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Clouds of Open Connection: Open Spectrum, Digital Television and Digital Inclusion

Sergio Amadeu da Silveira

Low income communities and individuals in Brazil are now grasping the importance of the Internet. The boom in blogs and user-friendly databases worldwide have greatly expanded hypertextual writing and the production of news and information across the web. Even television programs disseminate news about the advantages and benefits of the World Wide Web, spurring Brazilians to take an interest in its potential. Yet the unequal concentration of income, and the poverty experienced by most of Brazil's population, represents an enormous obstacle in the expansion of the Internet and its services in country.

Recent data reflects the large disparities in the country. According to the research conducted by IBGE (the Brazilian Geographic and Statistics Institute), in 2007, Brazil's population reached 189 million inhabitants. At that time, there were still nearly 14.1 million illiterate people over the age of 15 in Brazil. The Gini (GINI) coefficient, which measures the unequal concentration of income, has been falling steadily since 2004 (when the index was 0.547), but in 2007 it reached 0.528. The percentage of shared households with any kind of telephone reached 77%, while 31.6% of these households had mobile phones only. The same study showed that 88.1% of households had radios, 94.5% televisions, 26.6% personal computers and only 20.2% had Internet access.[1]

Communication costs in Brazil are one of the highest in the world. According to a study conducted by the Brazilian Association of Telecommunications Competitive Service Providers (TelComp), the megabit in Brazil reached a selling price of R$716.50 per month in 2007. The same megabit sold by Italian Tiscali was equivalent to R$4.36 per month. In France, Orange charged R$5.02, and in the U.S. one could possibly pay up to R$12.75. In Manaus – capital of the state of Amazonas – broadband connection cost 395 times more than in Tokyo, Japan.

In this paper I compare three models of Internet provision—the state-controlled model, the free-market model and the digital commons model. The latter is based on the idea of designating large areas of bandwidth "open" and publically available. I describe how the creation of free wireless connections in three small towns in Brazil exponentially increased the public use of information technology and Internet in locations where previously only dial-up services and low bandwidth connections were available. In Brazil, wireless networks have being used non-commercially and privately since 2000, particularly the Wi-Fi connection protocols 802.11A, 802.11B, 802.11G. However, a number of municipalities offer non-commercial and free wireless Internet connection. In this context, supporting the development of free Wi-Fi networks—maintained by municipalities—could create a healthy competition with the commercial services offered by telephone providers. Not only would this development lower costs, it would stand to initiate greater public access to the Internet for a wider range of people.

Just as the decrease in computer prices in Brazil—upon the implementation of the government program Connected PC—prompted a growth in computer sales, one could presume that the elimination or reduction of telecommunication costs in Brazil could enormously increase network usage. The pressure generated by free Wi-Fi connections, with its cheap technology and widely distributed signal in the cities, could improve the quality of paid services and cause a drop in connection prices.

Clouds of open connection in three cities

While other examples of the failures and successes in municipal Wi-Fi networks exist nationally and internationally, I focus here on three small Brazilian cities that now provide free Internet access for their populations: Quissamã, in the state of Rio de Janeiro; Sud Mennucci, in the state of São Paulo; and Tapira, in the state of Minas

Gerais. In Quissamã, 17,376 people live in an area of 716 km^2. In Sud Mennucci, there are 7,714 inhabitants in an area of 591 km^2. Finally, Tapira's population has reached 3,509 people within an area of 1,184 km^2. The three cities all provide wireless signal to 100% of their respective areas: since 2004 Quissamã has offered connection speeds of 128 kbps to individuals and 256 kbps to businesses; Sud Mennucci has ensured 256 kbps to everybody since 2003; and Tapira has provided more than 64 kbps to all of the population since 2004.

The costs of Internet provision were very different in these three cities. The city of Sud Menucci spent R$18,000 to implement the project and R$70,000 to enlarge its wireless network speed, security and stability. On the other hand, the city of Tapira spent R$5,000 in equipment and antennas for connection infrastructure. The implementation and maintenance expenditures in Quissamã have not been published. The monthly connection cost paid by Sud Mennucci to the telecommunication provider is R$5,800. Tapira pays R$7,900 per month for its Internet signal. Quissamã and Sud Mennucci websites use Linux servers and Apache web servers through Netcraft. Free Flos[2] software is used in these cities' networks. In Quissamã telecommunications centers—places for public free access to the Internet on desktops computers—are maintained by the city and utilize GNU/Linux platforms on their machines.

After the implementation of free wireless access services in these three cities, the number of Internet users soared quickly. The number of homes with Internet connection in Tapira increased six-fold compared to its original number. In Quissamã, this number grew eight times larger and Sud Mennucci experienced an astonishing growth of twenty-eight times greater Internet access. The following chart summarizes this growth:

	Quissmã	Sud Mennucci	Tapira
Implementation year	2004	2003	2005
Internet penetration before the implementation	200 homes	30 homes	50 homes*
Internet penetration in 2008	1.600 homes	840 homes	300 homes
Growth	8 times	28 times	6 times

Source: city reports available at www.guiadascidadesdigitais.com.br

* Estimate based on the number of computers in each city. Since in Tapira there were only 50 computers, the best case scenario would be that all 50 households would have Internet access, which is very unlikely.

These statistics are telling if one compares them to the rate of overall Internet growth in Brazil. The speed of growth in connected homes in these cities is much larger than the general market numbers if we consider the national average connection growth, registered in research conducted by the Internet Management Committee in Brazil. The average number of households with Internet access in Brazil jumped from 14.49% in 2006 to 17% in 2007. Tapira, with the lowest average out the three cities observed, grew 50% within less than three years of accessibility.

The open spectrum potential

Electromagnetic spectrum is a valuable public resource whose regulation is of extreme importance. In Brazil, radio frequency spectrum is controlled by the State and only can be used according to the Brazilian Frequency Range, Destination and Distribution Plan (PDFF). The National Telecommunication Agency (Anatel) is in charge of managing radio spectrum usage, regulating and monitoring its uses. As a result, each radio range is set for a specific application or service, according to what the Plan outlines. This plan was recently changed to incorporate the implementation of digital television in Brazil.

On June 29, 2006, Luis Inácio Lula da Silva, president of Brazil, signed Decree 5.820,[3] which defined the rules for implementing the Brazilian System of Terrestrial Digital Television (SBTVD-T) and the transmission and retransmission platform of sound and image signal broadcasting. The Decree re-organizes the allocation of Brazilian radio spectrum. According to the Decree, the transition period from the analog transmission system to SBTVD-T will last ten years, and during this transition period, programming will be broadcast using both analog and digital technologies. The channels used for analog transmission in the electromagnetic spectrum frequency ranges from 54 to 88 MHz (channels form 2 to 6) and from 174 to 216 MHz (channels 7 to 13); these will be returned to the federal Union after the transition period.

During the next few years, Brazil will discuss what must be done with the frequencies that will be freed up once the analog TV transmissions end. There is the exciting possibility of establishing a plurality of uses for them. Some groups in civil society, such as Intervozes, ASL, and Além das Redes, advocate for a more open spectrum model, a proposal that maintains that these frequencies should be available for common use. As I have argued elsewhere:

The digital transmission unit controlled by software can scan or sweep the spectrum searching for the best frequency for sending waves at any given time. Similarly, digital receptor units can constantly scan the spectrum to tune to a specific channel, even when its frequency changes. Therefore, the spectrum should not be turned into the private property of some people. It should be transformed into a common space. A path that many can pass by and transmit signals, respects the standards of public interest (Silveira, 2007, p. 50).

There are some who argue that such a model, based on municipal needs and the provision of publically accessible swathes of bandwidth, is untenable. The justification here is that state control of spectrum is necessary because radio frequencies are limited, scarce resources. For this reason, the federation states tend to advocate for the use of an exploration model, based on concessions and permissions that will be sold to the private sector, generally through bandwidth auctions—a model that has been used in other nations such as the United States and Canada. This model, in which the state sells off bandwidth to commercial brokers, is purported to be the best way to avoid the so-called "tragedy of the commons" or the inefficient use of a resource caused by its excessive chaotic or disorderly use. However, many researchers consider the state control of spectrum, and its sale to commercial enterprises, to be governed by other motivations. As Hazlett remarked on the regulation of radio frequencies in the United States: "Policy makers in the 1920s were not driven to public interest allocation of radio spectrum by airwave chaos. Just the opposite; chaos was strategically used to procure public interest allocation." (p. 95).

Such fears are unwarranted in the digital era. Digital technologies arguably allow for a more intelligent and efficient use of spectrum, neutralizing possible glitches or chaos as a moot point. Digital transmitters and receivers, software-defined radio, and smart radio can overcome the restrictions and interference of the analog world. There are existing examples of technologies that utilize the same radio frequency by many users at the same time. For example, CDMA (Code Division Multiple Access) technologies allow several cell phones to function at the same time, within the same frequency, with no interferences between them, because of their coded signals. As Kevin Werbach suggests, the digital division of these frequencies ensures that the capacity of the system to transmit useful information increases. The same spectrum can hold more communications. The intelligence of devices is substituting for brute-force capacity between them. Imagine what highways would be like if cars couldn't be steered quickly to avoid collisions and slowdowns. There would have to be huge buffers between each vehicle to prevent accidents… precisely what exists in the spectrum today. (2003, p.19)

Technically-speaking, the channels utilized for analog television transmission that will be returned to the Union could become be available to society for digital transmission. These excellent quality channels and frequency ranges, based on the direct access to radio spectrum, could provide a common way for communities, municipalities, and different groups to ensure cultural diversity through an effective means of implementing their right to communication.

Conclusion

In the context of present-day Brazil, there are three possible ways to provide public access to the radio spectrum that is opening up: issuing state-controlled concessions; privatizing the creation of secondary spectrum markets; or following a 'digital commons' model of open spectrum allocation. The current model, based on state control, is inefficient and it gives too much power to controllers of telecommunication infrastructure, who retain the exclusive right to the spectrum range. The privatized spectrum model treats spectrum like any private good or commodity. Radio frequencies would be sold by the state to private agents that could use them in the most profitable possible way, including selling or leasing them to secondary markets. This model of spectrum privatization will only worsen the problems of access in the context of Brazil.

The third option, an open spectrum model, is based on the notion of spectrum as a public resource that needs to be thought of as a commons. Working towards a policy of open spectrum is a way to guarantee that everyone in a particular area has access to both frequencies and public connections. In this model, the state would define the technical rules to ensure the system's interoperability. This includes: the common use of frequencies, like potential limits; approval of equipment; and orientation that ensures the best use of communication protocols within certain connection bands. Similar to road traffic, these state regulations allow every citizen to travel along freely if they respect traffic rules. As Benkler (2006) outlines,

> The choice between proprietary and commons-based wireless data networks takes on new significance in light of the market structure of the wired network, and the power it gives owners of broadband networks to control the information flow into the vast majority of homes. Commons-based wireless systems become the primary legal form of communications capacity that does not systematically subject its users to manipulation by an infrastructure owner. (p. 154)

As we have seen in the cases of the three cities, the model based on commons is technically viable and socially desirable. It could reduce communication costs, encourage local production and cultural exchange, foster the discovery of new uses, and interface with other wireless communication development. It could allow for the formation of mesh networks in a more efficient way, and that would enable the provision of free mobile technology between the inhabitants of certain localities. The fusion of Voice-over-IP (VoIP) with free signals in the best-range spectrums can stimulate communication, cultural production and local economies. However, as Werbach (2002) has warned:

> Improving existing unlicensed bands isn't enough. Most are so narrow and congested that their utility for open spectrum is limited. Furthermore, the high frequency of the most prominent unlicensed bands limits signal propagation. Lower-frequency spectrum that penetrates weather, tree cover, and walls would provide significant advantages for services such as last-mile broadband connectivity. (p. 16)

The 10-year window opened up by the 2007 move to digitization provides Brazil with the occasion to jump-start the public use of radio-frequency spectrum, which is critical for all forms of wireless communication. At that point, the analog television transmissions will cease, and most of the best quality spectrum frequencies will be returned to the state. If these spectrum ranges can be made publicly available, this could enlarge Brazil's communication capacity, as well as its technological, cultural and creative potential. It is up to communication researchers to demonstrate the benefits of creating greater access to the Internet through the open spectrum model.

The creation of clouds of open connection in Brazil would not only encourage the purchase of computers, it could increase the types and range of connectivity. Ensuring free network connections to the entire population could be used to improve the educational and cultural uses of the Internet and electronic government services, and it might expand the inclusion of local communities in global electronic commerce. In the information era in which we live, communication must be thought of as a right, not as a business. Free access, through the provision of open spectrum, helps crystallize the idea of communication as an essential human right.

Notes

1. Source: IBGE, Diretoria de Pesquisas, Coordenação de Trabalho e Rendimento, Pesquisa Nacional por Amostra de Domicílios 2007.

2. "Richard Stallman and the FSF introduced the term 'free software'. Later, the Open Source Initiative proposed 'open source software', allegedly to avoid the linguistic uncertainty associated with the English term 'free', specifically used by the Free Software Foundation to preserve the underlying concept of freedom. The 'libre software' term was introduced for the same reason, and used specially in Europe. The term 'FLOSS' was introduced by Rishab Gosh in the context of EU-funded project 'Free/Libre and Open source software: survey and study' started in 2002 as a catch-all term for free software and open source as described in this section. In this report we will use mainly the term FLOSS." Retrieved from guide.conecta.it/FLOSSguide.pdf

3. This information was published in Souza, A. P., Pinheiro, D., & Athayde, P. (2008, August 13). O Brasil cai na rede. *Carta Capital Magazine 508*, 28.

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Biography

Sergio Amadeu da Silveira is Sociologist and Doctor of Political Science. He is a professor at Cásper Líbero Foundation.