,444,966	24%	49%	$177,055,470
RONDONIA	60%	74%	$226,375,644	68%	74.49%	$82,617,275	20%	31%	$93,914,602
RORAIMA	55%	74%	$53,222,095	51%	71.34%	$19,423,752	23%	41%	$21,072,255
RIO GRANDE DO SUL	68%	74%	$1,681,315,974	68%	73.85%	$613,607,288	25%	29%	$703,717,772
SANTA CATARINA	66%	74%	$878,793,697	66%	73.57%	$320,721,521	21%	33%	$359,410,795
SERGIPE	62%	74%	$292,770,981	26%	66.08%	$106,848,689	20%	55%	$112,265,355
SAO PAULO	71%	75%	$6,075,742,971	71%	75.16%	$2,217,382,232	37%	38%	$2,475,960,058
TOCANTINS	53%	70%	$189,840,299	56%	69.43%	$69,283,462	14%	34%	$76,569,559

The data indicate that the cellular telephone market is reasonable well developed, covering 63% of town populations, but with a remaining market gap of another 12%. Most regions generally mirror these conditions, with cellular coverage in the 60% to 65% range. There are some glaring exceptions, apparently worthy of priority attention, such as Bahia, where access is only 49%, while the market frontier could reach 74%, and Maranhao, where current access is 41% compared with a market frontier of 72%. In these types of locations, it would behoove the regulator to examine what barriers might be preventing cellular operators from expanding service further into these provinces. Specifically, the areas that the Model indicates should be within the market frontier but are not currently served tend to be towns/cities of greater than 20,000 population; according to the data there are some 192 such towns in Brazil currently without cellular network coverage.

The access gap is nearly the same size in all regions, between 25% and 30% of the market. These gaps typically include most towns smaller than 1,000 in population. In Tocantins, for example, which has the largest access gap at 30%, there are an estimated 900 such towns, spread throughout an area of some 200,000 square kilometers:

Population	Cell Phone Market Results							
	Current Market		Average Net Cost per Town			Gap Results		
Population size	Towns unserved	Pop unserved	Annual Cost	Annual Revenue	Net Annual Cost	Addressable Pop (total)	Uneconomic Pop (total)	Net Annual Deficit
>500k	0	0	$0	$0	$0	0	0	$0
100 to 500K	0	0	$0	$0	$0	0	0	$0
20 to 100K	0	0	$0	$0	$0	0	0	$0
10 to 20K	6	53,626	$451,810	$635,220	-$183,409	48,264	5,363	$0
5 to 10K	19	106,236	$259,273	$355,559	-$96,286	95,613	10,624	$0
1 to 5k	13	47,297	$173,570	$202,929	-$29,359	42,567	4,730	$0
0.3 to 1K	157	111,072	$83,317	$34,418	$48,899	0	111,072	$7,673,816
<0.3 K	732	183,086	$70,784	$9,352	$61,433	0	183,086	$44,989,731
						186,444	314,874	$52,663,546 total

The cellular market results also show the net subsidy cost that would be required under prevailing conditions to eliminate the uneconomic access gap in each region. The overall total is about US$ 27 billion, with widely varying amounts needed for different regions. In Sao Paolo, for example, the subsidy cost to eliminate the access gap would be over US$ 6 billion, whereas in Amapa it would cost only US$ 75 million.

With respect to Internet access, the Model results for Brazil reflect the forward-looking technology and market assumptions discussed above. The data provided indicate that pubic Internet access is already quite widespread throughout Brazil, in principle within reach of 56% of the town populations through telecenters or the equivalent. The market efficiency gap is another 16%, meaning that local Internet access for some 72% of the country also appears to be within reasonable reach of the market (at the community or town level). It would be necessary to test these findings by evaluating the sustainability of small telecenters in various representative settings using affordable technology solutions, but given these results, there should be a strong basis for encouraging and promoting market-based public Internet access throughout the country.

As for broadband service, as explained the data on current levels of access to broadband networks is highly estimated, but the model can still reasonably project the potential frontiers and gaps. On the basis of the model's assumptions regarding wireless broadband deployment, current access is shown at 30% of the market, and the market frontier is about 44% population coverage (note that this includes all urban areas as well as smaller towns and cities). The theoretical subsidy cost to achieve universal broadband access would be about $11-billion. There are some interesting regional results, however. The market frontier for broadband access in Sergipe, is 55%, the second highest in the country beyond the Federal District, even though this is one of the smaller provinces overall and only has an estimated 20% broadband access at present. The broadband market frontier for Sao Paulo, on the other hand, is very small, and would require over US$ 2.4 billion in subsidies to close, implying that upgrading to broadband in this large urban area may not be as cost-effective for current operators. The reasons for these results are at least partly attributable to the fact that the model does not assume that any new revenue streams are directly generated by broadband upgrades; it assumes that users will spend essentially the same amount, in the aggregate, for Internet access whether it is for broadband or narrowband service. This assumption is appropriate for determining the threshold size of the market in most areas, especially where incomes are relatively low, and little or no Internet service is currently available, so that broadband can only be justified by the surplus demand beyond that for basic Internet connectivity. In wealthier urban areas, however, additional demand for broadband level Internet is likely to materialize among higher income strata, where such service would be affordable as a "luxury" beyond basic connections. The model does not seek to measure this type of luxury demand, nor were data collected on this aspect of the higher-end market, so in these areas it undoubtedly underestimates the true market opportunity. The more immediately useful findings are indicated in the majority of provinces, where providing forward-looking broadband networks can apparently be achieved partly by the market itself.

IV.3.2 Bolivia

There are nine departments in Bolivia, ranging in population from only 52,000 to over 3,000,000, with similarly wide variation in population densities and other demographic conditions. Bolivia's telephone industry has always stood out from most of the rest of Latin America, in that local services have been provided by some 13 different local cooperatives, some of which are extremely small, together with the national operator, Entel. We received detailed data on telephone access for all departments, although only estimates for fixed vs. mobile or Internet access and broadband access, but these disaggregated inputs nevertheless allow reasonable approximations of the present state of the market, and calculations by the model of the market and access gaps for the different service categories. An important component of the input data indicates the breakdown of population centers to the level of over 27,000 very small villages in Bolivia that have populations below 300 persons each. When conducting the model analysis, which examines net access costs on a per-town basis, we recognized that measuring the requirements to install facilities in each of these small villages tends to drive up costs and decrease the scope of the market efficiency frontier significantly. We therefore also ran an alternative scenario of the model which excluded these smallest villages, yielding quite different results. These are both shown in the chart below:

Summary Results **BOLIVIA**

Infrastructure shared % **0%**

Region	**Cellular Telephone**			**Telecenter/Internet**			**Broadband**		
	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost
National	**68%**	**71%**	**$2,568,998,372**	**67.0%**	**69%**	**$3,155,825,673**	**34%**	**36%**	**$1,510,372,758**
BENI	70%	73%	$208,823,900	68.5%	71.78%	$92,397,323	13%	13%	$84,369,966
CHUQUISACA	45%	46%	$203,164,951	43.9%	45.32%	$396,049,951	18%	22%	$123,164,488
COCHABAMBA	68%	76%	$174,110,873	66.8%	68.82%	$420,598,410	31%	36%	$132,626,309
LA PAZ	71%	72%	$502,996,112	70.2%	71.07%	$753,927,195	46%	49%	$338,205,946
ORURO	65%	70%	$232,628,990	64.1%	65.34%	$399,881,380	26%	30%	$129,210,253
PANDO	47%	47%	$90,120,740	46.0%	46.03%	$41,874,204	10%	10%	$35,106,243
POTOSI	38%	39%	$499,711,842	36.9%	38.42%	$712,058,949	12%	12%	$298,824,683
SANTA CRUZ	82%	84%	$511,608,387	80.0%	82.42%	$244,684,846	43%	43%	$292,820,998
TARIJA	72%	72%	$145,832,578	70.9%	70.91%	$94,353,415	24%	24%	$76,043,872

Alternative results excluding smallest towns (< 300):

National	**89%**	**90%**	**$283,355,391**	**87.5%**	**89%**	**$103,964,882**	**45%**	**45%**	**$245,477,963**
BENI	88%	88%	$34,499,048	85.6%	89.69%	$4,519,125	16%	16%	$11,693,530
CHUQUISACA	78%	80%	$28,173,132	76.9%	79.40%	$12,757,345	32%	32%	$17,636,626
COCHABAMBA	88%	91%	$32,748,453	86.6%	89.31%	$17,294,253	41%	41%	$44,706,130
LA PAZ	91%	92%	$61,919,265	89.7%	90.83%	$29,228,520	60%	60%	$55,163,610
ORURO	92%	92%	$9,583,943	90.8%	92.64%	$3,188,521	37%	37%	$7,996,287
PANDO	85%	85%	$8,283,372	84.1%	84.07%	$641,214	18%	18%	$1,750,603
POTOSI	79%	79%	$34,206,939	77.7%	77.71%	$11,669,090	26%	26%	$22,161,302
SANTA CRUZ	91%	91%	$61,647,998	89.0%	91.76%	$19,174,763	48%	48%	$69,120,270
TARIJA	89%	89%	$12,293,242	88.2%	88.18%	$5,492,051	30%	30%	$15,249,605

Recall the precise interpretation of the model results, and hence the meaning of the two different charts above. The current access and market frontier figures indicate the percentage of the population that currently have access or can be provided access to the service in question on a competitive, market-driven basis, where “access” is measured at the level of each town or village within the country or department. So the first group of results indicates the frontiers and gaps for achieving access down to the level of every local town or village throughout the region, while the second group limits the question to achieving access for towns of greater than 300 population. As a practical matter, many such small towns are often likely to be within nearby distance of larger towns, so that their populations will often gain some degree of access in any case through adjacent communities. But by looking at the data from this slightly less microscopic perspective, the costs and prospects for "universal" access appear significantly more realistic.

Specifically, in the case of cellular telephone service, the total country results indicate that Bolivia has essentially reached a level of 68% coverage, close to the market frontier of 71%, and it would cost some US$ 2.5 billion in net subsidy to extend that access to all small villages and towns. Removing the towns below 300 population from the analysis, current access reaches 89% of the rest, while the market frontier is 90%, and the subsidy cost to reach all of the above 300 population towns market would be US$ 283 million. These differences are most pronounced in the Departments with the lowest current penetration, especially Chuquisaca and Potosi. In each case, present access to cell phone service is below 50%, which is near to the absolute market frontier. These departments are heavily weighted toward rural communities, with about half of their populations living in towns of 300 or fewer persons. Thus, when we relax the goal for increasing access to remove those small towns, the rest of the province can achieve nearly 80% on a commercial basis. According to the initial results, the net cost to extend coverage to the entire department, including small towns, would be about US$ 200 million for Chuquisaca and US$ 500 million in Potosi. It would require a micro-study of those departments specifically, however, to determine to what extent strategically placed network deployments might allow coverage of many or most of these isolated small towns on the most cost-effective basis.

With respect to public Internet access, Bolivia's results are somewhat different from those for Brazil. For the entire country, the market frontier is 69%, which is only slightly above current levels of access. Again, there are significant differences when smaller towns are excluded, as current access increases to 87%, and the market frontier extends to 89%. The net subsidy cost that would be required to close the gap entirely would be US$ 104 million when excluding the smallest towns, but fully $3 billion to establish Internet telecenters in virtually every town in the country. What characteristics of the Internet market segment drive these results for Bolivia? In essence, it is the size and number of small towns in the regions, even where the sub-300 towns are removed from the analysis. It is not financially practical for the market to establish sustainable telecenters in most towns with populations even up to 1,000, given the level of fixed costs in comparison with the low revenue potential. In a more in-depth market analysis, either an entrepreneur and/or the regulator might examine to what extent centralized telecenters might be of value to groups of towns together, and hence financially viable as at least an interim step toward further expansion, but the model is not able to make this determination with the data available.

Regarding broadband service, we again only have general estimates on current levels of deployment in Bolivia, although anecdotally such service is available at least in La Paz and Santa Cruz, but not much elsewhere. In calculating the market frontiers for broadband, the model does not find more than a handful of areas in which the expansion of broadband access would be commercial viable beyond current estimated access levels under prevailing (and forecast) conditions. The factors affecting these results for urban areas are essentially the same as for Brazil, but the market potential for the entire country appears to be much less attractive everywhere. This is probably a conservative result, as there are likely pockets outside the cities where growing Internet demand could generate sufficient revenues to justify upgrades to affordable (wireless based) broadband connections. In any event, the estimated net subsidy cost to upgrade the entire country to broadband capacity, at least down to the level of towns greater than 300 population, would be some US$ 245 billion; to upgrade all villages of all sizes would cost over US$ 1.5 billion.

IV.3.3 Colombia

The data provided for Colombia are perhaps the most disaggregated “micro” level data obtained during this project, representing detailed provincial information from each of Colombia’s 32 departments. The largest of these include Cudinamarca and Valle, with total populations of 9.3 million and 4.5 million respectively, while such provinces as Guainia and Vaupes contain fewer than 50,000 persons, and have population densities of less than one person per square kilometer.

On the whole, the data indicate that Colombia has already achieved significantly high levels of access, particularly among population centers above 1,000 persons, to both cellular network coverage (an average of over 63% access) and public Internet services (66%), with some important exceptions, and an estimated 38% community access to broadband networks:

Summary Results **COLOMBIA**

Infrastructure shared % 0%

Region	Cellular Telephone			Telecenter/Internet			Broadband		
	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost
National	**63%**	**86%**	**$1,308,748,298**	**66%**	**72%**	**$3,319,005,652**	**38%**	**45%**	**$1,255,932,541**
AMAZONAS	56%	71%	$14,588,785	55%	69.01%	$5,731,969	0%	0%	$5,437,753
ANTIOQUIA	60%	83%	$112,200,911	57%	63.25%	$419,920,236	38%	47%	$146,687,831
ARAUCA	44%	73%	$37,071,956	70%	75.14%	$20,212,336	13%	16%	$18,771,998
ATLANTICO	72%	97%	$0	72%	75.44%	$162,629,453	56%	60%	$7,762,792
BOLIVAR	64%	84%	$48,369,301	66%	72.40%	$161,807,803	33%	42%	$60,896,992
BOYACA	56%	82%	$49,990,240	59%	71.48%	$103,930,403	24%	51%	$52,375,389
CALDAS	59%	83%	$4,825,051	71%	75.36%	$85,010,620	24%	28%	$19,128,545
CAQUETA	46%	74%	$66,807,213	68%	74.66%	$33,622,575	25%	25%	$32,444,685
CASANARE	43%	73%	$44,724,861	60%	64.40%	$23,561,768	13%	13%	$23,225,131
CAUCA	41%	73%	$75,514,200	63%	69.27%	$101,226,203	13%	14%	$70,390,751
CESAR	65%	75%	$60,479,803	69%	75.02%	$77,503,833	26%	26%	$53,674,711
CHOCO	29%	72%	$62,474,900	39%	60.19%	$34,094,506	19%	19%	$30,682,011
CORDOBA	65%	84%	$60,496,533	71%	75.24%	$102,231,636	14%	18%	$64,292,677
CUNDINAMARCA	70%	97%	$0	71%	75.28%	$661,564,928	58%	63%	$58,939,215
GUAINIA	61%	61%	$13,486,090	60%	70.17%	$3,075,481	0%	0%	$3,080,910
GUAVIARE	38%	73%	$21,889,370	37%	40.60%	$9,693,066	0%	0%	$9,447,529
HUILA	55%	83%	$48,977,667	65%	72.07%	$72,726,467	27%	36%	$48,910,050
LA GUAJIRA	70%	76%	$68,925,328	68%	74.66%	$39,041,224	29%	32%	$32,985,482
MAGDALENA	62%	83%	$52,087,164	55%	63.61%	$110,323,672	15%	23%	$57,851,655
META	59%	74%	$104,792,233	67%	74.14%	$56,017,200	35%	35%	$50,753,179
NARINO	47%	82%	$79,607,905	52%	68.40%	$130,189,997	12%	20%	$82,334,397
NORTE DE SANTANDER	60%	83%	$46,910,762	61%	70.81%	$108,240,894	46%	52%	$50,828,353
PUTUMAYO	26%	72%	$48,896,742	56%	60.67%	$27,274,020	0%	2%	$26,317,326
QUINDIO	68%	97%	$0	71%	75.28%	$42,810,691	45%	50%	$4,267,891
RISARALDA	66%	97%	$0	72%	75.54%	$71,819,648	51%	55%	$9,603,731
SAN ANDRES	70%	97%	$0	69%	74.96%	$5,704,485	65%	72%	$96,114
SANTANDER	64%	83%	$65,593,381	67%	73.88%	$152,480,088	47%	55%	$71,314,267
SUCRE	64%	96%	$0	70%	74.98%	$61,815,719	25%	34%	$10,809,095
TOLIMA	59%	83%	$26,506,971	69%	74.72%	$97,086,310	25%	32%	$36,386,638
VALLE	71%	84%	$79,414,754	72%	75.48%	$328,768,201	49%	54%	$108,460,914
VAUPES	63%	68%	$2,081,629	63%	67.15%	$2,031,919	0%	0%	$1,553,650
VICHADA	15%	70%	$12,034,549	15%	27.82%	$6,858,301	0%	0%	$6,220,876

Recall again that the access results for each category represent geographic availability in population centers of each type of network. As for penetration, the current picture in Colombia is quite different, with average cellular subscription at about 23%. It is interesting to note that, while the market frontier for cellular telephone access in Colombia is fully 86%, the estimated net subsidy cost to achieve full coverage of all towns is over US$ 1.3 billion. This is because the remaining 14%

of locations that do not currently have access to cellular network coverage are very dispersed across the different provinces, and thousands of towns and villages. For example, current access and the market frontier in the Amazonas province is 56%. The populations not within reach of commercial cellular networks in that province consist of some 18,000 persons spread across about 54 towns, in an area covering 46,000 square kilometers. (Note that the three larger towns would appear to be within the market frontier.) Thus, the net annualized cost to bring cell phone service to just one of these towns is in the range of US$ 50,000 to US$ 80,000, and the overall one-time subsidy to deliver service to all of them would be about US$ 4 million. The following table shows the model's internal calculations for this province, just for the build-out of cellular service:

Region: AMAZONAS

Population centres	Cell Phone Market Results								
	Current Market		Average Net Cost per Town			Gap Results			
Population size	Towns unserved	Pop unserved	Annual Cost	Annual Revenue	Net Annual Cost	Addressable Pop (total)	Uneconomic Pop (total)	Net Annual Deficit	
>500k	0	0	$0	$0	$0	0	0	$0	
100 to 500K	0	0	$0	$0	$0	0	0	$0	
20 to 100K	0	0	$0	$0	$0	0	0	$0	
10 to 20K	0	0	$0	$0	$0	0	0	$0	
5 to 10K	2	8,065	$528,909	$678,671	-$149,762	7,259	807	$0	
1 to 5k	1	3,001	$363,925	$402,806	-$38,881	2,701	300	$0	
0.3 to 1K	10	7,049	$122,852	$68,318	$54,534	0	7,049	$543,100	
<0.3 K	44	11,096	$98,023	$18,660	$79,363	0	11,096	$3,503,971	
						9,960	19,251	$4,047,071	total

Similar results are found for Caqueta, Guainia, Guaviare, and several other provinces with highly dispersed and remote population centers. The policy decision for these locations must evidently determine the priority social and economic value of helping to extend the national mobile networks to these last outposts, as opposed to other possible subsidy and development choices.

As for the Internet in Colombia, the input data indicated that 66% of communities already have public access to the Internet, apparently at the district or sub-regional level (presumably through dial-up connections). The model indicates that further extension to about 72% access would also generally be economically viable, while the remaining access gap of 38% would require subsidies in the overall range of US$ 3.3 billion to reach full national coverage.

The data provided for Colombia do include estimates of the current levels of access to broadband networks, with total coverage currently at about 38%. This includes all larger cities, as well as some moderate sized cities, but virtually no smaller towns and villages. Note that this "access" finding is far larger than actual present broadband service penetration or subscription levels, which are apparently in the range of only 2%. As explained above, community-based access to broadband networks is merely the starting point for service penetration, and we can assume that broadband take-up will expand over time in those areas where networks have become available, particularly as retail prices decline. The model indicates that the current access levels are somewhat below the market frontier of around 45%, i.e., that some further extension of broadband access would be commercially attractive, but more than half the market is not yet economically viable for broadband deployment, even assuming forward-looking technologies. Again, this result is driven by the conservative assumption of no additional revenue streams that would be available for broadband, given the fact that basic Internet access is already portrayed as nearly universal. As the market evolves, especially in urban areas, it may well be that additional demand for high-speed services will change this situation in many areas of Colombia.

IV.3.4 Mexico

We received detailed data for all 31 states in Mexico concerning deployment of cellular mobile networks and public Internet telecenters, although current broadband access data could only be estimated. The data provided were at the level of "municipios", rather than individual towns and villages, but we have again extrapolated these inputs to estimate the population and network distribution in smaller towns throughout the country. These inputs indicate that cellular coverage and public Internet access are quite widely available throughout the country, reaching about 70% of the population:

Summary Results **MEXICO**

Infrastructure shared % 0%

Region	**Cellular Telephone**			**Telecenter/Internet**			**Broadband**		
	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost
National	**71%**	**83%**	**$3,647,571,211**	**70%**	**75%**	**$5,605,172,056**	**31%**	**36%**	**$2,700,992,654**
Aguascalientes	72%	84%	$4,426,061	72%	76%	$67,085,884	41%	45%	$14,692,395
Baja California	73%	76%	$221,641,012	72%	76%	$180,880,136	48%	48%	$131,652,247
Baja California Sur	73%	76%	$62,607,988	72%	76%	$30,836,058	30%	30%	$28,216,615
Campeche	72%	76%	$94,238,873	71%	75%	$50,226,573	27%	28%	$45,738,539
Chiapas	71%	84%	$181,730,299	70%	75%	$285,125,386	21%	30%	$186,599,430
Chihuahua	71%	76%	$416,094,759	70%	75%	$222,005,933	36%	38%	$196,769,015
Coahuila	72%	76%	$309,568,359	72%	75%	$167,114,549	37%	38%	$148,423,106
Colima	72%	84%	$8,940,567	71%	75%	$39,220,531	25%	29%	$13,088,818
Durango	71%	76%	$197,745,608	71%	75%	$105,345,933	26%	28%	$97,489,292
Guanajuato	73%	84%	$21,291,131	72%	76%	$331,220,319	34%	37%	$72,660,567
Guerrero	67%	76%	$168,357,083	59%	73%	$223,950,599	27%	37%	$150,497,096
Hidalgo	69%	84%	$28,964,475	69%	75%	$160,807,385	13%	21%	$50,326,012
Jalisco	71%	84%	$162,376,441	71%	75%	$459,732,954	35%	40%	$192,820,546
Mexico	72%	97%	$0	72%	76%	$906,375,087	37%	41%	$53,477,418
Michoacan de Ocampo	71%	84%	$132,240,944	70%	75%	$289,835,793	25%	37%	$141,249,002
Morelos	72%	97%	$0	67%	71%	$108,983,244	24%	29%	$11,837,192
Nayarit	72%	76%	$85,070,235	72%	76%	$66,915,412	22%	23%	$52,869,488
Nuevo Leon	72%	84%	$156,542,242	71%	75%	$278,816,895	40%	44%	$160,154,679
Oaxaca	64%	70%	$284,074,621	63%	69%	$255,209,105	16%	16%	$183,077,438
Puebla	68%	84%	$21,950,998	68%	74%	$360,470,877	25%	41%	$77,441,873
Queretaro	72%	84%	$15,253,357	72%	76%	$100,697,272	35%	39%	$27,945,621
Quintanaroo	73%	76%	$116,546,668	72%	76%	$63,626,890	30%	30%	$56,421,603
San Luis Potosi	71%	76%	$186,782,403	71%	75%	$167,208,357	28%	29%	$123,393,310
Sinaloa	73%	76%	$165,829,714	72%	76%	$184,478,079	36%	39%	$129,094,104
Sonora	71%	76%	$303,220,949	70%	75%	$161,216,923	34%	36%	$143,328,488
Tabasco	73%	84%	$51,892,359	72%	76%	$137,572,898	34%	38%	$60,162,285
Tamaulipas	72%	76%	$250,184,064	71%	75%	$200,212,984	31%	32%	$151,566,475
Tlaxcala	66%	83%	$46,899,900	66%	74%	$47,880,653	13%	22%	$60,659,867
Veracruz	71%	76%	$768,604,976	69%	69%	$558,491,555	22%	22%	$388,110,755
Yucatan	67%	83%	$117,498,773	66%	73%	$106,887,210	30%	39%	$92,982,509
Zacatecas	69%	84%	$86,695,366	69%	75%	$81,141,714	20%	27%	$81,079,102

The market frontier for cellular access is about 83%, with 17% of the market, mostly smaller towns, falling outside the market gap. The region with the lowest current access is Oaxaca, with only 64% cellular coverage, and a market frontier of 70%, and a subsidy cost of nearly US$ 300 million to serve the remaining areas. Other regions indicate that closing the final gaps would also be quite expensive: US$ 768 million in Veracruz, $300 million in Sonora and Coahuila, and US$ 416 million in Chihuahua.

The Internet results indicate that 70% the country already has access to at least basic public Internet access, and the market frontier is just 5% above that. Oaxaca is again the lowest current access at 63%. Total subsidies required to establish public Internet access throughout the country would be in the range of US$ 5.6 billion.

Data on current access to broadband networks was only estimated at 31%. The model's calculation of the approximate market frontier for broadband access is about

46% of the population. Subsidies that may be required to support further broadband expansion could be quite substantial, on the order of US$ 100 - US$ 150 million or more for most states. Again, evolution of this market may change those conditions in the near future.

IV.3.5 Chile

There are 12 regions in Chile, ranging in size from 92,000 to 6 million. We received input data for each region, but similar to Mexico and other countries, this was provided initially at the level of “Comunas”, rather than individual towns. We have extrapolated the data to cover estimated population distribution among smaller towns, and estimated network and service coverage as well. The current access data for broadband are estimated based on broadband service penetration in the fast growing Chilean broadband market.

Based upon these data and assumptions, the Model’s calculations for Chile produce the following results:

Summary Results CHILE

Infrastructure shared % 0%

Region	Cellular Telephone			Telecenter/Internet			Broadband		
	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost	Current Access	Market Frontier	Access Gap Capital Cost
National	**72%**	**85%**	**$920,427,719**	**71%**	**75%**	**$1,098,339,401**	**27%**	**30%**	**$633,786,404**
I REGION	71%	76%	$65,063,369	71%	75%	$30,995,385	32%	32%	$32,957,629
II REGION	72%	76%	$92,180,396	71%	75%	$37,303,973	32%	32%	$45,244,609
III REGION	71%	76%	$49,282,588	70%	75%	$19,206,551	24%	24%	$25,430,820
IV REGION	72%	76%	$85,682,235	71%	75%	$44,320,209	28%	28%	$48,938,605
V REGION	71%	84%	$29,567,132	70%	75%	$115,705,871	24%	34%	$40,477,090
VI REGION	71%	76%	$42,471,367	70%	75%	$60,973,817	19%	25%	$45,787,025
VII REGION	70%	76%	$99,770,196	70%	75%	$66,660,625	21%	24%	$62,816,709
VIII REGION	71%	76%	$99,760,203	71%	75%	$142,844,312	25%	27%	$110,842,246
IX REGION	71%	76%	$105,497,617	70%	75%	$67,500,245	20%	22%	$66,085,887
X REGION	70%	76%	$151,438,812	70%	75%	$78,775,552	21%	24%	$91,283,003
XI REGION	66%	66%	$50,206,175	65%	65%	$7,345,299	15%	15%	$11,445,241
XII REGION	71%	71%	$49,507,630	71%	74%	$11,389,845	31%	31%	$14,058,072
XIII REGION (RM)	73%	97%	$0	72%	76%	$415,317,718	31%	35%	$38,419,468

Both the cellular market and the Internet market have reached about 71%-72% coverage, with a market frontier of 85% for cellular access, and 75% for Internet. The cost to expand to the final 15% of the cellular market is about US$ 920 million, suggesting that these unserved areas are indeed extremely remote and costly. Similarly, the 25% of the country lacking in public Internet access at the local level would require over US$ 1 billion in subsidy to reach that uneconomic portion of the market. The market frontier results for broadband are based upon the estimated current levels of access, showing 27% current access and only a 30% market frontier, beyond which further expansion of broadband network access would not be seem to be commercially attractive. However, the same caveats apply to Chile as to the other countries with respect to broadband opportunities, and it is important to recognize that there is still considerable room for continued growth in the broadband market within those municipalities where such networks are already available.

IV.4 Analysis of findings and implications for policymakers

The findings arising from this exercise provide important insights into the status and trends in Latin American telecommunications markets, and implications for Universal Access policies and programs in the region. At the outset, we must again acknowledge the effectiveness of market access policies in generating investment and growth throughout the region, especially in access to cellular mobile telephone services. As has been increasingly acknowledged in telecommunications development circles, cellular telephones have become the new basic service of choice, due to levels of availability, affordability, and convenience that have far exceeded in less than a decade the impacts that traditional fixed-line telephones were able to achieve in nearly a century. From this perspective, it seems that the main emphasis of universal access policies concerned with voice telephony – indeed even those aiming to shift toward universal voice *service* – should emphasize these market realities, and avoid investing scarce resources in fixed network deployments, where mobile services can (and often already do) serve the market with little or no subsidy.

Moreover, the work of the cellular market is not yet complete, as most countries have yet to see their mobile networks extend all the way to the market frontier. This may be due to lingering entry and investment barriers in some cases, or simply to the fact that network buildouts are proceeding at their own pace, and ultimately take time to reach all segments, with the least profitable inevitably saved for last. In either event, the focus of policy should be on further enabling these market forces to seek out and serve the areas that they have not already reached, but not necessarily to distort or artificially prop up these markets with unneeded subsidies, for example. Public funding initiatives that may aim to help accelerate universal access to (mobile) voice telephony need to be carefully tailored to avoid pre-empting market forces, as long as operators are available and willing to expand toward the frontier own their own. On the other hand, for the true access gaps, the policy question involves not only identifying and quantifying these gaps on a case-by-case basis, but determining what socio-economic criteria and priorities should drive allocation of public resources to fill those gaps. In many cases, as we've seen, the net cost to reach the last unserved, uneconomical segments of the population with mobile (or other) networks can be extremely high (as indeed are the costs of providing other services to these populations). It is useful, at a minimum, to consider the cost-benefit tradeoffs of financing such investments, as opposed to alternative uses of the same limited funding resources.

With respect to Internet access, the most interesting finding from analysis of several countries' data in this area is that, here again the market should be able to do much of the work without significant subsidy incentives. The critical point is that the model's calculations indicate that Internet access could be financially viable for large segments of many countries. Where this may already be occurring, these developments validate the finding for other countries that the market frontier for Internet access may be far beyond its present levels, even toward nearly universal access itself. And if such countries have not yet seen growth patterns in Internet services comparable to the cellular market, there is certainly evidence to suggest that they will, given appropriate incentives and opportunities for market forces to take hold.

Because the Internet business model that is utilized within this analysis does not depend upon connectivity to the traditional national network(s), and instead allows for independent access via VSAT and local telecenters wherever this appears most cost-effective, it may be that much of the existing market gap for this Internet access is attributable to barriers to the establishment of such stand-alone networks. We have found several instances of successful networks built along these lines (see Chapter VII and Annex 3), but these approaches are only just beginning to receive favorable support in many countries, both among policymakers and the business community. It is worth pointing out that the network architecture involved in this scenario also allows for public voice access via the telecenter, so that in some instances where cellular access may be unaffordable, the Internet solution also yields the voice telephony solution as well. In other cases the two services complement each other, giving consumers additional options, and the model results suggest that both types of networks can be economically attractive in the same locations. Thus, the model's analysis tends to reinforce much of the qualitative results discussed in the chapters that follow concerning the need to highlight and encourage development of small, localized telecommunications operations, including telecenters, which do not require control by large national operators. And the incentives required to encourage expansion of these options do not necessarily depend so much upon lucrative financial resources as market entry opportunities and a receptive regulatory regime.

Finally, the model's review of the broadband market, while it depends upon less reliable data and more forward-looking assumptions, nevertheless supports a conclusion that broadband connectivity is very much within the range of options for telecommunications development across much of Latin America. Recall that one of the key assumptions influencing the model's estimates of the market and access gaps for broadband networks in particular is the fact that it does not directly attribute "new" revenues to such networks, as users' incomes are assumed to be allocated to services (voice, Internet) rather than technologies. This is, however, a conservative assumption for several reasons, as has been suggested already. First, for higher income users, improved transmission capacity will indeed be likely to generate higher revenues, although since these customers tend to be mainly in urban areas, this effect by itself may not have much influence upon expansion of broadband access to more remote regions. Additional important factors, however, could be more decisive. One of these is the capability of broadband networks to deliver Voice-over-Internet Protocol (VoIP) service at very low prices, in addition to traditional Internet services. Including such service in the analysis would have the effect of transferring a considerable slice of what are now "voice" revenues toward the Internet, and specifically the broadband market category. While there would undoubtedly be losses to the voice telephone industry, the gains for the broadband segment could be significantly greater, and the resulting business climate for broadband connectivity, even in smaller, more remote locations, would be potentially very substantial. Similarly, broadband networks could also benefit from revenue contributions from other customer sources, such as local governments, schools, and businesses. Particularly where wireless access technologies can be deployed, each of these groups can potentially utilize the network without incurring additional infrastructure costs, and where there is adequate high-speed capacity, this type of demand, and hence revenues, could also be quite significant.

In this respect, the model results quite probably establishes a low-end, conservative boundary for what the telecommunications markets in Latin America can continue to achieve through economic and regulatory incentives and new technological and service configurations. It suggests that there is considerable room for market-based growth, and even more with strategically targeted subsidies, and that perhaps the most promising medium to longer term approach will be the provision of integrated services over broadband access networks, at least in a large number of locations. These ideas are explored and elaborated further in subsequent chapters of this report.