"Wireless Broadband Access for Latin America"

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Abstract

In this paper we present the potential adoption alternatives and patterns in Latin America for wireless broadband. We review both WiFi as a potentially inexpensive but still quite deficient technology and third generation cellular services which are considerably more expensive. In order to help us understand the adoption patterns for Latin America this paper uses the patchwork adoption framework (Garcia-Murillo, 2003). Which argue that great income, educational, and technological disparities have led to a patchwork adoption of technology. Taking into consideration those disparities as well as the technological differences between cellular based data networks and WiFi we present a model that helps us determine how these two technologies will diffuse in Latin America. Using a the simulation software Ithink®, we predict that both third generation technologies and WiFi based technologies will coexist but, given the income disparities, we will see the more expensive one diffusing at a lower rate than the least expensive ones.

1 Introduction

Voice connectivity in Latin America is predominantly achieved through wireless technologies. The wired infrastructure was under resourced, poorly maintained and rarely upgraded. Because of this, after liberalization, the fastest and least expensive way of providing connectivity to the region was through cellular phones. While cellular telephony facilitated quick access to voice communication it is now facing an important challenge as the region moves toward connecting to the Internet through fast broadband networks. The problem nonetheless is that the current wireless network will require significant upgrades in order to support data. If this is not done various segments of the Latin America population will likely be on the wrong side of the digital divide.

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In this paper we present the potential adoption alternatives and patterns in Latin America for wireless broadband. We review both WiFi as a potentially inexpensive but still quite deficient technology and third generation cellular services which are considerably more expensive.

In order to help us understand the adoption patterns for Latin America this paper uses and further refines a theoretical framework used before by García-Murillo on patchwork adoption (Garcia-Murillo, 2003). The framework's main idea is that Latin America as a region cannot be categorized as being all on the wrong side of the digital divide. Instead the great income, educational, and technological disparities have led to a patchwork adoption of technology where the wealthy can adopt and have adopted state of the art technology even before most people in developed nations, there are also many other poorer segments of the population for which adoption patterns are much slower or even non-existent.

Taking into consideration those disparities as well as the technological differences between cellular based data networks and WiFi we present a model that helps us determine how these two technologies will diffuse in Latin America. We predict that both third generation technologies and WiFi based technologies will coexist but, given the income disparities, we will see the more expensive one diffusing at a lower rate than the least expensive ones.

2 Patchwork adoption framework

This framework was originally suggested by García-Murillo (Garcia-Murillo, 2003). In this paper we readdress the issue to help us determine the adoption trends for wireless broadband technologies.

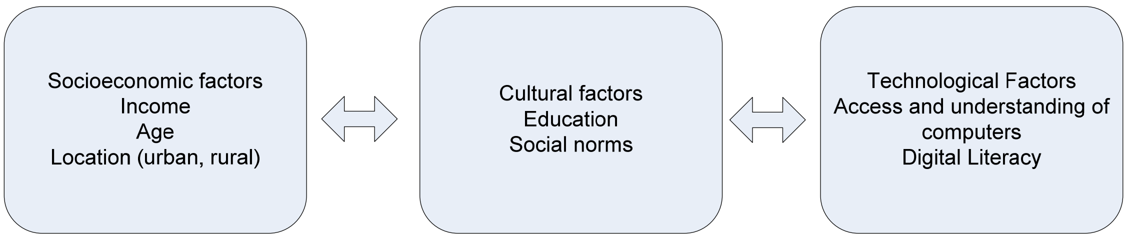
The literature on adoption has generally assumed a certain amount of uniformity in the population. They take into consideration the fact that there are some individuals that are more amenable to technology and will tend to adopt technology much sooner than those who have averse feelings toward innovations (Rogers, 2003). Other diffusion theories (Adams, 1992 {Davis, 1989 #144) (Hendrickson, 1993)} concentrate on the features of the technology instead of on the attributes of the individuals that determine adoption. Thus problems of adoption are identified as being problems with technology rather than people.

In this paper we argue that technology adoption will vary not only because of the technological preferences or the technological attributes of an innovation but also because of socioeconomic, cultural (ie. education and social rituals) and technological factors that can lead to pockets of adoption and non adoption in any given country.

While not necessarily focusing on issues of adoption, a recent book published by the International Development Research Center entitled "Digital Poverty: Latin American and Caribbean Perspectives" (Petrazzini, 2007) recognized the fact that the digital divide is an issue of poverty and inequalities in society which can leave some segments behind in the information society.

Figure 1 shows that factors have dual causality effects. While income affects educational opportunities these in turn affect income. Similarly while education affects digital literacy, lack of digital literacy can undermine educational opportunities.

Figure 1 Factors that lead to patchwork adoptions



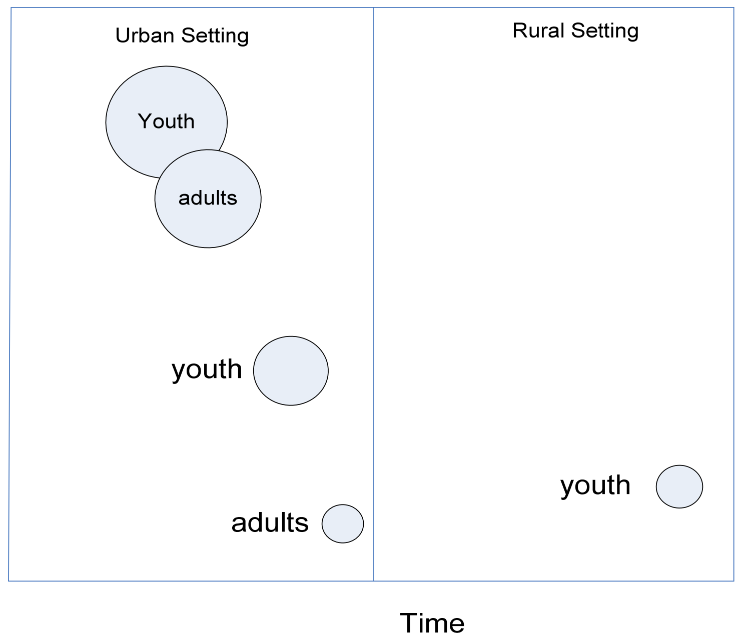
Because in Latin America there are such great inequalities in each of these three sectors technology adoption for different segments would occur, we expect, at different rates for different segments.

The urban and rural wealthy are likely to have access and the material assets necessary to adopt state of the art technology. The young population in this segment is thus in tune with the developments that are taking place around the world. These are digitally literate individuals who are active global participants through the use of international information networks. In addition this youth, given their privileged status, are likely to also be fluent in English, the predominant language of the Internet.

Because of the close interrelation between income, education and technology we use "wealthy" to refer to those who have high income, are highly educated, and have a high digital literacy. Those who do not have these characteristics are defined as poor.

Figure 2 thus presents a scenario of the type of adoption that we expect to see in diverse populations such as those in Latin America

Figure 2. Illustration of patchwork adoption



Note: Larger diameters indicate larger segment adopting

3 Context

There are several things that make adoption of technology in developing countries distinct from in developed countries. First the distribution of the population is different. Instead of having several large and medium cities with relatively developed rural communities in developing countries there are usually a few mega cities with many isolated and severely underdeveloped rural areas. In developed nations there are large middle classes with small segments of the very wealthy or poor. In developing nations there are few wealthy individuals, a small middle class, and many poor people. Income distribution also gives rises to differing access to education. Once again there is a segment of the population that can afford technologically sophisticated private education. The same group of people enjoys connectivity and computer access at home while many segments of the population have limited access to technology and public schools rarely integrated access to these networks. Large megalopolises are densely populated with all of the basic services while rural areas lack these services.

It is also important to recognize that income and education have an impact on the way the population uses telecommunications services. While in developed countries people have access to computers and broadband connectivity, in Latin America the communication device is the mobile phone. Given the size and speed limitations communications happens through prepaid voice or text messaging. In order for adoption to occur, technology needs to be introduced taking into consideration the social and cultural traits of the population.

In this paper we do not examine the micro level cultural and social factors that affect adoption but rather the macro factors that lead to the patchwork adoption of technology, in this case wireless broadband.

In order to understand how broadband is likely to be implemented and adopted in Latin America it is important to recognize the great differences that exist between the poor and the wealthy in the region. These differences are present in urban settings but of course they are more pronounced when the comparison is made with rural communities.

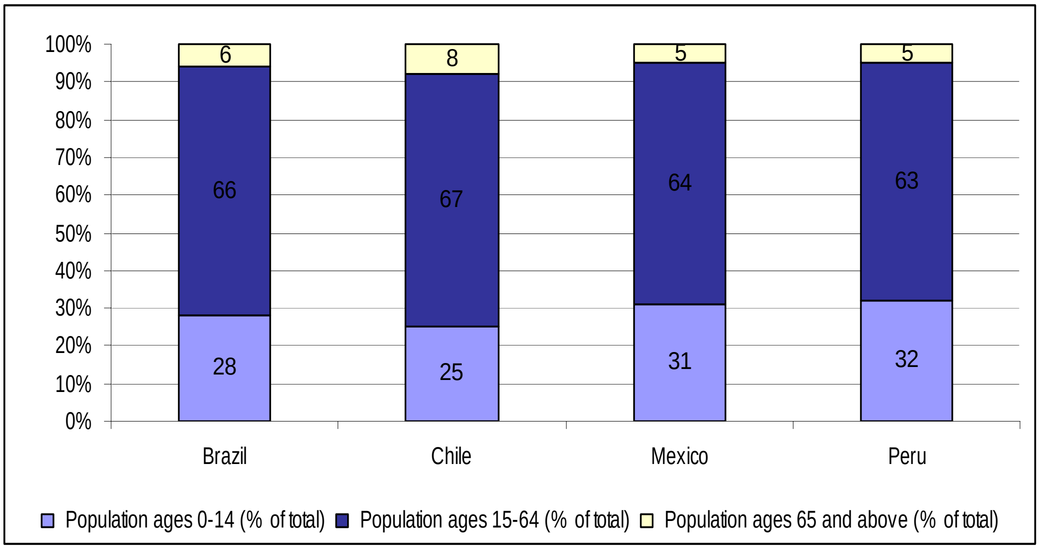
Socioeconomic issues, including access to basic services, educational, and technological differences need to be addressed because these are all factors have been found to be related to adoption patterns (Sundqvist, Frank, & Puumalainen, 2005).

3.1 Socioeconomic differences

Socio economic factors that can have a role in the process of adoption are income and age.

One of the great differentiators between developed and underdeveloped nations is the age composition. While in developed nations the population has been declining and older adults make up the largest percentage of the population. In Latin America the age composition is still considerably young. Figure 3 presents the age composition of the four countries under study.

Figure 3. Age distribution in Latin America



Source: (World Bank, 2007)

A large percentage of the population are children while seniors are a small minority. An adoption strategy that focuses on work or professional related applications will have less appeal among this young population.

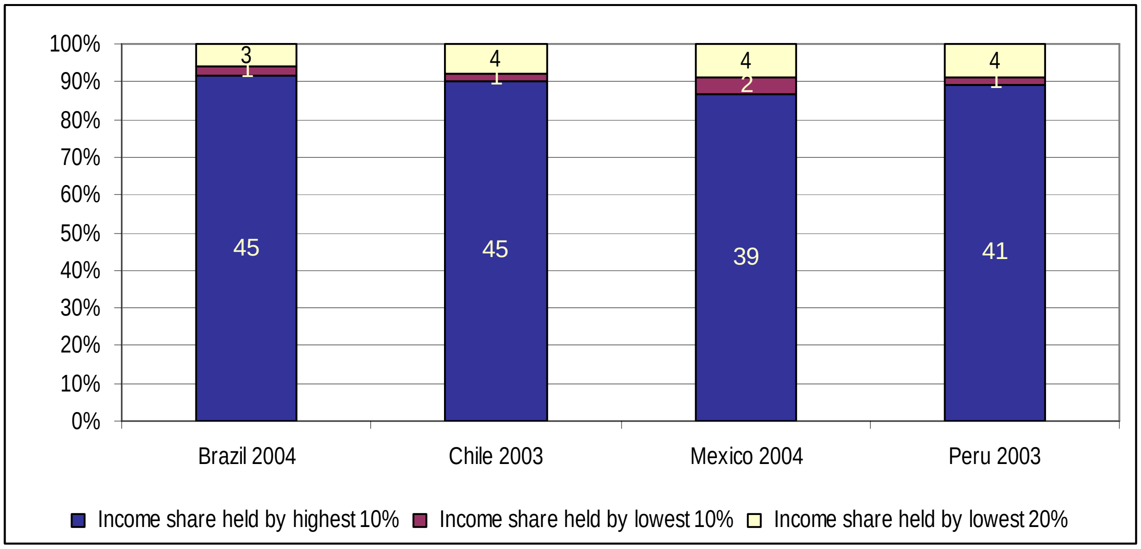
When talking about technology adoption a young population should be considered an advantage given that young people are more willing to tinker with devices and are more likely to experiment with technology. Young people are also much more socially inclined than older adults whose professional and family obligations may limit, compared to their younger counterparts, the amount of communications that they may want to do via voice or data.

However even though young people can more easily learn about technology income can be an important limitation and this is one of the great disparities that lead to different patterns of adoption within a country.

Among this very young population there are great instances of unemployment. The lack of employment opportunities contributes to the great income disparities. In the four countries under study the percentage of unemployment among youth between the ages of 15 and 24 is 18%, 7%, 7%, and 21% for Chile, Brazil, Mexico, and Peru.

Income disparities in the population is made clear by the distribution. As can be seen in figure 4, 30% of the population perceives not much more than 5% of the total income while 10% of the population perceives more than 40% of the total income. This wealthy section of the population has an adoption rate that is similar to the adoption rate in developed countries. It would not be surprising if this segment of the population in Latin America is among the earliest adopters in the world as they have the means to afford the latest technologies.

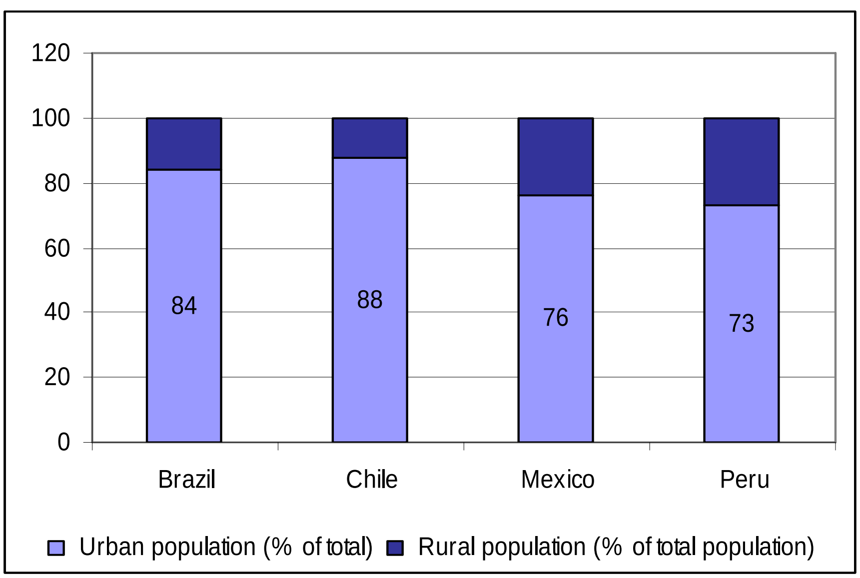
Figure 4. Income disparities



Source: Own development data from the World Bank

It is also wrongly perceived that Latin America has large populations in rural areas. Contrary to that belief much of the population resides in urban centers where the adoption patterns between the poor and the wealthy differ. While many efforts to increase connectivity in the region have identified about rural communities, there is an equally challenging problem when one looks at the huge concentrations of populations in urban centers that have large pockets of abandonment for many services including connectivity.

Figure 5. Population distribution

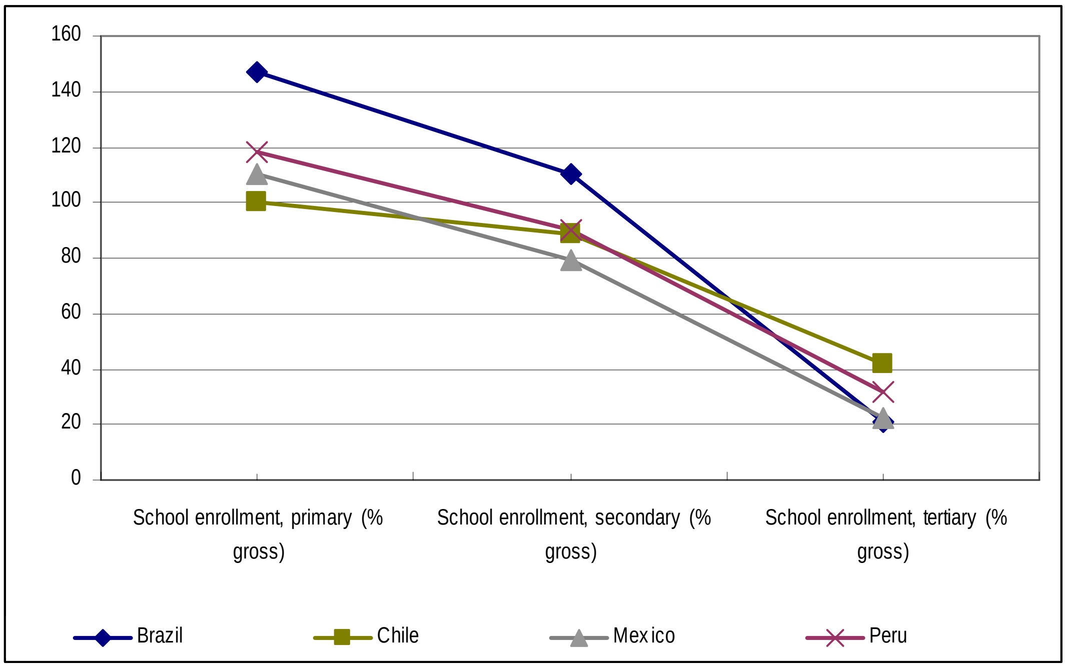


Source: Own development data from the World Bank

3.2 Cultural Factors

The literacy rate in Latin America is close to 100%. This means that the adult population—15 years of age or older—can read and write. Most students finish primary education; about 80% of them continue to secondary education and about a third go on to pursue a bachelors' degree. In high income countries the percentage of enrollment in tertiary education varies between 60 and 80% which is about twice the enrollment in Latin America.

Figure 6 shows the progression of enrollment



Source: Own development data from the World Bank

While there is still much progress to be made on the educational level, governments do recognize that access to the Internet is important for education and many efforts have been made to try to provide connectivity. These efforts are just beginning but much progress has been made. The most recent data from the World Bank indicates that penetration of computers at primary and secondary schools is around 50% in these four countries. It is generally more common to have computers in secondary schools than in elementary ones. This means that young people are able to have access to the Internet through their schools.

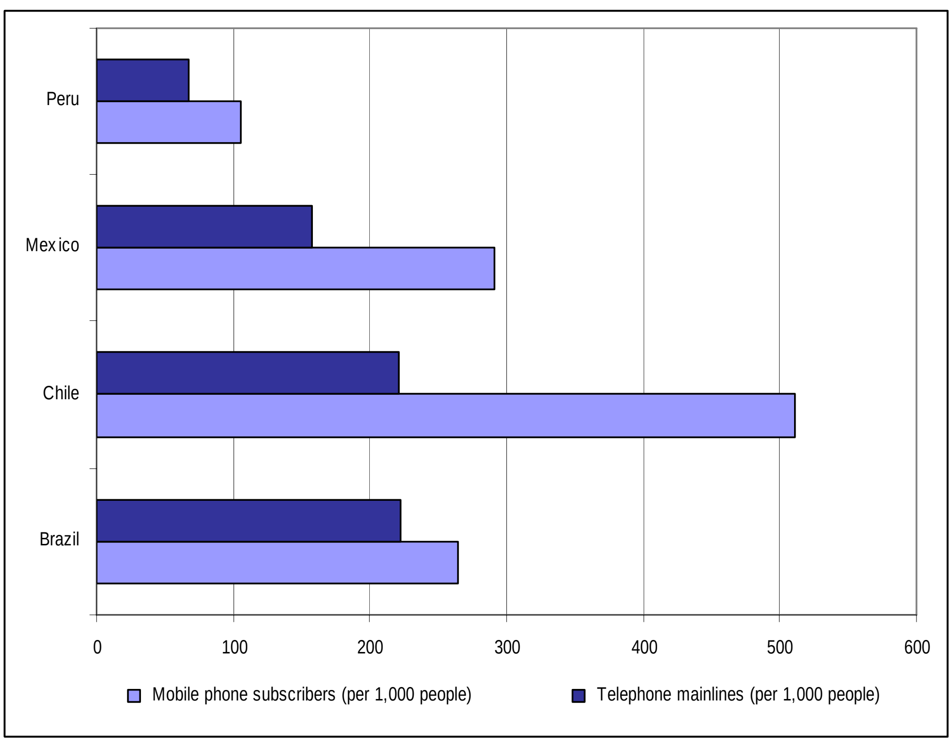
With respect to the cultural traits of Latin American Internet users, a recent study by the Venezuelan consulting company Tendencias Digitales indicates that Internet users who read blogs are interested in entertainment, technology, news, and personal experiences. This is clearly in tune with the youthful demographics that are prevalent in the region. At the same time many Internet users in the region access videos through YouTube and Google. In Chile, for example, the study reported that Internet users connect to the web to read and write blogs, to watch videos, to play online games and to post photos {Tendencias, 2007 #83}.

Given that a large percentage of the population is quite young they are likely to be familiar with Internet technologies and the applications that are available through this network. With the desire to access videos the demand for broadband will increase as more and more people obtain access to the network.

3.3 Technological factors

In Latin America wireless connections exceed wired lines. In the four countries that we are focusing on for this study this is certainly the case. Figure 7 shows that in each of these countries the wireless infrastructure dominates . In the case of Chile wirelines are almost tripled by wireless. In Mexico and Peru the wireless doubles wireline. Only in Brazil are the two types of infrastructure almost equal. This means that even when the copper lines are upgraded to be able to provide ADSL or only a small percentage of the population will have access to it.

Figure 7. Wireless and wireline infrastructure 2003



Source: Data from the World Bank

Cable, an alternative infrastructure for broadband, has also developed slowly in Latin America. In the four countries that we focus on in this paper none of them exceed 20% penetration according to the most recent information. It is thus not surprising to see ADSL as the dominant wired access to broadband networks in the region.

Broadband through the wired infrastructure will reach a limit and once again the region will find itself in a situation where the demand for broadband access is greater than what is available. This is in part the reason why the wireless infrastructure grew so high so quickly and there is thus an opportunity for wireless providers to upgrade those wireless networks to provide fast speed data access.

In addition to the wired infrastructure limitations, there are also equipment limitations. The mobile phone is the most prevalent communication equipment in the region. Initially we believed that internet access through third generation networks would be difficult given that 3G technologies require 3G phones and these devices are quite expensive, from $300 in the used market to $800 for new equipment. Given this limitation and the income levels of the population it is clear that Internet access over mobile phones will be unlikely. However companies in the region have upgraded their networks to offer higher bandwidths that can be accessed through network cards that can be connected to computers. These cards are more affordable and access through a computer will offer greater flexibility to the users.

Computers will continue to be an obstacle to access as approximately 10% of the population owns a computer. This means that independent of the technology use of broadband will happen through school, work, or public computer centers. Given this deficiency a large number of Internet users in the region access the Internet in public places such as cyber cafés or telecenters {Tendencias, 2007 #83}.

4 Wireless broadband technologies

There are several wireless technologies that have been adopted and will probably be deployed in Latin America. The cellular technologies deployed could be divided in the following two branches: GSM/GPRS/EDGE/UMTS/HSDPA and IS-136 (TDMA), IS-95 (cdmaOne), and IS-2000 (CDMA2000). The non-cellular technologies that are interesting to consider are WiFi and WiMAX. WiFi is a technology that has gained acceptance especially in the residential market, but there are a few WiFi hotspots available in commercial hotspots in Latin America. On the other hand, WiMAX is promising technology that could be used to offer data and voice services in areas with no telephony or data access. The next subsections describe technical aspects of these four technologies.

4.1 GSM/GPRS/EDGE/UMTS/HSDPA

The 2G Global System for Mobile Communications (GSM) wireless system was designed as a pan-european digital cellular system in order to improve the different 1G cellular systems that had been deployed in Europe in the 1980s. GSM has enhanced voice quality and much more secure voice transmission than the 1G systems. GSM offers users voice with a good quality, but it was also designed to offer data transmission services such as fax, SMS, and 9.6 kbits/s data transmission. GSM can operate in the following frequency bands: GSM-450, GSM-850, GSM-900, GSM-1800 and GSM-1900.

GSM is now the most widely deployed cellular system in the world. GSM is a mature technology that operates in Europe, the Middle East, Africa, Asia, and the Americas.

General Packet Radio Service (GPRS) is a 2.5G wireless system that works on top of GSM and can be considered an upgrade of GSM. Whereas GSM is a circuit-switched technology in which a user receives a time slot with a maximum data transmission rate of 9.6 kbits/s, GPRS is a packet-switched system that enables a transmission at a data rate of up to 171.2 kbits/s. GPRS makes two main modifications to the GSM system: it changes the GSM radio interface and adds new nodes to the GSM fixed network section.

In the radio interface GPRS can work in a multislot mode, which means that GPRS can use the eight timeslots available in a GSM frequency channel. GPRS adds also three new coding schemes to the CS-1 coding scheme of 9.6 kbits/s of GSM: CS-2 with 13.4 kbits/s, CS-3 with 15.6 kbits/s and CS-4 with 21.4 kbits/s. There are then four coding schemes available in GPRS. By multiplying the transmission rate of CS-4 (21,7 kbits/s) by 8 (8 timeslots), the maximum data transmission rate is obtained: 171,2 kbits/s.

In the fixed network section two new nodes were added: serving GPRS Support Node (SGSN) and Gateway GPRS Support Node (GGSN). The SGSN node is a packet-switching node that controls the GPRS calls. The GGSN node is in charge of connecting the GPRS users with external packet data networks such as the Internet.

Enhanced Data Rates for GSM Evolution (EDGE) and Enhanced GPRS (EGPRS) can be considered 2.75G systems that work on top of GSM and GPRS networks. EDGE implements a multislot capacity and defines new coding schemes that work with the 8 Phase-Shift Keying (8PSK) modulation. By using the coding scheme 9 (MCS-) that permits 59.2 kbits/s in all the eight timeslots, a maximum theoretical data rate of 473.6 kbits/s is achieved. Moreover, EDGE used a technique called “incremental redundancy” that is not found in GPRS and that increases the probability of correct decoding by transmitting more redundancy information.

Universal Mobile Telecommunications Systems (UMTS) is a 3G wireless cellular system that works with the Wideband Code Division Multiple Access (W-CDMA) air interface. In order to deploy UMTS, a new W-CDMA air interface needs to be installed from scratch because the GSM/GPRS air interface can not be reused. In this sense, a new base station, called Node B in the UMTS nomenclature, has to be installed. The GPRS nodes GGSN and SGSN are used in the fixed network section of UMTS. UMTS permits a data transmission rate of 2 Mbits/s.

Together with High Speed Downlink Packet Access (HSDPA), UMTS can offer a maximum theoretical transmission rate of 14.4 Mbits/s. HSDPA is considered a 3.5G system. HSDPA uses the following techniques: Adaptive modulation and coding (AMC), fast packet scheduling and an Hybrid automatic repeat-request (HARQ) scheme.

4.2 IS-136 (TDMA), IS-95 (cdmaOne) and IS-2000 (CDMA2000)

IS-136 is a 2G wireless cellular system that is based on the Time Division Multiple Access (TDMA) technique. Several carriers in the world adopted IS-136 but in they last years they started migrating to GSM/GPRS and to Cdma2000 in order to implement a 2.5G cellular system. IS-136 is an upgrade of the IS-54 system, which is based on the 1G wireless system Advanced Mobile Phone System (AMPS). IS-136 is also known as Digital AMPS (D-AMPS) and has a transmission data rate of 9.6 kbits/s.

Interim-Standard 95 (IS-95) is a 2G CDMA system with the brand name of cdmaOne. The IS-95 standard describes the air interface with the definition of the Physical (PHY), Medium Access Control (MAC) and Link Access Control (LAC) layers.

CDMA2000 is a 2.5G/3G system that was standardized by 3GPP2 and that improves the IS-95 system. CDMA has the following standards: CDMA2000 1xRTT, CDMA2000 EV-DO (Evolution-Data Only) and CDMA2000 EV-DV (Evolution-Data/Voice).

CDMA2000 1xRTT basically made modifications to the IS-95 radio interface and its deployments have a limited peak rate of 144 kbits/s. Depending on the modality used, CDMA2000 EVDO has data rates of 2,4Mbits/s and 3,1 Mbits/s in the downlink. Finally, CDMA2000 EV-DV offers a downlink transmission of up to 3.1 Mbits/s.

4.3 WiFi

WiFI is a wireless technology based on the IEEE Ethernet 802.3 Local Area Network (LAN) technology that was modified to take into account a wireless interface. The Wireless LAN (WLAN) standard was created and it was named IEEE 802.11. WiFi defines a new physical and data link layer. WiFi works in the 2.4GHz and 5GHz bands. There are several WiFi standards but the most widely known standards are 802.11b and 802.11g. The 802.11b standard offer a theoretical maximum rate of 11 Mbits/s, whereas the 802.11g standards offers 54 Mbits/s. In both cases, the range can be around 80-100 meters.

WiFi is a successful technology because the WiFi equipment (a router) is simple to install and the price is affordable in residential environments. Moreover, many laptops include a WiFi antenna.

4.4 WiMAX

Worldwide Interoperability for Microwave Access (WiMAX) is an IEEE 802.16 standard that defines new Physical and MAC layers. WiMAX offers data and voice services and it needs a Base Station in order to offer the service in a cell. In a point-to-point transmission, the range of WiMAX can reach up to 30 miles with a throughput of 72Mbits/s for the whole cell.

WiMAX is simpler to deploy and operate than a cellular network and could be a helpful way to offer data and voice services in rural and suburban areas in Latin America that still do not have access to telephony and data services.

5 Simulation

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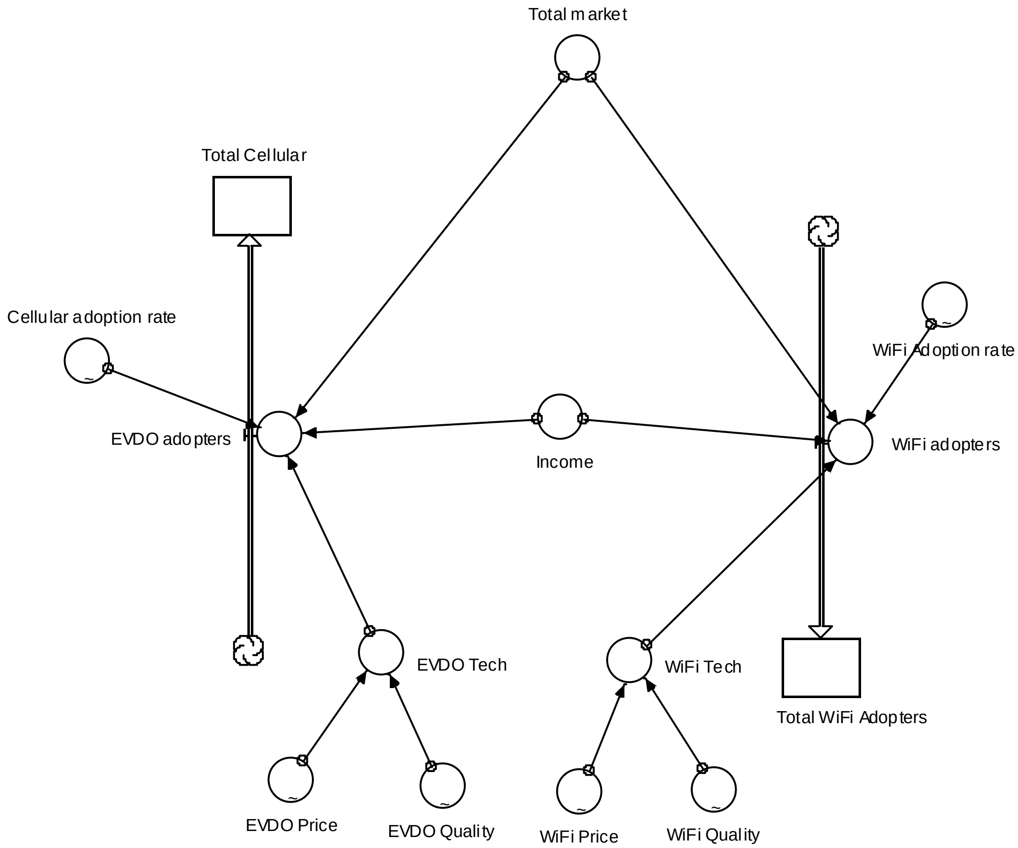
It is common in academic research to write about regulation and technology after the fact. This is because it is much easier to obtain data and then evaluate the outcomes. This type of analysis is important and useful because it helps to identify both failures and successes of the process. There is nonetheless also a need for work that will provide some guidance for the future although, understandably, this approach is riskier and more prone to errors. The data is extrapolated into the future from which there is no certainty.

For this paper we used a modeling software called iThink® to help us determine the diffusion patterns of cellular based technologies such as EDGE and EV-DO as well as WiFi. The model, as a simplified version of the real world, is imperfect but we hope it captures some of the most important elements of the way that adoption can happen.[1]

This preliminary model includes two of the three components described in the previous section, technological and economic factors. The model also combines the cellular based technologies into one and contrasts them with WiFi. The reason why we combined the two cellular technologies is because of the great similarities between them and the little difference that the user perceives between the two of them. Figure 8 shows the adoption model.

Figure 8. Model for cellular vs. WiFi adoption for broadband access

[1] We welcome feedback on the model and would be grateful for any suggestions by other authors that have used this modeling software. [[necessary?]]



The model includes the total market share, the expected adoption rate for each of the technologies, and the technological and economic factors.

The model assumes that cellular based technologies are substitutes of WiFi broadband access. Because of this, the model initiates with a total **market share** of 100% from which WiFi and Cellular broadband access will take a portion based on the income and technology parameters.

The adoption rate varies between cellular and WiFi. Because of the price differences between these two technologies we expect that the adoption rate of cellular will be closer to that of the Internet in these countries while the adoption rate for WiFi, we assume, will be similar to second generation cellular. We expect 3G broadband access to be similar to the Internet because the monthly cost is higher than what we expect WiFi access to be. We thus use second generation cellular as the proxy for the WiFi adoption rate.

Technology is a combined variable that includes quality and price. Table 1 has a formula that combines price and quality with each given a weight. We assume that, for the most part, individuals will put greater weight on price than quality. The former receives a weight of 7 on a ten point scale, while the latter is weighted at 3.

The price variable is represented through a graph for both technologies. We assume that over time, as adoption increases, the costs for the provision of these services will go down and thus the price. For both technologies the initial price is the price that currently prevails in the region for these two services. The price for 3G access is simulated to decline from $120 to $95 while the price of WiFi decreases from $25 to $22 over the course of the simulation.

Quality variable is represented on a scale from 1 to 10. In general to determine the quality rate for these two technologies we considered four factors: reliability, speed, security, and convenience. Reliability is determined by the amount of time that the system is up and available to the user. The speed is the throughput in kilobytes that data is sent through the two networks. Security is measured by the probability that the network could be hacked and pose a threat to the user, and convenience is determine by the geographic availability of the network. In general we believe that cellular based technologies are more reliable, safer and more convenient than WiFi given that these networks are more pervasive and users can connect from almost any urban location. WiFi, although inferior in those areas, does offer higher bandwidth than 3G services.

As a dynamic model, it assumes that quality for both will improve and, while initially we have 3G cellular services rated at 7, we expect it to increase to more than 8 while quality for WiFi is expected to increase from 4 to 7 over a 5 year period.

Table 1 shows the formulas and explanations for the different variables of the model

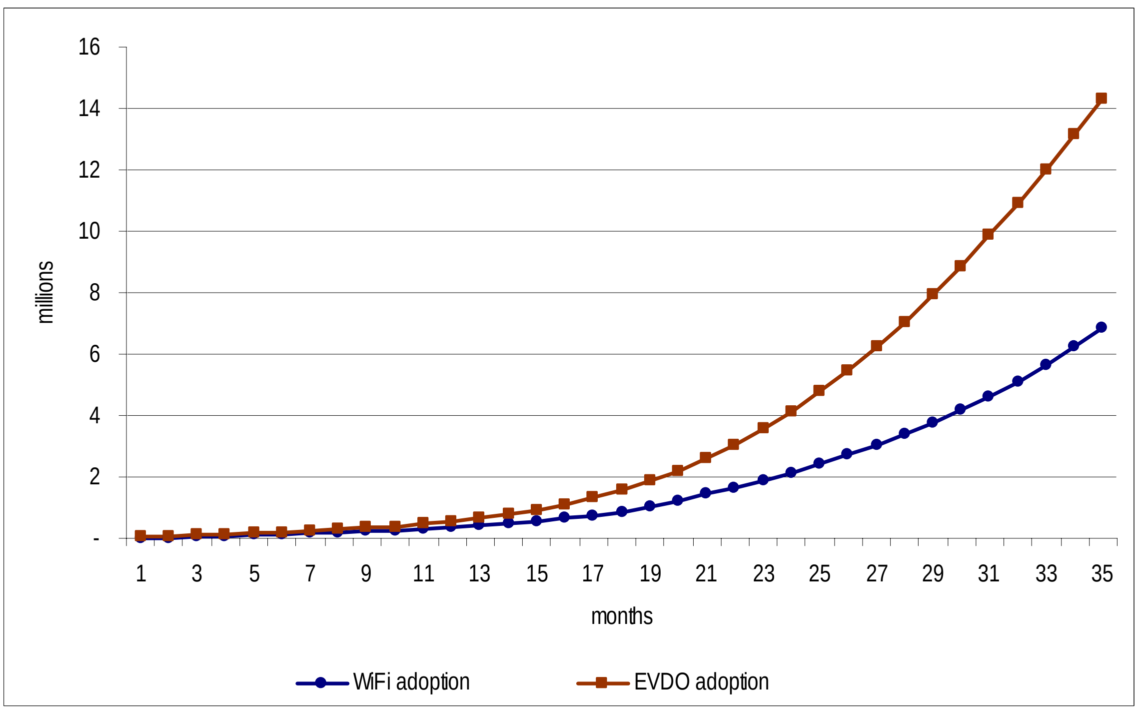
Table 1. Definition of model components

Model Component	Formula	Explanation
3 G cellular adopters		Rate of adoption based on economic and technological conditions
WiFi adopters	IF(Income <1200) and (WiFi_Tech <20) THEN (WiFi_Adoption_rate* Total_market) ELSE 0	WiFi rate of adoption based on economic and technological conditions
3G Technology	3G_Price*.7+ 3G_Quality*.3	Composite variable that combines the price and quality variables
WiFi Technology	WiFi_Price*.7+ WiFi_Quality*.3	Composite variable that combines the price and quality variables
3G Price	This was represented through a graph that begins with the current price of $120 a month and declines over a 36 month period to $95	Current price for the 3G cellular services
WiFi Price	This was represented through a graph that begins with the current price of $25 a month a declines over a 36 month period to $22	Current price of the technology
3G adoption rate	The adoption rate is a graph that simulates the adoption rate for the Internet	Adoption rate trend based on Internet adoption of the last 10 years
WiFi adoption rate	The adoption rate is a graph that simulates the adoption rate for cellular	Adoption trend based on 2nd generation cellular adoption
3G quality	This is represented also through a graph that begins at a rate of 7 and	The quality variable is assessed on a 1 to 10 scale

	increases to 8.7 over a 36 month period	
WiFi quality	This is represented also through a graph that begins at a rate of 4 and increases to 7 over a 36 month period	The quality variable is assessed on a 1 to 10 scale
Income	Income is represented as a constant and it is varied throughout the simulation	Income is the average monthly income

The simulation developed for this paper is a simplified model that captures only the technological and economic factors. Figure 9 shows the pattern of adoption for both 3G and WiFi technologies. It is clear from this simulation that both technologies will coexist as people with high income levels will be able to afford 3G access while the more affordable WiFi will have greater appeal among poorer segments even with the quality problems of this technology.

The simulation software first determines which technology will be adopted based on the criteria specified. Thus the first decision is whether, given certain economic and technological preferences, an individual will choose WiFi over cellular. Once that decision is made the system calculates the adoption rate.



5.1 Policy implications

Regulation and policy in Latin American nations tends to be reactive. This is not necessarily bad as most technological developments come to the region at a slower pace than in developed nations. However there are many pressures for regulators from major corporations that will try to delay or impede the implementation of technologies that cannibalize more profitable markets. Regulatory decisions are thus made with great pressure from these carriers.

In addition there is a strong pressure to connect rural communities and many efforts have been made through universal service programs to offer connectivity to these isolated areas. There are, however, many segments of the population that live in urban areas, who could potentially have access to the Internet but, because their income level, lack of computers and computer literacy, they have had limited opportunities to take advantage of these networks.

The simulation reflects this pattern of adoption. The more expensive cellular technology will evolve but the market will be limited given the cost of connection. In fact many of the companies that are offering the service now target the business segment alone for this broadband connectivity.

The simulation predicts that WiFi will have a greater uptake mostly because of the lower price that it exhibits. People can connect to the Internet through WiFi in restaurants and cafés either for free or at a lower rate than the cellular option.

The patterns of adoption mimic the income differences and, based on this patchwork adoption, regulators and policy makers should recognize these differences and implement programs that target urban populations. A one size fits all approach to connectivity will not be enough to alleviate these deficiencies. There is a need for policy that takes into account the demographics of the nation, the lack of connectivity at home, and facilitates not only access at reduced rates but also opportunities to learn about the Internet and the types of services and opportunities available. Clearly young people can learn quickly and they will explore the network to satisfy their personal interests but they should also be made aware of the educational opportunities, government services, and career sites that can help their academic or professional life.

Potentially government and companies can partner to offer training and access at lower rates. Regulators, also, in spite of the pressure from established carriers they should provide opportunities for less expensive technologies to flourish. Creative solutions have been developed in the region by operators such as purchase of computers from telecom operators at reduced prices that can be paid in installments.

Because of the way technology is adopted in less developed countries, regulation for the sector needs to take into consideration differences to make sure that these segments of the population are not left behind. For example, there should be policies to ensure that the urban poor are able to get access to these services. This can be done through school and community centers or, in the case of the rural dweller, through the use of spectrum that does not disproportionately benefit the cities while the rural areas are ignored. One of those policies could be twinning, the granting of spectrum licenses that require provision to rural areas in addition to cities.

6 Conclusions

In this paper we explore wireless broadband adoption in Latin America. This is an important issue that both regulators and operators are facing given that today connectivity through high bandwidth methods are becoming increasingly necessary. Both of these entities need to realize and utilize the strengths and weaknesses of the population to foster use. Unlike the rural areas where the main problem is lack of any type of connection, in urban areas the main problem is lack of technology literacy skills, income, and access to computers.

The high income differences allow the adoption of state of the art technologies such as 3G wireless but, in the presence of less expensive options there is also another segment of the population that can access those networks, mainly WiFi in commercial establishments. More importantly there is also a sector that will not be able to take advantage of these networks at all. In the absence of policies that target these isolated urban pockets there will continue to be a lack of resources to access these networks.

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