BRAUDEL PAPERS

Document of the Fernand Braudel Institute of World Economics Associated with the Fundação Armando Alvares Penteado - N. 47 2013

Poor strategy weakens progress

The Internet in Brazil

Peter T. Knight

South Gama

Editor's note: *Most of the readers of Braudel Papers make use of the Internet in their daily lives, without knowing how it works or understanding its achievements, its economic and technological challenges, and its role in the evolution of Brazil's society. Peter Knight, who has studied Brazil's development for almost five decades, seeks to explain.*

The Internet is a great invention of the 20th Century that is changing the civilization of the 21st Century. Its power grows with the fiber optic cables that are now the nerves of the world economy. No other technology permits greater speed of transmission nor generates greater economies of scale at such a low cost as fiber optic cables. Thanks to this worldwide system of storing, organizing and sharing information, 90% of the data that exists in the world today was created over the past two years. This enormous flood of data is expected to double every two years through 2020.

The Internet has become the world's most important means of processing information, comparable to the invention of the printing press with moveable type by Johannes Gutenberg, which expanded access to the printed word and the horizons of human knowledge since the 15th century. In that time paper and ink were fundamental. Today the physical means of communication are fiber optic cables, supplemented by satellites and terrestrial wireless technologies. Extending over land, under oceans or in space, together they are creating the basic infrastructure of the 21st century.

Fiber optic cables and the rapidly expanding processing power of computers are reshaping our economy. Packets of information, data, text, voice and image are sent over these cables, reduced to zeros and ones transmitted over the Internet using TCP/IP (Transport Control Protocol/Internet Protocol) Combined with other information and communication technologies (ICT), the Internet is a tool with multiple uses that strengthens economic and social development as well as political participation. More and more, all forms of electronic communication – including telephony, Internet, radio and television – are being transmitted over the Internet on fiber optic cables.

Brazil has to move fast to accompany these developments. The Internet's growth in Brazil is being encouraged by federal, state and municipal governments, multinational companies in large and medium-sized cities, and small Internet service providers (ISPs) that I call broadband pioneers. These small ISPs have played an important role in digital inclusion of the population, including in remote areas of the country and that face many challenges.

Pioneers in Amazônia

To build their business, young Internet entrepreneurs in Amazônia reach neighboring communities via radio links from high towers with equipment powered by solar panels. Building these towers can require transporting equipment and tower components over very difficult dirt roads, using small pickup trucks, as well as barges and boats on the myriad rivers of the rain forest. Many of these providers are pioneering young people in the most connected age groups, between 18 and 24 years old.

Continued on page 3.

Peter Knight *is a founding member of the Fernand Braudel Institute of World Economics and former chief economist for Brazil at the World Bank.*

Fernand Braudel Institute of World Economics
Associated with Fundação Armando Alvares Penteado (FAAP)
Rua Ceará, 2 – 01243-010
São Paulo, SP – Brazil
Tel.: 55 11 3824-9633
e-mail: ifbe@braudel.org.br
www.braudel.org.br

The author would like to thank Eduardo Carvalho, Geraldo Coen, Michael Stanton and Vinton Cerf for their technical support.

Braudel Papers is published by the Instituto Fernand Braudel de Economia Mundial

ISSN: 1981-6510

Editor: Norman Gall
Designer: Givanilson L. Góes
Assistant: Nicolas Tavares

The Future of the Internet

Vinton Cerf

Forty years have passed since the first drafts of the Internet design were written. Much has happened since that time, but we now will focus on the future. In this article I will discuss scenarios for mobile computing and education.

Mobile devices are accelerating development of access and applications. Mobile infrastructure is expanding everywhere. Speeds and functions multiply as faster processors, more memory and improved display technologies enhance these platforms. Cameras, microphones, speakers, sensors, multiple radios, touch-sensitive displays, and location and motion detection continue to evolve and open up new application possibilities. Standards and open source software facilitate widespread adoption of applications. What is perhaps most significant is that these smart devices derive much of their power from Internet access. The Internet, cloud computing and mobile devices are mutually reinforcing to launch new businesses and create new economic opportunities.

Ubiquitous computing and education

Mark Weiser, a chief scientist at Xerox PARC in Silicon Valley, coined the concept *Ubiquitous Computing* in 1988. He meant several things by this term, among them the notion that computers would eventually fade into the environment, operating everyhere. Entertainment devices; cooking appliances; automobiles; medical, environmental, and security monitoring systems; our clothing; and our homes and offices would house multiple computing engines of various sizes and capacities. Many, if not all, would be interconnected, responding to demands of users. Weiser's vision is rapidly being realized today.

Such systems can include tens to hundreds of billions of devices. Managing complex interactions at such magnitudes will require powerful hierarchical and abstracting mechanisms. Since our mobile society will lead to a constant background churn of devices forming subsets in homes, offices, automobiles, and on our persons, the challenge is daunting. Self-organizing mechanisms, hierarchically structured systems, and systems that allow remote management and reporting will play a role in managing the Internet.

For further insight into this evolution, consider the position location capability of the Global Positioning System (GPS). Even small, low-powered devices (such as mobile devices) can locate themselves if they can access satellite transmissions. Adding to this capability is geo-location that uses mobile cell towers and ,public Wi-Fi locations. Appliances such as *Google Glass* are also entering the environment. They are wearable computers that hear, see,and respond to gestures and spoken commands. Google self-driving cars offer another glimpse into the future of computing, communication, and artificial intelligence. Computers will become our partners in a common sensory environment – one that is not limited to human senses. All these systems can use networked information and computing power unparalleled in history. The systems are potentially self-learning. They improve over time and may communicate among themselves, cooperateing on a scale never before possible.

We can now see the outlines of a potential future in which virtually all knowledge can be found for the asking; in which Internet applications continue to evolve, becoming part of an integrated and global environment. Our daily lives are likely to be filled with information and data gathered from many sources and subject to deep analysis, benefitting individuals, businesses, families and governments. Public health and safety will be influenced by these trends.

In 2012, two of my Google colleagues used the Internet to teach an online class in artificial intelligence under the auspices of Stanford University. They expected about 500 students, but 160,000 people signed up for the course! We call such classes "MOOCs" (*Massive, Open, OnLine Classes*). Of the 160,000 who signed up, something like 23,000 actually completed the course. How many professors of computer science can say they have successfully taught 23,000 students?

There are costs, but they are borne in part by students and in part by the university. Among thse costs are for Internet access, equipment, multicast or similar capability and salaries of professors and teaching assistants. Sometimes ,professors prepare online lectures that students can watch as many times as they want, whenever they want. Professors then hold classroom hours that are devoted to solving problems, an inversion of typical classroom usage. This idea could expand to include non-local teaching assistants.

What is potentially different about MOOCs is *scale.* Interaction and examinations are feasible in this online environment, although the form of exams is somewhat limited by the capabilities of the online platform used. Start-ups are using these ideas.

People who are currently employed also can take these courses to improve their skills and position themselves for new careers. From young students to retired workers, such courses offer opportunities for personal growth, and they provide a much larger customer base than is usually associated with university or college programs. These classes can be seen as re-invention of the university, the short course, the certificate program, and other forms of education. This has the potential to change education at all levels and provide new options for those who want or need to learn new things.

The dark side

To the generally optimistic and positive picture of Internet service must be added a realistic view of its darker side. The online eviroment and the devices we use to take advantage of it are filled with software. Unfortunately programmers have not discovered how to write software free of mistakes and vulnerabilities. It is becoming clear that the hazards of using computers and being online have come to the attention of democratic as well as authoritarian regimes. There is tension between law enforcement and the desire of citizens for privacy and freedom of action. There are disputes over what protections the law should guarantee. Balancing these tensions can be difficult, having to do with the content and uses of of the Internet.

Abuses are widespread and alarming. Fraud, sexual stalking, harassment, misinformation, incitement, theft, operational interference, and a host of other abuses have been identified. Efforts to defend against them are often stymied by lack of jurisdiction, especially across international borders. We will continue to debate these problems well into the future.

The world that lies ahead will be immersed in information that embodies extremely deep analysis and management. Artificial intelligence methods will permeate the environment, aiding us with smart digital assistants that empower our thought and our ability to absorb, understand and gain insight from massive amounts of information.While we have new tools with which to think, we still need to use them to distinguish sound information from unsound, propaganda from truth, and wisdom from folly.

Vinton Cerf *is widely known as a "Father of the Internet". He was co-designer of the TCP/IP protocols that govern packet information flows and of the basic architecture of the Internet. He is currently Vice President and Chief Internet Evangelist of Google. This article was adapted from "Looking Forward" by Vint Cerf, published in The Internet Protocol Journal, Vol. 16, No. 2, June 2013.*

This essay will raise three questions:

• Why is the development of high-speed Internet connectivity and mobile voice, data and video services critical for Brazil's development in the 21st century?

• Why do Internet connectivity and mobile telephony (voice, data, and video) services cost so much for such low quality compared with other countries?

• What can and is being done to improve these services and reduce their cost to consumers?

The huge increase in the processing power of chips, and the devices that contain them (computers, tablets, smartphones, etc.), has drastically reduced the cost of transmitting, processing, and storing data, making them cheaper and more accessible throughout the world. Communication based on the Internet protocols is rapidly substituting the older technologies and the business models based upon them.

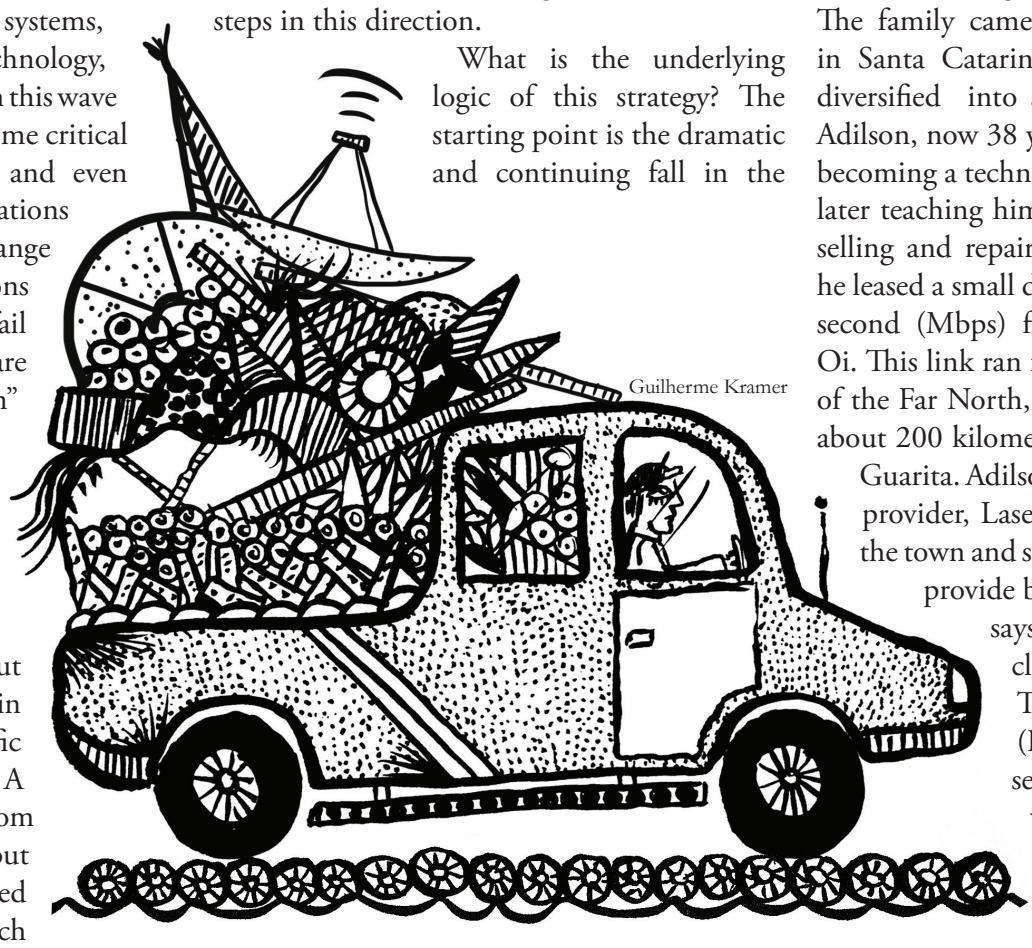
Strategic connections

Change is so rapid that institutions have been unable to keep up. Advanced systems, such as biotechnology and nanotechnology, depend on ICT. Strategies based on this wave of technological change have become critical in shaping the competitiveness and even survival of individuals, cities, nations and businesses. This wave of change empowers people and organizations to leap ahead of competitors that fail to adopt these strategies. These are the "waves of creative destruction" that the great economist Joseph Schumpeter (1883-1950) analyzed in his book *Capitalism, Socialism and Democracy*.

Because of this creative destruction, growth of traditional telephony has slowed throughout the world, with use declining in some countries. Much voice traffic already flows over the Internet. A large part of this traffic comes from traditional telephone companies, but an increasing portion is generated by computer-based software such as Skype, Viber and WhatsApp. Meanwhile, mobile devices proliferated. Globally the number of mobile phones already exceed the number of fixed line phones in 2002. By 2012 they reached 6.8 billion, compared with 1.2 billion fixed line phones. Cellphone penetration globally is expected to pass 100% of population in 2013. But estimates of the number of unique mobile subscribers vary from 3.2 to 4.3 billion, since many subscribers have more than one mobile phone or a phone with more than number (separate SIM card) to take advantage of special offers or coverage of different operators.

Intensive use of the Internet should be a central strategy to accelerate the development of cities, states and countries. This strategy can be called eTransformation. In Brazil this strategy can help achieve a broad range of goals, like improving such basic public services as education, health, public safety and urban transport; two-way communication between citizens and governments; promotion of social inclusion, and a dramatic reduction in transactions costs throughout the economy.

Recent demonstrations in Brazil against corruption, impunity and poor public services have highlighted institutional weknesses that not only affect livind standards, but also incur high costs, reducing productivity and lowering economic potential. All of these problems can be attacked using the powerful tools made available by the ICT revolution. Brazil's new transparency law can be better implemented and corruption curtailed if information on government transactions, budget detail and execution of infrastructure projects are available online through transparency portals. Improving the quality and reducing costs of education and health services, mapping crime in real time and deploying police forces more efficiently, easing traffic flow, dealing with major emergencies through ICT-powered government operations centers are just a few of the ways in which information technology can strengthen the performance of institutions. Government service centers like São Paulo's *Poupatempo,* that speeds issuing of personal documents, and Bahia's Centers for Serving Citizens are first steps in this direction.


Guilherme Kramer

What is the underlying logic of this strategy? The starting point is the dramatic and continuing fall in the cost of processing, transmitting and storing data, information, and knowledge. The best-known principle of this revolution is Moore's Law, proposed by the co-founder and former CEO of Intel, Gordon Moore. Moore's law posits that the number of transistors that can be placed in an integrated circuit chip doubles every two years, yielding a 50% reduction in the unit cost of processing data. There are similar principles captured by other "laws", such as Butter's Law – according to which the quantity of data that can pass through an optical fiber doubles every nine months, leading to a fall in the unit transmission cost of 50% in the same period.

There are huge economies of scale in Internet infrastructure. These are derived from the presence of high fixed costs but low marginal costs for providing increasing amounts of the good or service. The average cost per unit sold falls as the number of units sold increases. The main channels of the Internet – the trunk lines – are fiber optic cables, both terrestrial and submarine, connected to optical equipment like routers and datacenters of the principal operators. No technology allows a higher speed of transmission and is more efficient. These scale economies are derived from the very low marginal cost of adding more fibers to a cable before it is installed. Thus there are opportunities for different operators or users to collaborate when investing in fiber or other facilities that provide more capacity than needed at low cost. This excess capacity can be leased to other users. This is a win-win proposition because the costs to each operator for fibers in a shared cable is lower than if that operator alone had to bear all the costs of investment for the capacity it needs. The more partners share the investment costs, the lower the unit costs per user.

New towns and agrovilas

These transformations are changing living standards in the remote areas of Brazil. In 1986 Adilson Klaffke's family arrived in the region of Nova Guarita, now a town of 2,500 people in the far north of Mato Grosso that developed in the 1980s as a result of the gold rush in the deforested fringes of Brazil's Amazon region. The family came from São Miguel do Oeste in Santa Catarina, started farming and then diversified into selling lumber. But their son Adilson, now 38 years old, took another course, becoming a technician fixing television sets, and later teaching himself to be an IT professional, selling and repairing computers. Six years ago he leased a small dedicated link of 1 megabit per second (Mbps) from the telephone company Oi. This link ran from Sinop, called the Capital of the Far North, a city of 110,000 inhabitants about 200 kilometers to the southwest to Nova Guarita. Adilson launched an Internet service provider, Lasernet, that served 320 users in the town and seven *agrovilas* in the vicinity. "I provide better quality service than Oi", says Adilson. "With this I can win clients in the *agrovilas*. Even the Transportation Department (Detran) in the town uses my service. Previously, Detran would not issue documents because it had no access to the Internet." Now the farmers use their connections to order agricultural inputs and to access technical information, weather forecasts, news of Brazil and the world and to maintain contct with relatives and friends in the South of Brazil.

There are many young Internet entrepreneurs all over Brazil: for example Leandro Dias, founder of Direct Wi-Fi, in Campo Magro, Paraná; Samuel Pereira and Asafe Coimbra of NetRocinha in Rio; Renato Salomão de Oliveira of Rondonet, with its headquarters in Ariquimes, Rondônia; and Roberto Filgueiras of Print Internet, in Macaé, Rio de Janeiro. Brazil has some 4,000 small ISPs registered with Anatel.

In 2013, Klaffke got approval for a Multimedia Communication Service (SCM) license from Anatel. This license allows him to offer not only broadband, but also telephone and cable TV services. For others, obtaining a SCM license is too expensive. Many providers could pay the license fee (recently lowered to R$ 400), but they could not meet all the requirements set by the telecommunication regulator, Anatel, such as hiring a telecommunications engineer.

The result is a high degree of informality. According to the estimates of Abrint (Brazilian Association of Internet and Telecommunications Providers), there are about 9,000 providers, both licensed and informal, operating in thousands of municipalities all over Brazil.

Brazil's myriad small service providers are a rarity in the global Internet economy. In most countries Internet services are offered only by a few large companies, many of them government monopolies. "Some countries have no independent provider," says Basílio Perez, president of Abrint. "The diversity in Brazil should be encouraged." Many small providers began as dialup operations around 1995. "Since many of them have 18 years of experience", says Perez, "we can say that this market is reaching maturity."

The small providers are mostly in small towns. In big cities the market is dominated by big companies. Initially the service was offered by telephone companies using existing infrastructure, as with Telefônica's Speedy and Oi's Velox. Later, cable TV companies entered, expanding the market for broadband and competing with the telecoms. Cable TV companies, however, shunned small cities where the population density and income levels discouraged investments. Their absence provided opportunities for small entrepreneurs, who began operating via wireless links – at lower costs and prices – and then, as they grew and acquired financial capacity, switched to optical fiber. With small differences, this is the story of Adilson Kalffke and many other small providers.

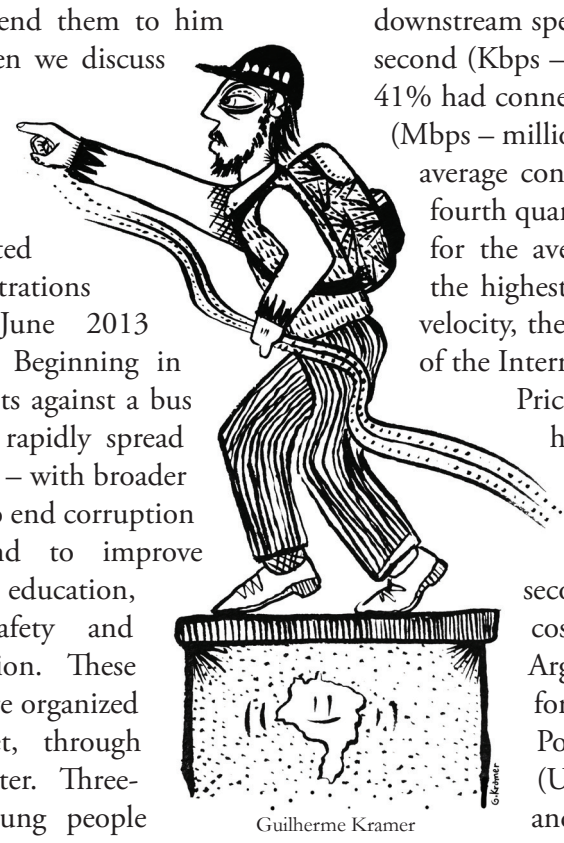
Compared with the Internet service available in rich countries and some not so rich, Brazil's networks are expensive, slow and unreliable. However, access is almost universal, whether in distant locations in Amazônia or in the peripheries of the big cities. According to the latest National Household Sample Survey (PNAD), published this year, 83 million persons 10 years of age or older accessed the Internet in the three months prior to the survey. The Internet has become an instrument for political mobilization and more direct and continuous participation through social media. It cannot easily be controlled by governments. Brazil is the second largest market in the world for Facebook, with 58 million accounts. Twitter has more than 40 million.

"Internet in my DNA"

Today almost all young people have access to the Internet. Their devices may not have all the latest capabilities, but access, even when precarious, is widely available. While researching for this essay, I met young people from the periphery of São Paulo who were participating in the Reading Circles Program of the Fernand Braudel Institute that has reached thousands of students in public schools in these low-income suburbs of Greater São Paulo and in states of the Northeast. I asked these youths how they used the Internet. They all said that they used broadband daily, almost all in their own homes. One uses a Wi-Fi connection of a neighbor (for which he paid about R$15 [US$7] per month). Many also accessed the Internet from smartphones and sometimes from lan houses (paid public access points usually operated by young entrepreneurs), where many had their first contact with the Internet. All are connected with friends through Facebook and sometimes by e-mail, which is used for more formal communications. They download music, watch films in streaming video, research using Google and seek knowledge – and not only for their school work.

"I have the Internet in my DNA," says Mateus Gomes Sousa Santos, an eighth-grade student from a municipal school in São Miguel Paulista. "If I don't have access to the Internet I fell isolated and stressed. The Internet is a basic and essential service in all homes," says Bhrian Machado da Silva. "Today, someone who has no access at home can get it anywhere, like a lan house (a store offering paid Internet access), a library, a community center, or at work. The Internet is a necessity, not only to communicate, but to learn, meet people, and locate old friends," says Mariana Silva da França. "In our school, the teacher helps us to prepare for technical courses that complement our middle school. He poses questions, then we search for the answers on the Internet and send them to him by e-mail. And then we discuss the results face to face," says Luis Guilherme Castro.

Young people like these participated in the demonstrations that began in June 2013 throughout Brazil. Beginning in São Paulo as protests against a bus fare increase, they rapidly spread around the country – with broader demands, such as to end corruption and impunity and to improve the quality of education, health, public safety and public transportation. These demonstrations were organized using the Internet, through Facebook or Twitter. Three-fourths of the young people who went into the streets were mobilized by social media.


Guilherme Kramer

For Manuel Castells, director of the Interdisciplinary Internet Institute of the Open University of Catalonia (Spain) and professor at the Annenberg School of Communication at the University of Southern California (USC), social networks have caused a rapid acceleration in historical time that, associated with the power of networked computers, "is disintegrating the current mechanisms of social control and political representation," part of what he calls "informational capitalism," Castells believes that a "countervailing power" was released by the Internet, giving social movements autonomous communication tools outside the control of governments.

Competition, cost and quality

The Brazilian telecommunications market is the sixth most competitive in the world for fixed, mobile, and broadband and is more competitive than in most European countries, though in many parts of Brazil incumbent telecoms still monopolize fixed line service and keep prices high. As of February 2013, half of Brazil's population could choose between four mobile broadband operators and another 13% could access three operators, while only 12% had no access to mobile broadband. Surveys show that the percentage of Brazil's population aged 10 or over that accessed the Internet rose from 30% in 2005 to 49% in 2012, and homes with Internet access increased from 21% to 40%. Businesses with 10 or more employees that accessed the Internet reached 98% in 2011 and businesses with websites reached 59%.

Investment in telecommunications services has been substantial, totaling some R$200 billion (approximately US$100 billion), unadjusted for inflation, since the privatizations of 1998. In 2012 fixed line broadband connections reached almost all of Brazil's 5,657 municipalities. But penetration of fixed broadband lines, as opposed to cell phones, in 2012 was only 8.6 per 100 residents, lower than Chile, Mexico, and Argentina and less than a third of that in the United States. The total number of fixed broadband connections in Brazil reached 20 million and is projected to grow to 30 million in 2014. Transmission speeds are slow. Of Brazil's active fixed broadband users, 44% had average downstream speeds of between 512 kilobits per second (Kbps – thousand bits per second), and 41% had connections at 2 megabits per second (Mbps – million bits per second) or more. The average connection speed for Brazil in the fourth quarter of 2012 was 2.3 Mbps, 79% for the average of the 55 countries with the highest Internet traffic. The faster the velocity, the better and more efficient is use of the Internet.

Prices, while falling, are still very high. In a recent study comparing the monthly average cost per Mbps capacity in 15 countries, Brazil was the second highest with an average cost of US$25, exceeded only by Argentina (US$46). Compare this, for example, with Chile (US$23), Portugal (US$11), United States (US$3.33), Finland (US$2.77), and South Korea (US$0.27).

Another survey, by the ITU (International Telecommunications Union) in 161 countries showed that Brazil had the most expensive cell phone service in the world. The charge for a one-minute call between mobile phones of different operators at peak demand hours cost US$ 0.74, or double the price in other Latin American countries like Mexico and Argentina. This being said, the average prices paid by Brazilians are still high.

The high cost of telecommunications services in Brazil is influenced by three factors: excessive taxation, high interconnection fees and domestic content regulations. Excessive charges for leasing transmission capacity where a provider lacks its own infrastructure also contribute.

1. Excessive taxation. The telecommunications sector bears the highest tax burden of any sector. In ten states and the Federal District the ICMS (value added) tax alone is 25% of the gross price, for others it is as high as the 35% imposed in Rondônia. Most taxes are calculated on the gross revenue, e.g. telephone bill, including all these taxes. For the states with a 25% ICMS, the main taxes (Cofins, PIS/PASEP, ICMS, Fust, and Funtel) equal 30% of the total bill, but if calculated as rates on revenue net of these taxes, the rate is 43%. And in states with higher ICMS rates the total tax burden on net revenue is even higher, reaching a maximum of 49% in Rondônia.

How the Internet began

The Internet was born in the United States as a network of networks. Initial work was done by researchers at the Massachusetts Institute of Technology (MIT) in the 1960s to develop packet-switched communication between computers. Packet switching provides greater security, maximum use of available bandwith, communication between devices at different speeds, resilience to line failure by diverting signals via other routes and ability to function during disasters when telephone service is interrupted. Packet switching enabled creation of the research network ARPANET at the U.S. Defense Department that became operational in 1969. ARPANET was not designed for military use, as is commonly thought, but rather to support computer resource sharing among research universities backed by the Pentagon.

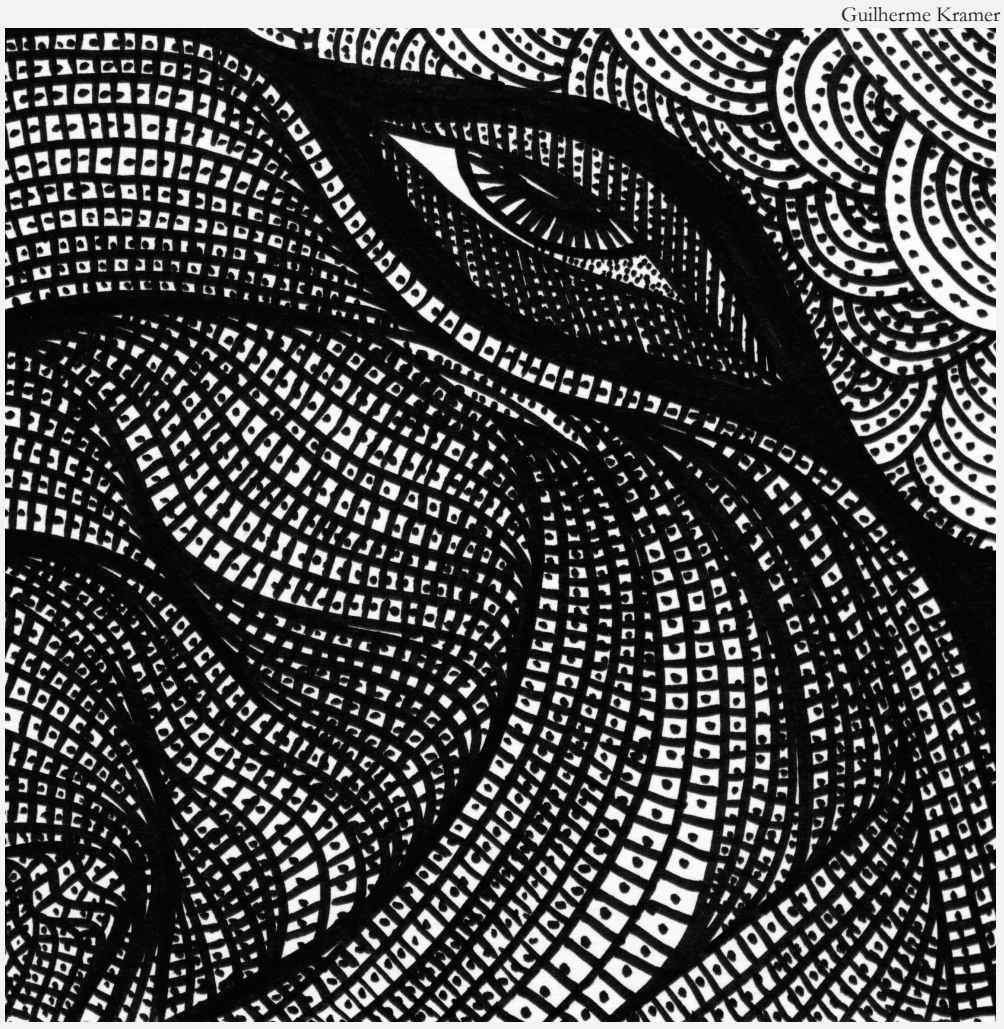
The next critical advance was the invention of TCP/IP (Transport Control Protocol/Internet Protocol) in 1973 and reported in a paper by Vinton Cerf and Robert Kahn in 1974. These protocols allowed what is known as "open architecture networking" permitting interconnection between diverse computer networks wherever located. Further work for the Pentagon extended the concept to Packet Satellite and Packet Radio networks that were interconnected to the ARPANET in 1983, thereby launching the Internet.

Parallel work by Paul Baran at the RAND Corporation in California sought to create a decentralized communications system that could survive a nuclear attack. Cerf told me: "Baran articulated the utility of packetization for voice although he called the units 'message blocks'. His system was never built, but his work became known to the ARPANET designers after the basic design work was done. While I was running the Internet program I wanted to make the Internet resilient to nuclear attack and even demonstrated its self-healing capability, using airborne packet radios, in cooperation with the Strategic Air Command. So Baran's ideas did find fertile ground in the Internet if not in the ARPANET." Many other researchers contributed to the theory and design of what became ARPANET and then the Internet.

As local area networks, microcomputers and more advanced workstations became widely used in the 1980s, the Internet grew rapidly. In the mid-1980s ARPANET was linked to the academic NSFNET of the National Science Foundation. New Internet service providers began offering access to commercial customers. By 1995, it was clear that academic users would no longer need dedicated networks, being adequately served by commercial ISPs, so the NSFNet was shut down. In 1996 a new academic and scientific network called Internet 2 and was launched at much higher speeds as a private network run by the universities.

Meanwhile, another major breakthrough took place in Europe, at the European Organization for Nuclear Research (CERN), where Tim Berners-Lee invented a network-based implementation of the hypertext concept of links that became the World Wide Web. The Web was articulated in Hypertext Markup Language (HTML) a basic code that facilitates access and communication on the Web. In 1993 the Web took off with the introduction of the first widely-disseminated web browser called Mosaic. The first mobile phone with Internet connectivity was the Nokia 9000 Communicator launched in Finland in 1996.

Guilherme Kramer



The development of the Internet in Brazil began later. Its history goes back to 1987 when a meeting between academic researchers and representatives of the government and Embratel was held at the University of São Paulo. Their aim was to develop a network to facilitate communication among Brazilian academic and scientific communities and with their colleagues in other countries. In 1988 and 1989 three Brazilian institutions – the National Laboratory for Scientific Computing (LNCC) in Rio de Janeiro, the São Paulo State Foundation for the Support of Research (Fapesp), and the Federal University of Rio de Janeiro (UFRJ) – separately established linkages with three different institutions in the United States using Bitnet (Because It's Time Network), a network permitting the exchange of e-mails and files. In 1989 the National Research Network (RNP was established by what later became the Ministry of Science and Technology.

Brazil joined the global Internet in May 1992 with two international links set up by academic institutions during the United Nations Conference on the Environment in Rio de Janeiro, known as Rio 92. Using these links, and with the support of the United Nations Development Program and the British government, Alternex, a network linking NGOs and run by the Brazilian Institute for Social and Economic Analyses (IBASE), itself a NGO, provided Internet access to the Global Forum, a NGO event held in parallel with UNCTAD. Alternex was the first Brazilian ISP to serve individuals outside academic, research, and government organizations.

Commercial use of the Internet in Brazil only began in 1995. The new government of President Fernando Henrique Cardoso sought to end the state monopoly of communications, but it took three years to enact the needed legislation that privatized the state-run telecoms. Meanwhile conditions had to be created for the commercial Internet to grow outside the control of the soon-to-be-extinct state-run telecoms. State telecoms were banned from offering Internet service to end-users.

To monitor developments, and to draw up new rules for the Internet in Brazil, the Brazilian Internet Steering Committee (CGI) was created in 1995 by a formal agreement between the Ministries of Communications and of Science and Technology, to provide support for the newly created Brazilian commercial Internet through public-private cooperation. Michael Stanton, now director of Research and Development at the RNP, told me that "with the protection and guidance CGI provided, 'a thousand flowers bloomed', and new private ISPs sprang up all over Brazil, many of them derived from BBS (Bulletin Board Systems), previously linked by dial-up lines. These new ISPs obtained access to the Internet either from state-run Embratel or from the RNP, until the newly privatized telecoms took over in the late 1990s. CGI continues to set the rules for the Brazilian Internet." CGI is currently composed of 21 members, representing government, business, civil society and the scientific and technology community. This multi-stakeholder model has attracted favorable international attention and been adopted by national Internet governance bodies in other countries.

The institutional framework in Brazil

The current institutional framework of Brazil's telecommunications system was established by the General Telecommunications Law of 1997. This law created the National Telecommunications Agency (Anatel) as the regulatory agency charged with defending the interests of the State and the citizen, encouraging competition, universalizing telecommunications services and updating telecommunications technology.

The telecommunications law, together with a constitutional amendment passed in 1995, ended the state monopoly under Telebras, the holding company for public-sector telecoms in each state, through their privatization in 1998. The goal was to create a competitive telecommunications market and provide a wider range of affordable telecommunications to Brazil's population.

Anatel has administrative independence and financial autonomy while officially linked to the Ministry of Communications. Anatel's directors are appointed by the President of the Republic for fixed terms after approval by the Federal Senate. Anatel's funding is provided from the federal budget and the Telecommunications Supervision Fund (Fistel). Fistel's revenues come from a variety of sources, the most important being fees for maintaining phone numbers. Fiscal revenue for the period 2001-2012 totaled R$44.2 billion. Also intended to finance the sector is the Fund for the Universalization of Telecommunications Services (Fust). Established in 2000, Fust is financed by a 1% tax on the gross revenue of telecommunications operators. Over the period 2001-2012 Fust revenue totaled R$14.3 billion.

But the telecommunications sector receives only a tiny fraction of these resources. They are mostly diverted to other purposes. Fust revenue and some 90% of Fistel revenue have never been used for their intended purposes. Rather than finance telecommunications, they were used to help build a primary surplus to pay interest on federal debt.

2. High interconnection fees. The fees charged when calls are transferred between different carriers, and between fixed line and mobile phones, are very high. Excessive inter-carrier fees lead to the use of mobile phones that can use multiple SIM cards. Another effect of the high interconnection fees is that they encourage the use of pre-paid plans for mobile phones. Indeed, 79% of mobile lines are prepaid. For these the costs per minute are exorbitant. Prepaid phones are used by poor people only to receive calls, since in Brazil the caller pays. As the interconnection fees are higher than the price per minute of calls from prepaid plans, a prepaid plan user who never makes a call, but receives interconnected calls, becomes more lucrative for the operators than one using a post-paid plan. Inter-carrier transfer fees are being reduced by Anatel by two-thirds between 2012 and 2015. Until then, interconnection fees in Brazil will still be among the highest in the world.

3. Domestic content rules. The price of computers, telecommunications equipment, smartphones, and new fiber lines are all inflated by domestic content requirements – including those recently imposed to qualify for exemptions from some federal taxes.

Besides being expensive and slow, customer service in Brazilian telecommunications inspires many complaints. Mobile telephony and data services are prone to dropped calls. It got so bad that Anatel suspended the sale of SIM cards by TIM in 19 states, Oi in five, and Claro in three in July 2012, requiring them to present detailed state-by-state improvements plans, with special attention to dropped connections and customer service.

Despite the cost and quality issues, wireless broadband coverage has been growing fast, and the four largest providers (Vivo, Claro, TIM and Oi) together reach over 3,643 of Brazil's municipalities with some 90% of Brazil's population as of September 2013. The number of wireless broadband connections had reached 96 million, an astonishing increase of 51% over September 2012. Of these, 81 million were to cellphones, including smartphones, and 15 million to data terminals, including modems, tablets, and debit and credit card readers. In addition there were 553 thousand new, much faster 4G mobile connections. Brazil's mobile broadband penetration rate of 30 per 100 inhabitants at the end of 2012 was 50% higher than everage for Latin America. Tablet sales in 2012 reached 3 million, smartphones 16 million. In the second quarter of 2013 alone smartphone sales reached 8 million, 110% of sales in the same period of 2012. Of these, 90% ran Google's Android operating system, and the average price of smartphones sold fell from R$ 730 to R$ 550.

Smartphones and tablets are in fact handheld computers that can access the web and also do free video and audio conferencing and text chat over wireless connections to the Internet. Smartphones using Google's Android operating system could be purchased for as low as R$300, in effect making them the poor person's computer that can use a Wi-Fi connection to make calls using free software such as Skype. The penetration of these devices will accelerate with the continued fall in prices. The global research firm IDC forecasts sales of smartphones in Brazil will reach 29 million units in 2013 or 81% more than 2012, making the country the 5th largest smartphone market in the world.

The role of government

Government needs to update legislation and reduce excessive taxation of telecommunications. At the start of a new era dominated by Internet-capable mobile phones and other hand-held devices, the General Telecommunications Law remains an anachronism since it was passed before the explosion of Internet usage, especially mobile broadband, and thereby focused on fixed line telephony. Punishing taxes and fees, while easy to collect, are regressive, and run contrary to the government´s goal of digital inclusion. A case may be made that they actually decrease tax revenues. In sum, they reduce the contribution of digital technology to reduce inequality and accelerate economic development.

But the most serious problem is the absence of an overarching national strategy of eTransformation impacting all sectors and avoiding uncoordinated and even contradictory policies. The only official attempt was a report published in 2000 summarizing a five-year study and entitled *The Green Book on the Information Society in Brazil* by a team at the Ministry of Science and Technology, with contributions from hundreds of specialists. It proposed specific actions in planning, budgeting, execution and monitoring of the plan, but no legislation. But the plan was never implemented.

Looking more narrowly at the expansion of broadband services in Brazil, the first serious attempt at a national policy and program was the National Broadband Program (PNBL) enacted in 2010. The goal of the PNBL is to hasten the population´s access. Telebras, a federal telecommunications company that had been inactive since the privatization of state telecoms in 1998, was revived to execute the PNBL.

Several states are building their own fiber optic networks outside the capitals. The leaders are Pará – with its Navegapará program, that goes beyond Belém's MetroBel network initiated by the National Education and Research Network (RNP) to reach 56 of Pará's 144 municipalities – and Ceará, where the state ICT company, Etice, has built a 3,000-kilometer ring of fiber optic cables around the state that, with its wireless extensions, reaches 88 percent of the state's population. Called the Digital Belt, its nucleus is Gigafor, also co-financed by RNP's community network program in Fortaleza. At various points along the fiber trunk lines there are towers from which municipalities not on the Digital Belt can connect through wireless links, allowing them to communicate with the state government and other municipalities. A fundamental characteristic of these growing state networks is partnerships between the RNP, electric power companies, municipal governments, private telecommunications operators, and, more recently, Telebras.

Among the characteristics of the best state and municipal networks are:

- the state or municipality takes advantage of unused fiber allocated to it in the state capital's Redecomep;
- partnerships are established with RNP, municipal, state and federal public enterprises, private telecoms and Telebras to extend reach and share costs;
- complementary fiber and wireless networks are built to fill in gaps and provide capillarity (urban as well as rural);
- maintenance and operation are outsourced to private firms; and
- states or municipalities lease excess capacity in their networks to private operators to generate additional revenue, helping to cover operating and maintenance costs.

The ambitious federal goals for mobile coverage is frustrated by the chaotic system for

licensing antennas in urban areas. Licensing a small barely-visible antenna requires fulfilling the same strict requirements as a large one. Licensing is subject to 250 different laws in different municipalities. Operators complain that one of the reasons for poor quality mobile service is that demand has exploded, while licensing new antennas is a complex and slow process. "In some municipalities licensing requires approval from seven different agencies. It can take up to 18 months to complete the process. We think that it is possible to cut this time to 60 days," said Communications Minister Paulo Bernardo.

Unfinished tasks

The history of development in Brazil's interior is intrinsically related to the expansion of the means of communication. In the Amazon state of Rondônia, the installation of a telegraph line, in 1909, and the opening of a highway, BR-364, along the path of the telegraph line promoted the region's development and the birth of Cacoal, a municipality now served by a small Internet service provider (ISP) using fiber optic cables.

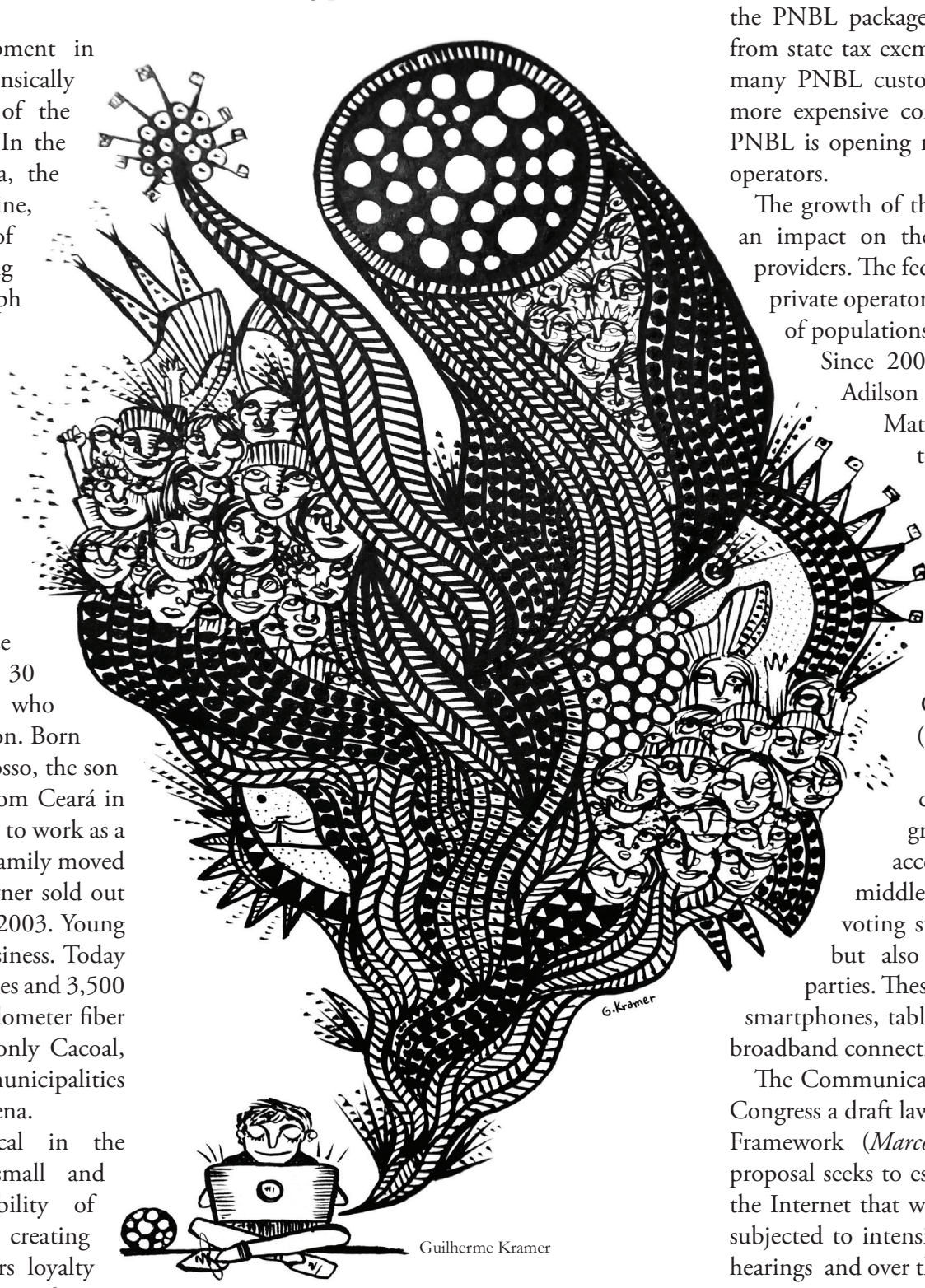
With a population of about 80,000, Cacoal is served by Speed Travel, a small Internet service provider (ISP) run by 30 year-old Ed Carlo Saboia, who represents this transformation. Born in Rondonópolis, Mato Grosso, the son of parents who migrated from Ceará in the Northeast, Saboia began to work as a local ISP in 2000 after the family moved to Rondônia. The firm's owner sold out to Saboia and his father in 2003. Young Saboia rapidly grew the business. Today Speed Travel has 10 employees and 3,500 customers. He built a 40-kilometer fiber optic ring that serves not only Cacoal, but also the neighboring municipalities of Pimenta Buena and Vilhena.

Speed has been critical in the competitive market of small and medium ISPs. The viability of the business depends on creating customer loyalty. Customers loyalty depends on faster and more efficient connections. The career of Leandro Dias de Almeida, owner of Direct WiFi, in Campo Magro, Paraná, is reflects the effort made by many young entrepreneurs all over Brazil. The business started small. Direct Wi-Fi leased a 1 Mbps radio link with which Almeida served 15 customers. In 2011 the business doubled: he leased a 2 Mbps link from Copel, the state electric power company, and the clientele reached 30. The next year, the business doubled in size again, with a 4 Mbps link. Up until then the growth had been merely geometric. He made a great leap in 2013, by leasing a fiber link of 200 Mbps. Like Saboia in Rondônia, speed was Dias de Almeida's business.

What about the government? What is being done to increase coverage, speed, and quality of both fixed and mobile broadband connections?

Let us analyze some measures.

1. Expanding broadband networks. More priority was given by the federal, state and municipal governments to network expansionBut Brazil still lacks a national multisectoral strategy. Aneel, the electricity regulator, plays a key role by ruling over state power generating companies. These companies have some 20,000 kilometers of fiber optic cables in what are called Optical Ground Wires (OPGW) hung from pylons that carry high-voltage lines, and contain unlit (dark) fiber that can be leased to telecommunications operators, including private telecoms and the RNP. State-level public power distribution companies have similar high-voltage lines, and also lower-voltage lines hung from poles carrying fiber optic cables that can be leased. Petrobras, the state oil company, has also installed fiber optic cables with unused dark fiber along its pipelines.



Guilherme Kramer

Revived in 2010, Telebras was tasked with implementing the PNBL. This state telecom has steadily expanded its network of fiber optic cables, in large part through public-public and public-private partnerships. This allowed rapid expansion of Telebras trunk lines in rings that provide redundant links in case of failure at any point in the system. Telebras also is investing in its own fiber optic links to provide high capacity redundant links to the six cities where the Confederations Cup soccer matches were played in 2013 and to the 12 cities that will host the World Cup matches in 2014.

To support a program called New Paths (*Veredas Novas*), Telebras is extending its network to some 180 interior cities, where the network will reach some 300 universities and research institutions. In each city it is establishing a local access point, with radio and eventually fiber connections to ISPs that agree to offer low-cost Internet service at a minimum of 1 Mbps. These ISPs can also offer faster connections at market prices. In practice, the small and medium ISPs and the large operators – like Oi, Telefônica, Embratel, TIM, and Algar Telecom – that offer the PNBL packages, in some cases benefiting from state tax exemptions, are discovering that many PNBL customers soon want faster and more expensive connections. In this way, the PNBL is opening new markets for the private operators.

The growth of the Telebras network has had an impact on the prices offered by private providers. The federal government encourages private operators to expand digital inclusion of populations in underserved markets.

Since 2005, small entrepreneurs like Adilson Klaffke of Nova Guarita in Mato Grosso were often the first to provide Internet service to remote communities. The number of these firms has doubled in the last two years as a result of the PNBL and simplified and cheaper procedures for acquiring Multimedia Communications Services (SMC) licenses from Anatel.

Expansion of high-speed connections was spurred by growth in demand for Internet access by the emerging lower middle class. This group provides voting support for the government, but also is courted by opposition parties. These new consumers, are buying smartphones, tablets, and laptops – and want broadband connections.

The Communications Ministry in 2011 sent Congress a draft law called the Civilian Internet Framework (*Marco Civil da Internet*). This proposal seeks to establish principles governing the Internet that were drafted by the CGI and subjected to intensive debate – both in formal hearings and over the Internet, via social media. Despite strong support from the Internet Society of Brazil and CGI, this proposal has stalled in Congress.

The main dispute is over the definition of "network neutrality": the principle that all Internet traffic should be treated equally, or more specifically, that that ISPs should enable access to all content and applications regardless of the source, and without favoring or blocking particular products or websites. Large telecoms oppose or seek to limit this neutrality not just in Brazil, but all over the world. They claim that they should be able to prioritize certain kinds of traffic to prevent a small number of users (e.g. those downloading high-definition video) from raising costs for other uses.

2. Education. Broadband connectiions in schools and universities is needed for Brazil to achieve international competitiveness and more

Guilherme Kramer

social development. The federal government is meeting this demand its program of Broadband in the Schools. in addition to *Veredas Novas* for colleges and universities. Universities will be able to use advanced applications, databases, digital libraries, remote instruments and, most importantly, the opportunity for their researchers to join collaborative research groups with other institutions across the country and abroad.

Beginning in 2008 telecommunications operators were required to provide broadband connections at increasing speeds to all urban public schools. This was obtained at virtually no budgetary cost by the so-called "exchange of obligations" agreed in April 2008 whereby the operators were relieved of the requirement to provide thousands of outmoded Telecommunication Services Posts with public phone booths, fax machines and Internet-connected computers. The number of connected schools tripled to 70,399 by 2013, leaving only 7% of all schools unwired.

3. Major international events present challenges and an opportunity to improve Brazil's telecommunications infrastructure. Two have already taken place this year – the Confederations Cup and the visit of Pope Francisco to Brazil for the church's World Youth Day. In addition, the World Cup matches will be held in 12 Brazilian cities in 2014 and the Summer Olympic Games will take place in 2016 in Rio de Janeiro.

The dark side of the Internet

Spam, data theft, child abuse, invasions of privacy, terrorism and cyber warfare are facets of what we call the dark side of the internet.

Spam – unsolicited and unwanted e-mail – made up 72% of e-mail traffic in 2012, according to internet security firm Kapersky. Spam imposes waste of user time, the costs of filtering where possible, and the clogging of the "pipes" of the internet with useless or harmful traffic. But spam can also be more dangerous when it includes "phishing": links to fake websites, robbing data, including usernames and passwords to access financial institutions, and inserting viruses or other malware into the user's computer.

The estimated cost of global cybercrime is US$114 billion annually. Based on the value victims surveyed placed on time lost due to their cybercrime experiences, an additional US$274 billion was lost. With 431 million adult victims globally in the past year and at an annual price of US$388 billion globally based on financial losses and time lost, cybercrime costs the world significantly more than the global black market in marijuana, cocaine and heroin combined (US$288 billion).

Privacy issues have been with us since the early days of the internet, but have attracted much attention recently. Huge amounts of data are being collected – both for legitimate purposes volunteered by users (e.g. information placed on social networks or obtained by eCommerce firms like Amazon or Netflix) or obtained surreptitiously by government or corporate spy agencies. These data are then analyzed using powerful "big data" techniques. The extent of this surveillance has recently been dramatized by the revelations of Edward Snowden, a young former contract employee of U.S. intelligence agencies.

Cybercrime and cyber-espionage are huge global enterprises.

Cyber warfare is a potential threat mobilizing huge expenditures for offensive and defensive measures. Its effects were demonstrated by the Stuxnet attacks on Iranian nuclear facilities. The vulnerability of all kinds of critical systems, including banks, power grids, transportation controls, and military communications is a fact of life. Defending against such threats is both costly and never totally effective. Recent accusations and counter accusations by US and Chinese officials concerning intrusions in government and corporate systems are only the tip of the iceberg. These experiences show that, like most any technology, the internet can be used to inflict damage and loss as well as to create benefits.

We are on the right path, but more haste and cooperation are needed. Internet technology represents an advance that benefits the economies that can invest in electronic infrastructure, giving users fast, cheap and efficient connections. The importance of a network-interconnected society goes beyond the efficiency gains made possible by powerful devices fed by fiber optic cables and high-speed wireless connections. The electronic infrastructure, however, is only a means – a means to implement an eTransformation strategy for attacking long-standing institutional problems that hold back Brazil's development.

Two challenges

Brazil faces two Internet challenges, both overcoming cultural poverty and isolation as well as keeping pace with rapid advances outside Brazil. Today, another new wave of innovation is being powered by Big Data, analytics, mobile, social and cloud computing. The environment is moving from monolithic applications to dynamic services; from structured data at rest to unstructured data in motion; from PCs to unprecedented numbers and kinds of devices; from stable to unpredictable workloads; from static infrastructure to cloud services; and from proprietary standards to open innovation.

Small entrepreneurs like those in Amazônia are important, linking national trunk lines to remote places, as if moved by the "invisible hand of the market" described two centuries ago by Adam Smith in *The Wealth of Nations.* "It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest," Smith wrote.

José Selestino started his Internet business in the small town of Uruará in Pará, astride the Transamazon highway, a continental road still unpaved and plagued by mud and potholes. This 33 year-old broadbrand trailblazer four years ago leased a fiber optic link originating in Brasília, built towers, installed Wi-Fi equipment, and provided technical support to maintain the loyalty of his clients.

But Brazil must do more than this The challenge of the Internet is part of a broader challenge of investment in education and infrastructure to sustain social justice and enable Brazil to play a relevant and constructive role in the world economy. In achieving this, the Internet would become a powerful instrument of national integration, nourishing human cooperation in real time.