VI. The opportunities and challenges of mobile broadband

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A. Introduction

Thanks to the elimination or reduction of entry barriers to the ICT sector, as well as innovative business models, most of the world's population now has access to voice services. Mobile telephony provided a vehicle for even low-income sectors in developing countries to have connections to these services. In addition, low-income populations can use less sophisticated handsets to connect to the Internet and access general news and information (Samarajiva, 2009). Most 2G devices in use throughout the world do not, however, have capacity for searching or downloading complex information; that is, they are not capable of providing full access to all of the potential benefits of ICTs. That is why broadband access is a crucial issue for a majority of the world's population.

In Latin America,[2] significant progress has been made. In March 2010, there were 35 million high-speed Internet access connections over fixed networks in the region, predominantly DSL (66.7%) and cable modems (25.3%). This still falls short of what is needed, however. The majority of the population still does not have broadband access, and the average transmission

1 The authors thank Fernando Ramírez for his valuable contribution in the preparation of this chapter.

2 In this chapter, references to Latin America include the following countries: Argentina, Plurinational State of Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and the Bolivarian Republic of Venezuela.

speed for those who do is about 2 Mbps (Galperin and Ruzzi, 2010), which clearly limits their ability to reap many of the benefits of the Internet, including access to information about employment, health and governance.

Mobile broadband offers a unique opportunity to provide broadband access in developing countries. First of all, this platform does not require the substantial investment in infrastructure needed for fixed broadband deployment. And, in addition to not being dependent on customer-dedicated infrastructure, mobile broadband has another important advantage: its ubiquity. In fact, most of the population in the region already has access to mobile services (penetration exceeds 91%). In March 2010, 31.3 million mobile broadband connections were already in operation; this base is equivalent to more than 45% of Internet subscriptions (including dial-up connections) and more than 47% of broadband connections in the region. Countries such as Nicaragua, Ecuador, the Plurinational State of Bolivia and El Salvador have more mobile than fixed broadband connections.[3]

These statistics indicate that the preferred type of connection to the Internet in Latin America is via mobile broadband. Mobile broadband seems to be repeating the growth pattern followed by the mobile phone —which surpassed the number of fixed lines in 2001 and, 10 years later, has a service base more than five times larger— but at an even quicker pace. Moreover, the expansion of mobile broadband use will be even faster because people with lower incomes already have access to mobile services. In this context, it makes sense to consider what the region's main opportunities and challenges will be moving forward.

This chapter addresses these issues. First, the status of mobile broadband in the region is analysed; then, some of the opportunities opened up by this platform are reviewed; and, in closing, the main challenges and obstacles that must be overcome in order to allow its development to proceed at an even faster pace are discussed.

B. The status of mobile broadband in Latin America

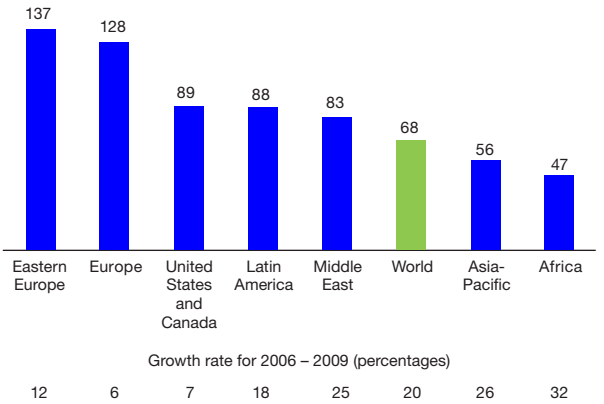
Mobile telephony has become the ICT with the highest level of penetration in the world. In late 2009, there were more than 4.6 billion active mobile phones (GlobalComms, 2010), which is more than four times more than the number of fixed telephone connections. In March 2010,

[3] In India, there are four times as many mobile netizens as fixed ones (Booz, Allen and Hamilton, 2007).

there were over 505 million active accounts in Latin America, representing a penetration rate of over 91%. This platform is therefore positioned to be one of the main vehicles for a wider dissemination and penetration of broadband services.

Latin America is in a much better position than most developing regions (see figure VI.1). In only three years (2007-2009), the number of mobile subscriptions rose by 200 million, and it continues to climb at a healthy growth rate (9.5% per year in the first quarter of 2010). This has allowed the region to surpass the penetration levels of the United States and Canada.

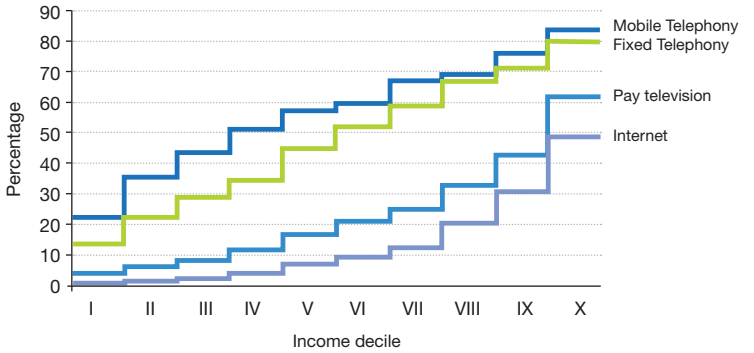
Figure VI.1.
Penetration rates for mobile telephony in the world, 2009
(Lines in service for every 100 people)



Source: GlobalComms (2010).

Mobile telephony has penetrated population segments that no other ICT has been able to reach (LAC, 2007). For example, in Mexico, mobile telephony is the dominant platform in all income brackets (INEGI, 2009, on the basis of data from 2008) and, in the poorest quintile, more than 30% of households had at least one mobile phone. In view of the fact that the subscription base has grown by over 15% since the survey was conducted (10.6 points of penetration), it is expected that, by the end of 2010, the penetration rate for this income stratum will exceed 40% (see figure VI. 2). In other words, mobile telephony is ushering in universal access to voice services.

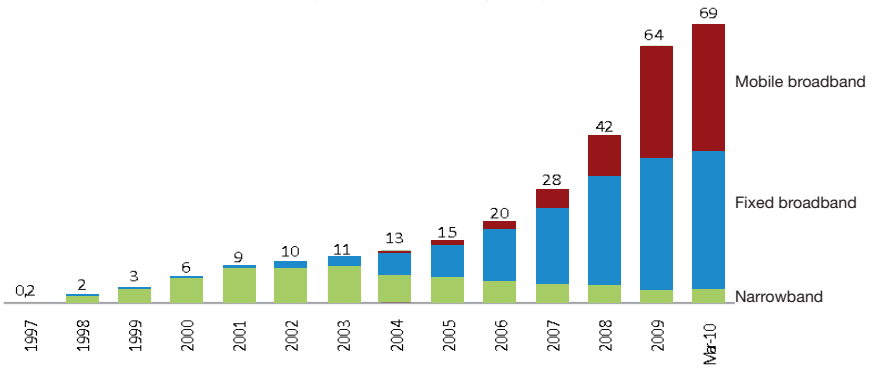
Figure VI.2.
Penetration rate for telecommunications services, by income decile, in Mexico
(Percentage of households with at least one connection)



Source: *ENIGH 2008*, INEGI, 2009

The term "broadband" generally refers to fixed broadband. In March 2010, there were 35 million fixed connections, predominantly DSL (66.7%) and cable modem (25.3%), in Latin America. In less than 10 years, the region's level of fixed broadband connections had grown so much that it matched the number of fixed telephone lines existing in mid-1993 and the number of mobile phones registered in the region in mid-1998 (ITU, 2010). These figures provide an incomplete picture of the situation, however, since, as of March 2010, 31.3 million mobile broadband connections were already in service, which was the equivalent of more than 45% of total Internet subscriptions (including narrowband dial-up connections) and more than 47% of the region's broadband connections (see figure VI.3).

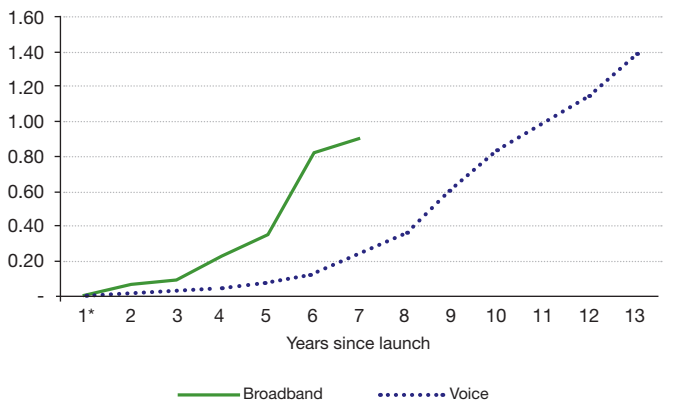
Figure VI.3
Internet connections in Latin America
(Millions of subscriptions)



Fuente: ITU (2010) y Telegeography (2010)

Mobile broadband adoption is replicating, but more rapidly, the trend that was seen in mobile telephony 15 years ago. In 2001, 11 years after the mass launch of mobile telephony in Latin America, the number of mobile phone users had surpassed the number of fixed lines for voice service. In 2010, there were more than five times as many mobile lines as fixed lines. Just seven years after the launch of mobile broadband, there are already more than 0.8 subscriptions to mobile broadband for every fixed broadband subscription (see figure VI.4), and market estimates suggest that there will be more mobile broadband lines than fixed broadband by early 2011.

Figure VI.4
Ratio of mobile to fixed subscribers
(Number of mobile subscribers for every fixed line in service)



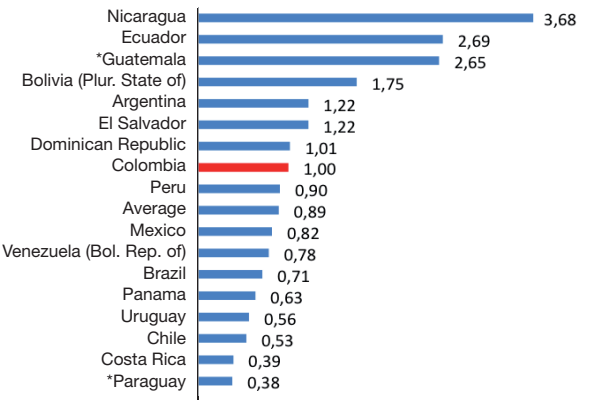
Source: Prepared by the authors with data from ITU (2010) and GlobalComms (2010).

* 1991 for mobile telephony; 2004 for mobile broadband.

Note: The most recent data for each series (year 13 for voice, year 7 for broadband) are as March 2010.

All the evidence points to one conclusion: the preferred type of Internet connection in Latin America will be mobile broadband. This platform will make it possible to achieve broadband's universalization in much the same way as mobile telephony has become the nearly universal technology in use for voice services. Today, seven countries already have more mobile broadband connections than fixed connections (see figure VI.5).

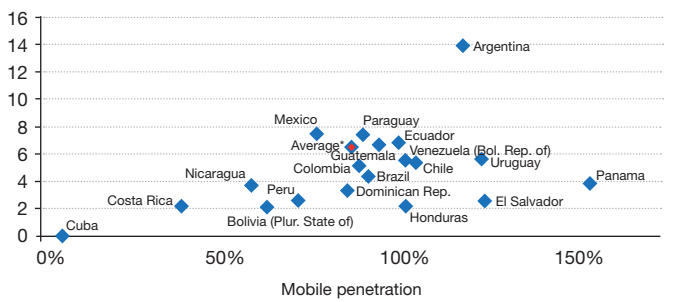
Figure VI.5
Number of mobile broadband connections for every fixed broadband connection
(March 2010)



Source: ITU (2010) and GlobalComms (2010).
*The data for these countries correspond to December 2009

As the mobile market continues to grow, the number of broadband connections, measured as a percentage of total subscriptions, is skyrocketing. In late 2008, only 2.3% of all mobile connections were broadband; in March 2010, they exceeded 6.2% of total subscriptions (see figure VI.6). The distribution by country is fairly homogeneous, with two exceptions: Cuba, where mobile broadband services were unavailable when this publication went to print; and Argentina, which has the most highly developed mobile broadband market in the region.

Figure VI.6
3G subscribers as a percentage of total mobile subscribers



Source: ITU, 2010 and GlobalComms (2010).

* Average mobile penetration in the region: 91%. Average mobile broadband penetration: 6.2%.

Most 3G network launches took place between 2007 and 2008 (see table VI.1), which was when several countries released additional spectrum or operators felt that the technology and the market were mature enough to begin to offer mobile broadband services at affordable prices.

Table VI.1.
3G networks in Latin America
(Selected countries)

Country	Operator	Platform	Frequency (MHz)	Launch year
Argentina	Claro Argentina	W-CDMA	1900	2007
Argentina	Telecom Personal	W-CDMA	1900	2007
Argentina	Telefónica Móviles (Movistar)	W-CDMA	1900	2007
Brazil	Algar Telecom	W-CDMA	2100	2008
Brazil	Brazil Telecom (BrT)	W-CDMA	-	2008
Brazil	Sercomtel Celular	W-CDMA	-	2008
Brazil	Telecom Americas (Claro)	W-CDMA	850	2007
Brazil	Telemar Norte Leste (Oi)	W-CDMA	2100	2008
Brazil	Telemig Celular	W-CDMA	2100	2007
Brazil	Telemig Celular	W-CDMA	850	2007
Brazil	TIM Brazil	W-CDMA	850	2008
Brazil	TIM Brazil	W-CDMA	2100	2008
Brazil	Vivo Participações	CDMA2000	800	2004
Brazil	Vivo Participações	W-CDMA	2100	2008
Chile	Claro (antes Smartcom)	W-CDMA	1900	2008
Chile	Entel PCS	W-CDMA	1900	2006
Chile	Telefónica Móviles (Movistar)	W-CDMA	1900	2007
Colombia	Colombia Móvil (Tigo)	W-CDMA	2100	2008
Colombia	Comcel (América Móvil)	W-CDMA	850	2008
Colombia	Telefónica Móviles (Movistar)	W-CDMA	2100	2008
Mexico	Iusacell (including Unefon)	CDMA2000	800/1900	2005
Mexico	Telcel (América Móvil)	W-CDMA	850/1900	2008
Mexico	Telefónica Móviles (Movistar)	W-CDMA	850/1900	2008
Peru	América Móvil Perú (Claro)	W-CDMA	850	2008
Peru	Nextel del Perú	W-CDMA	1900	2009
Peru	TEM Perú (Movistar)	W-CDMA	2100	2009
Peru	TEM Perú (Movistar)	CDMA2000	800	2004

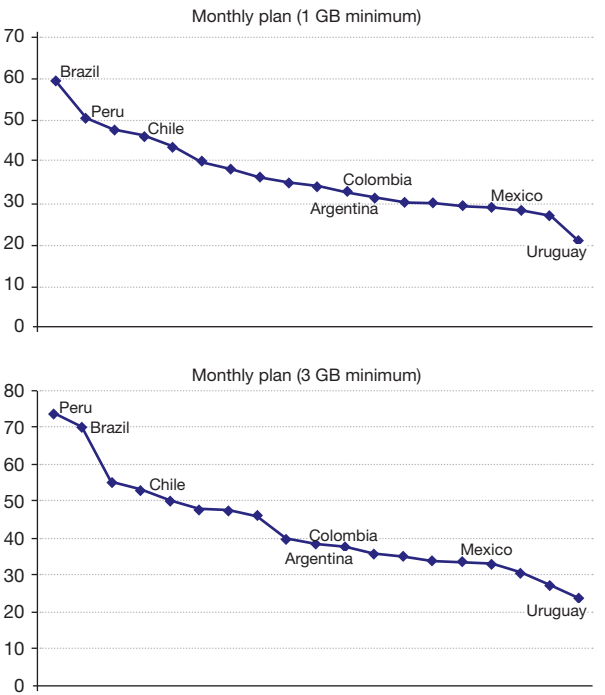
Source: GlobalComms 2010.

The adoption of mobile broadband has been spurred by a significant decrease in the price of terminal devices thanks to worldwide economies of scale.[4] However, the cost of service continues to be high in Latin America, and this will probably result in a slowdown in adoption unless prices can be brought down. On average, monthly service costs around US$ 63 per month, but with very significant differences across countries. For example, in Peru, a monthly subscription of at least 1 GB costs about US$ 50 while, in Uruguay, it

[4] According to Buttkereit et al. (2009), the price of mobile devices affording broadband access is around US$ 25 in the United States.

costs about US$ 20 (see figure VI.7). As the amount of data to be transferred increases, the differences become even more pronounced (US$ 74 and US$ 24, respectively).

Figure VI.7.
Average fixed cost of monthly plans of mobile broadband
(US dollars per month)



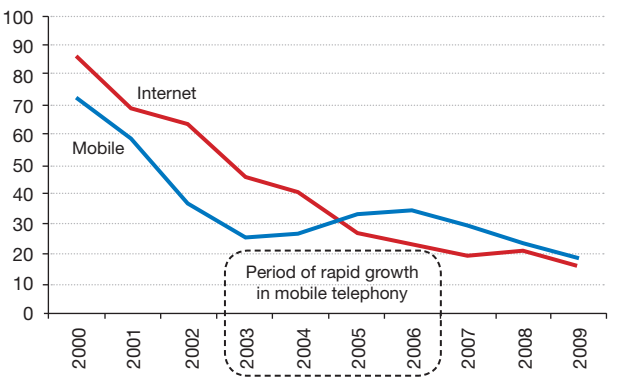
Source: Galperín and Ruzzier (2010).

Recently, operators in the region have begun to offer prepaid mobile broadband services.[5] While the introduction of this service has been gradual, it is expected that, before long, all Latin American operators will be offering both postpay and prepay plans.

[5] Operators offering prepaid mobile broadband services: Argentina: Claro and Movistar; Brazil: TIM, Vivo and Claro; Chile: Movistar, Entel PCS and Claro; Colombia: Comcel, Movistar and Tigo; Mexico: Telcel, Movistar and Iusacell; Peru: Claro and Movistar.

In order to fully understand the status of mobile broadband and its possible future course of development, the current relationship between Internet users and the existing infrastructure needs to be examined. Internet penetration has grown steadily over the past 10 years,[6] and, as of 2010, the Internet was being used by almost one out of every three people in Latin America. However, year-on-year growth rates have been declining, and a period of rising rates such as that seen in mobile telephony between 2003 and 2006 has not yet been observed (see figure VI.8). The rapid growth of the base of connections, paired with the linear growth of the user base, has meant that the number of users per connection is declining significantly. There are two reasons for this shift. On the one hand, broadband access is becoming individualized: access is increasingly private, especially in the residential sector, and the relative importance of community access centres and other access groups (businesses, offices, universities, schools) has declined. On the other hand, with the advent of mobile broadband, the number of people with more than one broadband connection has increased significantly (see figure VI.9).

Figure VI.8.
Internet penetration in Latin America: annual growth rates
(Percentages)

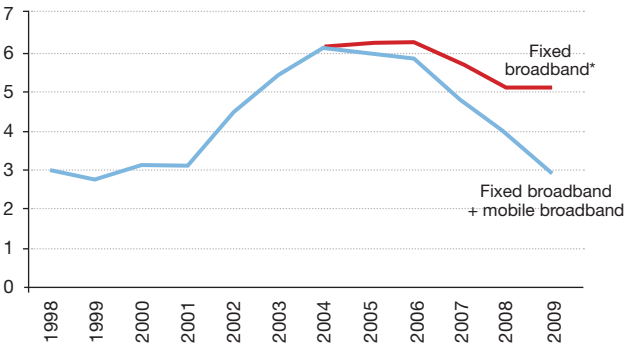


Source: ITU (2010); Internet World Stats (2010) (www.Internetworldstats.com).

* Moving tri-annual average growth rates.

6 Based on information reported by countries to ITU. Penetration is usually measured by determining the number of people who have accessed the Internet in the last 12 months. This information was supplemented with data from Internet World Stats (www.internetworldstats.com) (2010).

Figure VI.9.
Number of users per Internet connection



Source: ITU (2010); Internet World Stats (2010) (www.Internetworldstats.com).
* Includes dial-up connections (narrowband), of which there were fewer than 3 million at the end of 2009.

In this context, mobile broadband opens up major opportunities for development, but it also poses challenges. There are more questions than answers at this early stage of the platform's development, and the level of benefits which trickle down to society will most likely depend on how effectively the region meets those challenges. Is it possible that mobile broadband will enable Latin America to succeed in becoming a full member of the information economy, just as mobile telephony allowed it to do in the case of basic voice services? Is it possible that mobile broadband will turn out to be what finally drives an acceleration in the adoption and appropriation of Internet in the region?

C. Mobile broadband: an opportunity for development

ICTs offer new opportunities for economic and social development, as has been clearly illustrated by the advent of mobile telephony. The cost structure of this service has made access feasible for marginalized segments of the population in cities, as well as people in geographically isolated areas. On the one hand, fixed telephony's local loop is a dedicated resource for each subscriber, so the cost lever is the connection cost rather than its use. On the other hand, mobile telephony —a radio base connection, which is equivalent to the loop— is shared, so the cost lever is its use rather than the connection. This is the main reason why operators can offer variable subscription plans based on new business models such as prepaid service. Moreover, fixed networks still operate mainly over copper infrastructure, which makes them prone to multiple

technical problems (Buttkereit et al., 2009): continuous maintenance is required along the entire cabled network, they are subject to service interruptions due to weather and poor urban infrastructure, and they are vulnerable to theft and vandalism. Mobile networks, on the other hand, can dispense with a significant part of the physical infrastructure, at least with regard to the local loop.

Technological advances are also increasing the amount of information that can be transmitted over a limited part of the spectrum, although it is true that these advances are now approaching their theoretical limits. Be that as it may, this fact, along with the possible cellular reuse of spectrum, generates greater economies of scale in the operation of a mobile network.

Mobile broadband offers a range of opportunities for the development of a more equitable, skilled, productive and competitive society. Internet, accelerated by the advent of fixed broadband, created a positive discontinuity in the democratization of information. However, this wave of change bypassed most emerging countries, including those in Latin America, and, as a result, they have not become fully integrated into the globalized world. Mobile broadband once again presents a discontinuity which, given its characteristics, can be exploited to reduce the digital exclusion of the region. Thus, the conditions are in place to generate a virtuous circle of growth and incorporation into that globalized world.

The social and economic effects of mobile broadband can be assessed from two perspectives. On the one hand, mobile broadband can be seen as a substitute for fixed broadband. On the other hand, it can be understood within a context where both access modes complement each other by servicing different market segments.

1. Opportunities for mobile broadband as a substitute for fixed broadband

Mobile broadband —an almost perfect substitute for fixed broadband— can deliver all of the same economic and social benefits which have been discussed in other chapters. In this chapter, we highlight three effects of broadband penetration based on the assumption that mobile broadband will become the main modality for the achievement of universal access.

Higher economic growth: Investment in mobile broadband and network deployment has a direct and immediate impact which has a multiplier effect on the producers of equipment and content. It helps boost firms' productivity by allowing them to adopt more efficient processes and to save resources

through outsourcing (Katz, Flores-Roux and Mariscal, 2010). In addition, its use accelerates innovation through the introduction of new services and increased human capital formation. Several empirical studies have measured the impact of broadband penetration on GDP growth (for a discussion of the findings in this respect, see chapter 2 of this book).

Promoting social inclusion: The increased access to information that is provided by broadband reduces the digital gap and is becoming an important tool for creating opportunities at all levels of society. The creation of more and better opportunities has a significant impact on social inclusion and reduces the concentration of wealth.

Potential for improving the quality of education: Although there is an ongoing debate as to the extent to which ICTs contribute to improved student performance and the best approaches for ensuring that they have the most effective impact possible, numerous initiatives are being undertaken around the world to incorporate these technologies into education, starting with a massive deployment of connectivity. Mobile broadband, the existence of other wireless networks (e.g., femtocells, WiFi and WiMAX technologies) and the popularization of intermediate access devices (e.g., e-reading devices such as Kindle, which is a cross between a computer and a mobile phone, or the multi-use iPad) may make a substantial contribution in this area.

2. *Opportunities for the use of mobile broadband as a complement to fixed broadband*

The uses that can be made of mobile broadband as a substitute for fixed broadband are certainly important, but these technologies will have an even greater impact if they are viewed as complementary services that can be deployed in different market spaces, as each platform has different attributes. Complementarity is possible because of three characteristics of mobile broadband that distinguish it from fixed broadband: (i) it is mobile, (ii) it is ubiquitous, allowing access to the Net from virtually anywhere, in much the same way as now occurs with mobile telephony, and (iii) it has a cost structure in which variable costs are dominant and depend almost entirely on consumption.

These three seemingly simple characteristics have the power to generate an infinite host of additional benefits and opportunities. Each gives rise to an area of opportunity that is inherent in mobile broadband: (i) the democratization of access to information (in principle, the Internet), (ii) an acceleration of appropriation and the attainment of digital literacy, and (iii)

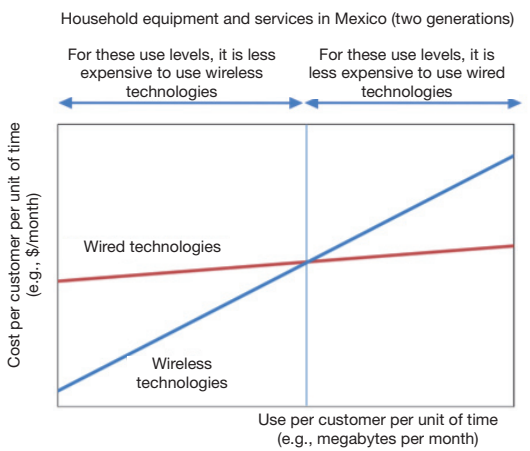
the incorporation and utilization (including real-time access anywhere) of the applications and information needed by private companies and governments to carry out transactions.

(a) Democratization of access

As discussed in the first section, mobile broadband will play an important role in enabling millions of people to have Internet access. It will be the predominant form of Internet access throughout the region and will make the benefits of broadband available to a majority of the population: it will thus serve as the primary means of democratizing ICTs.

The underlying reason for this is that mobile broadband, unlike fixed broadband, has a cost structure based on variable costs, i.e., the main driver of costs is consumption. This means that virtually every customer is profitable, because if a customer does not consume, no costs are generated (see figure VI.1). Given this fact, combined with the steady decline in the price of terminal devices, more and more people may opt for this mode of access. Operators providing wireless broadband service will therefore increasingly focus on launching services with low entry barriers and minimal maintenance requirements, allowing customers to pay only for what they consume. The availability of these services will generate a demand which, although small in terms of each customer, will, in the aggregate, represent a volume that will bear the costs of deploying and operating the network.

Figure VI.1.
Comparison of the cost structure of broadband modalities



Source: Prepared by the authors based on Booz & Company.

(b) Positive discontinuity in the appropriation of Internet

A widespread incorporation of the Internet into people's daily lives has not yet occurred in Latin America. Only one out of every three Latin Americans used the Internet in 2009 (ITU, 2010; Internet World Stats, 2010). In other words, the appropriation of this technology on a mass scale has still not occurred. There are several reasons for this, with the most important of them being the cost of the service, which reduces affordability; the lack of the types of content and applications needed to meet basic, everyday needs; and the fact that large segments of the population do not know how to use this technology (digital illiteracy), which is probably the greatest barrier.

Individual services with network effects tend to be adopted rapidly, as has occurred not only with mobile telephony but also with social networks like Facebook and online messaging services such ICQ, QQ, Microsoft Messenger and BlackBerry Messenger. Virtually the entire population can use a mobile phone; the fact that basic mobile broadband services are offered on familiar devices with an almost universal presence will facilitate the adoption of Internet and its incorporation into daily life. Mobile broadband is positioned to become an important element in the development of digital literacy, given that the learning curve involved in mastering its use is substantially less steep than it is in the case of computer use. It will therefore help to bring down one of the main barriers to Internet adoption by acting as an intermediate step in the acquisition of digital literacy and ownership.

(c) Real-time access to information and content anywhere

In order to carry out any transaction, information must be accessed or generated and stored for later recovery and use. Most business processes, as well as interaction within the government and between governments and citizens, require the exchange of information. If the exchange is simple, it usually can be conducted in real time. However, more complex information exchanges involve several steps, each of which may take hours, days or sometimes even months. These processes tend to be inefficient and to generate transaction costs. Mobile broadband can substantially reduce such costs in situations where the possibility of exchanging information in real time from any location generates significant efficiencies in processing the transaction.

Many examples of these sorts of situations can be found in private enterprise and the related business processes, as well as in the public domain. These types of cases can be sorted into three categories:

- Transactions of goods and services that rely on large amounts of information or time-sensitive information or that require data storage

(e.g., customer information, product information, inventory updates or management, development and sale of custom products). A case in point is door-to-door sales and the management processes (insurance, package delivery) and services related to such sales (incident reports for insurers, real-time tracking of packages, delivery, post-sales and inventory management). All these activities can be conducted much more efficiently by sharing information in real time, and many of them do not require the physical movement of people to complete the process.

- A government's relationship with its citizens (e.g., identification of citizens in various situations, citizens' requests for information of a public nature and citizen participation). This category includes public safety initiatives that permit the rapid identification of persons or property (e.g., vehicle registrations), the right to access information in a timely manner, regardless of location and time, and elections and plebiscites, among many other mobile e-government initiatives.
- Ongoing services relating to a person or object that is in transit which require a constant exchange of information. This category includes many health initiatives, remote monitoring, advertising and tracking services.

Mobile broadband opens up opportunities for building applications that will dramatically change how people, businesses and government interact. In the future, the imagination and creativity of developers will generate applications designed to meet increasingly specific needs. These applications will make it possible to:

- Make the delivery of health services more flexible thanks to the capability for the mass transmission of data (images, medical records, drug inventory management) and remote patient support, which will improve patient care and outcomes while reducing costs.
- Improve the efficiency of services designed to ensure public safety and security which depend on the transmission of data and information, independently of location.
- Increase the effectiveness of programmes aimed at combating poverty and promoting social inclusion (see box VI.1) through their real-time management in marginal areas, which will lower costs, produce positive impacts in less time and reduce the resource waste.
- Generate demographic and market information in a timelier manner by permitting census and sampling results to be fed into a database in real time. This will permit information to be made available much more quickly than at present.

- Increase the efficiency of public or private services that depend on the fieldwork of service personnel.
- Strengthen social networks, which are an engine for the development of digitally literate societies.

Mobile broadband opens up a wide range of possibilities beyond those offered by fixed broadband. In order to take advantage of them and translate them into increased public well-being, public policy will have to operate on the assumption that mobile broadband will be the priority mode of access and that it will be the job of entrepreneurs and innovators to ensure that this instrument achieves its full potential. Public policies should therefore focus on eliminating entry barriers and providing incentives for progress in this area.

Box VI.1.

Mobile broadband and its use in anti-poverty programmes

Broadband, whether fixed or mobile, helps to promote social inclusion. An example of one valuable application of mobile broadband is its use in the management of programmes aimed at combating poverty to improve not only programme targeting but also programme monitoring and oversight. The two largest-scale initiatives to fight poverty in Latin America are the Mexican Oportunidades programme and the Bolsa Familia in Brazil. Under these programmes, State financial support for mothers is conditional upon their fulfilment of certain obligations (e.g., ensuring that their children attend school and receive a full course of vaccinations). Two of the major challenges for these programmes have had to do with identifying suitable beneficiaries and ensuring the proper delivery of cash benefits. Pilot programmes have already been launched in which field operators are in direct contact with a central office through devices equipped with wireless broadband. Field operators can assess potential candidates' profiles; sign them up for the programme on the spot or disqualify them, as the case may be; make changes in the records on their status, address and number dependents; and notify the central office in real time that programme obligations have been met. As a result, processes that used to take several months can be completed in minutes. This possibility has substantially increased the efficiency and equity of these programmes and creates incentives for compliance with programme obligations, as well as reducing the chances of inappropriate resource use and the possibility of fraud.

The delivery of resources via fully electronic media is still in the research phase, but a faster data connection will allow more rapid and efficient delivery of funds. Although the region's mobile banking efforts have met with little success, the delivery of funds through electronic means is expected to have a major impact on the economy by promoting the use of banking services and decreasing the likelihood of fraud and crime. It will also reduce the number of cash transactions, which will promote the formalization of the economy and make money laundering more difficult.

D. Challenges in taking advantage of the potential of mobile broadband

In order to exploit the opportunities discussed above, a suitable regulatory framework for the promotion of technological convergence is needed. One of the main tasks is eliminating entry barriers to the sector, which are prevalent in almost all of Latin America in terms of institutions, interconnection of networks, processes for granting licences and permits, spectrum availability and the development of infrastructure.

1. Institutional barriers

Economic regulatory action has the complex task of influencing companies' behaviour in ways that will ensure its compatibility with the public interest.[7] Regulatory agencies seek to provide incentives to improve corporate performance through the rules, regulations and contracts that they establish. To a large extent, their chances of success are determined by the effectiveness of the institutions responsible for regulatory policy design and implementation. In order for the regulatory process to be successful, sound institutions are therefore needed that are capable of issuing transparent, predictable and credible policies. In Latin America, the first entry barrier to the sector is related to its institutional weakness, which does not allow it to generate the necessary legal certainty for investment. Regulatory processes should provide for public hearings to inform the community about ongoing developments and to ensure that the views of stakeholders are taken into account. They also need to provide for transparent policy design and implementation procedures. For mobile broadband, the institutional process of granting licences for the use of radio spectrum (discussed below) is of particular importance. In institutional terms, these processes have moved very slowly, with years going by between one spectrum auction and another, and this has created an artificial scarcity of spectrum. Moreover, in many cases, the auction process has lacked transparency and flexibility and has been overly demanding in terms of eligibility for awards.

[7] The concepts of public interest and social welfare are not only difficult to measure but are also difficult to define in general terms. For the purposes of this analysis, "public interest" is understood to mean the process by which regulatory objectives are defined. An inclusive and open regulatory process that seeks to benefit the majority of the stakeholders in the community is compatible with the public interest.

2. Interconnection

A number of Latin American countries' experiences in the area of interconnection have been quite similar, and interconnection is included in most of the telecommunications laws or regulations as a mandatory process. Most countries (for example, Peru, Argentina, Chile and Brazil) have interconnection rules that deal with technical, economic and legal issues. One of the most notable exceptions is Mexico, where the rules for interconnection were published 15 years after the telecommunications law was enacted and have been legally challenged by practically all of the companies involved.

Interconnection allows the system to work seamlessly and is the main lever for the transfer of value between companies in the sector. The conditions governing interconnections determine the market structure and the degree of competition. In virtually all countries, operators are allowed to negotiate rates freely, and a cost-based methodology has been the preferred way to calculate rates, especially in cases of intervention by regulatory authorities. Since interconnection pricing and conditions are the most influential variables in terms of the proper operation of the system, it would have been more effective to determine them, insofar as possible, beforehand, which would have left fewer issues open to further negotiation and reduced the need for subsequent conflict resolution mechanisms. However, this has not been the case, and interconnection has been a highly contentious issue, not only in Latin America, but virtually the world over, and has proven to be the most formidable barrier to telecommunications development.

Packet transmission technologies and, more specifically, technologies based on Internet protocol, offer a unique opportunity for achieving a sound form of market development that focuses on social welfare. Innovative models for promoting investment and competition should be sought that will avert the numerous lawsuits that are currently hampering development.

This is the time to rethink interconnection. Current interconnections with standards based on time-division multiplexing which target and are tailored to circuit-switched networks are not properly aligned with the performance and economic aspects of packet-switched networks (Hirsch, 2010). New models should be considered with a view to determining the feasibility of arriving at a model equivalent to the peering arrangements existing among tier 1 networks on the Internet. For situations where the balance of costs and traffic is similar, it can be determined whether it makes sense to establish a "bill and keep" system, in which operators do not pay for interconnection; this is equivalent to paying in kind (an operator pays for the termination of its traffic on another

network with the termination of the traffic from the other network on its own network). It is also important to consider how these models affect the viability of low-use consumers, especially in the case of outbound traffic.

The efficiency of retail price structures for end users and the distribution of network costs depend on the kind of interconnection arrangement that is in place. There is no single model of efficient interconnection, as the choice depends on the context, but it is clear that the increased capabilities of next-generation networks will allow for a better ratio between wholesale and retail prices.

3. Process for granting licences, permits and concessions

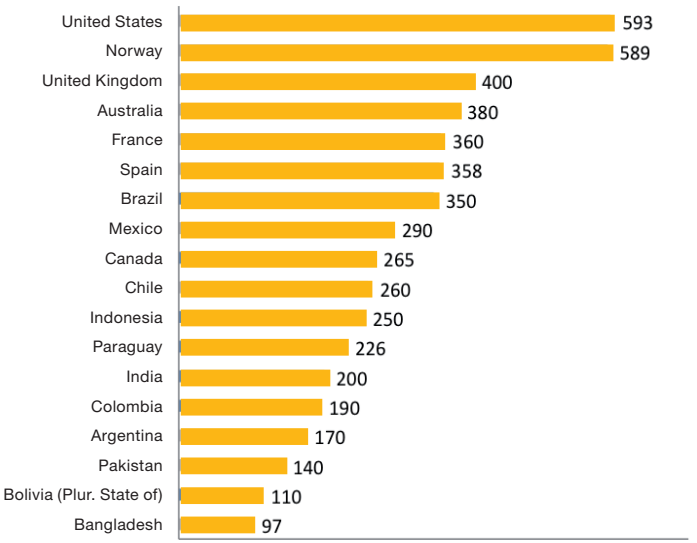
Several countries have launched a new generation of deregulation policies designed to promote convergence. This policies include a new licensing strategy that gives operators the freedom to offer all the services that their technology platforms enable them to provide. Within the region, Argentina, Peru, Guatemala and El Salvador are among the countries currently granting licences that allow operators to supply any telecommunications service that they wish to offer, thereby promoting greater competition.

However, these are isolated cases in the region. Many countries in the region continue to employ discretionary processes for granting licences or impose numerous restrictions and conditions. The most efficient strategy would be to grant licences or concessions on an objective basis and to do so swiftly, without introducing additional conditions or discriminatory tenders. During the bidding process, coverage and economic benefits should be taken into consideration.

4. Spectrum availability

Spectrum is the most indispensable resource for the provision of mobile broadband services. The way in which it is made available to the market —through auctions or mechanisms such as direct allocation— is the most important aspect of regulatory policy in terms of the development of the sector. Although regulatory institutions in Latin America are beginning to release more of the spectrum to mobile operators, the percentages involved are still quite small when compared to those of countries with more developed and competitive telecommunications sectors (see figure VI.10). The deployment of new generations of mobile services is limited by the amount of spectrum available.

Figure VI.10.
Spectrum available for mobile operators, 2010
(MHz)



Source: Cabello (2010)

A preliminary analysis of four Central American countries that are relatively similar in terms of the size of their economies and their levels of development points up a negative association between the amount of spectrum allocated, on the one hand, and prices and market concentration, on the other, as the more spectrum that is granted at auction, the lower prices and concentrations turn out to be (see table VI.2). El Salvador and Guatemala have auctioned off more spectrum and display better performances in terms of price and concentration. To obtain a robust result, an analysis covering more countries would have to be carried out over a longer period of time.

Table VI.2.
Average price of mobile broadband, allocated spectrum and market concentration, 2010

	Average fixed cost of a plan per day (US dollars)	Allocated spectrum (MHz)	Concentration (Herfindahl-Hirschman Index)
El Salvador	1,98	210	2686
Guatemala	2,50	172	3494
Panama	5,00	130	3747
Nicaragua	5,74	90	5333

Source: Prepared by the authors on the basis of DIRSI (2010), GlobalComms (2010) and Cabello (2010).

These preliminary results are consistent with the findings of other studies that show that the spectrum management policies implemented in El Salvador and Guatemala have generated benefits for consumers. El Salvador carried out a major reform process in 1996-1997 in which it recovered and reallocated frequency bands that were idle and allowed a more flexible use of the spectrum. These policies have resulted in an increase in the number of competitors and a significant decrease in prices, which has boosted the sector's efficiency (Hazlett, Ibarguen and Leighton, 2007). To date, El Salvador has five operators and one of the lowest levels of concentration (2686 as of 2009), as well as one of the highest levels of penetration (128.8% as of March 2010). However, the lack of scale and the low purchasing power of the population have slowed the mass deployment of mobile broadband networks, and the percentage of the total base of mobile telephony represented by mobile broadband users is the lowest of all (2.2% as of March 2010).[8]

Guatemala is one of the paradigmatic cases of a government allocation policy. The General Telecommunications Act of 1996 removed the regulatory constraints that had prevented operators from making extensive use of the available spectrum (Hazlett, Ibarguen and Leighton, 2007). Guatemalan law allows operators to apply for the blocks of spectrum that suit them before the bidding is opened, without the authorities intervening to assemble these blocks beforehand or to determine their use. The trade-offs between different uses are therefore managed by the licensees themselves, without regulatory intervention.

Guatemalan law revolutionized spectrum management policies, as it was developed along two innovative lines. First, it established that bands of spectrum were to be made available to those who applied for them for the purposes that the applicants themselves defined. It also established usufruct property rights, and operators could therefore modify the type of use that they made of their assigned radio spectrum over time. These rights include the ability to sell or lease the allocated spectrum for the benefit of others, which led to the development of an emerging secondary market for spectrum bands. These rights were institutionalized through the establishment of usufruct frequency titles.

Until a few years ago, Guatemala was the country with the highest largest amount of available spectrum in the region, but it has begun to lag behind since then (currently 192 MHz). However, the use of that spectrum is reflected in a

8 Apart from Cuba, where, as of 2010, these services were unavailable.

wider range of services, lower prices, faster deployment of mobile broadband services (proportionally, it is the fourth-largest user base in the region, after Argentina, Mexico and Paraguay) and significant gains in consumer surplus (Hazlett, Ibarguen and Leighton, 2007). One of the crucial factors in these polices is a change in the underlying axiom for the regulation of the sector whereby property rights are granted to portions of the spectrum.

The migration from analogue to digital terrestrial television gives rise to a major discontinuity in terms of the development of mobile telecommunications: the so-called "digital dividend".[9] In order to conduct a cost-benefit analysis of the use of this spectrum for mobile services or for radio broadcasting services, it becomes necessary to determine which of the two will generate more social welfare. Several studies (Value Partners, 2009; Analysis for ARCEP Mason, 2009) show that the optimal allocation of spectrum in terms of social well-being apportions the larger share to telecommunications services. Releasing the 700 MHz band, previously assigned to radio broadcasting services, would provide an additional 180 MHz. A calculation of social cost-benefits indicates that the social benefit of reallocating this spectrum would amount to between US$ 1.17 and US$ 1.23 per MHz per person (Muñoz, 2009). In another study, Hazlett and Muñoz (2009) found that an increased release of spectrum in the six largest markets in Latin America would result in significant social benefits, with an increase of 20 MHz resulting in direct benefits equivalent to about US$ 54 per capita.

GSMA, a private business association of mobile operators and other stakeholders (2009), also provides arguments for a greater allocation of spectrum to mobile technologies, given that the efficient use of GSM technology has significant effects on economic variables such as productivity, innovation, employment and competitiveness.

The digital dividend provides a valuable opportunity for achieving greater broadband coverage in the region. In Latin America, however, the situation has not yet been clearly resolved. The timetable for the so-called "analogue blackout" (the switching off of analogue television) continues to be extended (see table VI.3). The discussions have, in part, focused on the standard, but the important point is that transition dates are being put back by at least five years, which also delays the realization of the digital dividend.

[9] The "digital dividend" refers to the amount of spectrum that will be freed up in the switchover from analogue to digital terrestrial television. Digital television uses the spectrum six times more efficiently than analogue television does, which makes it possible to reassign spectrum to other services without compromising open television (European Union, 2010). See http://europa.eu/legislation_summaries/information_society/l24114_en.htm

Table VI.3.
Decision date regarding the standard for digital TV and the analogue blackout

Country	Decision date regarding the standard	Date set for the analogue blackout
Argentina	8/2009	2019
Bolivia (Plurinational State of)	5/2010	Undefined
Brazil	6/2006	2016 (but could be extended)
Chile	9/2009	2017
Colombia	8/2008	2017
Costa Rica	4/2010	2018
Ecuador	3/2010	Between 2016 and 2020
El Salvador	4/2009	2018
Mexico	7/2004	2015
Paraguay	6/2010	Undefined
Peru	2/2009	2023
Uruguay	8/2007	Undefined
Venezuela (Bolivarian Republic of)	9/2009	2019

Source: Regional Technical Telecommunications Commission for Central America (COMTELCA) and regulatory agencies in each of the countries.

In this context, three scenarios are possible. First, the band may not be reassigned, remaining under the control of the radio broadcasting industry; this would run counter to the interests of a proper form of management of spectrum and international trends. Second, the band could be assigned later on, but this approach significantly delays the possibility of seizing a unique opportunity to make a better use of a scarce State-owned resource and therefore incurs a high cost in terms of social welfare. Finally, it is possible and advisable to reassign the 700 MHz band without waiting for the "analogue blackout". This third scenario is feasible because the UHF band is barely used for radio broadcasting services in the region. For example, in Chile, only 7 of the 48 licenses available in the metropolitan area are in use. In Argentina, the band of 512 MHz to 806 MHz is hardly used. In Mexico, the 700 MHz band has only 11 television broadcasters, all in cities in states bordering the United States.

Therefore, unlike countries where the use of 700 MHz is subject to an orderly transition, the impact of reallocation in Latin America would be much smaller. There is no reason to postpone the use of this spectrum in the region; its reallocation should be one of the short-term priorities in most countries.

5. Infrastructure availability

The deployment of telecommunications infrastructure is one of the crucial elements for increasing competition among suppliers and generating higher service penetration. Appropriate legislation for encouraging competition, an abundant supply of radio spectrum and suitable interconnection agreements

are necessary to achieve greater efficiency in the sector. However, if the available infrastructure falls short of what is needed, these other measures will not be enough. The availability of modern communications networks at affordable prices is a determinant for the entry of new companies in local markets.

To address the infrastructure deficit, three levels of infrastructure must be considered: inter-urban transport networks (backbone), urban transport networks (backhaul) and local networks.

The presence of long-distance transport networks and their access to the Internet are essential in order to ensure the efficient provision of mobile broadband services at reasonable prices. Different countries have adopted different models, but all have focused on promoting competition and the duplication of infrastructure. Countries such as Australia, the Republic of Korea, South Africa and Mexico have taken this path. Brazil has opted for a mixture of the infrastructure provided by traditional carriers with an exchange of "universalization" obligations (obligatory backbone connections to take the place of the installation of public telephones, especially in smaller towns), the reactivation of Telebrás and an investment of US$ 8 billion to build open networks.

Very little attention has been devoted to the problem of urban transport networks in the region. In cities, there are several alternatives, but a lack of investment in this segment of the network, along with difficulties in obtaining *rights*-of-way, posts, *ducts* and conduits, is likely to generate a bottleneck in the short term. Policies should be directed towards promoting investment in this segment before these shortfalls come to represent serious constraints for the development of mobile broadband.

Finally, the availability of infrastructure in the "last mile" has been one of the most contentious issues of debate for over a decade now, with the controversy mainly focusing on the question of "local loop unbundling". In the case of mobile telephony, the debate has dealt with two main facets: the resellers of services (commonly referred to as mobile virtual network operators, or MVNOs) and the sharing of certain types of infrastructure (especially the towers).

Operators with large market shares do not view the possibility of operating as an MVNO as an attractive proposition and generally rule it out. However, for smaller operators, it is a way to make better use of their infrastructure without doing any great harm to their market share. For example, in Mexico this modality is offered by Movistar. Another example is Maxcom, a company that originally offered fixed services but that now offers integrated services (triple or quadruple play) using Telefónica´s mobile network to supplement its own network.

Sharing towers reduces investment costs as well as having a lower environmental impact. The introduction of this model has made slow progress in the region, but it is becoming an increasingly relevant option, as the ownership of the towers is of little strategic value and does not represent a sustainable competitive advantage once coverage is competitive. If this situation is not resolved by regulation, it will be determined by the market, which is, in fact, already beginning to do so.

E. Conclusions

This chapter has identified the opportunities and challenges involved in the development of mobile broadband in Latin America. In terms of opportunities, the outlook is optimistic; the potential benefits of mobile broadband are even greater than those afforded by fixed broadband, which have been identified in other chapters of this book. Access to the benefits of the Internet is likely to be democratized through the use of mobile devices.

However, progress along this path is not guaranteed. If headway is to be made in this direction, long-standing regulatory issues in Latin America will have to be addressed. Entry barriers to the sector have to be dismantled, starting with institutional barriers that lead to the design and implementation of non-transparent and inflexible policies which limit the adoption of new technologies and thus perpetuate the digital exclusion existing in the region. Mobile broadband technology offers promising opportunities for economic growth and social development throughout the region. However, the technology has no value in and of itself; if must be effectively deployed and adopted by the population. The role of the authorities is not to limit this opportunity but rather to serve as a transparent regulatory entity, to auction off spectrum, to promote social inclusion and investment, and to intervene only in cases of evident market failures.

Bibliography

Álvarez, C. (2008). *Derecho de las telecomunicaciones*, Miguel Ángel Porrúa, Mexico.

Analysis Mason, DotEco and Hogan & Hartson (2009). "Exploiting the digital dividend – a European Approach" Available online at: http://www.analysysmason.com/ec_digital_dividend_study

Barrantes, R. (2007). "Convergencia Tecnológica y Armonización Regulatoria en América Latina: Evolución Reciente y Tendencias: El caso de Perú." CEPAL – DIRSI, 2007.

Buttkereit, S., Enriquez, L., Grijpink, F., Moraje, S., Torfs, W., and T. Vaheri-Delmulle (2009). "Mobile Broadband for the Masses: Regulatory Levers to Make it Happen." McKinsey & Company.

Cabello, S. (2010) "Gestión del espectro: demanda y debate sobre sus usos alternativos" Ponencia presentada en Acorn Redecom 2010. Brazilia, Brazil. Available online at www.dirsi.net.

DIRSI (2007) "Oportunidades móviles: pobreza y telefonía móvil en América Latina y el Caribe". Available online at: http://dirsi.net/node/92.

Friedrich, R., Ward, J., Singh, M. and A. Lesser (2007). "The Mobile Broadband Opportunity in Emerging markets" Booz Allen Hamilton. Available online at www.boozallen.com

Galperin, H. y C. Ruzzier (2010). "Las tarifas de banda ancha en América Latina y el Caribe: Benchmarking y análisis" CEPAL-DIRSI, 2010.

Galperín, H. (2007). "Convergencia Tecnológica y Armonización Regulatoria en América Latina: Evolución Reciente y Tendencias: El caso de Argentina." CEPAL – DIRSI, 2007.

GSMA (2009). "Digital dividend for Mobile: Bringing broadband for all" GSMA. Available at: http://www.gsmworld.com/documents/dd_spectrumoverview.pdf

Hazzlet, T. y Muñoz, R. (2005). "A Welfare Analysis of Spectrum Allocation Policies" George Mason, Law and Economics Research Paper Nº 6- 28 ...

Hazlett, T., Ibarguen, G. and W. Leighton (2006). "Property Rights to Radio Spectrum in Guatemala and El Salvador: An Experiment in Liberalization" *George Mason Law & Economics Research Paper* No. 06-07. Available at: http://www.law.gmu.edu/faculty/papers/docs/06-07.pdf

Hirsch, C. (2010)."Oportunidades y riesgos en la migración a interconexiones IP" Unpublished.

International Telecommunications Union (ITU) (1995). "Interconnection Regulation Self-Learning Materials", BDT/Regulatory Reform Unit, 2003.

Katz, R.; Flores-Roux, E.; Mariscal, J. (2010). "The impact of taxation on the development of the Mobile broadband sector", GSMA and Telecom Advisory Services LCC.

Koutrompis, P. (2009). "The Economic Impact of Broadband on Growth: A simultaneous approach", *Telecommunications Policy*, Volume 33, Issue 9, October 2009, Pages 471-485.

Mariscal, J. (2007). "Convergencia Tecnológica y Armonización Regulatoria en América Latina: Evolución Reciente y Tendencias: El caso de México." CEPAL – DIRSI, 2007.

Mariscal, J., Ramírez, F. y Aldama, A. (2008). "Competencias en las Telecomunicaciones de México" Mimeo.

Muñoz, J. (2009). "Estimando el valor social de reasignar la banda de los 700MHz en Latinoamérica" Ponencia presentada en la XII Cumbre de Regulatel – Ahciet. Medellín, Colombia.

Nicolai, C. (2007). "Convergencia Tecnológica y Armonización Regulatoria en América Latina: Evolución Reciente y Tendencias: El caso de Brazil" CEPAL – DIRSI, 2007.

Qiang, C., Khalil, M., Dongier, P. (2009). "Information and Communication for Development" The World Bank, Washington, D.C.

Samarajiva, R. (2009). "How the developing world may participate in the global Internet. Economy: Innovation driven by competition" Report for Joint Workshop on "Policy coherence in the application of information and communication

technologies for development" organized by the Organization for Economic Cooperation and Development (OECD) and the Information for Development Program (infoDev), World Bank, 10-11 September 2009, Paris, France.

Spectrum and Value Partners (2008). "Getting the most out of the digital dividend. Allocating UHF spectrum to maximise the benefits for European society"

Unión Europea (2010). "Hacia una utilización óptima del dividendo digital" UE. Available at http://europa.eu/legislation_summaries/information_society/l24114_es.htm

Álvarez, C. (2008). *Derecho de las telecomunicaciones*, Miguel Ángel Porrúa, Mexico.

Analysis Mason, DotEco and Hogan & Hartson (2009). "Exploiting the digital dividend – a European Approach" Available at: http://www.analysysmason.com/ec_digital_dividend_study

Barrantes, R. (2007). "Convergencia Tecnológica y Armonización Regulatoria en América Latina: Evolución Reciente y Tendencias: El caso de Perú." CEPAL – DIRSI, 2007.

Buttkereit, S., Enriquez, L., Grijpink, F., Moraje, S., Torfs, W., and T. Vaheri-Delmulle (2009). "Mobile Broadband for the Masses: Regulatory Levers to Make it Happen." McKinsey & Company.

Cabello, S. (2010) "Gestión del espectro: demanda y debate sobre sus usos alternativos" Ponencia presentada en Acorn Redecom 2010. Brazilia, Brazil. Available online en www.dirsi.net.

DIRSI (2007) "Oportunidades móviles: pobreza y telefonía móvil en América Latina y el Caribe". Available online at: http://dirsi.net/node/92.

Friedrich, R., Ward, J., Singh, M. and A. Lesser (2007). "The Mobile Broadband Opportunity in Emerging markets" Booz Allen Hamilton. Available at www.boozallen.com

Galperin, H. y C. Ruzzier (2010). "Las tarifas de banda ancha en América Latina y el Caribe: Benchmarking y análisis" CEPAL-DIRSI, 2010.

Galperín, H. (2007). "Convergencia Tecnológica y Armonización Regulatoria en América Latina: Evolución Reciente y Tendencias: El caso de Argentina." CEPAL – DIRSI, 2007.

GSMA (2009). "Digital dividend for Mobile: Bringing broadband for all" GSMA. Available at: http://www.gsmworld.com/documents/dd_spectrumoverview.pdf

Hazzlet, T. y Muñoz, R. (2005). "A Welfare Analysis of Spectrum Allocation Policies" George Mason, Law and Economics Research Paper Nº 6- 28 ...

Hazlett, T., Ibarguen, G. and W. Leighton (2006). "Property Rights to Radio Spectrum in Guatemala and El Salvador: An Experiment in Liberalization" *George Mason Law & Economics Research Paper* No. 06-07. Available at: http://www.law.gmu.edu/faculty/papers/docs/06-07.pdf

Hirsch, C. (2010)."Oportunidades y riesgos en la migración a interconexiones IP" Unpublished.

International Telecommunications Union (ITU) (1995). "Interconnection Regulation Self-Learning Materials", BDT/Regulatory Reform Unit, 2003.

Katz, R.; Flores-Roux, E.; Mariscal, J. (2010). "The impact of taxation on the development of the Mobile broadband sector", GSMA and Telecom Advisory Services LCC.

Koutrompis, P. (2009). "The Economic Impact of Broadband on Growth: A simultaneous approach", *Telecommunications Policy*, Volume 33, Issue 9, October 2009, Pages 471-485.

Mariscal, J. (2007). "Convergencia Tecnológica y Armonización Regulatoria en América Latina: Evolución Reciente y Tendencias: El caso de México." CEPAL – DIRSI, 2007.

Mariscal, J., Ramírez, F. y Aldama, A. (2008). "Competencias en las Telecomunicaciones de México" Mimeo.

Muñoz, J. (2009). "Estimando el valor social de reasignar la banda de los 700MHz en Latinoamérica" Ponencia presentada en la XII Cumbre de Regulatel – Ahciet. Medellín, Colombia.

Nicolai, C. (2007). "Convergencia Tecnológica y Armonización Regulatoria en América Latina: Evolución Reciente y Tendencias: El caso de Brazil" CEPAL – DIRSI, 2007.

Qiang, C., Khalil, M., Dongier, P. (2009). "Information and Communication for Development" The World Bank, Washington, D.C.

Samarajiva, R. (2009). "How the developing world may participate in the global Internet. Economy: Innovation driven by competition" Report for Joint Workshop on "Policy coherence in the application of information and communication technologies for development" organized by the Organization for Economic Cooperation and Development (OECD) and the Information for Development Program (infoDev), World Bank, 10-11 September 2009, Paris, France.

Value Partners and Spectrum (2008). "Getting the most out of the digital dividend. Allocating UHF spectrum to maximise the benefits for European society"

European Union (2010). "Towards optimal use of the digital dividend" UE. Available at http://europa.eu/legislation_summaries/information_society/l24114_en.htm

Database

INEGI (2009). "Encuesta Nacional de Ingresos Gasto de los Hogares Mexicanos" INEGI 2009.

Internet World Stats (2010). "Internet Usage Statistics" Available at: http://www.internetworldstats.com

ITU (2010). "Free statistics" Available at: http://www.itu.int/ITU-D/ict/statistics/

GlobalComms (2010). "GlobalComms: All Regions" Available at: http://www.telegeography.com