

REGULATORY AND MARKET ENVIRONMENT

STUDY ON INTERNATIONAL
INTERNET CONNECTIVITY
Focus on Internet connectivity
in Latin America and the Caribbean



M A R C H 2 0 1 3
Telecommunication Development Sector



International Internet connectivity in Latin America and the Caribbean

March 2013



This study was prepared by Mr Oscar Messano. The content of this report was presented during the seminars and meetings of the regional groups of the ITU Study Group 3 for Africa (SG3RG-AFR) in May 2012 and for Latin America and the Caribbean (LAC SG3RG) in March 2012.



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Foreword

It is my pleasure to introduce this report on International Internet Connectivity (IIC) in Latin America and the Caribbean; this is part of a series of regional reports that address the present situation of Internet connection as well as future developments and challenges.

These reports have been developed through collaboration between the ITU Telecommunication Development Bureau (BDT) and the Telecommunication Standardization Bureau (TSB) with a view to supporting policy makers, national regulatory authorities and operators in understanding the many aspects of international Internet connectivity. This work also correlates well to the WTDC-10 regional initiatives related to the reduction of Internet access costs.

The digital revolution of the 21st century is being underpinned and in many cases driven by the growth, access and use of the Internet, but it has also led us to a modern indicator of division and poverty: exclusion from this revolution, from access to the Internet or telephone, and from the benefits of today's information society.

This report sets out concrete recommendations to enable conditions for healthy and dynamic competition in the market as well as for the reduction of the cost of Internet connection at the international level and proposes measures to encourage use of the Internet, and to promote development of local content especially in developing countries.

I hope that the results from this report will assist the ITU Membership in their efforts to address the issues surrounding Internet connectivity and ensure the continuing promotion of digital inclusion for all.



Brahima Sanou
Director
Telecommunication Development Bureau

Executive summary

The contents of this study focus on the key interconnection issues, both at national and international levels, the stakeholders and their characteristics. It also describes the role of Internet exchange points (IXPs) and network access point (NAPs) and their importance in the development of broadband, as well as the significant role of the backbones.

Interconnection is the cornerstone of the 'network of networks': the Internet. It can be considered to be the most important factor conditioning the growth of the Internet, since it affects all the services that are accessible therein.

The bandwidth is directly proportional to the capacity of the T1 first network operator level, and the cost of the Mb is an element that affects its use. In the existing model, the pure SME operators (Pure Internet Service Providers - pISPs - hereinafter), have very little bargaining power with respect to the T2 and T1 operators, and this drastically limits their growth and the development of services.

The study of broadband in the two regions has shown that there exists a concentration of Internet services. The incumbent telecommunication companies are those which usually concentrate the traffic in these regions. These companies handle close to 80 per cent of the interconnection market, and their tariffs make it difficult, if not impossible, for pISPs to compete.

The advantages of technology, the economic model of pISPs, and the development of broadband, spotlight IXPs and NAPs as the solution, not only for these two regions, but also for countries with similar problems.

There are also barriers arising from the regulatory context, such as lack of competition or unfair competition, in instances where there is poor regulation, or where regulation is not enforced.

It can also be noted that the deployment of broadband in the region is limited to large and medium urban centres. However, in some cases where regulatory policy and subsidies are implemented, then it can also become available in other areas.

The impact of cellphones is also discussed. The 5.6 billion existing units means that approximately 80 per cent of the population on our planet has a cellphone, and the study describes the success and limitations of the mobile Internet. Undoubtedly, mobile technology is ideal for voice communication and text messaging, but it is seemingly unsatisfactory when 3G cellular networks are employed for broadband access in LAC countries. It should be noted that in European countries this system works well.

There are certain instances where state bureaucracy and the lack of clear policies are important barriers to the deployment of new networks and the development of the Internet.

It is evident that corporate associations and non-governmental organizations (NGOs) are an important resource for supporting the development of the Internet in developing countries, contributing to the reduction of the digital divide.

Some of the other barriers to the development and access of Internet are highlighted, such as the lack of power supply, illiteracy, generation and cultural divides.

The issue of interconnection and transit, which runs across both of the regions covered in this study, and how it is affected by the installation of traffic exchange points (NAPs/IXPs) is examined. Special emphasis is used to describe the best practices that can ease the problems that have been exposed, taking into account regional differences.

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1 Introduction and objectives

The main objective of this study is to develop models of best practice that will help countries to significantly improve broadband penetration, with particular emphasis in marginal and rural areas. This study is based on the experience of countries from sub-Saharan Africa and Latin America and the Caribbean.

The models proposed in this study are based on diverse economic and technical experiences, as well as marketing models that are being developed and implemented in sub-Saharan Africa, and Latin America and the Caribbean.

Concerning the economic and technical analysis, the greatest barriers to obtaining results are economic. Some main questions are raised in this study:

- How can infrastructure be deployed in these regions, while at the same time providing affordable Internet access to all?
- How can the Internet be made available at affordable prices to low income users?
- How can the cost of International internet connectivity be lowered?

In both sub-Saharan Africa and Latin America, the development of the objectives outlined in this study face significant challenges. These two regions will be looked at, including: normal practices regarding Internet access, statistical comparisons on value and quality of services to end users, and how these correlate to developed countries.

The study will look at how the interconnection value chain is developed, at both national and international levels, an important factor in the development and deployment of networks.

The added value of the NAP (Network Access Point) or IXP (Internet Exchange Point), and how they influence the development of broadband penetration, content and improved quality of service to the end user will also be considered.

One of the most significant elements in the analysis of international interconnection is the use of a regional backbone that can keep data traffic within a certain region, instead of having it transit countries in another region or continent. The possible solutions to this mode of interconnection will be described. Can a regional backbone be created? Are traffic exchange points (IXPs/NAPs) part of the solution?

Solutions to problems of national and international interconnection will be proposed through regional best practice, including models that can be replicated in order to resolve interconnection and broadband deployment deficiencies.

2 IIC – Definition of international Internet connectivity

At the highest level, international Internet connectivity (IIC) is provided by those companies known as T1 (Tier 1), large operators of high capacity networks. Other operators connect to a Tier 1 backbone either directly, or through other companies. The T1 providers refer to each other as “peers”, a term which originated from the premise that outbound traffic was similar to inbound, as regards the Internet.

Few companies are defined as T1 operators, and this enables and facilitates the commercial agreements between them. They usually have global presence, or at least they operate in a number of different countries and/or continents.

With respect to submarine cables, these are often owned by consortiums of companies (some governments participate through national operators), and link capacity is often proportionate to the percentage of investment of each member of the consortium.

Cases can arise in which certain anchorage sites (this refers to the places where the submarine cable reaches land), enable the development of traffic exchange points (NAPs/IXPs), under the management of the cable operator.

2.1 Interconnection and IICs at a global level

Submarine cables have a leading role to play with regards to interconnection and traffic, as do land cables, be they copper or fibre optic, microwave systems, and satellite systems.

Intercontinental and international traffic are borne by the submarine cables, and from one country to another through shoreline anchors deployed in different parts of a country or interconnecting countries. Cables continue to be laid between countries following the coast, and anchored in various locations of the same country, or interconnecting countries.

Once the submarine cable reaches land, there are several potential variations of interconnection:

- a. The owner or consortium may have an operator designated for this function in the country where the submarine cable reached land. This may only involve negotiation of the technical and commercial aspects.
- b. The owner or company that is a member of the consortium has operations in this area, region or country therefore this cable interconnects and gets its own international connectivity. This can be repeated for each of the members, even if any of them was a governmental agency.
- c. The cable operator, one of the participants or the consortium as a whole, do not have operations in this area, region or country. Consequently it makes the capacity available to the market. Usually, the capacity is sold before the landing project is finished, ensuring financial returns immediately as from the launching date of the cable.
- d. Another mode is related to the provision of transit, it means a transparent connectivity to another point in the planet. This can include a number of different services including Internet. This doesn't affect the party that rents out the cable and enables these services, since it only provides transmission capacity.
- e. The operator, owner or consortium must contract transit from a local company, in order to connect its operating company for interconnection service.

In cases involving copper, fibre or microwave land networks, the interconnection conditions do not vary substantially. The commercial conditions will certainly vary in some important cases, as will be seen in this document.

Interconnection using satellite links do not have a significant role in international Internet connectivity in the two regions under discussion, due to the technology limitations and to the associated costs, which result in this type of link being used merely as a last alternative solution. However, satellite links are very important in other regions, in particular for Pacific Island nations.

2.2 National and international Internet interconnection

Tier 1 operators usually do not pay each other for transit services (allowing the use of a network to interconnect with another). The contractual conditions may include the costs for this service, but this should not be considered the norm since peer-to-peer contracts are not public, and there are a lot of specific agreements including peering, and also smaller operators.

T1 operators

The operators in Table 1 own submarine cables, in some cases also terrestrial cables, are present in ten countries or more, are active in the Latin America and Caribbean (LAC) region, and their main activity is provision of connectivity, transit and interconnection of other T1 operators who are their peers. All of them own submarine cables in the region.

Table 1: LAC T1 operators

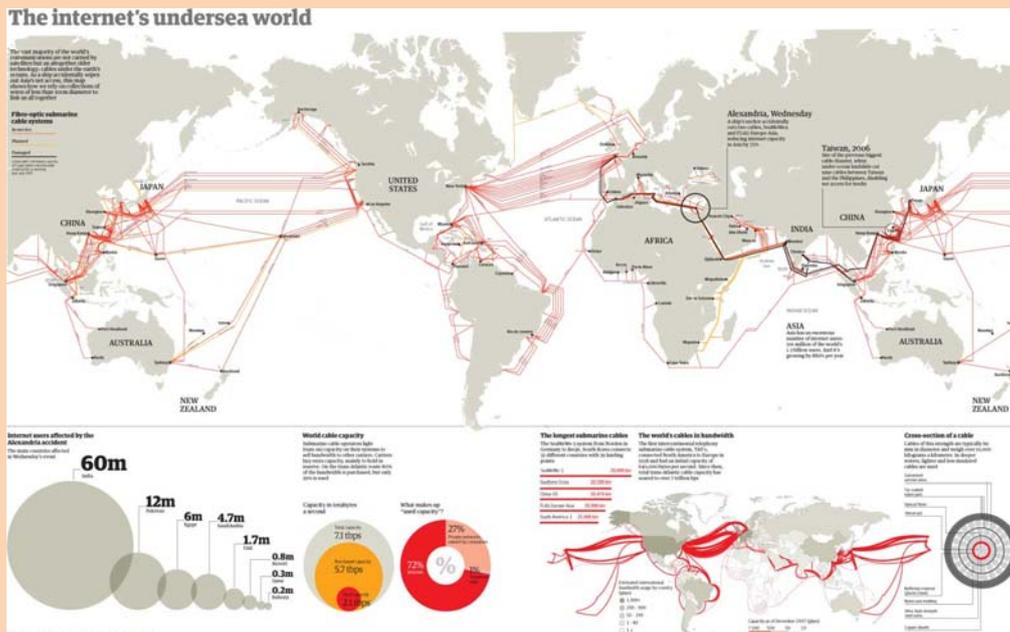
T1 Operators				
Alba1	Américas I	Américas II	Antel-Telecom	Atlantis
Cable & Wireless	Columbus Networks	GCN	Global Crossing	Globenet
GT&T y Telesur	Internexa	LA Nautilus	Maya Networks	Panamericano
San Andrés	Tiws	Unisur		

Submarine cables

The submarine cable network is extensive and covers the whole planet (see Figure 1). In recent years there have been few new projects, the most recent being the laying of the submarine cable between Venezuela and Cuba, between Uruguay and Argentina, the Dominican Republic, Jamaica and the Virgin Islands. The reasons for the low investment in technology are varied, such as existing cables with idle capacity, the high investment for new cable, and the extended duration of projects.

But this is changing, and elements of this change include multimedia services, network videos, and principally digital television, which are exponentially increasing the use of broadband in the networks, and this includes the submarine cables. Other elements concern the obsolescence of existing technology, the latest technology notably increasing the capacity of fibre, and the transmission and reception time (latency), which is vital to the Internet and to interactive Digital TV.

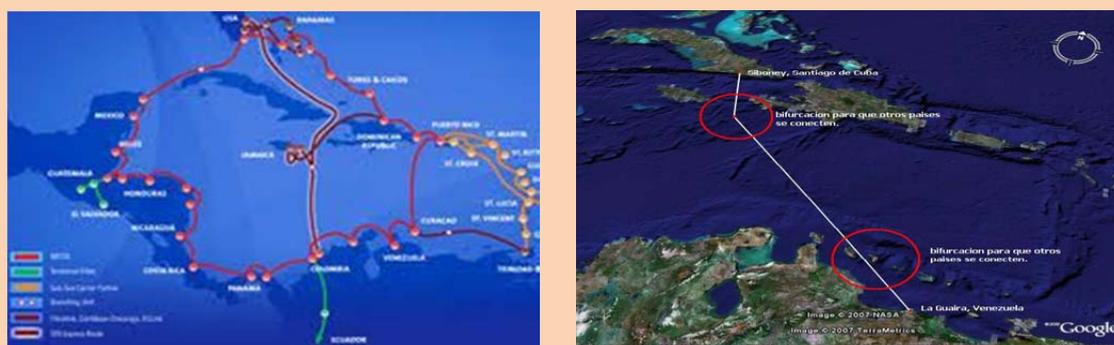
Figure 1: The Internet's undersea world¹



Source: Telegeography

¹ The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by ITU.

Figure 2: Existing cables: Venezuela – Cuba (left) and the Dominican Republic –Jamaica – Virgin Islands (right) (2010)



Source: Noticiassim

T2 Operators

T2 operators are those who operate national networks – within a country. Sometimes T1 operators also do so, and as providers of interconnection they provide national transit and even act as ISPs providing the final link in the connectivity chain. This can be seen with telephone companies who provide value added services to the end user (act as an ISP). Aside from these exceptions, the usual function of a T2 is to provide transit between the T1s and the ISPs.

Table 2: Examples of T2 operators

T2 Operators				
Ampath	AT&T	Auris	Br Telecom	Centenial
Clara	Columbus	BT	Cybernet	Digicel
Entel	Esnet	GBLX	GBnrt	Gilat
Global Carib	Grant	IFX	Internap	Internet 2
Level 3	Metrored	Navega Newcom	NTT	Orange
FT	Savis	Seabone	Sprint	TATA
Techtel	Telecom	Telesiwch	Telga	Terramark
Tnet	Twis	Verison	OX	

ISPs

Internet Service Providers (ISPs) have a direct relationship with the end user, and aside from connectivity or Internet access, provide different types of services, for example: electronic mail, access to content, etc. The ISPs mentioned in each case and country, cover between 83 per cent and 99 per cent of the market. Those with significant market share are in many cases T1 operators. In each country there is normally a large number of ISPs operated by SMEs. For example, in Brazil it is estimated that some 4 000 SMEs offer ISP services, and in Argentina there are 1 800. Usually these companies have a low market penetration as far as number of users is concerned.

ISPs can be put into two large categories (see Table 3):

- a those that perform their activities in high density population areas, and handle important market shares in their area of influence, and
- b those that cover the activities of the SMEs in the outskirts of large cities and/or small population centres in rural areas, which must pay high tariffs for connectivity and transit, acting as a barrier to growth of the small operators.

Landline broadband ISP operators

The market of broadband access to the Internet in Latin America is distributed between ten large operators. This market concentrates approximately 36 million users. The table below describe the market share in Latin American countries by operator.

Table 3: ISP categories

Argentina	Company	% of market	Bolivia	Company	% of market
	Arnet	30.3%		AXS	15.2
	Claro	0.9%		Comteco	22.5
	Fibertel	25.3%		Cotas Net	39.04
	Speedy	31.4%		Entel	20.0

Brasil	Company	% of market	Chile	Company	% of market
	GVT	8.7		Telefónica del Sur	5.0
	Net Virtua	25.9		Claro	7.5
	OI Velox	30.5		VTR	37.4
	Speedy	22.9		Movistar	44.2

Colombia	Company	% of market	Costa Rica	Company	% of market
	ETB	19.0		ICE	66.5
	Telefónica-Telecom	19.0		Racsa	33.5
	Telmex	23.0			
	UNE-EPM	25.0			

Cuba	Company	% of market	Ecuador	Company	% of market
	Etexsa	100.0		Claro	9.4
				C.N. Telecomunicaciones	51.1
				Grupo TV Cable	29.2

El salvador	Company	% of market	Guatemala	Company	% of market
	Claro	63.9		Claro	79.7
	Integra	7.5		Cybernet	4.6
	Tigo	26.1		Futura Network	4.1

Honduras	Company	% of market
	Cablecolor	13.0
	Claro	32.2
	Navega	30.6
	Sulanet	17.1
	Tigo	2.6

Jamaica	Company	% of market
	Cable&Wireless	65.9
	Flow	29.5

México	Company	% of market
	Axtel	3.3
	Cablemas	3.0
	Cablevisión	2.9
	Infinitem	68.9
	Megared	5.2

Panamá	Company	% of market
	Cable Onda	38.1
	Freedom	55.0

Nicaragua	Company	% of market
	Claro	92.5
	Icable	4.4

Perú	Company	% of market
	Claro	4.8
	Movistar	94.0

República Dominicana	Company	% of market
	Claro	78.2
	Onemax	3.2
	Tricom	17.1

Trinidad y Tobago	Company	% of market
	Flow	21.8
	TSTT	69.9

Uruguay	Company	% of market
	Antel	96.1
	Dedicado	3.8

Venezuela	Company	% of market
	ABA	82.1
	Inter	13.4
	Súper Cable	1.8

3 Broadband services on wireless networks (WiFi² or others)

The wireless transmission technology (Wi-Fi) enables connectivity in places where the “last mile” or the capillarity of the existing network is low or null. Although the wireless coverage is low, and its characteristics depend on the band it is operating on, the 2.4 Ghz transmission frequency (with a 45 meter high antenna) can achieve a coverage of some 8 km circumference. If however the 5.8 Ghz

² Wi-Fi is a commercial brand name registered by the Wi-Fi Alliance. This entity certifies that products conform to certain interoperability norms. The absence of this logo does not necessarily mean lack of compatibility with those products that bear it.

frequency is used and with a similar antenna, a coverage of some 3 km circumference is achieved, but the users will enjoy greater bandwidth.

Wi-Fi is an important tool to address the needs of low density population sites, and in other instances it acts as a supplement to, or competes with, the incumbent operator who, in the end, furnishes the necessary bandwidth that enables the Wi-Fi operator to provide his services. It must also be noted that the employment of Wi-Fi does not require a band usage licence, and this is an advantage to small and medium ISPs, who are not obliged to pay the regulator for use of the band. It is estimated that there are more than 500 million users worldwide served by this technology.



There are other wireless technologies such as WiMAX, microwave, satellite links, and cellphones.

WiMAX

WiMAX (Worldwide Interoperability for Microwave Access) is the fixed wireless standard IEEE 802.16 that allows for long-range wireless communication at 70 Mbit/s over 50 kilometres. It can be used as a backbone Internet connection to rural areas.

Its use enables a solution for the deployment of the so called 'last mile', since its coverage area is much larger than that of Wi-Fi, although the costs are higher both in equipment such as the installation of antennae. But this is compensated by a better performance.

Microwave

Microwave is used specifically for point-to-point links, and can be a solution to reach places without connectivity, with a medium range investment. Compared to Wi-Fi and WiMAX, its reach can vary between 24 and 28 km, depending on the equipment and the geographic characteristics. It enables a large amount of communications channels with minimum latency, among other features.

Satellites

Satellite is an expensive solution, even though the cost of the antennae has diminished notably over time, as well as with the additional devices required, such as the modem or satellite PCI card (DVB-S), the receiver of signals coming from LNB satellites, feeder or wireless, and the modem for access to the Internet connection.

The satellites used in telecommunications are geo-stationery, which means that the satellite remains stationary with regards to the surface of the Earth, at a distance of 36 000 km. Within this technology there are various transmission bands with advantages and disadvantages (depending on each case).

L Band

- Frequency range: 1.53-2.7 GHz.
- These wavelengths can penetrate terrestrial structures and require less powerful transmitters.
- Low data transmission capacity.

Ku Band

- Reception frequency ranges 11.7-12.7 GHz, and in transmission 14-17.8 GHz.
- The medium wavelengths penetrate most of the obstacles and transport a large volume of data.
- Most of the bands are assigned.

Ka Band

- Frequency range: 18-31 GHz.
- Spectrum for assignments available. The wave lengths transport large data volumes.
- Very potent transmitters required, and they are sensitive to environmental interferences.

C Band

- Frequency range: 3.4-6.4 GHz.
- Less susceptible to climatic effects such as rain compared to Ku and Ka Bands.
- Equipment costs are higher than Ku Band.
- The cost of bandwidth is still high, and to this must be added the logical latency time due to the effect of sending the radio signal 36 000 km to the satellite and receiving the downward signal another 36 000 km from the satellite. This has an important effect on Internet surfing but remains a valid option in the absence of other solutions.

Cellphone

The cellphone network is an option for access to bandwidth. There are different options for bandwidth access using a cellphone, one of them involves using the device as a data modem, the other is the use of a modem such as a USB (Universal Serial Bus) or pendrive (USB flash drive). This technology uses 3G band and has certain difficulties (see section 4).

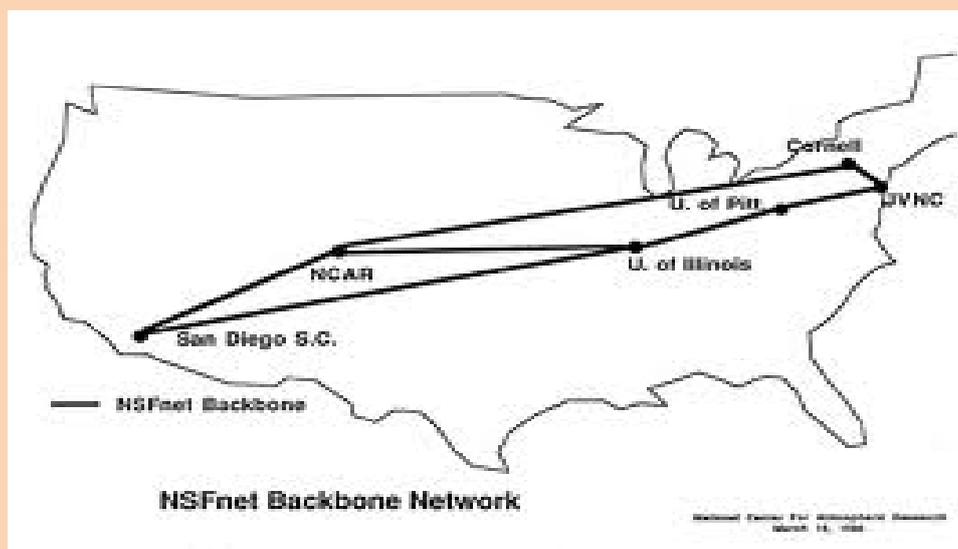
Backbone

Backbones are an important element of interconnection. Backbone refers to the interconnection of different geographic points, with certain architecture, usually known as a ring (not so much in reference to its geometric shape, but rather to capture the meaning of completing a 'circle' of connections). This architecture enables the connectivity security of the connected points to be high, since if any link between two points of the interconnection is severed, the interconnection would remain in service via another route in the ring.

Figure 3 shows part of the backbone of the United States National Science Foundation (NSF). The interconnection points are closed in a ring, not by the geometric shape but by the name given to data networks in this type of interconnection, where the traffic can go in two directions to reach the same point. If the San Diego/NCAR link is severed in San Diego, the traffic could continue to flow routed through the University of Illinois. In this backbone example, there is also a central link which improves the backbone and makes it safer.

In section 4, the strategic importance of interconnection, the NAPs and the backbones, and the deployment of bandwidth in the region are developed.

Figure 3: The National Science Foundation backbone



Source: National Science Foundation

4 The economic model of interconnection and broadband

The Internet business is based on a value chain consisting firstly of the end users: households, usually two or more users of the service in a household, although only one of them pays for the services; the small and medium enterprises (SMEs), again one account with several users; and finally corporations, one account and hundreds of users. Naturally the costs of these segments of users differ.

Next are the Internet Service Providers (ISPs), and these are companies dedicated to provide access to the Internet as their core business. The access to home or business can be achieved in different ways, but today it is mostly by means of broadband, which implies a permanent connection which is not dependent on a phone dialup call.

There are a variety of ISPs that can be catalogued by:

- market they cover;
- type of company;
- geographic deployment.

This can be subdivided into:

- local;
- regional in-country;
- regional - international.

Some ISPs may be included in the segment of those denominated as T1 or T2, and others are pure ISPs (pISPs).

The modes of interconnection between an ISP and the user may differ:

- One option is by means of a copper pair, which normally is the same as that used for fixed telephony. In such cases the most-frequently used technology is ADSL and its variants.
- Another option is by the provider of cable TV service, which uses the same network to offer Internet access, and some companies also offer telephony as part of the same service.
- Finally, wireless service providers using Wi-Fi services. This is done by means of a transmission node, and the provision and installation of a receiver known as an “access point”, installed on the customer’s premises.

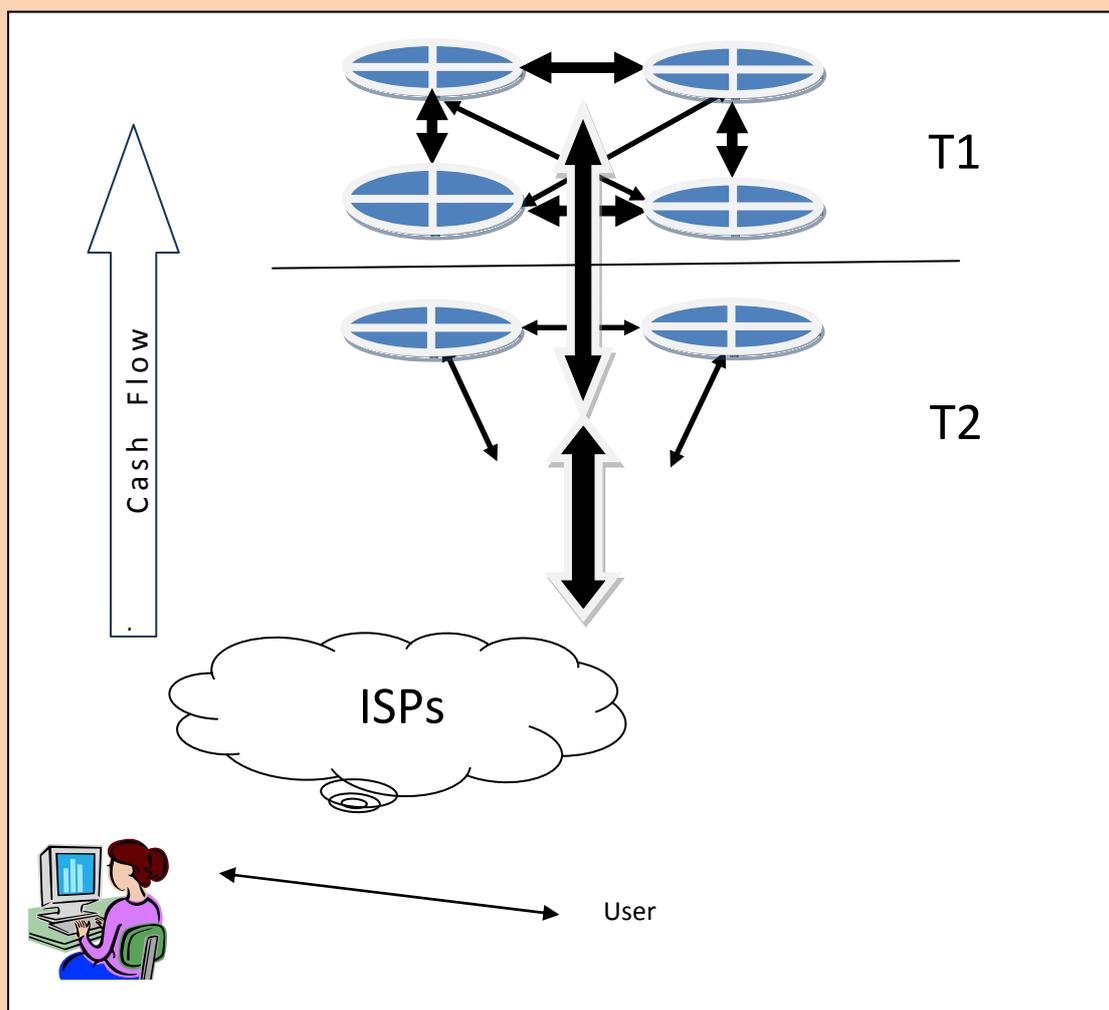
When a pISP, is involved then it must contract interconnection, transit and last mile facilities, and this can all be part of one package of services, (in this instance, the last mile refers to the interconnection from its node, data-centre or any other denomination), as far as the T2, or by means of a T2 or T1.

If the ISP has any sort of network deployed with the users, it will use it to reach them. Usually this is accomplished by means of Wi-Fi, otherwise it will also need to contract this service, and this is usually done with the same provider that enables access to the interconnection.

T2s, which are carriers and own proprietary networks, have the capillarity to reach the end user. Normally the T2s also fulfil the roles of ISPs and consequently, aside from enabling the interconnection of other ISPs, they compete with them for the business of the end users. With regards to international connectivity, the T2s reach agreements with the T1s for the access and transit of international traffic.

Finally the T1s, which own the submarine cables as well as the backbone land networks. The interconnection between them is cost free as it is amongst peers, and it is assumed the inbound traffic will be balanced by the outgoing thus resulting in a neutral balance. The diagram in Figure 4 graphically describes what has been defined.

Figure 4: Internet business value chain



Source: ITU

4.1 Generalities of the market

In those places that have high population density, the competition for market share is usually between the large operators as can be seen in Table 4. The price to the end user is normally on a downward curve due to this competition, and in some cities there is more than one large operator. A pISP, or an ISP that does not have a very extensive network can, due to the fact that it has a smaller structure and costs which are low enough, compete in price and service with the larger operators.

Away from the urban centres, access to the Internet and thus to broadband begins to be complicated for the user. In order to expand this concept see below a table from a study on broadband penetration which, although in some cases presented data from 2009 and in others from 2010, and as these figures have changed due to logical growth since then, nonetheless reflects a situation that still prevails.

Table 4: Broadband penetration: competition for market share

Countries	National penetration	Main Cities/areas	Local penetration average	Main Cities/areas	Local penetration average
Argentina June 2009	9.30%	Capital Federal San Luis Meuquen	46.20% 12.90% 11.50%	Mendoza Córdoba Santa fe Jujuy	6.90% 5.20% 3.70% 0.20%
Brazil December 2009	6.00%	San Paulo Sur Sudeste Centro Oeste	11.40% 7.00% 6.30% 6.10%	Norte Nordeste	3.50% 1.40%
Colombia June 2009	4.70%	Bogotá Antioquia Boyacá	12.30% 6.40% 5.905%	Eje cafetero Cundinamarca Valle-Choco- Nariño	4.10% 3.30% 2.20%
Chile March 2010	9.90%	Región de Antofagasta Región Metropolitana Región de Valparaíso	13.70% 12.90% 10.70%	Region of Atacama Region de Bio Bio Reg. of Lib. O'higgins Region of Maule	8.10% 7.70%& 5.30% 4.30% 4.30%
Perú December 2010	2.90%	Lima Arequipa Tacna	6.20% 3.50% 3.50%	La Libertad Ica Moquegua Lambayeque	2.7% 2.30% 2.10% 2.10%

The solutions to the issue of broadband penetration vary according to the place and the country involved, but in general companies that have activities in the region include:

- Cable TV companies that offer cable TV and add access to the Internet over the same network.
- Telephone Cooperatives that provide service where the incumbents do not, and who have also added access to the Internet to the services they offer.
- pISPs which develop the service mostly using wireless technology (Wi-Fi).
- The incumbents also have activities in many of these places, but charge prices that are very different from those charged in high density population centres, where they are much lower.

Where do these ISPs obtain connectivity and interconnection? Usually they are customers of the carriers in those places where these have presence. In any case, the commercial agreements could not be advantageous for the pISPs due to the high prices they must pay per megabit. This is the reason why the pISPs, and other actors described, contract insufficient bandwidth. Usually in these cases there are no options when it comes to selecting who shall be the provider of interconnection and transit.

The cost per megabit, which is the raw material in the business of providing access to the Internet, and thus the cost base which will define the tariff the end user will have to pay, is strategic in the business management of these pISPs.

Also, the high price of this factor (the megabit) will directly influence the quality of the service, as the pISP will try to distribute each megabit between the largest quantity possible of end users, and thus achieve an economic equation that enables its business to be profitable. This will directly affect the quality of the service that is offered.

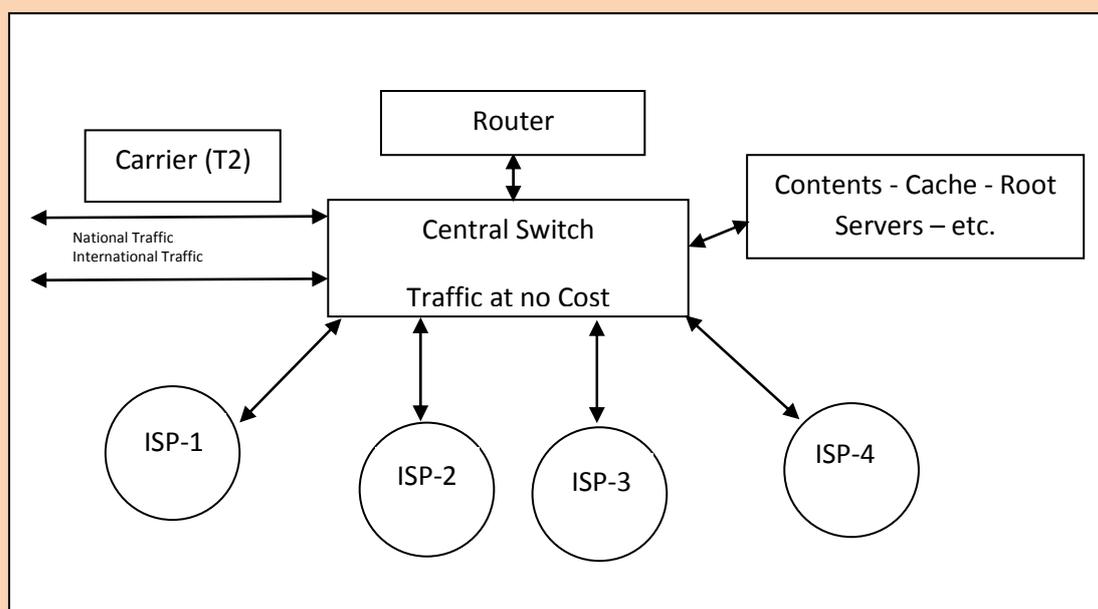
Can the pISP buy more megabits in order to improve the service? No, this would not be possible, since in this case its costs would increase and it would be unable to compete with the other operators in the area. It could only increase the bandwidth if the market in which it does business offers opportunities to obtain more users.

These economic conditions restrict the narrowing of the digital divide in these zones, and the development is slow since the incumbents are not interested in investing in areas that are not profitable, nor in improving the economic conditions of the contracts with the pISPs.

One of the solutions available in some instances is the national access points (NAPs) (also referred to as Internet Exchange Points – IXPs). When a NAP is available, the effects become drastically evident.

The typical model of a NAP is described in Figure 5:

Figure 5: National access point (NAP)



Source: ITU

The diagram represents a NAP where:

- In this case four pISPs. The more pISPs concentrated in one NAP, the better the economic equation. In the cooperative model the general expenses of the NAP are shared proportionately by means of a series of pre-established parameters. For example, considering the bandwidth to the switch port, since a 100 megabit port does not cost the same as 1 gigabit port. The general services, such as UPS, security, man hours, etc., are common to all members of the NAP.
- These four pISPs connected to the switch interchange traffic between themselves at no cost, except for the general costs as has been described. Consequently all the traffic generated by proprietary applications of these pISPs, such as the users' mails of each ISP, remain within the NAP traffic, as well as the services each one can offer on the Internet, for example the webpages hosted by any of the pISPs.
- The national traffic, or in other words that which allows connection to other NAPs, or pISPs, and lastly the international traffic or Internet, which in this model has a significant reduction due to the previous options.

- Finally, the joint leasing of bandwidth achieves a considerable reduction of the cost per megabit. In the example given, it would be perfectly feasible that the joint leasing would be approximately 300 megabits, while each one separately would be significantly less, and this joint contracting results in a reduction of the cost of interconnection due to the lower volume of leasing. The carrier or T2 operator economizes infrastructure by having only one point of interconnection, and finally and most importantly, the end user will benefit from a better standard of quality almost immediately, and later with a lower price for their subscriptions.

There are other effects that result from the creation of NAPS:

- The resolution of the DNS (Domain Name System) involves routers known as Root Servers distributed worldwide.

These are used to resolve the address of the computer where a specific domain name is logged, for example www.itu.int. There is a worldwide system that resolves the address of the computer that hosts that webpage.

Several NAPS within the region have installed mirrors (duplicates) of these Root Servers with two main objectives: reduce the search time, and increase the security of the Internet as a whole.

- Another side benefit involves Caches. The content providers use this technology to improve access to their content and also reduce the use of international interconnection. The most familiar example is “You Tube”. To get an idea of the magnitude of this application, 24 hours of video are added to You Tube every minute, as reported by the company itself.

The occupancy of bandwidth to send and access this significant amount of information is one of the nightmares of the information sent/received, and the cheaper option involves a fixed limited amount of incumbent companies and T1 operators, and is the core issue of the so called “Net Neutrality” discussion.

When a cache is installed, as is shown in the diagram of this example of a NAP (Figure 5), for example the Ecuador NAPs, since the NAPs network of this country, and hence all the network users, these users have access to the content in local mode (Cache), without using international bandwidth. The cost-savings that come with this are significant.

Finally, and by way of a summary, it has been demonstrated that the installation of NAPs brings benefits such as:

- an increase in the geographical area of Internet service provision (improved capillarity);
- reduction of the cost of bandwidth for the providers, in some cases a very important one;
- an increase in the quality of service provided;
- the possibility of providing broadband to locations which are far from urban centres;
- the development of SMEs in this sector.

Cellphones

Finally, connectivity by means of cellphones is mentioned. As already noted, the interconnection by means of cellular equipment or USB modems is an available technology.

This mode uses a technology known as 3G or third generation, and which enables voice, mobile internet, video calls and mobile TV.

At present, the use of a cellphone as a data access device is a very expensive method. On the one hand, the cellphones that enable this mode are high cost devices, secondly the cost of sending and receiving data is also expensive, and more so if roaming is being used, (i.e. the cellphone is used for this purpose when connecting to other networks, often the case when travelling abroad).

In the case of USB modems, the devices are low cost and sometimes are even free with the subscription to the data transmission service. This subscription usually offers a flat rate which involves paying a monthly fee with unlimited information exchange.

This technology could be an alternative for the deployment of broadband but, in high density population areas, even though access cells are numerous, the network usage for voice and text messaging ensure these cells operate at maximum capacity, which leaves little bandwidth available for data. This is detrimental to the use of USB modems, which upon being connected only access very limited bandwidth.

In areas of low density population, cells are scarce, resulting in the same limited bandwidth availability.

It is expected that the advent of 4G or fourth generation, which is estimated to be available in some countries within the region by mid-2012, will constitute an additional resource for the development of the mobile Internet, because 4G is based on IP (Internet Protocol), and could provide up to 100 Mbit/s for mobile communications and up to 1 Gbit/s for static mode communications. The future will determine whether the 4G economic model for data will contribute to reducing the digital divide.

4.2 Conclusions and challenges of the economic model

In summary, conclusions about the economic model for the interconnection and access to broadband, and since this is the basic resource of the 'Network of Networks', concern the economic model of the Internet itself.

The user whether home or corporate, and who is the last link in the commercial chain, pays different tariffs according to rules that are almost identical in the region.

- For those who reside in high density demographic areas, large or medium cities, and in which there is also competition between the service providers (although the market is shared by very few of them), the users benefit from reasonably low tariffs, as well as having the possibility of accessing more services such as, for example, Triple Play, a service which combines Internet, telephony and television.

Although penetration is larger in these areas, it is still far from reaching a percentage that can demonstrate that the digital divide has been significantly reduced, particularly if compared with countries in Europe and Asia.

- In locations with lower density populations, a strong increase in the access tariff is evident. This is a smaller market and mostly lacks competition. In some cases the presence of a pISP can somewhat improve the greater cost of Internet access. In some countries of the region, the Cooperatives are part of the solution.
- Finally, in rural areas, the situation is more complicated since the incumbent or large companies have no interest in this segment. The service is usually provided by small pISPs or medium companies and involves wireless systems. The costs for this sector are higher due to the greater cost of the equipment. The service provider must contract bandwidth from the incumbent in the zone, paying a high premium for each megabit leased. If the solution were satellite, this would add more cost to the service. If the most disenfranchised users were to be ranked with regards to access to broadband, this sector would certainly be in first place.

The providers of the Internet's basic resource – broadband – have been classified and their roles, as well as the markets they perform in, have been defined. So, what are the economic challenges for each sector?

- Carriers not included in the ten companies with major market presence. In this case this would depend on the layout of their networks. If these provide connectivity to places where the incumbents and large companies have no presence, they may be able to negotiate reasonable contracts, since they can also become a solution to the needs of these corporations. If on the contrary, their networks are in geographic competition, then each bit versus each dollar will be negotiated, and usually these costs will be higher than in the previous example.

It must be clearly understood that these costs will be directly reflected in the network access charges that the end user will pay.

- The Cable TV operators in the rural locations have different development levels in the region. They have the advantage of owning their own network and usually provide broadband. This enables them to have captive users – the Cable TV subscribers – and available bandwidth in their own network. Even though the negotiation for access to the Internet with the interconnection and transit corporations will not be easy, they have negotiation tools that can obtain better costs than other participants, especially pISPs.
- Finally the pISPs are small and medium enterprises that usually conduct their business in the small and medium marginal areas in rural areas. The negotiation of interconnection for this sector is much harder, since the difference in size of their companies is the main obstacle to secure reasonable rates for leasing bandwidth, the truth is that, without this sector the important digital divide in the region would be even wider.

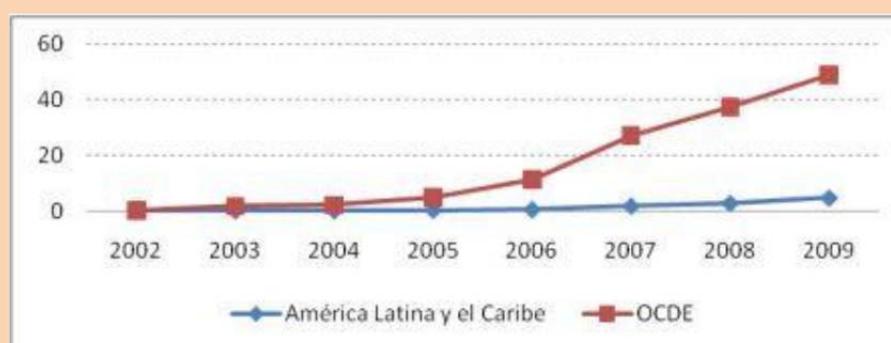
This is a general overview of the economic challenges of interconnection and development of broadband, their actors and how the end user must endure the difficulties of the model. The diagnostic and possible solution of this problem, based on best practices, will be explored next.

5 LAC country broadband access comparison

This section compares Latin America and the Caribbean (LAC) country data on the cost of access to broadband with other country data. In November 2010, the Latin America and Caribbean Economic Commission (CEPAL) decided to set up a Broadband Observatory, known as “ORBA”, and which was launched in May 2011. Some of the data this Observatory has produced will be used in this comparison.

The number of mobile broadband subscribers, as a percentage of the total population of Latin America and the Caribbean, increased from 0.2 per cent in 2005, to 4.7 per cent in 2009, while in OECD countries this percentage went from 5 per cent to 49 per cent over the same period (Figure 6).

Figure 6: Mobile broadband subscribers as a percentage of LAC population, 2002-2009

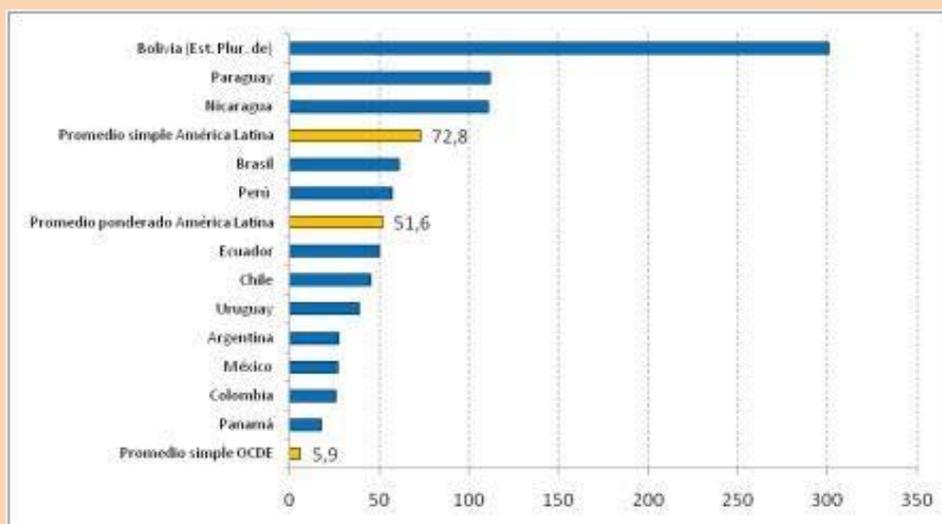


Source: OECD

Figure 7 reflects the cost of broadband in LAC countries in up to March 2011, showing an average cost of USD 72.8 dollars per Mbit/s, in contrast to the USD 5.9 per Mbit/s for OECD countries. This is a huge difference.

Bolivia tops the list, where the tariff measured against the Purchasing Power Parity (PPP), amounts to USD 300 dollars per Mbit/s. Panama ends the list, with a cost of USD 17.7 dollars per Mbit/s. This must be compared to the OECD average of USD 5.9 per Mbit/s.

Figure 7: Fixed broadband tariffs (USD/PPP per Mbit/s) 2011

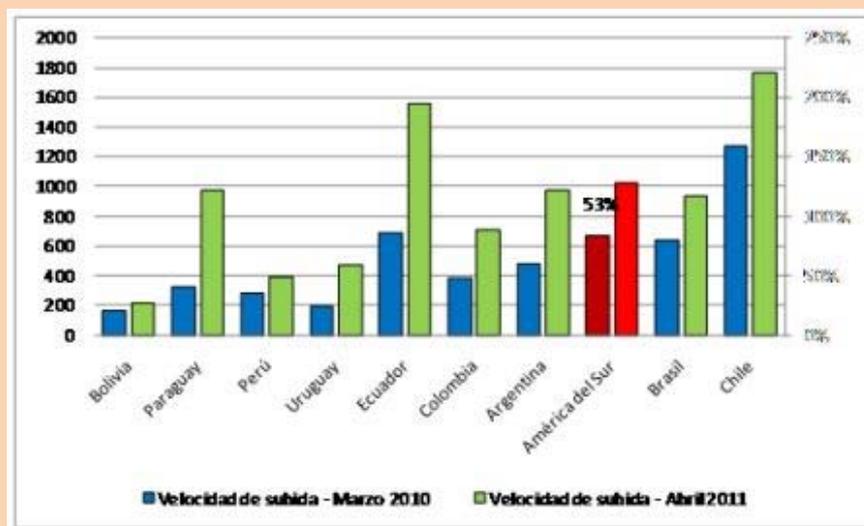


Source: CEPAL

Another of the measurements traditionally employed to measure the quality of broadband service is speed. The Observatory figures show that during the last year South America had an effective speed increase of 53 per cent in access to Internet broadband, both in the up and down links.

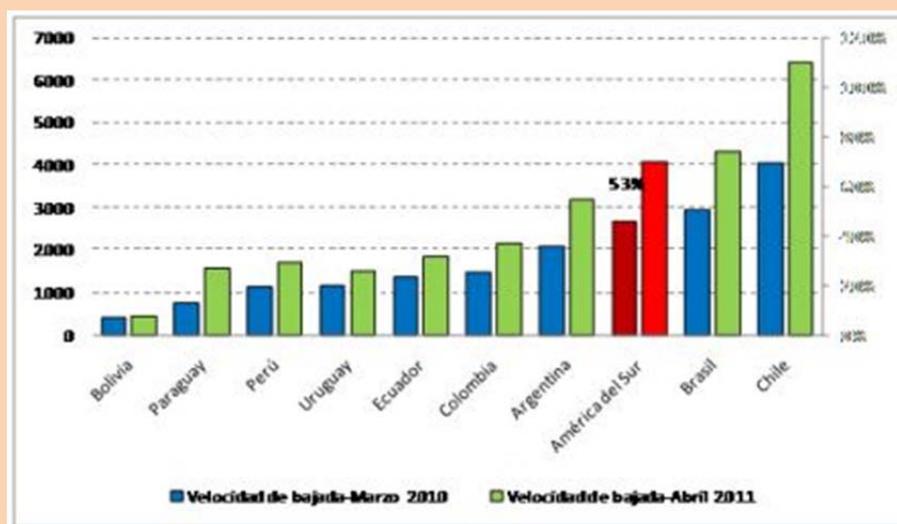
Chile is the outstanding case, where the uplink speed in April reached 1 767 Mbit/s, (39 per cent more than in April 2010), and the downlink reached 6 413 Mbit/s. In Bolivia the uplink speed was 210 Mbit/s, and the downlink was 428 Mbit/s (the lowest indicators in the region).

Figure 8: Evolution of broadband uplink/downlink speeds



Source: CEPAL

Figure 8: Evolution of broadband uplink/downlink speeds (*continuation*)



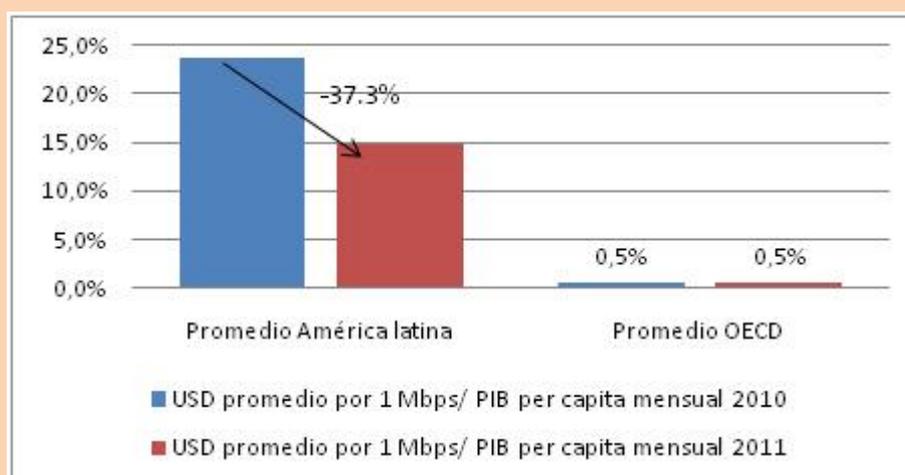
Source: CEPAL

5.1 Evolution of broadband downlink speed

According to the data produced by ORBA, between April 2010 and April 2011, there was a significant increase in access to fixed broadband services in the region, since the monthly income required for subscribing to 1 Mbit/s, was reduced throughout Latin America by a little over 37 per cent.

Ratio of fixed broadband tariff

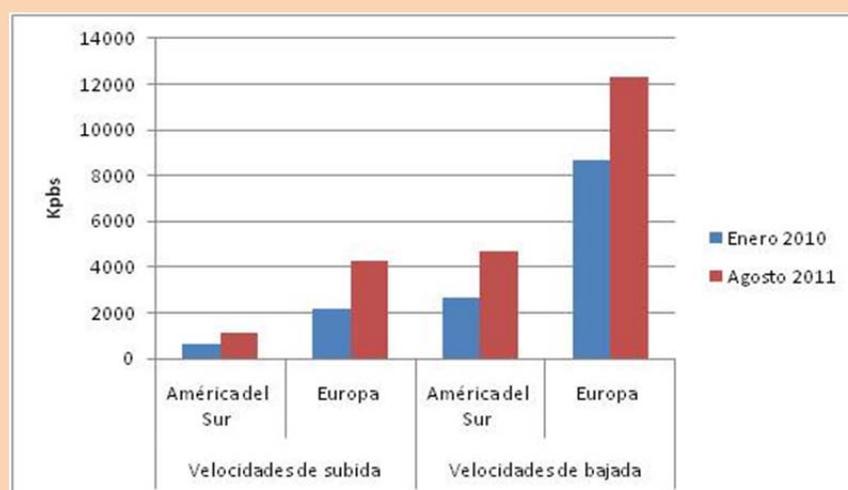
Figure 9: USD average per 1 Mbit/s/GDP per capita monthly



Source: ORBA

As can be observed, the costs of the service are almost five times higher than the average costs in OECD countries.

Figure 10: Effective downlink and uplink speeds



Source: OECD

Figure 10 illustrates that the South American countries also showed an improvement in the effective speed of Internet broadband access. The uplink speed increased by 64 per cent between January 2010 and August 2011, while the downlink speed increased by 75 per cent over the same period.

But this has not been enough to close the existing gap between the developed countries of the OECD countries and LAC countries. The uplink speed is almost four times faster than in the LAC region, while the downlink speed is practically three times faster.

5.2 The growth of the IXP in LAC countries

At the start of the development of the commercial Internet, from about 1995, the countries in the LAC region used value added services, such as: electronic mail, access to databanks, various online directories, information exchange, etc.

From the viewpoint of interconnection, both locally and internationally, this was not a barrier to the use of these services, since they were few and expensive, and hence not for mass consumption.

The development of the Internet brought about a new vision of connectivity, one where ISPs (the few in existence and those that rapidly started up in this new technology business) encountered some difficulties which were hard to resolve.

Each new company generated a demand for links to interconnect to the rest of the network. The philosophy of the Internet is that of the “network of networks”. On top of this, the conventional method of user access was via telephone lines using a “dial-up” mode, which obliged the ISP to lease a pool of telephone lines normally owned by the incumbent companies (both public and private sector), which usually had a communications monopoly.

This Internet business model, where practically all the services were (and still are) free of charge with the exception of the access charge, offered little opportunity for small and medium enterprises to develop. This situation was occurring all over the world. This prompted CABASE³, the Argentina Internet

³ Argentina Internet Association: www.cabase.org.ar/eng/index.php

Association (founded in 1989), and as the first entity in the region which brought together companies specializing in Internet services, to intervene.

After long months of discussions between CABASE members, ISPs, carriers (interconnection providers) and content providers, defined what became the first Internet exchange in Latin America.

CABASE selected a not-for-profit cooperative model to operate the CABASE Network Access Point (NAP), which began operations in 1998, and which quickly enabled significant cost savings in interconnection between providers. Since the intra-NAP traffic had no cost, a new stage of development and growth of the Internet began, in this case in Argentina.

Figures 11 and 12 illustrate interconnection provided through a NAP, the savings in terms of interconnect links and infrastructure, and security systems, etc.

Figure 11: ISP Interconnection to the Internet and content provider

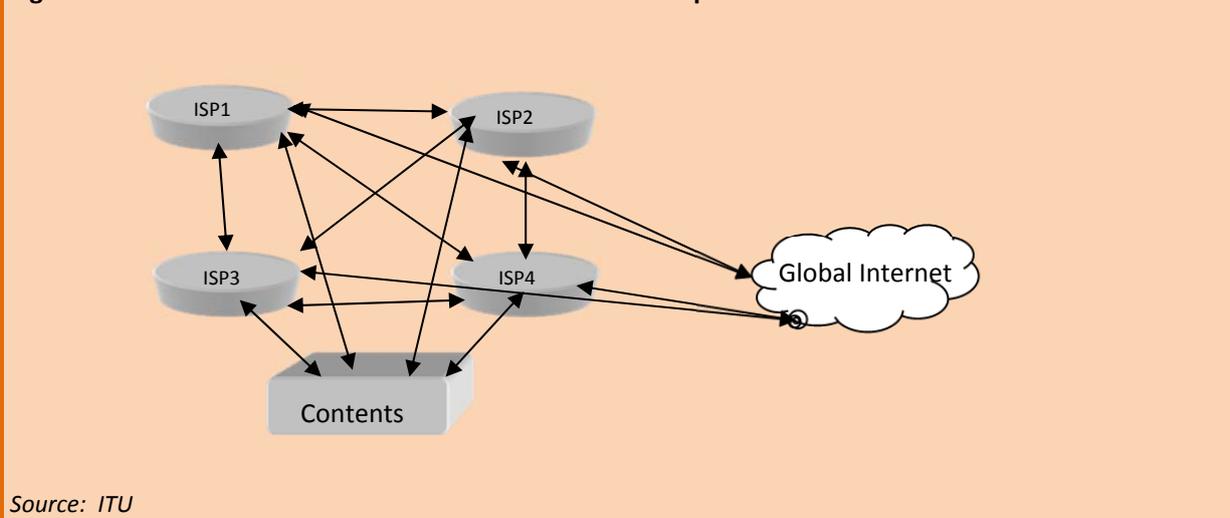
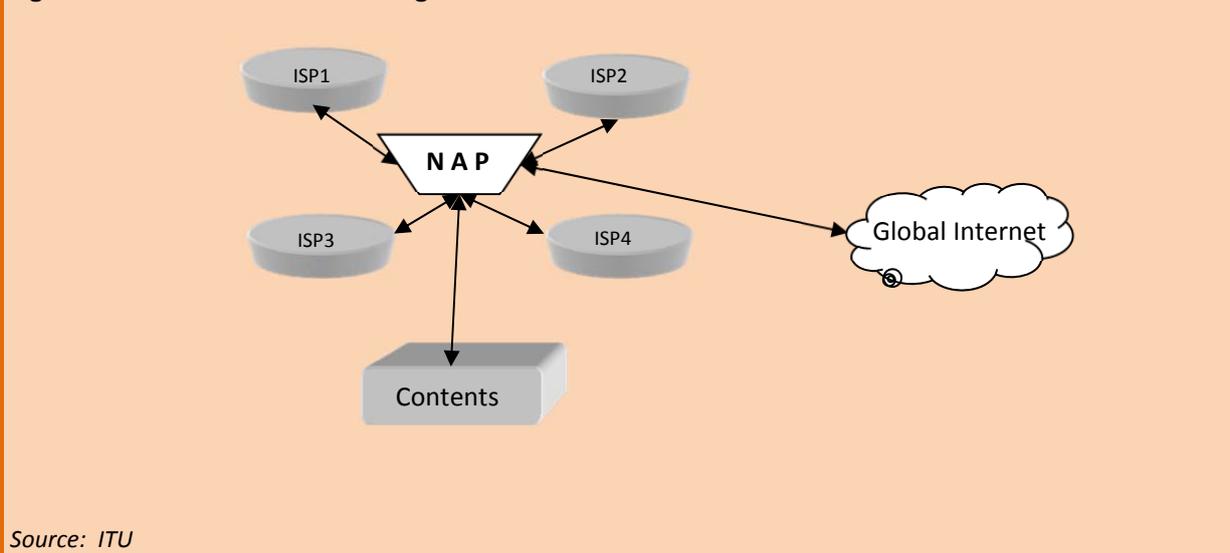


Figure 12: ISP Interconnection using a NAP



The success of this project quickly generated replicas in other countries. Colombia, Peru, Chile, amongst others, quickly adopted the associative model and, although not all NAPs were created as non-profit cooperatives, their objective was always the same – to improve the quality and cost of the services.

This CABASE initiative became a regional connectivity policy, and hence an initial NAPLA (NAP Latin America) meeting was held in Cartagena, Colombia in 2002. It was organized by the Colombian Informatics and Telecommunications Chamber (CCIT), which operates the Colombia NAPs, and from this point on this became an annual event, usually organized by LACNIC – The Latin America and Caribbean Address Registry.

On the other hand, the Brazil, Argentina and Ecuador models, with a high content of cooperative participation, demonstrate the advantages of developing more than one Internet exchange per country, which enhance the interconnection, connectivity and security in the respective country.

The Brazil Project, which is led by the Brazil Internet Steering Committee (CGBr), an entity made up of the different sectors in Brazil, and which has the largest amount of NAPs in the region, supports and promotes the development of NAPs in the country. The Sao Paulo NAP is the central point of traffic exchange, and provides training and equipment support for the other NAPs. Each one of the NAPs must accept the common interconnect and routing policies, and are free to develop their own commercial policies.

In Argentina, CABASE – the Argentina Internet Association, was the first entity in the region to inaugurate a cooperative NAP in Buenos Aires, which has been operational for more than ten years, and which is currently developing a project called “Federalizing Broadband”, which among other objectives aims to develop one or more NAPs per province. Currently six new NAPs are operational, and six more are being developed.

The case of Ecuador demonstrates that the size of the country is not important, nor the number of users, but rather the participants’ will to grow is the driving force, in this instance the ISPs and the entity to which they are members – AEPROVI – Association of ISPs, Carriers and Information Technology. To date they have developed three NAPs.

Associative models of NAPs

In order to clarify concepts, the most common associative models are defined as:

- Cooperative Model

A group of companies unite, usually under the umbrella of a non-profit Association, and constitute a NAP. This can also occur within an existing Association, and also a cooperative can associate with another entity in order to participate in a NAP. The economic advantages of this model are that, when a non-profit entity is involved, the cost of the services is notably lower in all aspects.

- Private model

This model offers two options:

In the first model, a company develops a NAP and then proceeds to rent out services within its own facilities, for example co-location (which consists of physical space, usually known as a “cage” since the space is closed by means of a metallic fabric, and only the lessee has access to the door).

Housing – in this case the lessee’s equipment is placed in a common space, and is maintained by the NAP personnel. With regards to connectivity, this is generally up to the lessee who can have multipoint connectivity, or else peer-to-peer (p2p), which involves one-to-one links. This is a typical business arrangement between private parties, wherein the lessor chooses who he will route traffic to and how, according to certain values and rules defined by the lessor.

- Mixed model

This is an unusual case but the Brazil PTT can be used (traffic exchange point) as an example, and one in which a non-profit Association – which is also multi-stakeholder – supports a project and cooperates with equipment and operational regulations, leaving the economic model up to the involved participants.

The last type of NAP refers to those that exist in countries listed as not having NAPs for various motives, such as:

- Telecommunications are run by the government mostly, which means that any interconnection of this type is performed by the government within its facilities.
- Countries where the incumbents have dominant market share and leave little space for competition, as in the case of Mexico where their frontier with the United States makes interconnection a non-contentious issue, in view of the low costs involved.
- Countries in which the Internet is not sufficiently developed, thus lacking a critical mass of operators that might develop a NAP.

And finally, with reference to security, the experience of the Haiti earthquake of 2010 demonstrates the undeniable importance of having more than one NAP per country, for the purposes of backup (which means a support system that can encompass software) – which may mean applications (programmes) or data files (information) - or equipment (hardware), and where duplicates of all or some of the items described are kept. In the case of a NAP, interconnection links are also included, or in other words a secondary NAP acts as a backup of the primary in the event of natural disasters or destruction.

5.3 Network exchange points in LAC countries

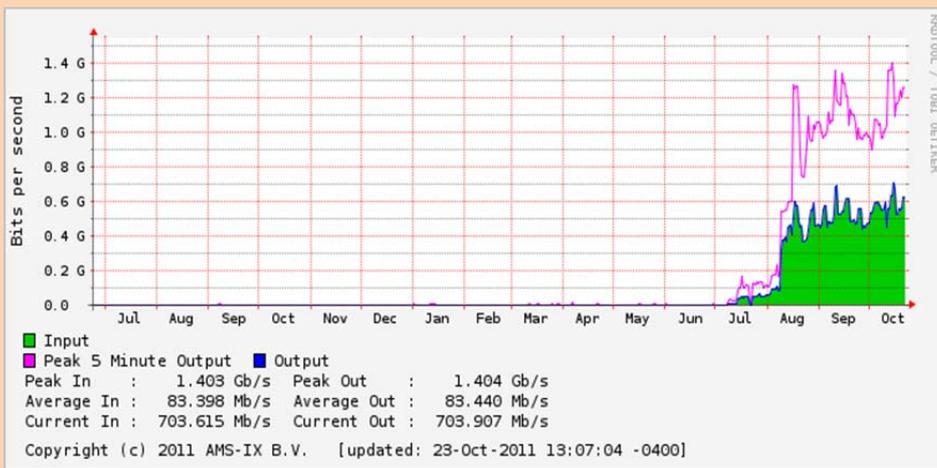
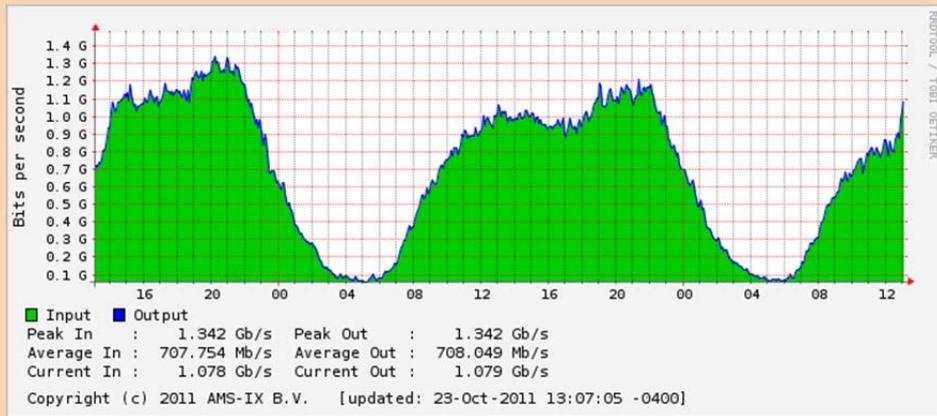
This section details how NAPs are constituted, the number of participants and date of foundation, including in some instances a comment on some of the technical characteristics, and traffic graphics where published. The figures mostly reflect the bandwidth of 2011, and the readings correspond to the period from October 15 to November 2, 2011.

Table 5: Netherlands Antilles NAPs

Netherlands Antilles		Nbr.of NAPs - 2		
Location	Model	Nbr.Part.	Founded	Institution
OCIX Philipsburg	Cooperative	7	2008	Open Caribbean Internet Exchange
CAR-IX Curacao	Cooperative	11	2009	Caribbean Internet eXchange

Figure 13 presents two NAP traffic charts showing one day of traffic, and one year of readings. In the case of Netherlands Antilles, two NAPS have been created – both by non-profit entities. The first of these OCIX (Open Caribbean Internet eXchange) is an independent Internet exchange located in Philipsburg, Sint Maarten.

Figure 13: NAP traffic charts (AMS-IX)

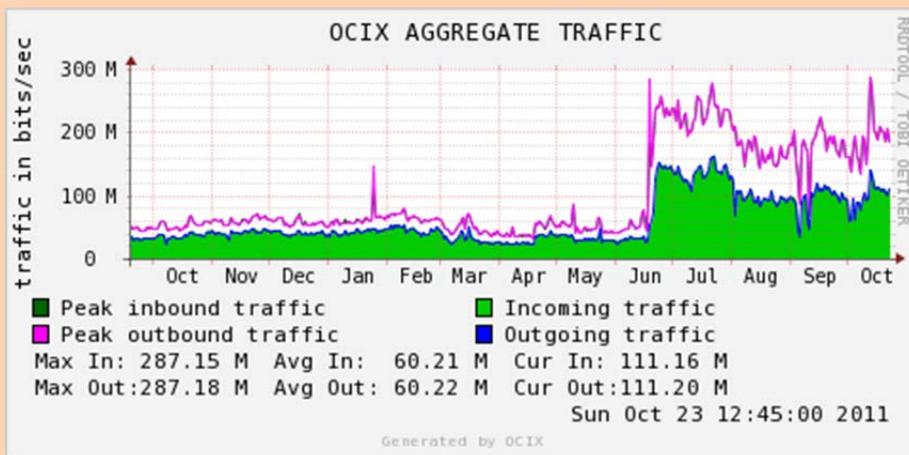
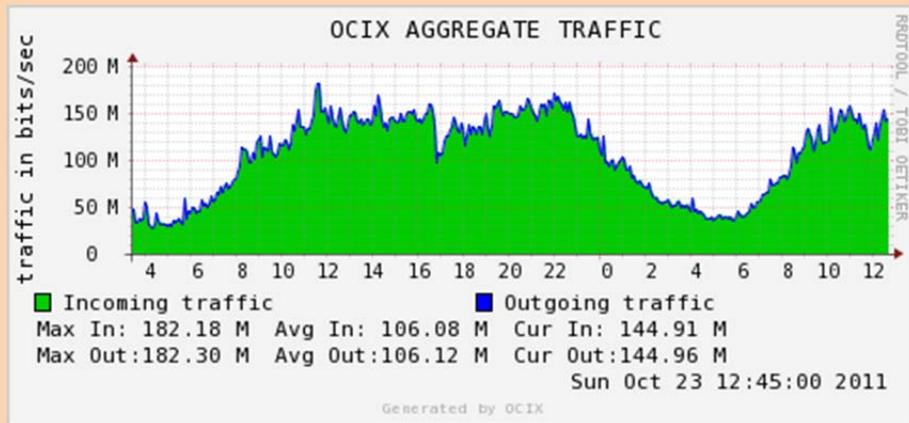


Source: CarIX

The second case and as self-defined is: "The OCIX is a neutral and independent not-for-profit Internet Exchange", as with the previous case, two charts are shown - one that comprehends one day of traffic, and the other the readings between July and October of 2011.

Argentina

Figure 14: NAP traffic charts (OCIX)



Source: OCIX

Table 6: Argentina NAPs

Argentina	Nbr. of NAPs - 2			
Location	Model	Nbr Part	Founded	Institution
Buenos Aires	Cooperative	42	1996	CABASE
Bahía Blanca	Cooperative	11	2011	CABASE
Neuquén	Cooperative	12	2011	CABASE
Rosario	Cooperative	17	2011	CABASE
Mendoza	Cooperative	9	2011	CABASE
Santa Fe	Cooperative	6	2011	CABASE
Mar del Plata	Cooperative	In Construction	2011	CABASE
Partido de la Costa	Cooperative	6	2011	CABASE
Córdoba	Cooperative	In Construction	2011	CABASE
La Plata	Cooperative	In Construction	2011	CABASE

Argentina created the first NAP in the Latin American region, and its success became an example for the deployment of NAPs to the rest of the region. Thirteen years later, in mid-2010, a project known as “Federalizing Broadband” was initiated. One of its main premises is the promotion and support for creating other NAPs within the country.

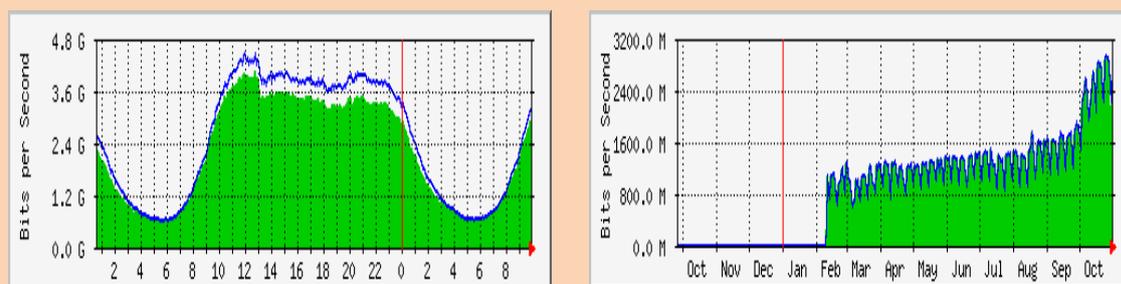
After an arduous task of evangelizing with the regional ISP Cooperatives, including representatives of the governments in each respective province, the creation of these NAPs was agreed upon.

Brazil

The interconnection to the central NAP (Buenos Aires) provides access to a mirror of the Root Server F, which resolves searches for Internet addresses locally, without generating traffic to and from the USA. A server from Verisign installed in the Buenos Aires NAP, resolves similar searches for ‘.com’ and ‘.net’ addresses. All this enables an important cost-reduction on international connectivity, as well as improving response time and network security.

The charts in Figure 15 correspond to the central NAP (Buenos Aires), covering one day of traffic, and readings from February through October. The charts showing latency and lost packets per connected ISP are also available, thus enabling quality verification of the service provided by the various participants.

Figure 15: Buenos Aires NAP traffic readings



Source: CABASE

Table 7: Brazil NAPs

Brazil	Nbr. of NAPs's-16			
Location	Model	Nbr. Part	Founded	Institution
	Cooperative / Commercial	472 Tot.	2004	CGIbr*
Americana	Cooperative / Commercial	11		CGIbr
Belo Horizonte	Cooperative / Commercial	17		CGIbr
Brasilia	Cooperative / Commercial	13		CGIbr
Campina Grande	Cooperative / Commercial	10		CGIbr
Campinas	Cooperative / Commercial	18		CGIbr
Curitiba	Cooperative / Commercial	25		CGIbr
FloreaNAPsolis	Cooperative / Commercial	10		CGIbr
Fortaleza	Cooperative / Commercial	11		CGIbr
Goiania	Cooperative / Commercial	11		CGIbr
Londrina	Cooperative / Commercial	16		CGIbr
Porto Alegre	Cooperative / Commercial	34		CGIbr
Recife	Cooperative / Commercial	5		CGIbr
Rio de Janeiro	Cooperative / Commercial	19		CGIbr
Salvador	Cooperative / Commercial	21		CGIbr
Sao J. Dos Campos	Cooperative / Commercial	7		CGIbr
San Paulo	Cooperative / Commercial	244		CGIbr

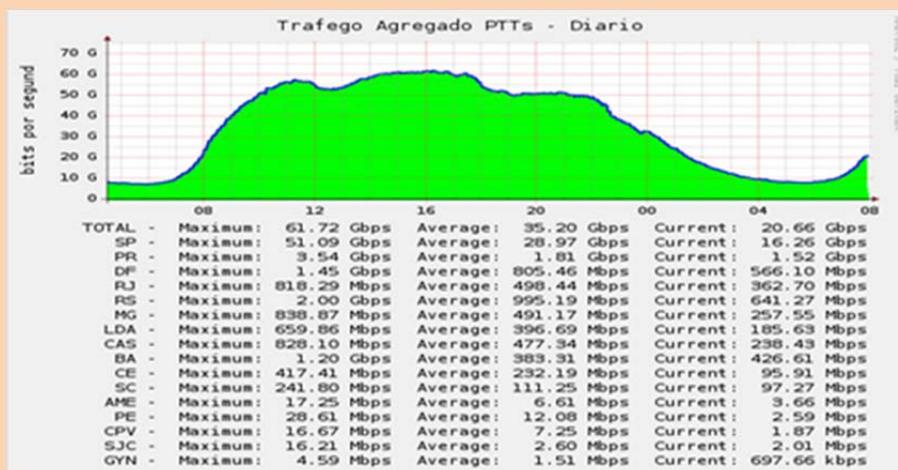
*Comitê Gestor da Internet no Brasil

The Brazilian Project known as PTT Metro, is led by the Brazil Internet Steering Committee, and includes the government, academic and private sectors. The general rules to have access to the project are:

- possess an ASN (Autonomous System Number);
- allow both multilateral and bilateral traffic;
- have only one NAP per locality;
- connect to the NAP with proprietary or rented fibre;
- the CGIbr can loan the equipment that illuminate said fibre;
- each NAP decides on its own economic model and on how its participants interact.

Figure 16 shows a chart for one day's traffic of all NAPs.

Figure 16: Brazilian Project (PTT Metro) traffic (one day)



Source: Comitê Gestor da Internet no Brasil

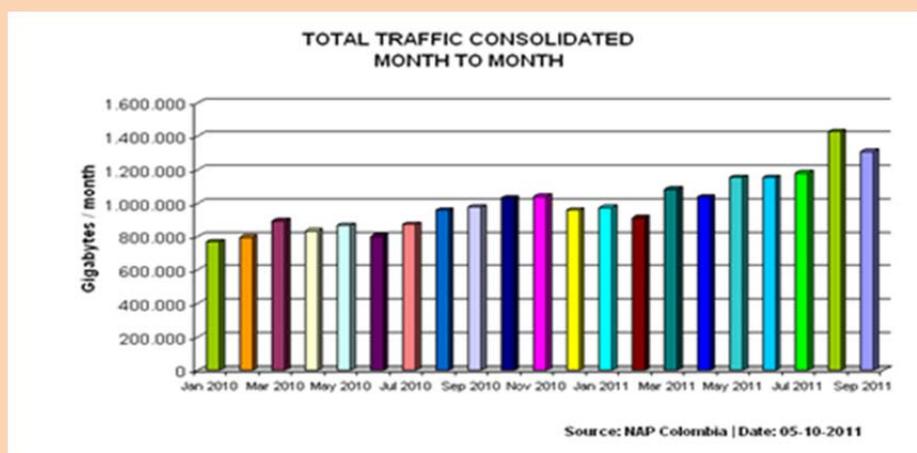
Colombia

Table 8: Colombia NAPs

Colombia	Nbr. Of NAPs - 2			
Location	Model	Nbr Part	Founded	Institution
Bogotá	Cooperative	16	1999	CCIT
Bogotá	Universidad	s/d	s/d	CIM
Bogotá	Private	14	2008	Terramark

The Colombian Chamber of Informatics and Telecommunications (CCIT), founded the first NAP in Colombia, and was one of the first pioneers of these initiatives in 2008. The Chamber is a non-profit association, and its core mission is the interconnection of members, in order to achieve interconnection and connectivity, thus achieving both economic and technological improvement.

Figure 17: Colombian Chamber of Informatics and Telecommunications NAP traffic



Source: CCIT

Cuba

Table 9: Cuba NAP

Cuba	Nbr. Of NAPs - 1			
Location	Model	Nbr. Of Part	Founded	Institution
Habana	State	5	2001	Etecsa

ETECSA, the Cuban Telecommunications Company, in 2001 created the Internet Exchange Point, thus taking the first step for development of the Internet on the island.

The connectivity of the island was based on satellite interconnection, and this was an impediment to the development of the Internet, due to the cost of broadband for this type of satellite service, as well as their characteristic latency. Currently the submarine optical fibre cable is installed, which connects Cuba to Venezuela, and according to the established timeframe will be operative at the end of 2011. As with the other cases, Figure 17 shows a traffic chart from the year 2006 until June of 2011.

Figure 18: Cuba NAP traffic (2006 – 2011)



Source: NAP Cuba

Chile

Table 10: Chile NAP

Chile	Nbr. Of NAPs - 3			
Location	Model	Nbr. Part	Founded	Institution
Santiago	Private	20	1997	NAPs Chile S.A.
Santiago	Private	13	s/d	ENTEL
Santiago	Private	14	s/d	Telefónica Mundo
Santiago	Private	6	s/d	Equant
Santiago	Private	6	s/d	Global Corssing
Santiago	Private	s/d	s/d	Chilesat
Santiago	Private	1	s/d	Intercity
Santiago	Private	s/d	s/d	AT&T
Santiago	Private	s/d	s/d	Manquehue

In Chile, some NAPs have special characteristics. When the need for NAPs began, how the operators and ISPs were to interact was not too clear. This prompted the Chile under-Secretary of Communications to sanction a regulation for ISP interconnection, on 22 October, 1999. This made interconnection between them obligatory. It also regulates the quality of the service as a parameter according to international standards. It stipulates the maximum terms pertaining to the implementation of these interconnections, and also regulates the quality of the service provided to the end user. No overall charts are available.

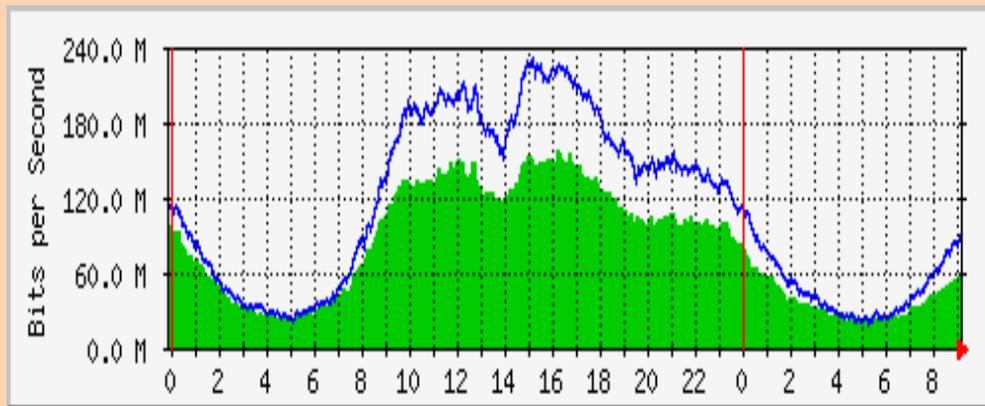
Ecuador

Table 11: Ecuador NAP

Ecuador	Nbr. of NAPs - 3			
Location	Model	Nbr. Part	Founded	Institution
Cuenca	Cooperative	2	2010	AEPROVI
Guayaquil	Cooperative	9	2007	AEPROVI
Quito	Cooperative	14	2001	AEPROVI

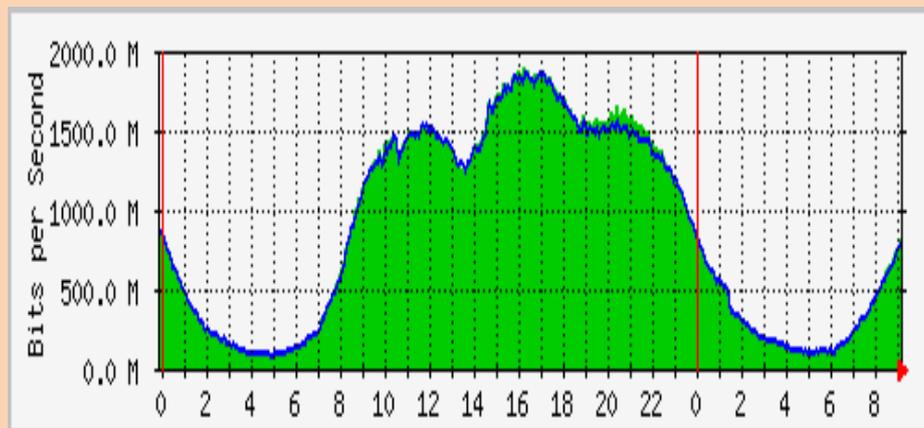
As previously commented, AEPROVI (Association of ISPs, Carriers and Information Technology) has a multilateral and obligatory policy traffic. The Cuenca NAP only has two ISPs, which demonstrates that the advantages of interconnection go beyond the quantity of connected ISPs.

Figure 19: Quito Daily



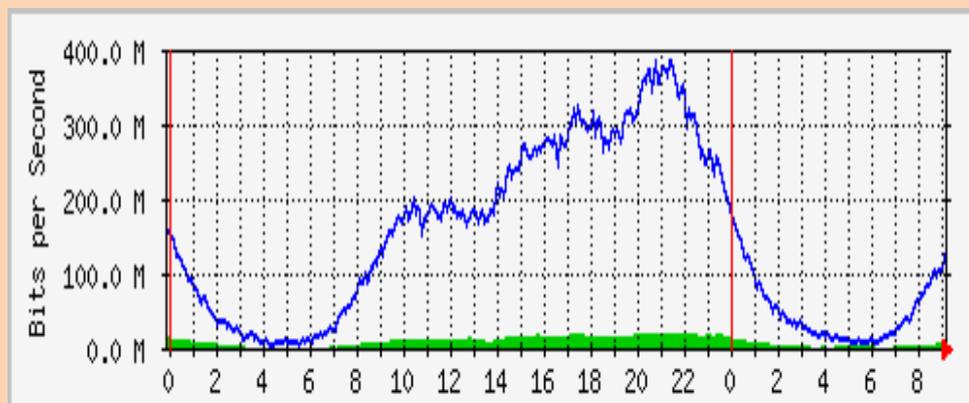
Source: APROVI

Figure 20: Guayaquil Daily



Source: APROVI

Figure 21: Cuenca Daily



Source: APROVI

Haiti

Table 12: Haiti NAP

Haiti	Nbr. of NAPs - 1			
Location	Model	Nbr. Part	Founded	Institution
Puerto Príncipe	Cooperative	4	2009	AHTIC IT

The Haitian Association for the Development of ICT (*Association Haïtienne pour le développement des TIC*) is the operator of the Haiti NAPs, it must be noted that the Haiti NAP continued to operate in spite of the terrible earthquake that hit the country on 12 January 2010, and it was an important resource when locating buried people. Also, the result of the evaluation of this event by the administrators of the NAP, emphasizes in their final analysis that the possibility of having more than one NAP, drastically reduces the chances of a blackout of communications and services in a country.

Nicaragua

Table 13: Nicaragua NAP

Nicaragua	Nbr. Of NAPs - 1			
Location	Model	Nbr. Part	Founded	Institution
Managua	Cooperativo	15	1995	AIN

No further information is available.

Panama

Table 14: Panama NAP

Panamá	Ctd de NAPs - 1			
Localización	Modelo	Cta Part	Fundado	Institución
Panamá City	Académico	s/d	s/d	CENACYT
Panamá City	s/d	10	s/d	Intered Panamá

No further information is available.

Paraguay

Table 15: Paraguay NAP

Paraguay	Nbr. Of NAPs - 1			
Location	Model	Nbr.Part	Founded	Institution
Asunción	Cooperative	15	2001	CAPADI

CAPADI is the Paraguay Chamber of Internet. Although the Chamber has no current general activities at the time of this report, the NAP is operational with some 22 points of presence in the country using optical fibre.

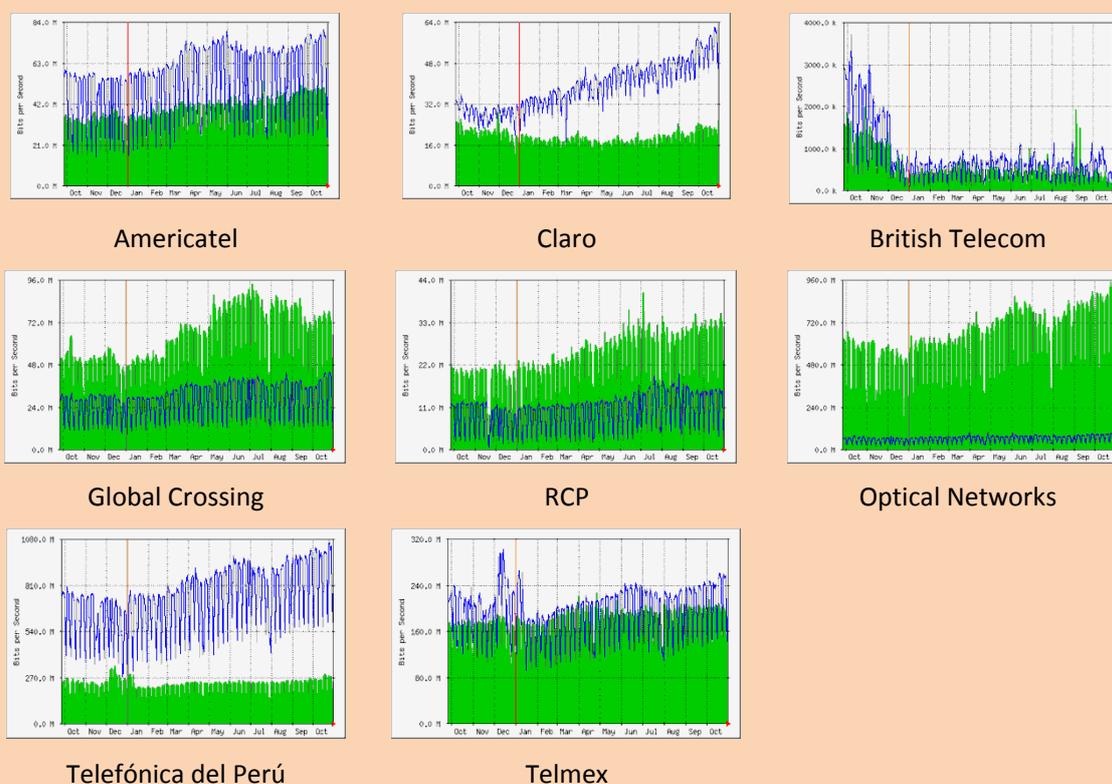
Peru

Table 16: Peru NAP

Perú	Nbr. Of NAPs's - 1			
Location	Model	Nbr.Part	Founded	Institution
Lima	Private	9	2001	NAPs Perú
Lima	Private	s/d	s/d	Internexa

After the signing of the agreement for the first NAP, Peru became the fifth country in Latin America to have this system, after Argentina, Brazil, Chile and Colombia. The charts in Figure 22 refer to some of the NAP Peru members, not to overall traffic. The uplink traffic, which refers to outbound traffic, is shown in green, the downlink or inbound traffic is shown in blue.

Figure 22: NAP Peru members



Source: Author

Dominican Republic

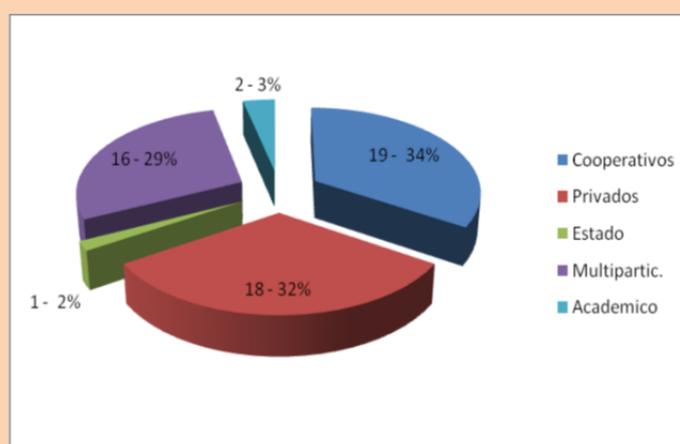
Table 17: Dominican Republic NAP

Dominican Republic	Ctad de NAPs - 1			
Location	Model	Nbr.Part	Founded	Institution
Santo Domingo	Private		2008	Terremark World

The NAP will be located in the Santo Domingo Cybernetic Park, where the Caribbean NAP will become operational in the future. It includes a building which will house the new NAP facilities, with 150 000 sq ft of space, and strict security measures that will be resistant to high category cyclones, since Santo Domingo is regularly subjected to these climatic phenomena.

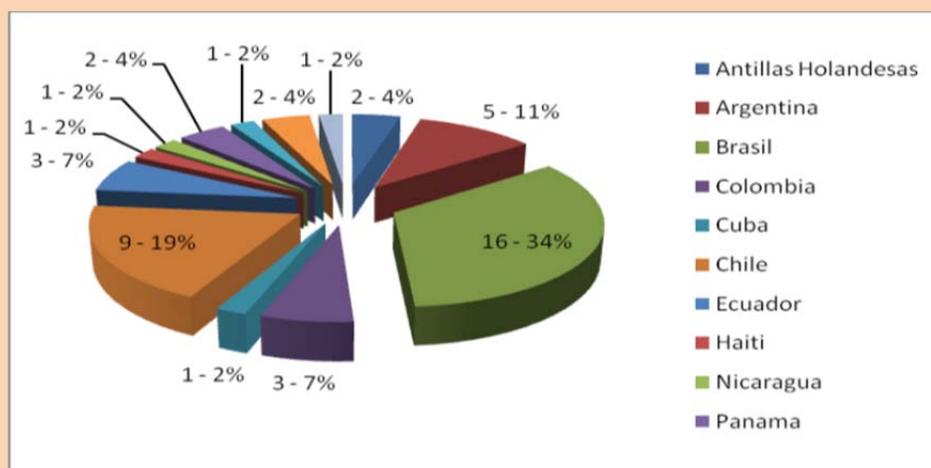
The chart in Figure 23 shows the distribution according to institutional model and Figure 24 shows distribution according to the number of NAPs per country.

Figure 23: Institutional model of NAPs



Source: Author

Figure 24: Number of NAPs per country



Source: Minplan

Countries without NAPs

The following countries do not have NAPs in either private or non-profit mode, but the communications companies of these countries have NAPs, as far as technical aspects. In countries such as Costa Rica and Uruguay the State has a monopoly in certain areas of the communications services.

Table 18: LAC countries without NAPs

Aruba	Bolivia	Belize	Costa Rica
Guayana Francesa	Guatemala	Honduras	México
Suriname	El Salvador	Trinidad y Tobago	Uruguay
Venezuela			

As commended in the previous paragraph, in those countries where communications are controlled by the state, the “NAP” is operated by the national telecommunication operator, for example: in Costa Rica and Uruguay. In the remaining countries, the NAP operator could be the telephone company or the provider of international communications, which usually provides all the services. This vision of the different options, according to each country, will contribute towards a clear understanding of the importance of NAPs, in the technical-economic solution of interconnection in Latin America and the Caribbean.

5.4 Projects within the region

Three examples of projects have been chosen to demonstrate that States can become involved, and produce the necessary changes that will promote the development of broadband. If to this the development of the NAPs is added, and the empowerment of pISPs (being able to be competitive), then the objective of this study is in sight, i.e. the reduction of the digital divide, and the enabling of the geographically and economically underprivileged to have access to ICTs. Also included are comments of a high ranking public official in Brazil, which reveal problematic issues that have been previously commented, and are herein confirmed.

Argentina – Project: “Argentina Connected”⁴

With regards to infrastructure, the Federal Fibre Optic Network will be developed. It has been declared to be of public interest by Decree N° 1552/2010, which creates the National Plan of Argentina Connected.

Through Argentina Connected, the Government of Argentina will promote the construction of national infrastructure in addition to the existing telecommunications networks (i.e. those owned by the traditional operators).

As a first stage, 10 000 kilometres of new networks will be developed, reaching a total of 35 000 kilometres, thus tripling the current installed capacity.

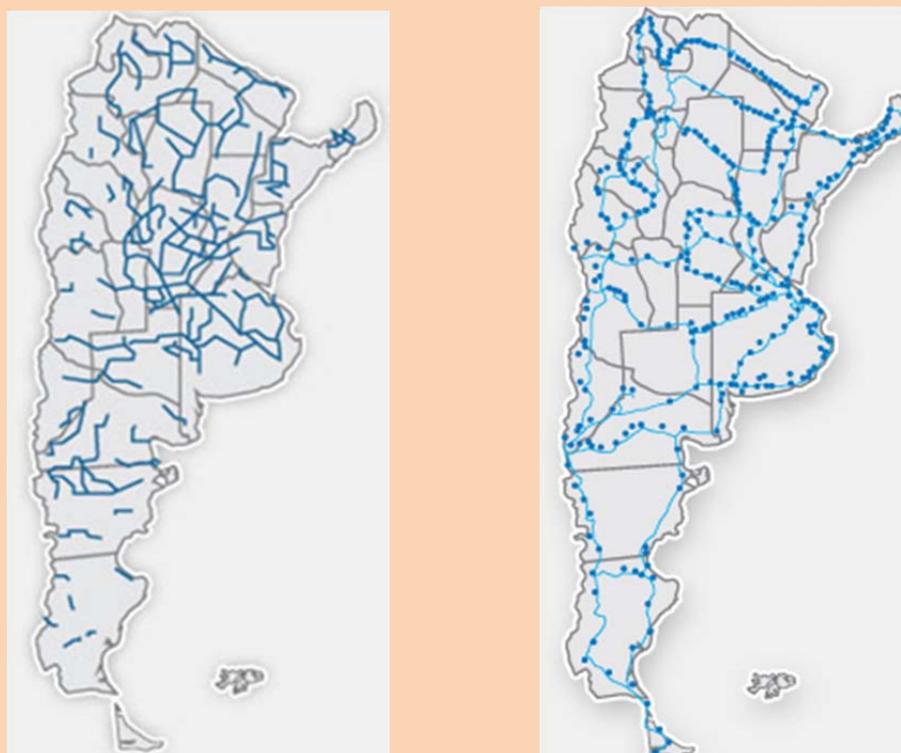
Through the deployment of infrastructure and the increased availability of services, a direct impact on the wholesale prices of data carriers will be achieved, resulting in a reduction of tariffs to the end user of Internet broadband and video. This will level the playing field on a national scale, increasing quality of service and reducing costs to the user.

⁴ See also case study overview: www.itu.int/ITU-D/treg/broadband/MinicasestudyBBArgentina.pdf

As can be seen on the maps in Figure 25, the deployment generates a number of rings (backbones) that contribute to network security. Eight regions have so far been tendered:

- NORTH REGION NOA
- CENTER EAST REGION
- CENTER WEST REGION
- SOUTH NE REGION NEA
- MISIONES REGION
- NORTH PATAGONIA
- SOUTH PATAGONIA
- NORTH NE REGION

Figure 25: Fibre optic infrastructure



Source: AR-SAT

In order to guarantee the availability throughout Argentina of an advanced telecommunications network, the Provincial Fibre Optic Network will be constructed in all the provinces of Argentina.

Through the deployment of this network, the objective is to connect each city, and enable interconnection of the backbone with local operators, which will provide the access services to the home.

According to the time frame, the construction of the provincial networks is planned in two stages:

- 1 the construction of 13 300 km of fibre optics;
- 2 the construction of 8 600 km of fibre optics.

Brazil – National Broadband Plan

Since 2010, Brazil is developing the National Broadband Plan. Cesar Alvares (Special Advisor to the Presidency) noted that *“The Brazilian government expects to implement a pilot of its National Broadband Plan in 300 cities of the country. The objective of the programme is to complete 30 million fixed broadband connections, and 60 million mobile connections by 2014, including Internet connections for all the government agencies, and the more than 70 000 schools that still lack connectivity, as well as the installation of 100 000 new telecommunications community centres”*.

Rogério Santanna dos Santos, President of Telebras, referring to a survey conducted in 2009, noted that “In spite of the measures adopted by the Brazilian government, to ensure greater digital inclusion, and the access to Information Technologies of the economically underprivileged populations, there are still large gaps in this field that reinforce the social exclusion in this country.

Brazil is the largest user in terms of time and connection, and is also the best connected, which shows that the use of the Internet is an important element of socialization. In spite of this enormous potential however, broadband is expensive in Brazil, is low speed and is concentrated in high income and population density regions. This is because the major part of these services are provided by three companies, who between them have 86 per cent of the Brazilian market, and are committed to servicing the A and B classes. We have the most expensive broadband in the world and even so it is insufficient, since it only exists in large cities and in the wealthiest areas of the country. The Brazilian government does not intervene in the wealthy suburbs of important Capital cities, since in these places there are many providers to satisfy this demand.

The Internet in Brazil is still an urban phenomenon, concentrated in high-income regions, due to the lack of interest of the telecommunications operators, who currently concentrate their business in the higher income and population density areas.

This reality demonstrates the urgency to develop the National Broadband Plan (PNBL), in order to bring the Internet to the hinterland, forgotten and condemned to eternal disconnection. We must above all, stimulate the market in this area since there are 1 700 Communications Services Licenses (WCS), already issued by the National Telecommunications Agency (Anatel). Yet in reality there is no competition, due to the infrastructure control of regional monopolies that make it virtually impossible for small providers to offer their services.

These are the reasons why the Brazilian government should use its infrastructure of more than 30.000 kilometres of fibre optics, to participate in the competition segment, which will occur in the service ambient and not in the control of infrastructure.”

Colombia – National Fibre Optics Project

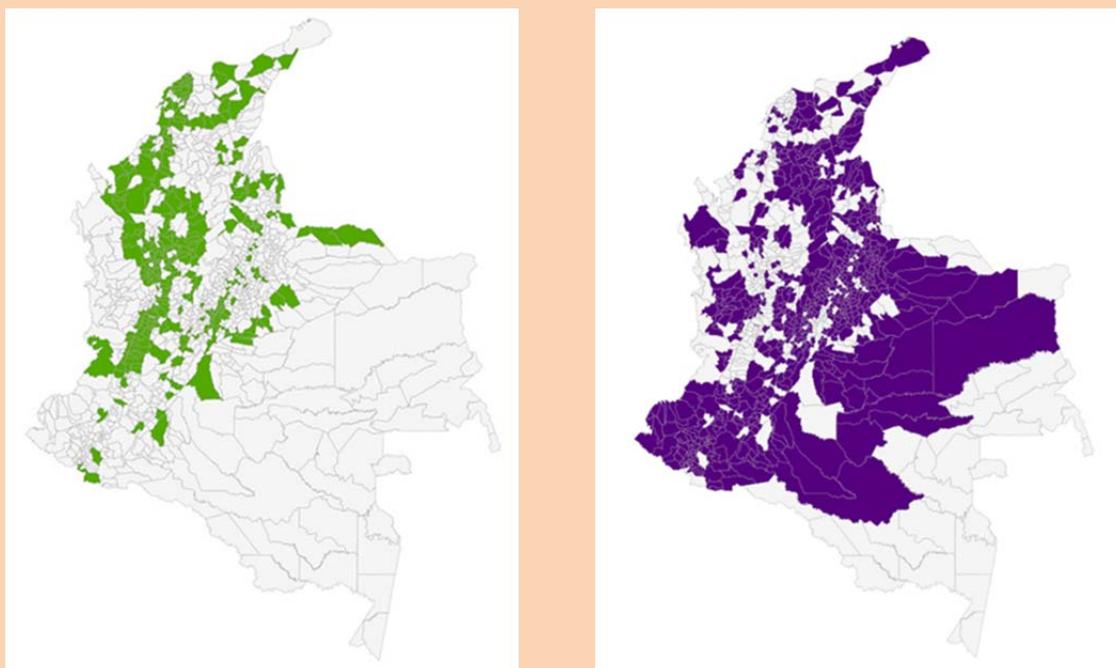
On 5 November 2011, the tender in Colombia was awarded. The following is a quote from comments published on this award:

“The Colombia Temporary Fiber Optics Union, a joint company formed by TV Azteca and Total Play, has been selected by the Colombia Ministry of Information Technology and Communications (MTIC), to implement and maintain a national fibre optics network. The network will connect 1 078 municipalities, and consists of 15 000 km of fibre optics. The project is a public-private cooperation for a total cost of 670 million dollars, part of which will be provided by the government.”

The project will seek to increase the number of connections to the Internet in the country, to 8.8 million by 2014.

The map to the left of Figure 26 shows the 325 municipalities that will be connected by fibre optics. The project will be implemented in three stages, and will be concluded by 2014, and the map to the right shows the national coverage of the project, enabling 753 locations to have fibre optic connections. These are included in the 2012/2014 stages.

Figure 26: Increasing the number of connections with fibre optics in Colombia (2012 to 2014)



Source: Author

6 Best practice

In the development of broadband, as mentioned before, factors and actors vary according to each case, but the study undertaken to review the participation of NAPs as a solution to improve Internet development, hence achieving a reduction of the digital divide, (although focused on Latin America does not mean it cannot be replicated in another region), demonstrate that this model takes the lead.

The general experience of countries in the region, whatever model of NAP has been implemented, be it private, multi-stakeholder or cooperative, has resulted in successful experiences, considering the economic, technical and also human aspects.

Observing the economic aspect, the reduction of economic and technical resources that the use of a NAP enables is important. The drastic reduction in the cost of bandwidth to be contracted, the economies regarding equipment and software, and common or general expenses, are just some of the most important issues.

In developing this document, the different NAPs and their models within the region have been described. Of these, the project that CABASE is implementing in Argentina at this time, which is a cooperative model, is the one which contributes the largest benefits to the core of this study, development of broadband and International Interconnection.

General conditions for participating in a CABASE NAP

- The participating companies must be members of the entity, CABASE, which in this instance is an NGO non-profit institution.
- Then they must file a request to participate in the NAP, and must accept its rules and regulations, which include these definitions:
 - Multilateral, must publish all its routes – all accesses to other networks or services must be accessible to the rest of the group.

- SLA (service level agreement), which includes the levels of acceptable errors, error recovery times, latency, loss of packets, etc. These readings will be published and accessible without restrictions, thus ensuring operational transparency.
- Present a technical project for connection to the NAP, which will require the approval of the NAP Technical Coordinator.
- Reaching the NAP (last mile interconnection) will be defined by the member, but must be contracted and implemented by a Carrier who is a member of CABASE and has presence in this NAP.
- The equipment required for the interconnection of the member to the NAP will be provided by the participant, and he will be responsible for maintenance of the interconnection and all his equipment.
- Costs policy: (a) General expenses which are shared equally by all – insurance, energy supply, UPS, security, etc. (b) Participant proprietary costs: rack space utilized as per equipment in use, link port dependant on bandwidth, for example 100 Mb or 1 Gb. All these result in a formula which is defined as a cost index known as “NAP Point”. The minimum participant charge is for 2 NAP Points.
- Accept the payment terms and the consequences of lack of payment (service cuts and penalties).
- Contribute to the reserve fund, which will be an amount suitable to the NAP infrastructure, and must be sufficient to address necessary purchases or operations required for contingencies of any sort or origin, for example natural disasters.
- The participating companies have one vote, independently of the size of the company.
- The decisions are taken by consensus, whether the issues be economic or involve technical and commercial policies. When necessary a vote will be called.
- Special cases: This refers to the interconnect requests from the academic or governmental sectors. The difference lies particularly in the sequence of payments, or some other specific necessity.
- The CABASE Board of Directors will be the authority that gives final approval to the NAP resolutions.

All this applies to the CABASE main NAP, which has operated successfully for more than 10 years in a limited territory – the City of Buenos Aires. Whereas undoubtedly this is the geographic area with the greatest concentration of users and Internet providers, it was not the solution to the problem posed by this study – Interconnection, reduction of the digital divide, deployment of broadband in the hinterland.

During 2010 CABASE launched a project called “Broadband Federalization”, aimed to diminish the inequities of the interconnection for the pISPs in the hinterland, and the services they provide to the populations that are remote from urban centres.

As a first item of the project, a survey was conducted on the networks that existed in the country and were not owned by the incumbents. The result was more than interesting, in view of the amount of fibre optic networks or microwave installations in the country, and which in some cases were not illuminated (operational) or had idle capacity, including the provincial government networks, or public service companies in the same condition.

Once this was completed, contact was made with some of the pISPs in different provinces, and with carriers (not the incumbents) who had a clear vision of the project and its results for the near future (which involved providing interconnection and transit services at a cost much lower than what the pISPs were then paying).

Very soon a carrier who was a member of CABASE, made a definite offer for interconnection, quoting costs that in some cases, and for some pISPs, meant a reduction of 90 per cent of the tariff they were currently paying the incumbent for each Mb.

Meanwhile the pISPs in the province of Neuquén, together with the provincial government began to assess the creation of a CABASE NAP in that province (Approx. 1 100 kilometres from Buenos Aires).

The first challenge was convincing the group of the enormous advantages of this “cooperative” association, in terms of the NAP and the non-profit status of CABASE, and that the competition that existed between them, could internally in the NAP become an opportunity for doing multiple business externally.

In the previous point, the experience of years in which the Buenos Aires NAP coordinated the relations between the different participants, pISPs, carriers, content providers and public entities, proved to be a positive influence. Maintaining a balance between the interests of different parties which sometimes were in opposition to each other, was an exercise that enabled CABASE to achieve invaluable experience, and this is capitalized in these new initiatives.

In summary, the Neuquen NAP was created as the first milestone of this project. Subsequently, and after this experience, enquiries were received from pISPs from other provinces, as well as carriers, all interested in participating in this project. It should be noted that those involved in the Neuquen NAP, participated actively in communicating this project and its benefits.

To date, and as can be seen in the tables in section 5.3, the locations of Bahia Blanca, Mendoza, Santa Fe (2), Partido de la Costa (Prov. Of Buenos Aires) are operational. Three more are in construction: Córdoba, Mar del Plata and La Plata (Prov. de Buenos Aires), and finally six more are in evaluation stage – Catamarca, Jujuy, Tucumán, Misiones (2) and San Luis.

This model is perfectly replicable, with logical variations according to country. Its implementation and operational launching is quick and the benefits for all parties – carriers. ISPs and users – soon become visible. Given these successes, this can undoubtedly be defined to be an example of best practices in the LA region.

Diagnosis

Telecommunications, including the Internet, reflect the globalization phenomenon, since they are global activities par excellence. Given this fact, to undertake a diagnosis on interconnection and broadband, one must first take a picture of the global conditions in which the activity is developed - telecommunications or basically the Internet.

The recent economic/financial crisis that struck Europe and the United States will in some measure or other affect the rest of the world. Among others the effects can be seen on the companies, which do not initiate new projects and, in some cases, suspend or reduce activity in other projects, and telecommunications is not exempt from this.

It is also important to highlight that this sector has not had significant investments in recent years. Adding this to the current situation of the economy, seriously threatens the chances of proceeding with investments in infrastructure that will be required for the development and technical updating of the Internet.

Although the forecasts indicate that the crisis will not seriously affect Latin America and the Caribbean, this should be taken at face value, as only the passage of time will tell if these forecasts are accurate. Also it should be noted that the companies that were surveyed regarding the deployment of broadband are all global, and thus are affected by the crisis. They had problems before, and these are accentuated in the present.

The concentration of the market in a few companies is a result of ten years of purchases, mergers of the successful companies in the sector, and the disappearance of those who were unable to compete. All this has contributed to the present situation.

When the time comes for companies to establish priorities or define investments, within a financial scenario that is complex to say the least, both globally and in the local internal economies, then the strategic plan is reduced to:

- minimum investment with maximum ROI in the short term;
- undertake those improvements that cannot be avoided, to ensure continuity of operations;
- sustain the home market of the corporation.

For the development of broadband as a strategic objective for Latin American countries, it is important to integrate the access to broadband within the national development plan. In addition, governments should promote projects involving the private sector, and especially encourage investment in infrastructure for Internet access in both urban and rural areas. This will also support the development of other sectors such as education, health, and the development of the national economy due to the positive impact of broadband on economic growth.

Final summary

The factors that converge to impede the development of broadband in LAC countries are:

- Lack of investment in the updating and expansion of basic telecommunications infrastructure – fibre optics – the building block of interconnection.
- Concentration of the market in only a few companies, which means low competition in the different market segments.
- Economic/financial situation with serious difficulties in the global market, and this is applicable particularly to companies of this sector.
- Almost exponential growth of the usage of bandwidth worldwide, and the pressure this brings to bear on the incumbents and the large companies, who cannot keep up with this growth in demand.

This non-exhaustive set of barriers has been the subject of discussion for several years now in various fora – public, academic, NGOs and private. The current consensus is that the solution cannot emerge from one single sector, but must come from the combination of all parties, and all efforts should flow towards this model if results in the near future are desired. Notes from the UNASUR (Union of South American Nations) meeting with the IDB (Inter-American Development Bank), with regards to studies undertaken by the latter, reinforce this point:

“In order to democratize access to broadband, the countries must maximize public-private cooperation, adopt fiscal incentives to promote demand, and support the creation of regional and local services and contents.

The UNASUR member countries should construct more national and regional connection points, in order to build a regional connectivity network, which would reduce distances for data traffic, and reduce costs. According to the statistics of the Latin America and Caribbean Economic Commission (CEPAL), between 75 and 85 per cent of the traffic in the region, including the locally produced content, pass through Miami. Comparatively, the largest percentage of traffic in Europe stays within its frontiers.”

This last paragraph refers to the NAPs, and the advantages of this as a development tool should be noted again.

The conditions are in place to generate a regional project that can diminish the asymmetries with regards to interconnection and access to broadband in LAC countries. Successful models and replicable best practices exist and are outlined in the next section.

Annex 1: Project based on best practice

This section defines a replicable model with a development agenda that is feasible for most countries in LA and that includes the following objectives to:

- 1 develop infrastructure for broadband;
- 2 deploy traffic interexchange points (PITs/NAPs/IXPs);
- 3 support small and medium ISPs;
- 4 generate a regional backbone.

First of all work on developing NAPs must be carried out. This is because they are the building blocks which enable the other three objectives. As has been seen, the development of a NAP can be divided into two main areas – technological and administrative/commercial.

There are various models of NAPs in the LAC countries, such as those in Brazil, Colombia and Ecuador, however, the CABASE NAP model most accurately reflects the implementation of best practice outlined in this study:

- based on the cooperative model (non-profit);
- guarantees transparency and rapid development;
- results are rapidly transmitted to the population within the coverage area of each NAP.

With reference to technology, this does not pose many complications since the equipment is well tested, and is well known in the LAC countries. It will, of course, be necessary to have technicians that are qualified for the project. The cost of creating a CABASE model NAP is relatively low and it could become sustainable with only five participating ISPs.

In the case of administrative/commercial aspects, there is an initial requirement for “evangelization” of the potential participants, since these are competing companies that must begin to operate cooperatively. This requires a period of adaptation of the participants in order to demonstrate to them the advantages of cooperation.

It is also important to have documentation with clear regulations, covering the following:

- administration;
- payment methodology;
- payment of links proportionate to their usage;
- Service Level Agreement model;
- models for internal/external meetings coordination;
- definitions regarding contents (e.g. cache and others), and their usage.

Creating a network exchange point

The following shows a model agenda for projects of creating NAPs, with their different stages and objectives.

Agenda model

Defini- tions	30	60	90	120	150	180	210	240	270	300
Days										
a)										
b)										
c)										
d)										

Definitions

- a) Define geographic areas for the installation of NAPs – country, state/province, city, etc.
- b) After the selection defined in a), the diverse actors must be approached, as per case and country, seeking to achieve consensus regarding objectives of interconnection and commercial policies, and last but not least – the definition of the technical project.
- c) Once the issues of point b) have been resolved, and the agreements signed, the installation of the NAPs ensues involving all aspects – equipment, interconnection, security, etc.
- d) Once the NAP is working, there are important factors that involve best practices, which on being implemented ensure that the NAP is successfully operated. To enable this, it is imperative to count on the participation of a support “Tutor” for the operation and administration of the NAP.

Development of infrastructure for the deployment of broadband

There is also a need to evaluate the development of infrastructure for the deployment of broadband and this should be coordinated with both public and private sector projects, as this would achieve greater synergy in the results.

When defining the mapping of fibre optic deployment, the inclusion of the NAPs, as well as the other variables normally considered in these projects, such as geographical accidents, target population, etc., should be taken into account.

This would enable a facilitating method of interconnection with other networks of various operators, since the NAP would perform as a neutral element in this interconnection. For example: if the operator of fibre optic “A” should decide to connect to the operator of Fibre Optic “B”, they must negotiate the corresponding agreements between themselves.

Should a NAP be employed for this purpose, then the operator is connecting to a neutral point wherein conditions are the same for all and where all routes are published.

This model enables the participation of small and medium pISPs. Government could contribute to these projects with some tax benefits, even if on a temporary basis. For example, a tax or municipal levy could be exempted for the first 24 months of operation, as a contribution to its development.

It is also possible to obtain donations from international organizations as regards equipment, which is an important factor during the initial stages of the project. Finally, external consultancy would be of great help.

Generating a regional backbone

It is public knowledge that a large amount of traffic, both intra-country and intra-regional, is channelled through the United States. This happens because although LAC countries have a number of important networks in several countries, there is no interconnection that can reduce this issue.

The solution calls for the creation of one or several backbones, in order to have interconnection rings. Objectively, there could be one each for South America, Central America and the Caribbean, and finally an interconnection between these.

The creation of a LAC backbone would greatly benefit the region with respect to network security, the economy, and greater access to bandwidth.

The following shows an agenda model for a backbone project with their different stages and objectives.

Agenda model

Network infrastructure information is already treated in other part of this project proposal, some other information is necessary for evaluating the interconnection needs for the creation of a backbone. In this sense, it will be necessary to undertake a survey of the best options for each interconnection segment, Country >-< Country, in order to define the best option, it means potential providers and/or the creation

of a new network. In both cases, the costs should be considered for the economic/financial study, as well as the execution schedule. An example of implementation agenda is proposed below.

Defini- tions Days	30	60	90	120	150	180	210	240	270	300	330	360
a)												
b)												
c)												

Definitions

- a) Identify the operating network providers, the interconnection projects or the creation of new fibre optic networks.

Once the countries to be interconnected are defined, the providers of network infrastructure, or the need for creating this infrastructure, must be identified and surveyed. The providers should be asked to submit their economic/financial proposals in all cases.

- b) Evaluation and resolution of contracts

Considering the previous item, the proposals should be studied considering both the economic as well as the technological issues, and then those providers who offer the best options should be selected.

- c) Execution of approved contracts

Begin with the tasks described in the previous item, and undertake follow-ups and audits on them, in order to complete the project on schedule.

It should be noted that the economic/financial support of international organisms could be obtained to ensure the project can be implemented.

Recommendation

Once the two stages of the project have been completed, it will be important, in order to evaluate its success, to use measurement criteria by means of a predetermined protocol. This will establish what improvements have occurred with regards to interconnection, to inbound and outbound regional traffic, as well as the increase of intra-traffic of the various networks. This measurement should be carried out for a period of one year, so that its results can be sufficiently reliable as regards both quantity and quality.

Glossary

3G	Third generation mobile telecommunications
ADSL	Asymmetric Digital Subscriber Line
Backbone	Interconnection of different geographic points, the infrastructure that interconnects a network, providing a path for the exchange of information.
ORBA	Broadband Observatory
CABASE	Argentina Internet Association
DNS	Domain Name System
ICT	Information and Communication Technologies
IDB	Inter-American Development Bank
IP	Internet Protocol
ISP	Internet Service Provider
ITU	International Telecommunication Union
LACNIC	The Latin America and Caribbean Address Registry
NAP	Network Access Point
NRA	National Regulatory Authority
OECD	Organisation for Economic Co-operation and Development
POP	Point Of Presence
PSTN	Public Switched Telephone Network
PTT	Traffic Exchange Point
SLA	Service Level Agreement
SWITCH	Device or Digital Logic Computer Networking
T 1	Tier 1, Identifies a 1.544 Mbit/s link
UNASUR	Union of South American Nations
USB	Universal Serial Bus
VSAT	Very Small Aperture Terminal
WiFi	WiFi Alliance
WiMAX	Worldwide Interoperability for Microwave Access
CEPAL	Latin America and Caribbean Economic Commission

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International Telecommunication Union (ITU)
Telecommunication Development Bureau (BDT)
Office of the Director
Place des Nations
CH-1211 Geneva 20 – Switzerland
Email: bdtdirector@itu.int
Tel.: +41 22 730 5035/5435
Fax: +41 22 730 5484

Deputy to the Director and
Director, Administration and
Operations Coordination
Department (DDR)
Email: bdtddeputydir@itu.int
Tel.: +41 22 730 5784
Fax: +41 22 730 5484

Infrastructure Enabling
Environment and
e-Applications Department (IEE)
Email: bdtiee@itu.int
Tel.: +41 22 730 5421
Fax: +41 22 730 5484

Innovation and Partnership
Department (IP)
Email: bdtip@itu.int
Tel.: +41 22 730 5900
Fax: +41 22 730 5484

Project Support and Knowledge
Management Department (PKM)
Email: bdtkm@itu.int
Tel.: +41 22 730 5447
Fax: +41 22 730 5484

Africa

Ethiopia
International Telecommunication
Union (ITU)
Regional Office
P.O. Box 60 005
Gambia Rd., Leghar ETC Building
3rd floor
Addis Ababa – Ethiopia

Email: itu-addis@itu.int
Tel.: +251 11 551 4977
Tel.: +251 11 551 4855
Tel.: +251 11 551 8328
Fax: +251 11 551 7299

Cameroon
Union internationale des
télécommunications (UIT)
Bureau de zone
Immeuble CAMPOST, 3^e étage
Boulevard du 20 mai
Boîte postale 11017
Yaoundé – Cameroon

Email: itu-yaounde@itu.int
Tel.: +237 22 22 9292
Tel.: +237 22 22 9291
Fax: +237 22 22 9297

Senegal
Union internationale des
télécommunications (UIT)
Bureau de zone
19, Rue Parchappe x Amadou
Assane Ndoye
Immeuble Fayçal, 4^e étage
B.P. 50202 Dakar RP
Dakar – Senegal

Email: itu-dakar@itu.int
Tel.: +221 33 849 7720
Fax: +221 33 822 8013

Zimbabwe
International Telecommunication
Union (ITU)
Area Office
TelOne Centre for Learning
Corner Samora Machel and
Hampton Road
P.O. Box BE 792 Belvedere
Harare – Zimbabwe

Email: itu-harare@itu.int
Tel.: +263 4 77 5939
Tel.: +263 4 77 5941
Fax: +263 4 77 1257

Americas

Brazil
União Internacional de
Telecomunicações (UIT)
Regional Office
SAUS Quadra 06, Bloco "E"
11^o andar, Ala Sul
Ed. Luis Eduardo Magalhães (Anatel)
70070-940 Brasília, DF – Brazil

Email: itubrasilia@itu.int
Tel.: +55 61 2312 2730-1
Tel.: +55 61 2312 2733-5
Fax: +55 61 2312 2738

Barbados
International Telecommunication
Union (ITU)
Area Office
United Nations House
Marine Gardens
Hastings, Christ Church
P.O. Box 1047
Bridgetown – Barbados

Email: itubridgetown@itu.int
Tel.: +1 246 431 0343/4
Fax: +1 246 437 7403

Chile
Unión Internacional de
Telecomunicaciones (UIT)
Oficina de Representación de Área
Merced 753, Piso 4
Casilla 50484, Plaza de Armas
Santiago de Chile – Chile

Email: itusantiago@itu.int
Tel.: +56 2 632 6134/6147
Fax: +56 2 632 6154

Honduras
Unión Internacional de
Telecomunicaciones (UIT)
Oficina de Representación de Área
Colonia Palmira, Avenida Brasil
Ed. COMTELCA/UIT, 4.º piso
P.O. Box 976
Tegucigalpa – Honduras

Email: itutegucigalpa@itu.int
Tel.: +504 22 201 074
Fax: +504 22 201 075

Arab States

Egypt
International Telecommunication
Union (ITU)
Regional Office
Smart Village, Building B 147, 3rd floor
Km 28 Cairo – Alexandria Desert Road
Giza Governorate
Cairo – Egypt

Email: itucairo@itu.int
Tel.: +202 3537 1777
Fax: +202 3537 1888

Asia and the Pacific

Thailand
International Telecommunication
Union (ITU)
Regional Office
Thailand Post Training Center, 5th
floor,
111 Chaengwattana Road, Laksi
Bangkok 10210 – Thailand

Mailing address
P.O. Box 178, Laksi Post Office
Laksi, Bangkok 10210 – Thailand

Email: itubangkok@itu.int
Tel.: +66 2 575 0055
Fax: +66 2 575 3507

Indonesia
International Telecommunication
Union (ITU)
Area Office
Sapta Pesona Building, 13th floor
Jl. Merdan Merdeka Barat No. 17
Jakarta 10001 – Indonesia

Mailing address:
c/o UNDP – P.O. Box 2338
Jakarta 10001 – Indonesia

Email: itujakarta@itu.int
Tel.: +62 21 381 3572
Tel.: +62 21 380 2322
Tel.: +62 21 380 2324
Fax: +62 21 389 05521

CIS countries

Russian Federation
International Telecommunication
Union (ITU)
Area Office
4, Building 1
Sergiy Radonezhsky Str.
Moscow 105120
Russian Federation

Mailing address:
P.O. Box 25 – Moscow 105120
Russian Federation

Email: itumoskow@itu.int
Tel.: +7 495 926 6070
Fax: +7 495 926 6073

Europe

Switzerland
International Telecommunication
Union (ITU)
Telecommunication Development
Bureau (BDT)
Europe Unit (EUR)
Place des Nations
CH-1211 Geneva 20 – Switzerland
Switzerland
Email: eurregion@itu.int
Tel.: +41 22 730 5111



International Telecommunication Union
Telecommunication Development Bureau
Place des Nations
CH-1211 Geneva 20
Switzerland
www.itu.int