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Macro-spatial aspects of the digital backbones network in Latin America

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1 INTRODUCTION

In just one decade, the infrastructure of digital backbones has extended itself at a global scale as a new channel of distribution of digitalised information (texts, sounds and images), superimposing itself on the traditional distribution channels. ICTs are gradually becoming the contemporary equivalent to the maritime and aerial commercial routes of the industrial age. Despite of the critical importance of the configuration and characteristics of this new infrastructure, urban professionals know little about it. The technical character of the networks, the rapid pace of technological change and the continuously transforming business environment in the telecommunications sector have constrained their understanding of this evolving infrastructure.

The general purpose of this paper is to explore and analyse the main features of the telecommunications infrastructures that provide Internet connection in the Latin American metropolises. Under the assumption that the architecture of the digital backbone networks is re-inforcing pre-existing urban hierarchies and spatial differences, this paper seeks to identify and examine how this is happening and what are the main consequences for the urban development of the large metropolises in Latin America.

2 TELECOMMUNICATIONS IN LATIN AMERICA

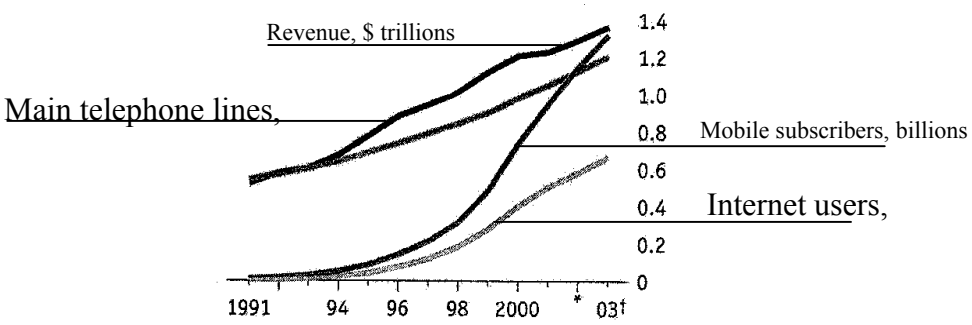
The telecommunications sector has been subject to constant, far-reaching, change since the late 1980s. Thanks to the growing and constant diffusion of ICT networks and devices in homes and businesses, today's world is different from what it was ten years ago. Telecommunications have passed from a relatively unimportant and low-growing sector, to a sector of rapid development and of strategic importance for the economic and social progress of nations. It was transformed from being an industry in itself, to become a vital enabler of all other industrial sectors. The telecommunications sector is currently both the core (major economic activities are mostly information processing and transmitting or depend critically on it) and the infrastructure of the information economy (World Bank, 2000).

During a very short period, the sector was undergone huge transformations that mainly refer to:

enormous technological innovations: Internet and mobile telephony have become pervasive in developed countries and increasingly present in the rest of the world; voice transmission and digital technologies are becoming a single industry; telecommunication networks have been transformed from analogue to digital and from territorially-based local networks to networks with global reach;

changes in the legal aspects: privatisation and deregulation of the telecommunications business; change from a public and regulated utility into a private and highly competitive business run by corporations, mostly of global scale; and uncertainty and instability: from a huge telecommunications hype to the crisis of the sector in a short period due to huge miscalculations, moves and risks taken by the telecommunications firms, that led several large firms into bankruptcy. The main flops refer to network overbuilding, the European 'Third Generation' (3G) spectrum license auctions flop, and the US management scandals and bankruptcies (Shaw, 2002).

Despite the crisis, the telecommunications business is still very profitable. In 1996 the top-ten telecommunications firms earned more than the twenty five largest banks in the world (Alaedini and Marcotulio, 2002). It is estimated that its gross operations margins are of the order of 40% (Nellist and Gilbert, 1999). According to the ITU the revenues of the total industry have reached $1.37 trillion in 2003 (see Graphic 1), while at the same time consumer spending on communications has grown faster than any other household spending (Standage, 2003).



Graph 1: Telecommunications global market 1991-2003 (Source: Standage, 2003, with data from ITU)

In Latin America, the reform and liberalisation of key economic sectors was a central element of the structural adjustment measures imposed during the 1990s. Within them, the reform of the telecommunications companies became a central element of structural change. The Latin American telecommunications reform has tended to follow the ITU formula which has three basic ingredients: (a) privatisation of the sector, (b) free competition and (c) (independent) regulation of the free competition (ITU, 2000). The results are the following:

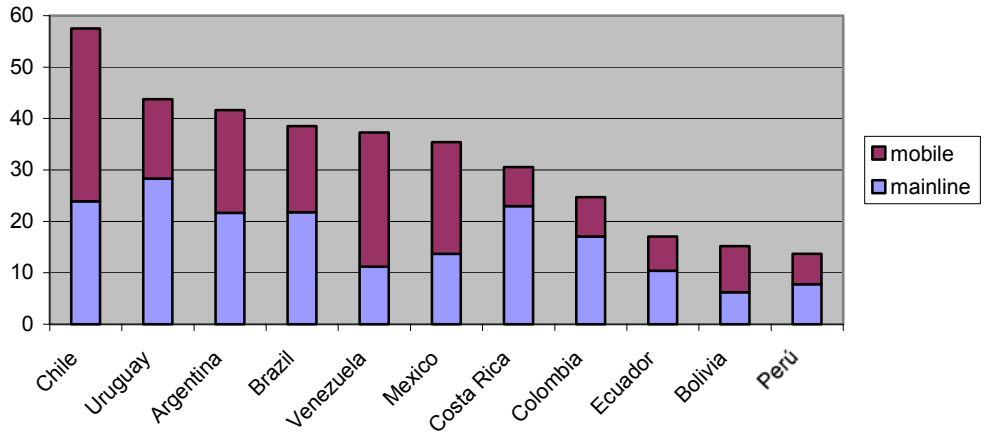
a) More than two thirds of the public telecommunications companies in Latin America have been partially or totally privatised. This is, after North America, the highest proportion in the world. The privatisation attracted large foreign investors, as local investors had not enough capital to buy the former monopolies. Large European and US American companies became the new

operators[7]. The companies that now dominate the telecommunications market are among the largest companies of the region[8], and sometimes the largest of the country, as in Mexico, Venezuela, Chile and Peru (Hilbert, 2001). One of the most dominant among them is Telefonica, which acquired the networks in Chile, Peru, Argentina, and Brazil (São Paulo). European companies focused on buying the former monopolies, while the US American companies, risking much less capital, have preferred to address their businesses to the new segments of Internet and mobile telephony.

b) The opening of markets for competition was, however, not immediate. Most countries granted the new companies a period of exclusivity that varied between four and ten years from the moment of the turning over of the carrier (ITU, 2000). With rising tariffs, the consumers often complain that the public monopoly have become a private monopoly. Even if now most countries allow competition in basic services, the level of competition has remained low. On the other hand, the region enjoys a high degree of competition in mobile and Internet services, segments which do not demand such high investments.

c) Most Latin American countries created regulatory bodies to promote an environment that attracts investment in telecommunications and the spreading of services. But, the institutional profiles of the telecommunications regulatory authorities are as variable as the socio-political and economic environment of the country in which they operate. Brazil and Chile, the countries with the highest teledensity of the region, are also the ones with the most progressive and effective regulators: Anatel and Subtel, the Sub-secretary of Telecommunications of Chile, which is not a special regulatory body but part of the Chilean Ministry of Telecommunications (therefore not an 'independent' regulator). They are both, with Peru, publicised by the ITU as good-practice examples of 'effective regulation' at global level.

Despite the radical reforms and the good practice examples, a closer look at the performance of the telecommunications sectors shows that the reforms have not been enough to benefit the final customers in most countries. A study of Latin American Economic Commission (CEPAL, 2000) points out that even if the sector has modernised itself and its networks, the users have financed the improvements in many cases. On the other hand, even if average teledensity[9] and the quality of the services have increased, the local access prices have generally risen after the privatisation, excluding a great part of the population from the market (ITU, 2000). Graphic 2 shows the levels of fixed and mobile teledensity in Latin American countries in 2001.



Graph 2: Mobile phone subscriber and fixed lines, per 100 inhabitants in Latin American countries in 2001 (Data source: ITU, 2002a)

Investments of telecommunications firms in Latin America have been mainly addressed to two main segments: infrastructure and contents.

Large international operators and independent consortia invested large capitals to provide Latin America with an appropriate infrastructure and to connect it with the US American backbones with a submarine fibre optic network. Nine large projects were executed to provide the region with 170 thousand kilometres of submarine cables, which amounted to US$ 20 billions (Fernandez-Maldonado, 2000). The total submarine cable capacity of South America increased from 13 Gbps in 1999 to close to 400 Gbps in 2001, an increase of 3000% in only two years (Shaw, 2001).

At the same time, there was an aggressive expansion of the telecommunications sector towards content industries (mass media and entertainment industries), considered strategic under the motto: "Content is king". A wave of mergers, mega-fusions, and the buying of the most innovating firms by the giants of the sector followed. The rhythm of mergers and acquisitions was so fast that it was almost impossible to follow all the events in the turbulent telecommunication market. But the global economic downturn and the fall of the NASDAQ in the stock market in April 2000 greatly affected the hegemonic ambitions of the large telecommunications firms. Telecommunications investment has slowed down remarkably since 2002. The business difficulties the Latin American telecommunications sector is experiencing are mainly related to the economic crisis affecting several countries of the region.

[7] The Mexican Telmex is the only large telecommunication company in the region in which national capital is in control of the firm.

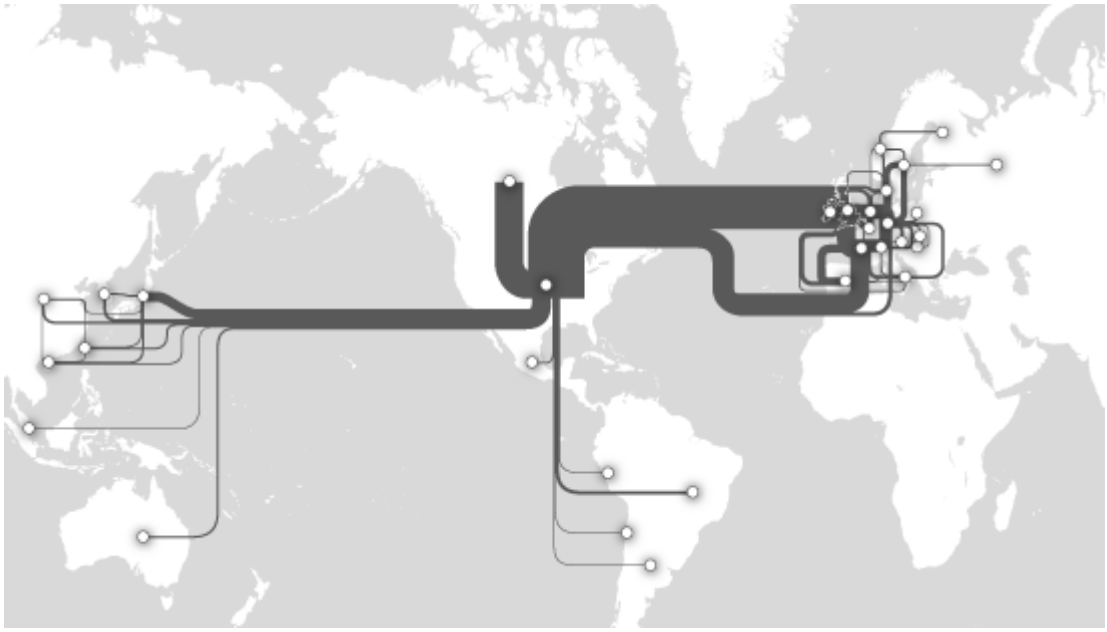
[8] In 1998, 29 of the 100 largest companies in the region were in the telecommunications sector (Callaos, 1999).

[9] Teledensity is the number of telephone lines (or subscribers) per 100 inhabitants.

3 LATIN AMERICA'S INTERNET BACKBONE NETWORK

Because of the Internet's historical origins, its nodality is still concentrated in the U.S. For at least a decade, American companies have aggressively dominated the global telecommunications industry, constructing networks primarily designed to meet the connectivity needs of U.S. businesses (Townsend, 2001a). Much of the development of the Internet has been concentrated within developed countries and major urban agglomerations.

Since the main nodes are located in the U.S., and a good portion of international Internet traffic transits via the backbones that traverse U.S. territory (see Graphic 3). While every region and nearly every country has a direct Internet connection to the U.S., direct connections between other countries have been less common. Furthermore, direct connections between different major regions are weak. The U.S. still serves as a central switching facility for inter-regional data traffic, being used as a transit point for data packets travelling from one major region to another.



Graph 3. Map of major international Internet routes, 2004 (Data source: TeleGeography Research Group – PriMetrica, Inc. © 2004).

Since 1999, this US-centric structure has begun to diminish (TeleGeography, 2000a), along with the huge deployment of trans-oceanic, satellite and terrestrial fibre optic networks, and the emergence of new Internet exchange points (NAPs) in the rest of the world. In Europe, intra-regional traffic is now mostly locally switched, and does not need to go to the U.S. and back. In 2000 some African countries begun to connect themselves with France, rather than the U.S, showing the importance of cultural and trade links for the Internet connectivity [10] (Bartlett, 2001). At the same time, there has been a shifting away from single dominant regional hubs in the U.S., Europe and Asia towards a more diffuse network (Townsend, 2001b). This trend is the result of the massive deployment of digital backbones that have been made in recent years.

Latin America is still dependent on U.S. connections for Internet traffic. The U.S. dependency is not only linked to the configuration of the networks, but also linked to content dependency as U.S.-based companies are the producers of the content of the most visited sites. Although the major Spanish language content producing countries are Spain and Argentina, still many Latin American portals and e-commerce sites house their data servers in the U.S, although this is slowly changing. Until late 1999, most countries still relied on lower-capacity satellite links for their connections to the US backbones (TeleGeography, 2000a). But, thanks to the culmination of several projects of submarine cables in the region, international Internet connectivity to Latin American countries grew 479.2 % in terms in deployed bandwidth between July 2000 and July 2001, from 2.7 Gbps to 16.1 Gbps (Bartlett, 2001, with data from TeleGeography). In 2003, the total regional bandwidth was more than 25 Gbps[11] (TeleGeography, 2003a).

The two largest submarine networks that were implemented in the 1999-2001 period, were E-mergia, owned by Telefónica and the Latin American Crossing, or Global Crossing, respectively (see graphic 4). Surprisingly, both submarine backbones display almost the same layout, being the only differences the connecting points at the Caribbean region. The cities located at the coast have been, obviously, the most favoured by the presence of the new backbones. Colombian cities, for example, are not connected by the Global Crossing trace, but three Mexican cities (Mexico City, Guadalajara and Monterrey) are connected. The increased bandwidth has greatly improved the performance of the networks in all Latin America. The backbones are currently lightly loaded, but there is still congestion occurring at the last mile.

[10] However, the TeleGeography 2001 study concluded that 80 % of international capacity in Asia, Africa and Latin America is still using U.S. backbones.

[11] The final capacity of these two rings is in Terabytes per second (one Terabyte equals thousand Gigabytes), so there is a huge installed capacity.

Graph 4. The E-mergia network (www.e-mergia.com) and Latin American Global Crossing (www.globalcrossing.com/xml/network/net_map.xml)

As Internet expands it becomes clear that large telecommunications carriers are competing to provide infrastructure and services on an end-to-end basis within private networks (OECD, 2002). In this new scheme, MCI, France Telecom and Telefónica are the dominant regional networks in Latin America. Other companies that have developed their own backbones and links to the U.S. during the past few years are AT&T, Latin America, Bell South and IBM. These trends confirm that the operation of the digital Internet backbones in Latin America is a matter of a few large telecommunication companies, of US or European origin. In this context, Telefónica appears as one of the most important players, with incumbent networks in several of the largest cities and operating networks at all levels of the Internet infrastructure. In this new infrastructural system that is constantly expanding, the metropolises represent then the locations where most of the components of the new system are located. Castells (2001) states it in few words: "*The Internet is a network of metropolitan nodes*."

4 THE METROPOLISES AS NODES IN THE DIGITAL BACKBONES NETWORKS

There are different ways to analyse the position of the cities regarding the Internet infrastructure. The simplest is just to measure connectivity (bandwidth) to international backbones. One of the most comprehensive is that advanced by the MOSAIC group (Wolcott, et al., 2001), which evaluates nations according to three main variables: (a) the (national and international) capacities of the backbones, (b) the number of Internet exchange points, and (c) the local connectivity: the type of access networks to end users.

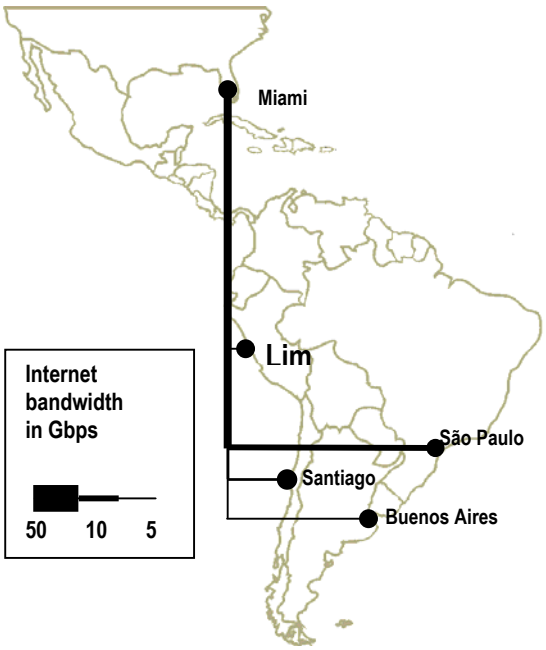
4.1 Backbone capacity

Connectivity indicators for metropolitan areas show that Latin America's Internet geography has a strong relation with the traditional hierarchy of its system of cities. However, as the networks are in constant evolution, the ranking of these node cities, those with the highest Internet connectivity, changes from year to year although it always remains among the same largest metropolises. Graphic 5 shows the main Latin American metropolises in the global Internet infrastructure, those with more than 5 Gbps of capacity in 2003: São Paulo, Santiago, Buenos Aires and Lima. Not surprisingly, these four cities constitute the most important nodes in the fibre-optic rings that circle the region.

If one pays attention to the evolution of the connectivity since 1999, one can see the huge growth in connectivity in the year 2001. The evolution of the position of cities in terms of bandwidth connectivity in the 1999-2003 period, shown in Table 1, illustrates how dramatically the bandwidth picture and the position in the ranking has changed between these years. The cities that benefited most from the increase of connectivity are clearly those that have a coastal location. The 2003 ranking shows that three of the four main cities have high urban primacy. Due to these new powerful connections, Mexican cities have decreased their position in the ranking.

Ranking	1999 (in Mbps)	2000 (in Mbps)	2001 (in Mbps)	2002	2003
1	São Paulo (284,2)	Mexico City (749)	São Paulo (4984)	São Paulo	São Paulo
2	Buenos Aires (146)	São Paulo (566,6)	Buenos Aires (4017)	Buenos Aires	Santiago
3	Mexico City (136)		Mexico City (2182)		Buenos Aires
4	Rio de Janeiro (123)		Santiago (1770)		Lima
5	Caracas (96,8)		Monterrey (1077)		
6	Monterrey (79)		Rio de Janeiro (1029)		
7	Santiago (47,3)		Caracas (433)		
8	Lima (38)		Lima (412)		
9	Bogotá (12)		Bogotá (312)		

Table 1. Top Latin America Internet hub cities in the 1999-2003 period (Data sources: TeleGeography 2000b; TeleGeography, 2001; ITU, 2002b; TeleGeography 2003a; TeleGeography 2003b; respectively)



Graph 5. Latin American metropolises in the global Internet in 2003 (Data source: TeleGeography, 2003b)

When one sees how the metropolises are connected, the U.S. centeredness appears clearly again. Table 2, showing the major Internet traffic routes, illustrates this. It is not São Paulo, but Miami the largest Latin American hub, with 7825 Mbps bandwidth to Latin America in 2001 (Shaw, 2001). New York, with 2003 Mbps, Dallas, with 1546 Mbps, and Los Angeles, with 975 Mbps, have also a position within the 2001 ranking of cities, although they are obviously not located in Latin American territory. Miami's link with Latin America improved greatly since the opening of the NAP of the Americas in its territory in the year 2000. Before that date, New York was the main Latin American hub (TeleGeography, 2000a). This geography reminds us that the Internet geography is still very dependent on the US networks.

Origin	Destination	Bandwidth (in Mbps) in 2000
São Paulo	Miami	3384
Buenos Aires	Miami	1455
Mexico City	Dallas	1340
Buenos Aires	Santiago de Chile	824
Buenos Aires	New York	698
Buenos Aires	São Paulo	666
Monterrey	Los Angeles	656
Santiago de Chile	Miami	503
São Paulo	New York	475
Rio de Janeiro	New York	378

Table 2. Major Internet traffic routes in 2001 (Source: Shaw, 2001)

However, thanks to the improvements in the networks, Internet connectivity between Latin American countries grew at the impressive rate of 2500 % during the 1999-2001 period (ITU, 2002b). This implies that a more diffused Internet infrastructure is also developing inside the Latin American region. In the new Internet geography that would be emerging, São Paulo would be becoming a major hub for international traffic exchange in the Latin American region (ITU, 2002b). The connectivity analyses of the Latin American cities reveal the importance of the size of the cities, their geographic location, their urban primacy and their relative importance in the global telecommunications market. This ratifies the trends to concentration already observed in other world regions.

4.2 Network Access Points

The architecture of the Internet backbone is made of many smaller networks, joined at key locations called, Network Access Points (NAPs), also known as Internet eXchange points (IXPs) or Metropolitan Area Exchanges (MAEs). They are physical installations created by third parties to facilitate interconnection between independent ISPs that aim to be a neutral meeting ground for ISP traffic exchange (TeleGeography, 2000a). Exchange points constitute an asset for the cities that count with them, because as points of local exchange, Internet traffic can be directed to a multiplicity of routes. Without a NAP, carriers have to route local and intra-regional traffic first to the international backbones and then back to the region or city, which is more expensive and inefficient. The importance of an exchange point depends of the number of ISPs involved and the peering between members (Drewe, 1999).

In 2002 there were 155 NAPs in the whole world, from which 51 in U.S. and Canada, 57 in Europe, 36 in Asia and Pacific, 10 in Latin America and 2 in Africa (TeleGeography, 2002a). Latin America had 13 Network Access Points (NAPs) in 2002, located in the largest metropolises: Buenos Aires, Mexico City, Santiago, Bogota and Lima. São Paulo concentrates four of them, from which three began to operate in 2001. There is also one in Panama City, Porto Alegre, Monterrey and Guadalajara.

4.3 Local connectivity

Local connectivity depends on the access networks (the so-called 'local loop') that get to the end users. The analyses of last mile connectivity are highly relevant for urban planners, since they are "the material basis for the 'death of distance'" (Graham, 2001:405). To have a good picture of the local connectivity attention must be paid to three main elements: (a) the basic networks, (b) high-speed (broadband) networks and (c) Internet data centres.

a) Data flows can travel through four main types of lines:

copper lines (used for the last mile),

coaxial cables,

powerful fibre optics (generally used in the backbones), and

wireless (microwave radio or satellite)

With the advent of digital networking, the architecture of the telecommunications networks at local level began to modify itself. To change from transporting voice flows to digital flows, they transformed themselves from hierarchical bundles of copper and coaxial cable into complex and inter-locking rings of optical fibre (TeleGeography, 2002b). The new telecommunications networks are now hybrids of different kinds of wires. Optic fibre is reserved for the backbone network since it is too costly to deploy it up to the last mile.

Globally, the traditional telephone line is by far the most common way to get connected to the Internet. In Latin America, most Internet access, both business and residential, is via dial-up too, so flows basically run locally over the telephone wires. But, since the telephone network was designed to carry voice flows, when it has to carry packet-switched flows, it becomes a low-speed network. For this reason, the local loop is generally a bottleneck, since the total end-to-end capacity of the network is obviously equal to the capacity on the 'weakest link'. It is possible to make it a high-speed network, by changing the transmission circuits and switches: the digitisation of the networks. In all the Latin American metropolises the fixed-line networks have been steadily expanded along with the digitisation of the networks, in a process that generally followed the privatisation processes. Most large cities have now a level of total digitisation or are close to reach it. As the incumbent carriers have the legal duty to provide connection to any metropolitan company or household (TeleGeography, 2001), telephone networks reach all the neighbourhoods of the city.

b) In developed countries bandwidth is slowly becoming cheaper and broadband networks are becoming popular, although the diffusion varies according to the particularities of the locations. The most used technologies are co-axial cables networks (the so-called cable modem), and DSL (dedicated copper lines). The operators are then the cable TV networks owners or the telephone companies. Other broadband technologies are more expensive and/or technically difficult to install. This includes the wireless networks, fibre-to-the-house (FTTH), and WiFi (Wireless Fidelity). WiFi is a very auspicious developmentthat is still in early phase, but operational in the main hot spots of the large cities. Broadband technologies have been used in Latin America since 1998, but their initial growth was slow due to high costs and technical problems. According to the 2002 ITU database the ranking of countries according to the availability of broadband is topped by Chile, followed by El Salvador, Argentina, Venezuela, Mexico, Brazil, Costa Rica, Guatemala and Peru (World Economic Forum, 2003:301).

Broadband growth has been spectacular in the countries with more affluent customers: Brazil, Mexico, Argentina and Chile. For example in Chile, high-speed connections grew at a 162% rate between March 2001 and March 2002, accounting for 217 thousand connections, from which 49.7% were cable modem and 38.7% DSL (Subtel, 2003). Analysts forecast a total of 1.2 million DSL users in Latin America at the end of 2003 (61% of them in Brazil) and 720 thousand cable modem users (30% of the in Mexico) (NUA Internet surveys, 2003). However, forecasts are generally tricky. The high price of these services (not less than $40 per month) makes it unaffordable for most people, so the ceiling of the market might be reached before analysts' expectations.

Even if the metropolises are the locations that enjoy a greater variety of overlapping high-speed digital networks, not all areas are equally connected to high-speed networks, only the business, media and elite districts, in a process that Graham (2001) denounces as the filtering of local connectivity. One the one hand, there exist firms that offer optic fibre to final users to those companies for which a good global connection is fundamental for the conduction of their operations. Despite that residential consumers are not such an important market, optic fibre networks have been reported in the exclusive enclosed neighbourhoods and condominiums that have emerged in some of the large metropolises.

The most wired spaces are evidently the business districts of the globally oriented cities, where multiple carriers compete to offer their services. According to the last strategy of data flows in private networks, these firms networks produce a typical example of 'glocal' infrastructural by-passing[12], avoiding contact with the local networks, sending and receiving the digital flows almost directly to and from the outside world. In other words, a process of global connections and local disconnections (Graham, 2001), which is also increasingly observed at differing social levels through the emergence of gated neighbourhoods in the Latin American cities.

c) Collocation and Internet data centres (IDCs), also called carrier hotels, server farms, web hotels, or telecom hotels, are also important digital facilities. They are a new urban facility that emerged as a result of the need of inter-connection in locations other than NAPs. It houses switches, routers and servers, providing floor space, power and network connectivity to institutional servers and suppliers of content. Clients can be large carriers, medium-sized ISPs or small dotcom companies, which rent space according to their needs. Data centres develop two main types of businesses: shared or dedicated hosting (renting of the technology: hardware, software and technical assistance so that the companies can have their servers in the centre) and housing or collocation (renting of the physical space, plus security and cooling systems) (Jurado, 2001). For technical reasons they need

[12] Local by-pass refers to the deployment of a parallel infrastructure network that connects valued users and places while it bypasses non-valued users and places within a city. Glocal bypass does the same but connecting local users and places with global circuits (Graham and Marvin, 2001).

to be located near abundant bandwidth, so its preferred location is in metropolitan nodes, near the connection to the high-speed backbone cables, close to the highest (business) demand, and with easy access to physical transportation (Graham, 2001).

These facilities grew explosively in cities of the U.S. and Europe until mid-2001. The end of the dotcom boom and the telecom crisis has made its growth less dynamic since then. But, the growth of these data centres has had clear spatial consequences for the cities involved. Large telecom carriers and specialised companies have recently built several data centres in the large metropolises of the region. These new facilities have improved the possibilities for good routing within the networks. Until a few years ago, the largest dotcom firms that provided content to the Latin American cyberspace were hosted in U.S. locations, since high-quality web-hosting did not yet exist in the region. But the connections had poor performance. The new submarine cables that began to operate in the region during 2000 and 2001 have made high bandwidth available and motivated new companies and existing carriers to construct web-hosting facilities. A report by the Phillips Group found 43 operational data centres and collocation facilities only in Brazil, Argentina and Chile in 2001, of which 28 were carrier-based (owned or linked to large regional carriers) (The Phillips Group, 2001).

5 CONCLUDING REMARKS

At macro scale, the current Internet topology in the region has a well defined structure that provides clear advantages to the large metropolises of the region, their main nodes. The key-components of the infrastructure international backbones, the NAPs, data centres and a variety of broadband technologies to transmit the information flows are almost exclusively located in these metropolises. As the metropolises largely concentrate the Internet connectivity, the other cities tend to link directly with them, producing an architecture of 'hubs and spokes' around the largest agglomerations, which generally have national reach. This suggests that the current Internet backbones' topology would be reinforcing the traditional primacy of the large cities.

On the other hand, in those countries with a less centralised urban system (Brazil, Mexico, Colombia, and Bolivia) a lesser degree of concentration in a singular point is observed. The networks tend to follow the pattern of their corresponding urban system, being monocentric networks in the case of countries of high primacy, and more diffused in the case of countries with a more balanced urban system. In these cases, the concentration is observed in few points. Mexico's proximity to the US networks has favoured its early connection to the Internet backbones, and facilitated a more diffused distribution of direct links to them.

Due to their huge capacity, the optic fibre rings that surround the Latin American region play a fundamental role in the regional Internet infrastructure. In this emerging geography, coastal locations acquire a double importance as nodes. Because of the expensive costs of deploying fibre-optics lines, port cities are favoured spots for the location of the main components of the Internet infrastructure. The most important connecting points in both networks – Miami, Rio de Janeiro, São Paulo, Buenos Aires, Santiago and Lima – have become the more consolidated nodes. The main node of activity in the Latin American Internet infrastructure is undoubtedly Miami, which through the years has acquired a privileged position as the gate to the U.S. businesses, tourism and immigration flows for Latin Americans. This regional familiarity with Miami has been translated into its new role as main gate to the U.S. backbones for Latin American traffic.

It is considered unlikely that the domination of Miami as Latin American hub will change in the near future, given that the macro-architecture of the Internet networks generally reflects the cultural and trade links among countries and regions and between them. The analyses of traffic routes between Latin American cities have confirmed this for the Latin American backbones. Those cities located closer to the U.S., and which, traditionally, have stronger commercial and cultural ties with the U.S., show less intra-regional traffic than the cities located in the Southern Cone (Mercosur countries), which have stronger economic links with each other, besides their traditional links with European countries. This suggests that the São Paulo-Buenos Aires axis might develop as an important regional hub in the long term. Initial trends in that sense have been observed, but it remains still uncertain to which extent will they consolidate.

Despite the fact that the spatial distribution of the Internet infrastructure does not differ radically from the commercial sea routes used for exports and import of products, a big difference does exist. The traditional advantage of Atlantic coast locations, more closely located to the great world markets disappears in the case of digital traffic flows. In this new network geography, distance becomes irrelevant, although location remains important.

The increase of the telecommunications demand in the secondary cities of the region will lead eventually to a more diffuse configuration of the regional network as more locations get connected with each other. However, due to the particularities of the nature of the networks the present structure will not change dramatically. Once the main spatial structure of a network has been deployed within a specific geographical space, no matter of its size, further changes and upgrades in the system will hardly affect its main overall shape - location of nodes, trunk connections and traffic flows (Goussal and Udrízar, 2000). Indeed, great portions of the global Internet infrastructure have been already completed and there exists a great installed capacity in the main lines of regional backbone networks. A more diffused network morphology may develop in the future. But, if intra-regional links will consolidate or not depends upon the local demand and on the political willingness of the governments involved.

At the local level, the overall situation of the ICT infrastructure in the lareg metropolises is satisfactory, since there is basic coverage in all neighbourhoods, which allows households and businesses to have access to telephone and Internet services. But if in the technical aspects, Internet access is widely available, effective access is a matter of economic affordability and in this regard, the privatisation of the networks has not represented an improvement from the previous situation for those households with low incomes, which in Latin America represent great portion of the urban residents. On the other hand, high-speed networks provide access in home and work to the economic elite. Poor residents do not have access at work since they work in low-skilled and informal jobs, and they have very limited possibilities for home access due to the high costs involved in domestic connections. The commercial-financial centres are highly privileged in terms of connectivity, with several layers of fibre optic layers, depending on the position of the city in the world economy. The deployment of premium networks in business and residential areas represent typical examples of local and glocal infrastructural by-passing.

These issues highlight the important role played by large telecommunications firms in the new geography of nodes that has emerged in the last years. Outside the full awareness of urban professionals, large telecommunications firms have become important agents of urban change during the last decade. The decisions about the location of the nodes and the number and direction of the links are, for the most part, in the hands of these private firms and are decided according to agglomeration economies and other 'imperatives' of the business world (Malecki, 2002), and with disregard to regional, national or local priorities. Equally important are the telecommunications policies, which are determined at national level. Townsend (2004) argues that the national telecommunications policies, become de facto urban policies, since those decisions taken on telecommunications issues (as the licensing of spectrum, regulation of new technologies) generate profound effects on urban economic development.

Evidently, the position of a city within the global backbones is of great importance for the attraction of foreign firms and foreign investments, as well as for the smooth link of the urban economies with the global economy. This leads to two other important issues: competition and dependence among cities. It is clear that the networks deepen these two processes. On the one side, the visible trends to concentration demand the cities a competitive attitude of urban marketing, which has little significance for the solution of the urgent problems that affect urban residents in Latin America.

On the other side, multiple links and relationships constitute a great advantage in a context of rapid technological advances and economic instability, which demand a fast reaction and adaptation to new situations. Additionally, the evolution of the regional backbone towards a more decentralised configuration through the emergence and deepening of links among the cities of the region holds many promises. In the context of regional integration, the Internet backbone network can play a great integrating role connecting locations according to their cultural and economic interests.

But despite the advantages that the Latin American metropolises have regarding the technical infrastructure of the Internet, the social contradictions of the metropolises are also reproduced in the field of telecommunications. To tackle this unfavourable situation, different programmes for universal access have been launched in the region, sometimes under an umbrella programme, sometimes as fragmented small scope policies addressed to different target groups (school students, low-income groups, isolated communities. Public funded national programmes have been implemented in Brazil, Chile, Peru, Ecuador, Colombia Venezuela, Argentina, Uruguay and more recently Mexico, with mixed results.[13]

At local level, the best example is the one of the government of the State of São Paulo, which has carried out an effective programme to provide Internet access in poor areas through Infocentros, the so-called *Acessa São Paulo*. There were 72 state Infocentros in São Paulo's peripheral neighbourhoods (plus 105 municipal Infocentros) and 69 in other municipalities of the state in May 2004, giving online courses to 20 thousand people (see http://www.acessasaopaulo.sp.gov.br/).

The bottom line is that the large metropolises which are the main nodes in the new Internet infrastructure, have abundant and cheap international backbone capacity that is underused. As such they constitute the best places for the location of the most advanced firms in the new economic logic, and in general for the integration of their local economy into the global. This constitutes a strategic advantage for the metropolises at macro level, but the situation is not the same at urban level, where only premium locations enjoy these infrastructural advantages. Progressive and innovative urban and telecommunications policies are urgently needed to extend this fundamental asset to the less favoured locations of the metropolises.

[13] The national connectivity programmes that stand out because of their effectivity are the ones of Chile, Brazil, Colombia and Venezuela.

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