

Restricted mobility and fixed-mobile convergence in Brazil

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Abstract

Purpose – This article aims to explore the impact of a particular regulatory framework for CDMA and GSM use by fixed-phone companies in Brazil on access, local-loop competition and fixed-mobile convergence.

Design/methodology/approach – The paper is based on the analysis of the three most significant cases in Brazil and the discussion of recent regulatory changes that facilitate access to radio spectrum on a secondary basis.

Findings – Among the findings of the study is that while fixed-wireless access (FWA) systems using CDMA seem to be more suitable to high-density, well-served areas, in which a large operator attempts to address a low-income market satisfied with restricted mobility – GSM systems deployed on a secondary basis are best fitted to address the digital gap in low-income, underserved areas, promoting local-loop competition in markets of little interest to traditional operators.

Practical implications – The conclusion outlines regulatory recommendations for promoting competition and the growth of innovative, small-scale operators that take advantage of new wireless technologies to address service coverage gaps.

Originality/value – The paper presents the first attempt to address the Brazilian CDMA- and GSM-based fixed wireless access experience from a regulatory perspective and analyzes the “ruralfone” case, which uses a fixed phone license to deliver GSM-based services in underserved communities, surpassing incumbent penetration in cities where there is no cellular network yet under a given regulatory environment in Brazil.

Keywords Mobile communication systems, Brazil

Paper type Research paper

Finding regulatory tools that promote network extension without distorting markets continues to be a key challenge for regulators worldwide. The challenge is even greater as technological convergence amplifies opportunities for market entry and yet questions the service boundaries upon which much of the current regulatory edifice is built. This article seeks to contribute to solve this regulatory puzzle by exploring the shifting boundaries between fixed and mobile phone services and its impacts on efforts to address the deficit of ICT networks and services in low-income and low-density areas in Brazil. More specifically, we compare the three most significant Brazilian cases of fixed wireless access (FWA) deployment and investigate the effect of recent regulatory changes intended to facilitate spectrum access by these new entrants in underserved areas.

The article exemplifies the challenges faced by telecom regulators as it becomes increasingly difficult to distinguish between FWA and traditional mobile services. This is particularly relevant for underserved areas in which new market players, by deploying innovative business models and exploiting the cost advantage of mature mobile technologies such as GSM and CDMA, are challenging copper-based incumbents. While relaxing existing service and spectrum access rules promotes such entry, both fixed and mobile incumbents seek to protect acquired rights.

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The article is organized in four main parts. The first provides a brief background on the evolution of the telecommunications sector in Brazil, while the second delves into the legal framework for fixed and mobile telephone services in Brazil, with particular attention to the definition of fixed wireless access (FWA) and “restricted mobility”. The third part examines how FWA/WLL and GSM networks have been deployed by fixed phone entrants in Brazil, focusing on three cases: Vésper Portátil, Embratel Livre and Local or Ruralfone. In the following part, the article addresses the regulatory tensions surrounding the definition of fixed and mobile services, discussing recent changes in equipment rules and regulatory initiatives seeking to promote entry by small-scale operators in low-income and low-density areas.

Prelude to fixed-mobile convergence in Brazil

The telecommunication reforms initiated in Brazil in 1985 has had two defining moments:

1. The creation of an independent regulator (Agência Nacional de Telecomunicações, or Anatel) in 1998.
2. The privatization of the Telebrás System, a state owned holding which was the largest Latin American telephone company at that time (Siqueira, 1993; Melo *et al.*, 2005).

Up until 1998, 91 percent of the Brazilian telephone lines belonged to the state owned Telebrás holding (Padilha, 2001, p. 26). This scenario shifted drastically after privatization, as the country was divided into four areas for incumbents of the fixed switched telephone service (STFC) and ten areas for incumbents of the emerging cellular mobile service (SMC), later converted to personal mobile service (SMP)[1].

Cellular services played an important role in the Brazilian regulatory reforms undertaken in the mid 1990s. After seven years of judicial battles, a constitutional amendment was passed in 1995 allowing private enterprises full rights to provide mobile telephony services. In practical terms, mobile and fixed telephone services would be clearly separated in 1998, when the 26 state-owned companies were finally assembled under three holdings for fixed telephone services and eight holdings for mobile telephone services.

Since then, Brazilian telecommunication regulation has been characterized by an incremental separation between fixed and mobile telephone services. To begin with, only fixed services are, strictly speaking, subjected to a public service regime. Furthermore, mobile operators are allowed to provide broadband service under the terms of their current license, while fixed operators require an additional license from Anatel as the service is restricted to data rates of 64 Kbps. In short, favorable tariff and service rules, coupled with lower deployment costs, resulted in the rapid expansion of mobile services in Brazil, while fixed services stagnated (Haugen *et al.*, 1994; Männistö and Tuisku, 1994; ITU, 2008).

In 2008, Anatel conducted a technical study (Anatel, 2008) in order to establish a ten-year market outlook and propose actions to update the regulatory framework, with particular attention to accelerating the diffusion of broadband access services and reducing access barriers in high-cost and low-income areas. This study became the basis for the enactment of the general plan of telecommunication regulation update (PGR). The plan identified mobile networks as the most appropriate alternative to accelerate network deployment, promote the provision of converged services and consolidate competition in the sector (Anatel, 2008, p. 133). A key concern for Anatel was to reverse the increasing service gaps between wealthy high-density areas and low-density, low-income ones.

Promoting the deployment of FWA was perceived as an alternative to reverse the stagnation of fixed services and promote deployment in underserved areas (Trinkwon, 1997). The deployment of FWA/WLL networks started in Brazil in 2001, when Anatel established rules for the use of the so-called user portable terminal equipment (in other words, mobile handsets) in fixed phone networks. Currently, fixed wireless access (FWA) is defined in Brazil as a wireless access application utilized by fixed telephony operators for local loop

connections, or wireless local loop (WLL). There are no precise limits for FWA terminal mobility, or possible enforcement methods to ensure that terminals are confined to a predefined area of mobility, since real estate dimensions vary considerably. Besides, Anatel's efforts to address this issue have also revealed that there is a right to mobility pursuant to STFC regulation.

After regulating the use of portable terminal equipment for fixed networks in 2001, Anatel's board of directors ruled on radio frequency usage, establishing that some radio frequencies assigned to mobile services (between 171-1755 MHz and 1805-1850 MHz) may be used by STFC operators on a secondary basis. This was reinforced by another resolution in 2006, which attributed, on a secondary basis, more SMP frequencies to STFC wireless applications. SMP radio frequency assignment to STFC on a secondary basis has had an apparent effect on the infrastructure cost of new entrants. Secondary use of frequency bands spares fixed operators from spectrum acquisition costs and authorization fees, while enabling them to take advantage of economies of scale in mature mobile technologies. As described by Weiss (2006), secondary use plays an important role as a technical, business and regulatory mechanism for more effective spectrum management and its use depends upon a temporal and geographic function.

The evolution of the Brazilian telecommunication legal framework has therefore resulted in a fertile environment for the convergence of fixed and mobile services, since the regulator has promoted the use of mobile telephony spectrum by new fixed-service entrants on secondary basis and authorized portable terminal equipment for use by STFC providers. As we shall discuss below, this has promoted entry by innovative competitors in underserved areas or for underserved groups (such as the elderly), though at the same time such changes have led to regulatory tensions that cast a cloud over the new breed of hybrid fixed-mobile market players.

Mobility on fixed services: case studies

The three case studies discussed in this section reveal the key regulatory challenges raised by fixed-mobile convergence in the context of efforts to increase competition and expand service offerings for underserved customers. They will be herein referred to by their commercial names: *Vésper Portátil*; *Embratel Livre*; and *Local*. Table I summarizes the main characteristics of each of these services.

Table I Case studies: key characteristics

	<i>Vésper Portátil/Embratel Livre</i>	<i>Local</i>
Business model	Low-income customers in urban areas Subscription-less service Low-cost deployment Handset economies of scale	Underserved areas Small-scale telecom operator Local entrepreneurship Low-cost deployment Handset economies of scale
Spectrum	Primary spectrum authorization (STFC frequencies) <i>Vésper Portátil</i> : 1935 MHz <i>Embratel Livre</i> : 1975 to 1990 MHz and 1895 to 1910 MHz	Secondary spectrum use (SMP frequencies) <i>Local</i> : 1835-1838 MHz and 1740 MHz (Radio frequencies not yet assigned for SMP providers on a primary basis in the areas where local operates)
Technology	CDMA	GSM
License	Service license: STFC Radio frequency license: WLL radio frequency licenses	Service license: STFC Radio frequency license: secondary use of SMP frequencies
Regions	All codes in Regions 1, 2 and 3 (national coverage)	Codes 85 to 88 in Region 1 ^a
Subscribers	2.5 million (December 2009 estimate)	6,000 subscribers (December 2008)
Note: ^a Area codes corresponding to the Brazilian states of Ceará, Pernambuco and northern Piauí		

Vésper Portátil

The first commercial use of FWA/WLL in Brazil dates back to 1999, when local carrier Telemar provided STFC with FWA/WLL in the city of Parati in the state of Rio de Janeiro. Shortly after, Bell Canada, Velocom and Qualcomm created Vésper, a joint venture aimed at providing STFC service using wireless technologies and competing with fixed incumbents Telefônica and Telemar in the key markets of Sao Paulo, Rio de Janeiro, Minas Gerais and 14 others. The arrival of Vésper was highly significant for a variety of reasons. On the one hand, it was the first attempt by a new entrant to compete with local incumbents in mature markets using FWA/WLL for last-mile access. This also represented a test for the newly established legal framework that attempted to promote competition through local-loop unbundling and asymmetric regulation between incumbents and new entrants. Lastly, as the regulatory battle moved to the courts, the judicial outcome was perceived as a key signal about the role that the judiciary would play in the new Brazilian telecom regulatory environment.

Bell Canada, Velocom and Qualcomm instituted Vésper to provide STFC in the state of Sao Paulo and other 16 states in Brazil, initially competing with two local carriers for fixed phone services: Telefônica, in the state of Sao Paulo, correspondent to the area with highest income and population density in Brazil, that is Region 3 of the General Plan of Concessions (PGO); and Telemar, in the states of Rio de Janeiro, Minas Gerais, Espírito Santo, Bahia, Sergipe, Alagoas, Pernambuco, Paraíba, Rio Grande do Norte, Ceará, Piauí, Maranhão, Pará, Amapá, Amazonas and Roraima, correspondent to Region 1 of the PGO, which encompasses the North and East regions of the Brazilian territory.

The use of FWA/WLL by Vésper was approved by Anatel's Resolution 271 of August 6, 2001, which authorized the use of cellular handsets for FWA/WLL applications as a substitute for STFC customer premises equipment. Vésper decided to deploy terminals embedded with CDMA IS-95 technology that worked at 14.4 Kbps. The network admitted roaming and handoff-handover. Vésper also offered customers the ability to originate calls in a radius up to 9 km around the subscriber's home or office, while the mobility area for a call in progress was equivalent to the city of Sao Paulo area and two nearby cities.

By allowing customers a certain degree of mobility, Vésper was testing the limits of the established separation between fixed and mobile services. As expected, mobile operators were the first to raise concerns about the ability of STFC licensees to compete in a market reserved for SMP licensees. In 2001, Telemar and Telemig filed administrative complaints against Vésper with Anatel, which in its first decision issued in August 2002 suspended the deployment of Vésper's services. The suspension was revoked a month later, when the regulator established that Vésper's services should be limited to so-called restricted mobility areas. Still, Anatel prevented any new deployment before it could certify that the operator complied with the above restrictions.

At the same time, mobile operators also filed suit in the state of Rio de Janeiro, arguing that Vésper was emulating mobile services restricted by federal regulation to SMP licensees. The plaintiffs' argument was based on the fact that fixed services bounded users to a specific home or office address, and asked for a judicial annulment of Anatel's rules allowing STFC licensees to deploy wireless personal voice and data communications terminals. In September 2004, the Superior Court of Justice recognized state jurisdiction over the issue. In August 2007, the Rio de Janeiro Court of Appeals concluded that Vésper did not violate STFC regulations. According to the Court, mobile operators failed to prove that the mere employment of mobile devices violated federal rules that bound fixed telephony services to a specific address, especially due to the changing nature of customers' real estate dimensions. On December 2008, the Superior Court of Justice denied an appeal by mobile operators, confirming the ruling that the mere technical possibility of handset mobility beyond the geographic area of the client's home or office did not violate the terms of STFC licenses.

The Vésper case reveals a regulatory landscape in which the regulator struggles to draw the line between fixed and mobile services, which led to a protracted regulatory battle in the courts. While the judiciary process ended by and large in a victory for Vésper, the lengthy

dispute hardly provided an enabling environment for the growth Vésper and other new market entrants betting on the use of low-cost wireless technologies to challenge incumbents.

Embratel

The second case of interest is Embratel's wireless local loop system. Until recently, Embratel carried out a role in the Brazilian telecommunication scenario very similar to that played by AT&T after the Bell System divestiture as a long-distance exclusive franchisee. Telebrás System history mimicked Bell System rise and fall described in Huber *et al.* (1999) passing through periods of regulated monopoly, quarantined exclusive franchises, duopoly system (Piragibe, 2001), and finally regulatory incentives towards competition.

Until 1999, Embratel was the only provider of international and inter-regional calls in Brazil. The period of duopoly system was then extended until 2002, when previous regulation preventing incumbents to compete with each other was finally overcome. Curiously, the Brazilian equivalent of AT&T, then a state owned enterprise, was acquired on July 1998 by a subsidiary of MCI WorldCom, Startel Participações Ltda, which bought 19.26 percent of Embratel's total shares. After that year of 2002, most of telephone incumbents, including Embratel, were finally granted to compete in other regions of the General Concessions Plan as competitive local exchange and long-distance carriers in the private regime. For that reason, Embratel initiated its local loop services only on December 2002 competing inside the stronghold of well-established incumbents, such as Telefônica, Telemar and Brasil Telecom.

Not surprisingly, Embratel's business model headed toward FWA/WLL facilities, applying them on its local telephony service over fixed-mobile network. This service called Embratel Livre is officially referred to as a former FWA/WLL service from Vésper, which was acquired by Embratel on December 2003, although Embratel's experience with FWA/WLL started earlier, in 2002, as a subscriptionless service (Embratel, 2007) in two cities – Fortaleza and Recife. On May 8, 2002, Embratel certified the anticipation of its univesalization goals and applied for local STFC permits in the remaining three regions of the General Concessions Plan. On August, 2002, Embratel was then authorized to provide local fixed phone services in all regions of the Brazilian territory becoming the first national competitive local exchange carrier after the privatization of the Telebrás System. Embratel started providing local services on December, 2002.

Embratel Livre, VipLine and NetFone services were designed by Embratel to penetrate in the local exchange carrier market, but only Embratel Livre aimed at low-income users. This service plan resembled Vésper Portátil in many ways such as the ability of originating calls in a radius of up to 3.5 km around customers' home or office (Capella, 2008) and the ability of performing roaming and handoff-handover using CDMA technology. After Vésper acquisition by Embratel in 2003, their FWA/WLL services were then gathered under the expression Embratel Livre, which has been reported as the only Embratel's strategy for increasing penetration of fixed local telephone services among low-income users.

In response to mobile companies' administrative complaints of July, 2004, Anatel required Embratel to convey through national press releases that Embratel Livre could only be guaranteed inside subscribers' home or office. Anatel's administrative decisions also prevented Embratel from promoting commercials or any advertising that imply to consumers that the fixed phone service called Embratel Livre could mimic mobile phone services. It also determined that Embratel must develop a parameter by which FWA/WLL mobility do not surpass three adjacent radio base stations or alternatively another parameter proposed by Embratel. In response Embratel hired the former Telebrás Labs (CPqD) to perform tests of signal degradation during the years of 2004 to 2007. The resulting analysis stated that CDMA technology in FWA/WLL systems would have its signals' quality thoroughly affected by the agency's intension to restrict mobility to an area of three adjacent radio stations. Until the present date, Anatel is analyzing the CPqD technical study, while Embratel Livre continues its rising penetration in the fixed phone market with plans designed to low-income users, although mainly in high-density high-income areas. From a universe of 101 cities in

2008, those with less than 150,000 inhabitants represented only 2.2 percent of the total amount of Embratel Livre users in Brazil. Figure 1 reveals the growth of Embratel Livre despite the overall stagnation in fixed services in Brazil.

Embratel depends on FWA/WLL technologies for its low-cost business model to attract urban low-income customers (in particular the elderly). Its flagship subscriptionless service, Embratel Livre, is presented as allowing what the operator calls “neighborhood mobility”. While less threatening to mobile operators than the original Vésper service, the model continues to pose difficult regulatory questions, which Anatel has attempted to address, as discussed below.

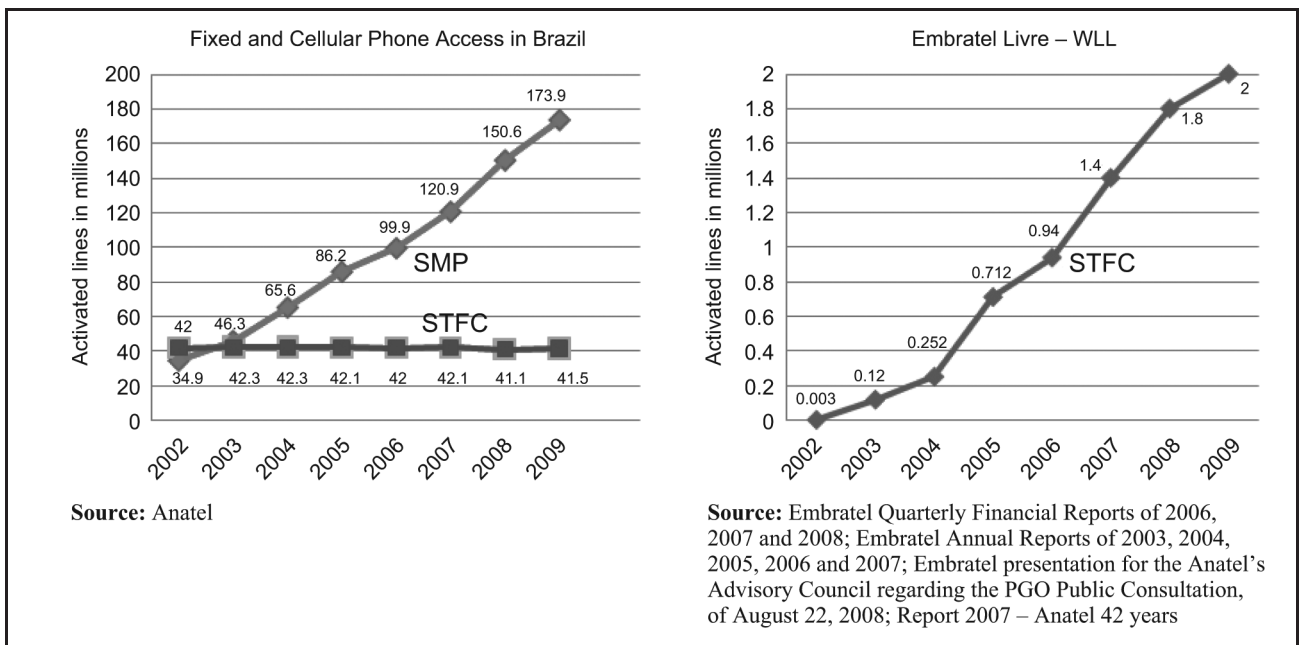
Local

The last case study relates to the use of GSM cellular technology to provide fixed telephony, and combines the challenge of a new entrant (Vésper case) with the success of a well-planned business model (Embratel Livre). Moreover, it clearly demonstrates the opportunities opened up by FWA/WLL technologies for small-scale operators to enter markets of little interest to traditional operators, combining local entrepreneurship, innovative business models and low-cost technologies (Galperin and Bar, 2006).

Local is the commercial name of the fixed telephone service provided by Local Serviços de Telecomunicações S.A., a subsidiary of the North American operator Ruralfone. In 2004 the operator was authorized to provide STFC in regions 85 to 88 of the General Plan of National Codes, corresponding to the states of Ceará, Pernambuco and northern Piauí in northeastern Brazil, a region characterized by low GDP and low population density (Macêdo, 2008). The service was launched on May 2005 in the city of Quixadá in the state of Ceará, a city of approximately 74,000 inhabitants with a GDP per capita of less than 1/3 of the national average (IBGE, 2008). After three years of operation, Local had 2,600 subscribers, surpassing the customer base of local incumbent Telemar (2,500 subscribers), which resulted in a teledensity increase of 70 percent during the period.

Between 2005 and 2009, Local expanded its network to three more hinterland cities: Quixeramobim (2006), Russas (2008) and Aracati (2008). Lack of financing prevented Local from reaching 17 cities by the end of 2008 as originally planned. Yet in 2008 the operator secured a US\$ 3.5 million loan from the International Finance Corporation (IFC), which was

Figure 1 The growth of Embratel Livre



interested in Local as a testing ground for new low-cost telecommunication models for rural areas in emerging markets. At the end of 2009, Local presented a new ambitious expansion plan that included ten small hinterland cities in the states of Ceará and Pernambuco. The operator does not subsidize its GSM terminals (its business model is mostly based on selling SIM cards), and offers only two basic plans: “No Control”, which offers unlimited local calls, and “Popular Local”, a subscriptionless service.

The success of Local can be attributed to four key factors:

1. Low-cost wireless network deployment and the correspondent effects on service prices, in accordance with the findings of Mariscal (2009) on strong negative correlation between spectrum allocation and prices in Latin America and Tan *et al.* (2006) on price competitive advantage as the most significant driver for fast deployment of low mobility services.
2. Locally appropriate business model and affordable pricing (per minute prices are about a third below the national average).
3. An entrepreneurial management focus, which takes advantage of the perceived positive impacts of mobile telephones on businesses in terms of ease of contact with customers and suppliers, profitability and reduced cost of transportation in less urban areas studied by Frempong (2009).
4. An enabling regulatory environment, in particular concerning spectrum use on a secondary basis and incumbent interconnection fees.

Following the microtelco model described by Galperin and Bar (2006), Table II summarizes Local's key strengths.

Table II Summary of Local's key strengths	
<i>Microtelco model</i>	<i>Local case</i>
Small-scale telecom operator	Small offices located in each city of operation Start-up capital: US\$1 million from private funds Expansion loans: US\$3.375 million from the US Government Agency Overseas Private Investment Corporation (OPIC, 2004); US\$119,250 from OPIC in insurance wrap (OPIC, 2005); US\$3.5 million, in 2008 from the International Finance Corporation (World Bank, 2008) Number of employees: 38 (March 2008)
Local entrepreneurship	Local employees: 85 percent of workforce is recruited from and continues to live in the cities where the service is offered Decentralized organization: door-to-door sales; home delivery of pre-paid cards Local community engagement Attention to service for public utilities and local governments
Innovative business model	Two simple plans: “No control” (Plano Sem Controle); and “Popular Plan” (Plano Popular) Low cost: “No control” is priced at R\$39.00 (US\$15.60) per month for unlimited local calls; “Popular Plan” charges R\$0.048 per minute (US\$0.019/min), as opposed to R\$0.070 per minute (US\$0.028/min) of fixed service national average
Low-cost technologies	WLL network GSM handsets offer economies of scale Single base station per city
Low-income, high-cost areas	Low-density region in Brazil's northeastern hinterland Low-income: in 2004, municipal GDP of R\$3,049 (US\$1,219) as opposed to National GDP of R\$10,692 (US\$4,276)
Note: Prices correspond to 2008 (currency exchange rate: US\$1.00 = R\$2.5)	
Source: Ruralfone Inc., World Bank Group and IBGE (2008)	

As noted, the regulatory framework presented a reasonably favorable environment for experimentation with new wireless technologies for STFC deployment: first, regulated interconnection fees prevented incumbents local carriers and long-distance carriers from suffocating new entrants; second, the regulator was particularly concerned with promoting competition in the last mile; lastly, SMP frequencies were available for use by STFC entrants on a secondary basis, which minimized spectrum acquisition costs. The combination of maturing low-cost technologies, local entrepreneurship and a supportive public policy environment created a fertile ground for Local's growth.

Regulatory tensions on the fixed-mobile frontier

The case studies discussed above exemplify how the maturing of wireless technologies for last-mile access combined with regulatory innovations aimed at optimizing spectrum use are blurring the lines between mobile and fixed telephony services, creating tensions as new market entrants seize opportunities and incumbents seek protection from competition. So far, Anatel has attempted to resolve disputes with only piecemeal changes to the existing legal framework, thus opening the door for market players to seek redress in the courts. The unintended result has been lengthy judicial battles that deter investors and fail to resolve the substantive issues.

The concept that has guided Anatel in its attempts to allow FWA/WLL for fixed services without disrupting the mobile market is restricted mobility. Between 2005 and 2006, Anatel issued several resolutions requiring STFC and SCM licensees to employ equipment with restricted mobility in the 2.1, 2.5, and 3.5 GHz bands. Nonetheless, the exact meaning of restricted mobility was left undefined, and thus regulatory battles moved to the courts. This approach also created asymmetries with STFC licensees in the 1.8 and 1.9 GHz bands, which fell outside the restricted mobility requirement.

In 2007, Anatel carried out a public consultation that proposed to incorporate the terms mobility feature (*função de mobilidade*) and restricted mobility (*função de mobilidade restrita*) in the certification rules for digital transmitters and transceivers used by fixed-service providers in point-multipoint applications in frequency bands above 1 GHz. By prohibiting these devices from activating their mobile capabilities, Anatel aimed at preventing new mobile broadband technologies (in particular the mobile version of WIMAX) from being used by fixed telephony operators. Resolution 492, issued in February of 2008, imposed limits over mobility, roaming and handoff-handover capabilities of transmitters and transceivers operating above 1 GHz. While not the main regulatory target, the resolution affected FWA/WLL networks such as those of Embratel and Local. The principle behind the resolution was that STFC operators utilizing FWA or WLL must abstain from mimicking the core characteristics of SMP licensees, i.e. mobility and wide-area roaming.

Disputes about restricted mobility have also surfaced in the General Concessions Plan (PGO), arguably the central document in Brazil's telecommunications legal edifice. The PGO specifies which telecommunication services are bound to a public service regime, among other key issues. The first PGO was enacted on April 3, 1998, and attributed a public service regime to the fixed switched telephone service (STFC) provided by the former state monopoly Telebrás. In doing so, the PGO defined STFC by enumerating its basic characteristics: "voice and signals transmission", "communication between specified fixed points" and "use of telephony process".

As part of the process of updating the PGO, Anatel launched a public consultation in which Embratel suggested the elimination of the word "fixed" from the definition of STFC. The text approved by Anatel's Board of Directors revealed that the regulator was willing to accept a more flexible definition for STFC services, but the final text approved by the Ministry of Communication and enacted by Presidential Decree 6654 of November 20, 2008 reestablished the original wording. As a result, the current PGO still defines STFC as a service that provides transmission of voice and signals between specified fixed points through a telephony process. Although neither the previous nor the current PGO specify the meaning of "telephony process" or "fixed points", the reestablishment of the original

definition of STFC represented a victory for SMP operators seeking to prevent new STFC operators from offering limited mobility services.

There are also uncertainties related to the use of SMP frequencies by STFC operators on secondary basis (as in the case of Local discussed above). So far, Anatel has allowed such use as part of what it has described as a temporary strategy to help expand fixed services in underserved areas. In fact, the policy was originally designed to help incumbent STFC operators reach their network expansion commitments by reducing network deployment costs. The regulator assumed that this strategy would also minimize frequency coordination costs between primary and secondary users, since incumbent STFC operators also held SMP licenses. However, the unexpected effect has been to open the door for disruptive new STFC entrants such as Local. Whether Anatel will authorize such spectrum sharing on a more permanent basis, and how it will react to potential interference disputes still remains to be seen.

In summary, the outlook for new STFC entrants seeking to deploy FWA/WLL technologies to serve low-income and low-density areas depends upon the consolidation of spectrum administration tools that:

- facilitate spectrum access (based on secondary use) in small and medium-size localities;
- create administrative proceedings to allow new players to point out inefficiencies in frequency use;
- incorporate new mechanisms to promote spectrum efficiency, such as spectrum pooling, flexible licensing, and pre-certification of equipment for use in license-exempt bands (Tonge and de Vries, 2007); and
- eliminate barriers to the development of secondary spectrum markets, in spite of the fact that spectrum trading may be of less importance in areas where frequency scarcity is low (Xavier, 2005).

Conclusion

The combination of an enabling regulatory environment for the deployment of FWA/WLL networks and innovative business models has resulted in the emergence of a new breed to fixed operators that, despite the overall decline in STFC services, are helping to extend services into low-density/low-income areas and serving clients of little interest to fixed incumbents in urban areas such as the elderly. Nonetheless, this has come at the expense of an unusual nexus of regulatory tensions between these new entrants, fixed incumbents and traditional mobile operators.

The cases described reveal that the new entrants have applied a variety of business strategies depending on local conditions and goals. In high-density areas, the deployment of FWA/WLL has allowed Embratel to defy the stagnation of fixed services. The low-cost, subscriptionless service with restricted mobility offered by the operator has successfully attracted low-income customers in areas well-served by the incumbent fixed operators. In the case of Local, several ingredients explain the ability to serve low density, low-income areas profitably:

- the use of a mature mobile technology (GSM) and low-cost spectrum access on a secondary basis;
- a successful business strategy based on simple, low-cost plans; and
- the engagement in community life typical of a microtelco.

However, the regulatory innovation that has enabled the emergence of these new breed of fixed-service competitors is under peril. The rules enacted by Anatel from 2005 to 2008 were designed to allow the deployment of FWA/WLL networks without disturbing the mobile market (Pereira Filho, 2003). Yet the growth of restricted mobility services got the attention of both fixed and mobile incumbents (which for the most part share corporate ties), which have since attempted in administrative proceeding and the courts to limit the growth of FWA/WLL

competitors. As discussed, key ingredients in Local and Embratel's business model, such as the use of SMP frequencies on a secondary basis and the provision of restricted mobility face an uncertain future.

The blurring distinction between fixed and mobile services presents both opportunities and challenges for Brazil. Anatel has so far moved in the right direction, enabling the growth of new competitors that challenge incumbents in established markets and open up new ones. Yet it has moved only timidly, thus creating multiple regulatory uncertainties and opening the door for incumbents to seek protection from competition in the courts. Without clear public policies aimed at consolidating the existing ingredients that favor the deployment of FWA/WLL networks and the emergence of microtelcos, Brazil may endanger a promising tool for simultaneously promoting universal service and fostering competition in telephony services.

Note

1. SMP is a broad term that encompasses, in Brazil, any mobile telephony service.

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