Geographical gaps in Portuguese broadband access.

Rethinking the role of public funding after years of trade liberalisation.

Abstract

Digital information flows, are influencing and interacting with real places in a very complex and dynamic way. The main objective of this article is precisely to present a detailed study about Portugal, with the purpose of questioning the effective role of broadband internet access on the decrease of regional disparities or, on the contrary, as an unexpected contribution to the aggravation of territorial inequalities. To answer this question, we will present a few cartographic analyses, with the spatial extent of the most recent broadband technological solutions available in Portugal (SDL technology, coaxial cable, fiber-optic cable, the WiFi access or the 3G/UMTS technology). Market failures originated by pro-competitive policies between private operators will lead us to rethink the role of public funding after years of trade liberalisation.

Introduction

In order to help us clarify the potential role of ICTs as instruments of local and regional development, we will discuss the problem of infrastructures in the Portuguese context, questioning the actual effects of the opening of the telecommunications sector to private competition. The aim of this article is to evaluate how the competition between operators has been influencing the way

Portuguese territories are being equipped as regards information flows through high-speed networks.

Rallet (2002: 180) argues that “the introduction of ICT as a tool of local development is not fundamentally a problem of infrastructure”, especially in consequence of the increasing number of alternative technologies, which will greatly reduce the areas of uncertainty. However, our analysis of the broadband diffusion, based on the most recent technological solutions (coaxial cable, SDL technology, fiber-optic cable, the WiFi access or the 3G/UMTS technology), clearly indicates that the competing operators develop market skimming strategies that leave aside the great majority of the Portuguese municipalities, including entire towns.

Places with no guarantees concerning the need of local information consumption, definitely represent an enormous risk for the private operators investment strategies, especially concerning the spatial configuration of their high-speed networks. As a consequence, we are witnessing a minimization of the impact of ICTs on the location of activities and jobs. But even more worrying, is the recognition of ICTs as instruments contributing to the increase of geographical disparities and territorial disintegration tendencies. As we will demonstrate, only the most developed and urbanized municipalities, those having the best physical communication networks, are currently benefiting from the competition between different broadband platforms, thus being able to explore more efficiently the potentialities of ICTs as tools for local development.

This scenario implies a considerable risk of increasing inequalities between different areas, especially for the less accessible, less populated and economically weaker Portuguese municipalities, which thus can hardly take advantage of the following: (1) the relocation of activities and jobs through the use of ICTs (aiming to reduce transportation, real estate and salary costs); (2) the creation of new activities and jobs arising from the prospects offered by the new means of telecommunication (production of hardware, e-contents, informatics and consulting services,…); (3) or even from the appearance of new patterns of spatial organization of services, with the development of long-distance networking co-ordination between geographically separated units or individuals.

Undoubtedly, the problem of inequality of ICT access has to do also with the ability to use it effectively, which is related with education, knowledge and the citizens' specific skills. Nevertheless, we believe that the connectivity to Internet-based networks is a basic prerequisite for further exploration of the learning processes in ICT applications, and, as a consequence, we must be able to provide a wider definition of the Telecommunications Universal Service in order to direct future negotiations between national bodies and private broadband operators. The evolution of this concept is foreseen in Portuguese Law, and we will try to systematize relevant information to support such revision.

Broadband access - a new infrastructure for productivity growth and social progress

Broadband, also known as high-speed 'always on' Internet access, supports the almost instantly delivery of large volumes of data, reducing waiting time and improving efficiency for users. Technically, this is not an unchanging concept, since what we now call broadband (defined as 256 kilobits per second downstream and 128 kbps upstream) will probably be narrowband tomorrow (Willis, 2002).

The increased Internet performance provided by this technology, promotes the improvement of the existing web-services and the creation of new ones, exploring the broadband ability to deliver new advanced e-contents and applications. However, the potential of broadband is related not only to its significantly higher speed, creating the necessary conditions for the delivery of innovative interactive services, but also to the ability to increase a more permanent use of those services, because broadband spurs a spontaneous and continuous Internet use as a result of its ‘always on’ feature.

As a result of such potentialities, and despite being a nascent technology, governments worldwide are increasingly acknowledging that a wide availability of broadband communication will be central to the economic and social development of their countries (Commission of the European Communities, 2002).

The benefits of broadband include productivity growth, as well as an increase in the living standards of contemporary societies. Among the various advantages arising from the dissemination of broadband, we can highlight its role as:

- an instrument for productivity growth, as a direct consequence of the use of Internet solutions for the improvement of organizational readjustments in the existing business processes; for the creation of new business opportunities; or for the exploration of new markets. As Willis (2002: 6) underlines, “fast connections allow businesses to save time and money and improve overall efficiency";

- a way to promote the reorganisation of working processes, with a more flexible workforce arising from the increasing number of mobile workers benefiting from on-line access to corporate applications;
- an enabling technology to improve human capital, providing an opportunity for upgrade skills with the encouragement of distance education solutions;
- a chance for progress in healthcare with the use of videoconferencing for the diagnosis and treatment of the patients;
- a possibility to improve the efficiency of public administration, by developing the existing public services; creating new interactive solutions (information services, license renewals, tax return submission, voting…); reducing bureaucracy between the state and the citizens or companies; or stimulating public participation and involvement in the policy-making process;
- a means to provide several entertainment options, such as video on demand, music downloading or chat groups;
- …

In order to support these applications, a wide range of technological options, with different features, have been developed (see Table 1). In the future, all these technologies are expected to coexist in order to "compete with one another (facility-based competition) and complete each other, resulting in hybrid technological solutions expected to facilitate widespread coverage" (Commission of the European Communities, 2004: 6). Access networks are likely to evolve into architecture solutions, with fibre optic coming increasingly close to buildings, and high-speed cable, DSL, wireless links, or fibre optic itself connecting the final user.

<TABLE 1>

In order to speed up the use of these technical methods, aiming to the spatial diffusion of broadband networks, the common strategy used by many countries is to encourage investment from the private sector (both from new entrants and from incumbent operators), removing legislative barriers in order to ensure effective competition between local telecommunication networks as well as to generate innovation and lower prices. These new regulatory frameworks and government policies should also "focus on issues where competition is not effective or where political objectives, e.g. territorial coverage with a view to cohesion, need to be ensured" (Commission of the European Communities, 2002). Meanwhile, are governments applying these principles of universality and equality, ensuring that technical conditions are being improved in under-privileged areas and promoting a dissemination of broadband access through all citizens and firms?

Broadband access – a biased tool for regional/local development

Broadband access is quickly emerging as the technology of choice for both businesses and households. Offering significant improvements in information transmission speed, broadband is progressively becoming a new location factor and consequently a new instrument to stimulate local/regional development. For this reason, it is important to distinguish the localities that are exploring the opportunities of these connections from those that are not.

An empirical work that has been conducted at a local level, in Franklin County, in the state of Ohio (USA), revealed the spatial manifestations of the inequities in broadband Internet access (by exploring the spatial diffusion of DSL technology). Results suggest that this emerging digital divide does not discriminate inner-city locations but the rapidly growing suburbs of Franklin County (Grubesic and Murray, 2002). This spatial limitation concerning the type and quality of Internet access via DSL is caused by the physical architecture of the copper infrastructure, mainly as regards the quality of the copper wiring, but also in terms of the proximity of households and businesses to the buildings that contains the circuit switching equipment for all telephones lines (a high-quality service is guaranteed only at a specific distance, around four kilometres, of those buildings).

The study of these spatial disparities was extended to all of the Ohio state (Grubesic, 2003) and to all of the USA (Grubesic, 2004), highlighting differences between rural and urban areas in the broadband cable and DSL service availability. Grubesic concluded that household and businesses density, as well as income and education, play an important role in the provision of such services. For instance, areas with an older demographic profile are less likely to obtain high-speed connections. On other side, more educated and wealthier people are segments that generate a significant level of demand for broadband services. Consequently, these investigations point out that urban areas and business districts are more attractive for broadband providers, because of their infrastructure densities and demand densities, and as a result they display dominant shares of both cable and DSL broadband infrastructures. Concerning the competition variable, rural and smaller urban centres appear to suffer from market dominance by a particular broadband provider, by contrast with the biggest cities, where several broadband platforms are available, thus ensuring more competitive prices and an increased quality of service.

Another study conducted in the United States emphasizes the conclusion that rural areas are lagging behind metropolitan regions where broadband access is concerned (Strover, 2003). This study reinforces the view that the absence of competitive access disproportionately affects services to rural populations, and, on the other hand, the relatively lower income levels of rural populations brings up serious affordability issues concerning the broadband subscriptions. Recognizing that Internet connectivity took more time to reach the rural America than elsewhere in the country, this study concludes that the existing policy approaches appear insufficient to achieve the goal of widespread rural development, since they were incapable of ensuring that telecommunications services are roughly comparable between urban and rural areas.

In order to understand the magnitude and the characteristics of the digital divide that is being traced inside developed countries, Barroso and Martínez (2004) conducted a study in Spain, within the Community of Madrid. Considering the common characteristics of the municipalities with cable broadband, they highlighted the combination of two different parameters: a population exceeding 20.000 inhabitants and a minimum concentration of 1.000 economic activity units by municipality. This slow progress (after the implementation was started, the cable deployment took five years to reach the municipalities within the Community of Madrid with over than 20.000 inhabitants) can be explained by the fact that the extension of broadband accesses depends on the improvement of the initial infrastructure, and in the Community of Madrid no cable television networks had been deployed in the past. Under these circumstances, the companies chose to implement the DSL technology over the cooper telephone network, covering in 2003 more than 99% of the population, but leaving out 68 municipalities representing 27% of the surface in the Community of Madrid. From these results, the authors concluded that the digital divide's impact is much smaller from a population perspective than from a geographical one, and consequently "from a territorial occupation model perspective, the digital divide adds a heavy burden to any attempt of correcting the depopulation tendency of rural areas" (Barroso and Martínez, 2004: 12).

All these studies confirm that these technologies are not widely available in all areas, and it seems as if all broadband providers are competing for the same pool of customers. Such gaps in broadband access are indicative that as a result of the privatisation of telecommunications, private providers tend to ignore rural markets providing services to the most lucrative urban sectors. For this reason, there is a "need for revaluating current policies seeking to promote equitable investment in telecommunication infrastructure" (Grubesic, 2003: 265).

The geography of the Portuguese broadband access

Recognising that the potential of the information society as regards the improvement of productivity and quality of life is growing due to the technological developments of broadband, the European Commission presented in June 2002 the eEurope 2005 Action Plan. The main intention of this strategic document is to take full advantage of a widely available broadband infrastructure, giving everyone the opportunity to participate in the global information society. This equitable concern is also geographical, as it becomes clear in one of its proposed actions:

> "*Broadband access in less favoured areas*. Member States, in co-operation with the Commission should support, where necessary, deployment in less favoured areas, and where possible may use structural funds and/or financial incentives (without prejudice to competition rules). Particular attention should be paid to outermost regions" (Commission of the European Communities, 2002: 17).

This means that in the places where private-sector investments are insufficient to ensure that citizens and businesses reap the benefits of widespread broadband, governments must get involved. Consequently, EU member states have been adopting National Broadband Strategies and pursuing public policies, in order to assist a widespread availability (acting in the supply-side of the market: infrastructure deployment) and use of broadband (acting on the demand-side of the market: increased usage), as it was highlighted in the eEurope 2005 Action Plan.

The National Broadband Initiative in Portugal sets out specific targets to be achieved by 2005, in particular stating that 50% of all households and enterprises will have broadband access to the Internet by then (Resolution of the Council of Ministers n.º 109/2003). While it seems to be difficult to materialize such an ambitious objective, especially in households penetration, according to recent data (see Table 2), the absence of a spatial dimension for the equitable application of this political goal is a much more worrying factor.

<TABLE 2>

However, while the Portuguese Government acknowledges the primary role of the market for broadband development, it also recognizes the role of public policies in an effective functioning of the market (Resolution of the Council of Ministers n.º 109/2003). In order to question the effectiveness of the instruments used to correct market failures or complement the action of market forces, we will present a cartographic analysis, trying to develop a better understanding of the spatial diffusion process of broadband penetration throughout Portugal.

> "Mapping of broadband availability is a useful starting point for the identification of underserved areas, and needs to be continuously monitored and updated given the rapid development of broadband

> throughout the Union" (Commission of the European Communities, 2004: 23).

In Portugal, broadband reached 5% of the population in January 2004 (571500 broadband access customers). Although Portugal is one of the very few countries in the European Union where the number of cable subscribers is higher than the number of DSL customers (59,4% and 40,1%, respectively, of the total broadband customers in the first quarter of 2004), DSL has been showing the highest evolution rates (see Figure 1) concerning the addition of new subscribers (20,1% between 2003 and 2004, against 46% with cable for the same period) and, as we will demonstrate, it is the most geographically widespread broadband option.
The initial preponderance of cable subscribers may be related to the fact that the extension of broadband accesses depends on the improvements of the initial infrastructure. Benefiting from the fact that cable television networks were deployed in the past in Portugal, it was possible to quickly provide broadband access by cable while it was necessary to invest in the implementation of DSL technologies over the cooper telephone network.

<FIGURE 1>

Despite the absence of information by municipality and for the two autonomous regions (archipelagos of Madeira and Azores), we can nevertheless state that all of the eighteen districts in Continental Portugal are equipped with SDL lines (see Figure 2). Still, a relative analysis of the number of SDL lines per inhabitant shows us that this spatial diffusion is illusory. In 2003, one single district (Lisbon) concentrated half of all Portuguese SDL lines, corresponding to a rate of 440 SDL lines per 1000 inhabitants. In contrast, there were seven districts, totalling 45% of the surface of Continental Portugal (Viana do Castelo, Vila Real, Bragança, Viseu, Guarda, Portalegre and Beja) with less than 57 SDL lines per 1000 inhabitants (the average for these seven districts was 40 lines per 1000 inhabitants, which was one-tenth of the Lisbon value).

This geographical disparity is not only marked between urban and less populated areas, but a detailed analysis shows also a huge discrepancy between Lisbon and the other Portuguese metropolitan area (Porto), which had, in 2003, less than half of Lisbon's SDL penetration rate (207 SDL lines per 1000 inhabitants)[1].

<FIGURE 2 and 3>

This spatial pattern of SDL broadband connection clearly demonstrates that market strategies of SDL ISP's (Internet Service Providers) are related to the most profitable segments of industry, services and population. In this case, the most profitable segments correspond to high-density urban markets, especially those urban areas that correspond to a high-quality density of demand (both residential and business-based demand), which is expected to generate higher returns of infrastructure investments[2]. Therefore, the higher penetration of SDL lines in Lisbon is explained because it is intensively urbanized, and it is clearly characterized by a predominance of industrial, financial and administrative services, as well as by cultural and recreational activities, whereas the Porto agglomeration's has a productive structure not so rich or diverse in terms of services, its industrial profile is more traditional and its human resources are not as qualified as Lisbon's.

Concerning the spatial distribution of broadband connection by cable[3] (see Figure 3), we can see that this broadband option was not available in 199 municipalities in the mid-2004 (in a total of 308 municipalities that exist in Portugal). Non-served municipalities correspond to almost 67% of Portuguese surface, but it seems clear that the areas with no cable broadband deployment are larger, because coverage in most served municipalities is far from complete[4].

With the exception of Viana do Castelo, the city that limits the north extension of the most institutionally, demographically and economically dynamic area in Portugal (close to the sea and stretching south as far as the Setúbal Peninsula), all Portuguese cities with more than 30 thousand inhabitants benefit from Internet access with a speed significantly faster than dial-up connections. There is a clear correspondence between the municipalities that have the best road accessibility and the cable broadband penetration, which emphasizes the fact that ICTs tend to aggravate territorial inequalities, reinforcing the existing patterns of physical communications.

This conclusion is confirmed by the analysis of competition in cable broadband access (generally responsible for higher quality services and in some cases lower prices), which is mainly taking place in densely populated areas. Only four municipalities, all of them located in the cores of the Lisbon and Porto metropolitan areas, are characterized by the presence of three cable ISPs. We have only 26 municipalities with two cable ISPs, located in the periphery of the two metropolitan areas or in the municipalities corresponding to Portuguese middle-sized cities.

The benefits of broadband are particularly significant for remote and rural areas, because they tend to shrink distances by the use of new interactive services, but, nevertheless, cable ISPs find it unprofitable to roll-out infrastructures in areas where the expected demand is insufficient to ensure a positive return on investment (rural consumers generally have modest incomes and education levels). This consequence of the privatisation of telecommunications services is responsible for a much more pronounced geographical digital divide in cable broadband technology than in SDL. While SDL is present in all Portuguese districts, four or the eighteen Portuguese districts do not have cable ISP services: Viana do Castelo, Vila Real, Bragança and Portalegre. This fact can be explained by the different amounts of investment required to upgrade the existent cooper telephone network or, to provide whole new infrastructures in the municipalities without cable televisions networks.

The need for a substantial initial investment for the deployment of new cable infrastructures explains why 4 of the 6 Portuguese cable ISPs (see Figure 4) decided to provide their services on a local basis (Bragatel in the city of Braga; Tvtel in the core of the Porto Metropolitan Area and Colt in the core of the Lisbon Metropolitan Area), or with a supra-municipality coverage area (Pluricanal, working from Pombal to Santarém, and exploring also two other markets in the cites of Abrantes and Torres Vedras).

<FIGURE 4>

The Internet operator Netcabo, which belongs to Portugal Telecom (the incumbent operator and concessionaire of the telecommunications public service), has a market strategy that avoids the scarcely populated municipalities in Portugal. Focusing on the more developed and dynamic areas, Netcabo expresses a clear preference for the two metropolitan areas and their surrounding municipalities, as well as for some of the Portuguese middle sized-cities. Cabovisão, the other cable ISP with an extensive cable infrastructure, has a coverage area that also includes the most urbanized areas (except for the northern extension of the two metropolitan areas), and, thanks to the ring configuration of its network, it also provides access to some urban agglomerations where Netcabo has no coverage (especially the Beira Interior urban system: Guarda-Covilhã-Castelo Branco) as well as some rural municipalities in northern Alentejo.

From all the Portuguese cable ISPs, Colt is the only one providing broadband access with a network entirely made with fibre optic technology (transmission of digital signal by means of light waves, which create large bandwidth – Gigabits per second). Its network in Portugal is restricted to the municipalities of Lisbon, Oeiras, Amadora and Loures (all of them in the central section of the Lisbon Metropolitan Area). The economic viability of such an investment depends on a spatial concentration of firms interested in transmitting huge amounts of information electronically (firms from such economic sectors as finance, information technologies, informatics, media…). As a consequence, the implementation of these networks is restricted to the urban areas where those firms are concentrated, according to market rules in search of profitable returns on their initial investments. This prerequisite can clearly cause an increasing over-concentration of those units, especially since the access to fibre-optic cable is becoming a new location factor for the establishment of firms that are currently emerging in these economic branches. This is a clear illustration of how the impact of ICTs on the location of activities, can be decisive to worsen already marked territorial disparities.

This conclusion is once again emphasized if we look at the spatial distribution of the municipalities with the most recent broadband access methods in Portugal, namely the WiFi and 3G/UMTS technologies (see Figure 5 and 6). Concerning the WiFi technology, the coverage is only significant in Lisbon, with 34 hotspots, and Porto, with 20 hotspots in public or semi-public spaces (restaurants, hotels or shopping centres), especially because we are dealing with the possibility of a wireless connection in a limited range, of no more than 100-200 meters, from each hotspot. As for the 3G/UMTS technology, it has appeared in parallel with the Portuguese organization of the UEFA Euro2004, which was responsible for the decision of starting the use of this technology in the eight cities where European Championship games were held (one private operator provided access in all these cities and the two other operators in some of them, stimulating a stronger competition in the central areas of the two metropolitan areas).

<FIGURE 5 and 6>

In order to try to predict the market evolution in the medium term, we decided to look at the spatial diffusion process that has been characterizing the expansion of cable broadband provided by the operator (Netcabo) that belongs to the enterprise concessionaire of the telecommunication public service (Grupo PT – Portugal Telecom). This analysis shows us, unsurprisingly, that this service was initiated in the Lisbon Metropolitan Area, with a diffusiveness tendency throughout the most important urban agglomerations, reflecting a clear hierarchical pattern (see Figure 7). More importantly, we verified that during the last year (from July 2003 to June 2004), only three municipalities have entered this list[5], whereas in previous years this technology had been implemented in about 13-16 new municipalities every year. Therefore, the expansion has significantly slowed-down, which could be a signal of the future market strategy set forth by this operator.

<FIGURE 7 and 8>

The analysis of the cable penetration rate in served municipalities (see Figure 8), shows that many of the municipalities in question include areas without service (the highest penetration rates are clearly associated with the two metropolitan areas) and, consequently, this operator still has considerable investment efforts ahead in the municipalities where it is already present (in June 2004, in more than one third of all municipalities benefiting from this ISP, the percentage of houses with cable technology was lower than 40%).

Therefore, this recent expansion tendency, clearly slow and based exclusively on market rules, will make it difficult to extend the cable network to a great number of municipalities, specially the farthest from urban agglomerations, where a slowly adaptation of existing infrastructures (SDL option) is the actual base for expanding broadband accessibility.

This slowness will probably increase the geographic digital divide in Portugal and accentuate the impact of the competition resulting from the urban concentration of the variety of choices for broadband Internet access. All this cartographic analyses allow us to say that the diffusion of this technology is clearly a market and profit driven process.

Conclusion

In this article, we tried to identify geographical gaps in terms of broadband accessibility in Portugal. In doing so, we presented evidence suggesting a need for new policies and the reformulation of current ones, seeking to promote equitable distribution of broadband infrastructure investments.

The privatisation of the telecommunications sector can help us understand why almost all Portuguese broadband ISPs have chosen to work exclusively the densest markets (or, in the case of SDL, to provide very low penetration rates outside the more lucrative urban markets). However, we also believe that, nearly ten years after the first phase of this privatisation process, the role of competition and deregulation should be rethought, taking into consideration the example of broadband access.

If private-sector investments are insufficient to ensure a widespread availability of these high-speed information networks[6], one would expect that, according to all political recommendations, the functioning of the market should had been complemented by effective public policies. In this article, we collected some empirical evidences that allow us to deepen our understanding of the geographical extension of broadband accesses, from which we can conclude the absence of such complementary actions.

Recognizing the importance of such actions, we present three possible steps to guide a public policy approach aiming at a widespread deployment of broadband access:

- new regulatory framework;
- spatial analysis with a rigorous identification of the areas lacking broadband access;
- definition and execution of a subsidy programme to ensure an equitable deployment of broadband access.

Updating the Telecommunication Universal Service concept

In our opinion, these pronounced spatial discrepancies, which result from focusing broadband infrastructure investments in highly-populated markets, will be one more factor in the gradual improvement of Portuguese territorial disintegration tendencies. This fact should lead us to rethink our concept of Telecommunication Universal Service[7], looking at broadband Internet access as an important goal for Portugal. A new regulatory framework, one which would extend the borders of this concept, should be seen as a first step to legitimise adjustments in the concession contract of the public telecommunications service, as well as further application of public funds to correct the inequalities created by the market, and ensure that broadband services will be available outside the urban areas and even in some excluded areas that also exist inside Portuguese cities.

It should be noted that the Portuguese legislation states that the Telecommunication Universal Service is an evolving concept[8], and it is our conviction that it is no longer possible to delay the recognition of the implication of broadband from a social and economic perspective, even if it does yet constitute a formal recommendation of the European Commission for the Telecommunication Universal Service (Article 4 of the Directive 2002/22/EC of 07 March 2002). Furthermore, there are already examples of the inclusion of broadband access to the Internet, for instance, the Federal Communications Commission of the USA has recently "extended the concept of universal service to cover terrestrial wireline technologies for Internet access such as cable and digital subscriber lines (DSL)" (Grubesic, 2004: 336).

Mapping of broadband availability

After the establishment of a new regulatory framework, a policy approach determined to erase the geographical digital divide must be preceded by a rigorous spatial analysis, in order to determine the exact spatial extent of broadband availability. In this article, we tried to give some contributions to this task, but the areas where this technology is not yet available must be formally identified (and continuously updated). This is clearly a prerequisite for the creation of more balanced public policies concerning equitable access to advanced telecommunication infrastructures and services. However, it is extremely difficult to achieve this goal in Portugal, because ANACOM (the National Authority for the Communications Sector) does not collect independent data (by municipality or zip code) concerning the areas where each ISP is currently available.

Public funding to guarantee a widespread availability of broadband access

The next step should be the definition and implementation of a subsidy programme to ensure that broadband access would be deployed efficiently and equitably. From a practical point of view, if privatisation and pro-competitive policies are not enough to ensure a reasonable geographical equality as regards broadband access, then there is no doubt that public policies must aim at a more substantial infrastructural equity, as a prerequisite to a widespread use and appropriation of advanced telecommunications services in less-populated markets. In order to adjust market failures or complement the action of market forces "public funding in under-served areas is frequently considered necessary to provide incentives and stimulate investment" (Commission of the European Communities, 2004: 8). For this purpose, the European Investment Bank allows member states to use Structural Funds for the assessment and selection of their broadband development projects, notwithstanding the fact that they should respect rigorous guidelines and criteria, namely:

- to commit projects that are part of an overall regional development strategy;
- to allocate funds to areas where the investment costs are hardly justifiable on purely commercial grounds (particularly rural and remote areas, sparsely populated, and by proposal of a local/regional public authority);

- to develop projects on the basis of a technology-neutral approach (the broadband technology solution must be clearly justified on the basis of a cost-benefit analysis);
- to ensure that public support does not distort competition rules (access for all operators under equal conditions must be granted).

Despite the publication of these guidelines in July 2003 (Commission of the European Communities, 2003), the Portuguese Government has not yet selected the projects that should receive support, or the model for the ownership of the subsidized infrastructure (see Table 3).

<TABLE 3>

Concerning the broadband coverage of under-served areas, the initial objective expressed on the Portuguese National Broadband Initiative (more specifically the Community Networks Project) had a different approach: the idea was to develop infrastructures in order to provide broadband access in 15 underprivileged municipalities (Resolution of the Council of Ministers n.º 109/2003). This restriction would have turned this measure into an arbitrary attempt to deal with the Portuguese geographical digital divide, especially if we take into account the actual territorial extension of the areas where broadband is still not available.

To sum up, we can say that in Portugal, broadband technologies are not benefiting all areas equally. As we have demonstrated, the mere application of pro-competitive policies was not sufficient to generate a widespread and timely dissemination of advanced broadband Internet services. In this article, we stated that complementary public policies should be promoted in order to guarantee an equitable access to high quality connectivity with internet-based networks. However, and while in this study we focused exclusively on the effective functioning of the market, from the supply side perspective (infrastructure deployment in under-served areas, where market forces do not make the necessary investments), for us it is also crucial to develop complementary strategies concerning the demand side of the market, where public support should also stimulate the appropriation of these technologies, with the development and implementation of better contents and interactive services.

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Table 1. Technologies that stimulate broadband penetration

Broadband technologies:	Main characteristics:
DSL technology (Digital Subscriber Line) using telephone copper network	There are different versions: ADSL (asymmetric DSL) where more bandwidth is allocated to downloading than to upstream; VDSL (Very-high-rate DSL) offering the fastest DSL speeds, up to 50Mbps (megabits per second).
Coaxial cable technology using cable TV networks	Users have a shared-access, so the available bandwidth per user depends on the number of users connected to the same cable (it is a technology where the digital signal tends to enfeeble over distance).
Fiber optic technology	This technology can provide huge bandwidth (Gbps – gigabits per second), by using light waves for transmission, which is responsible for the digital signal maintenance.
WLAN technology (Wireless Local Area Networks) also known as WiFi	This technology allows users to connect to a local area network through a wireless connection in a limited range, around 100-200 metres. With this method, users of each base station (hotspot) share the bandwidth, which can be up to 50 Mbps.
3G/UMTS technology (Third Generation Mobile Communications / Universal Mobile Telecommunications Systems)	Provides high data rates and allows Internet access on-the-move.
PLC technology (Powerline Communication) using existing electric power cables	In this method, the users share the available bandwidth, whose quality is also distance-dependent. There are already some pilot experiences, however there are still some issues concerning operating frequencies and interference thresholds to be resolved.
FWA technology (Fixed Wireless Access) using digital radio technology	Provides “always-on” Internet connection at a speed up to 326 Kbps, using digital radio technology and small (roof or wall) mounted dish antennas.
Free space optics	This technology makes use of laser transmission to communicate data through the atmosphere (somewhat analogous to FWA). Humidity, fog and wind may disturb the transmission.
Satellite	Provides the advantage of ubiquitous coverage but the disadvantage of some delay problems as well as high costs of terminal equipment.
HAPS technology (High Altitude Platforms)	Analogous to the satellite method, the signal here is sent by computer-controlled balloons and micro-light planes, drawing power from the sun and flying higher than most aeroplanes ever go, but only one-fifth of a satellite distance.

Source: Based on the systematisation presented in the Commission of the European Communities, 2004

Table 2. Broadband penetration in Portugal and European Union

	Portugal	EU average
% of population (January 2004)	5%	6% (15 Member States)
% of households (1st quarter 2003)	7%	10% (9 Member States)
% of SMEs (1st quarter 2003)	26%	39% (13 Member States)

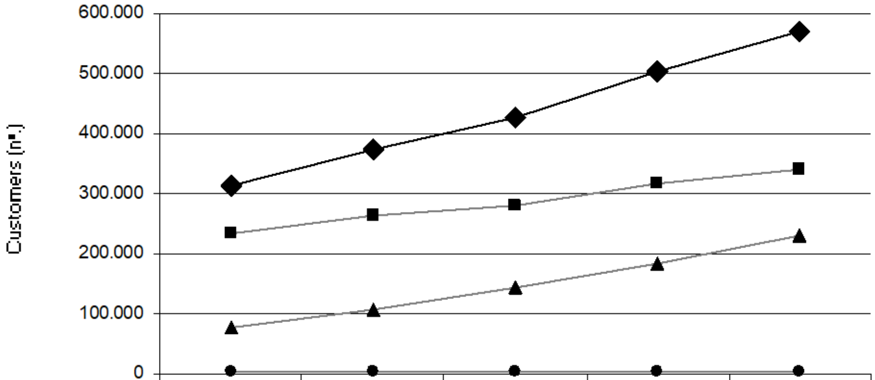
Source: Based on the Commission of the European Communities (2004)

Table 3. Models for the ownership of EU-financed broadband infrastructures

Infrastructure owned by public authority	In this case the infrastructure may be managed by the public authority or by a private entity; in all cases, the infrastructure must be open to all operators. In the case of being available to undertakings, received fees are not expected to cover the entire cost of the investment, and users of the infrastructure are not allowed to make extra profits in excess of a fair return.
Infrastructure owned by undertaking(s)	In this case the private entity provides co-funding for the implementation of the infrastructure, but it must also remain a facility opened to all operators at non-discriminatory conditions. The amount of public funding must be defined in order to ensure that the operator using the facility does not receive more than a normal market return for its activity.

Source: Based on Commission of the European Communities (2003, pp. 10-11)

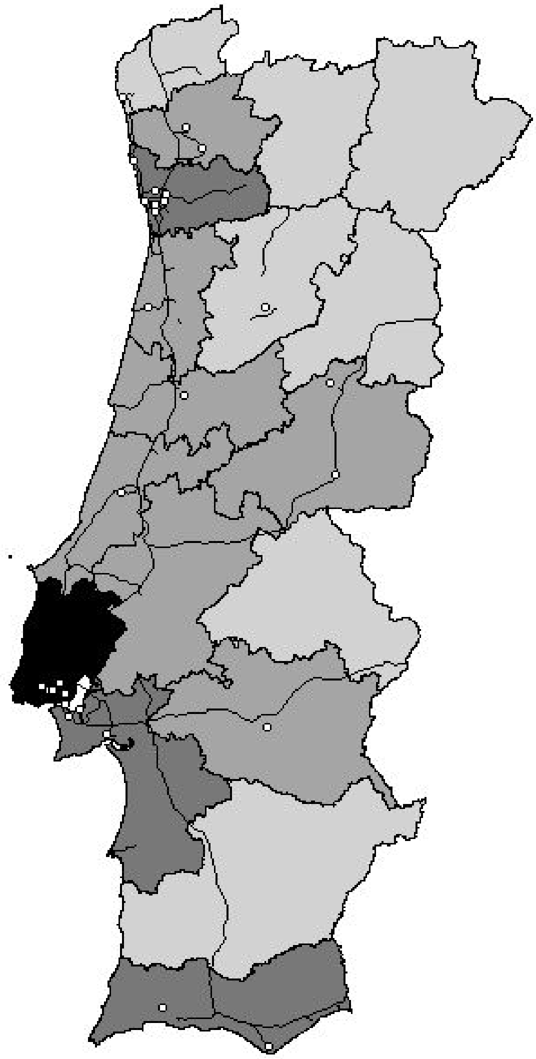
Figure 1. Recent evolution of Portuguese broadband customers (2003-2004)



	2003-1st Quarter	2003 - 2nd Quarter	2003 - 3rd Quarter	2003 - 4th Quarter	2004 - 1st Quarter
Total	312.387	372.204	425.835	503.119	571500
Cable access customers	233.095	262.339	280.270	315.577	339.345
SDL access customers	76.135	106.793	142.503	184.344	229.045
Dedicated access customers (other broadband technology)	3.157	3.072	3.062	3.198	3.110

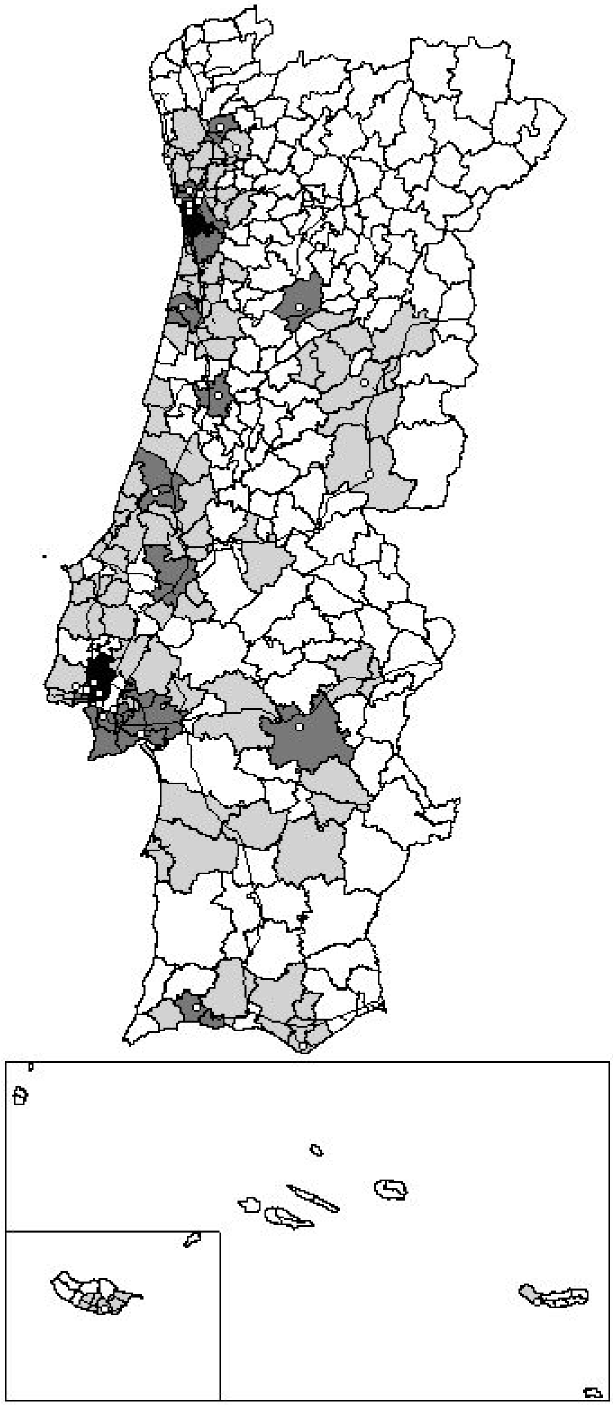
Source: Based on data from Anacom, 2004

Figure 2. Spatial distribution of broadband access by DSL technology (DSL lines per 1000 inhabitants by Portuguese districts), 2003



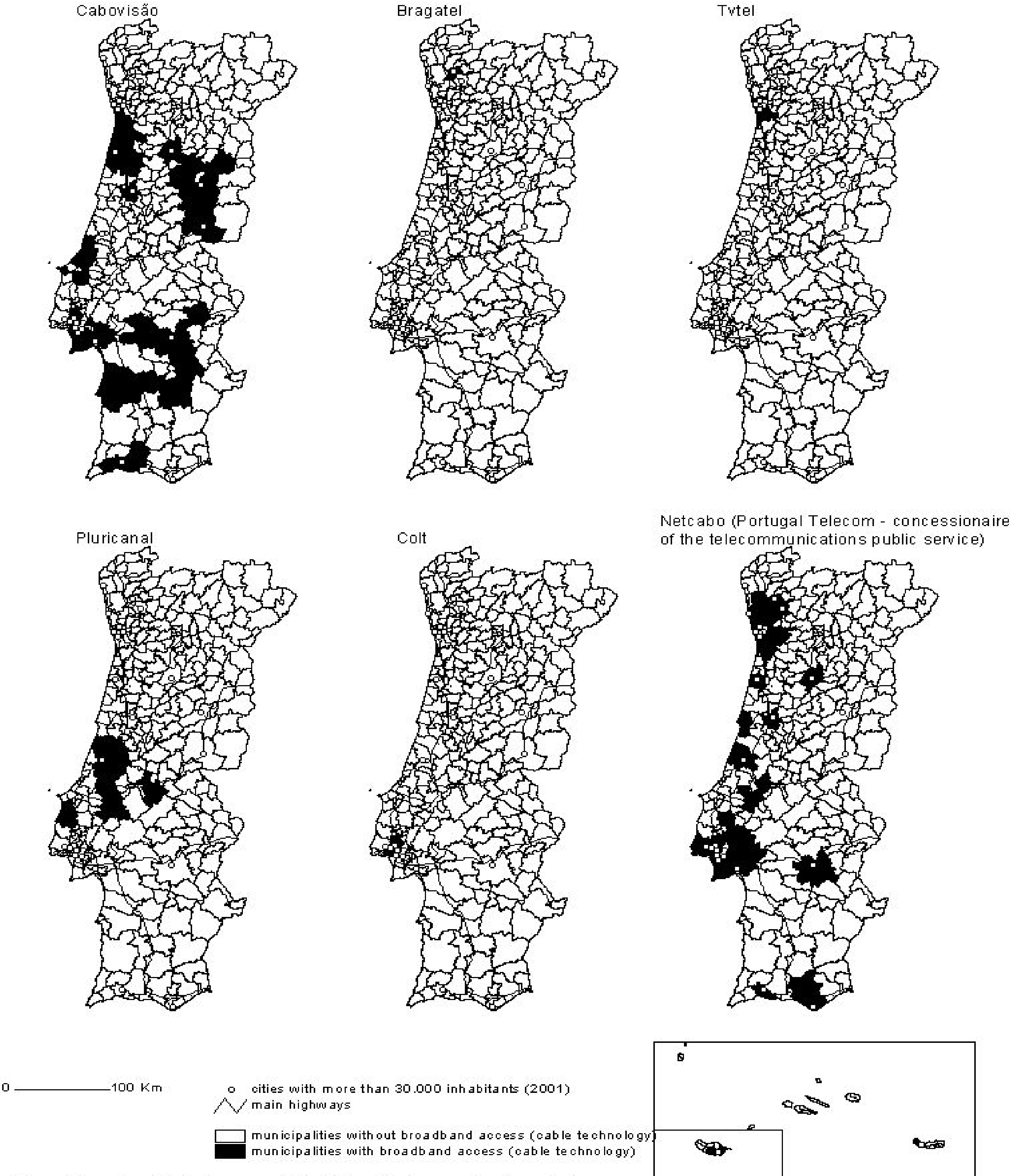
Source: Data collected in the Resolution of Council of Ministers n.º 109/2003

Figure 3. ISP's competition by Portuguese municipalities, in the provision of Internet broadband access by cable technology (June 2004)



Source: Data collected in the Portuguese ISP's with broadband access by cable technology

Figure 4. Portuguese municipalities served by ISP's providing Internet broadband access by cable technology (coaxial cable and fiber-optic cable), June 2004



Source: Data collected in the Portuguese ISP's with broadband access by cable technology

Figure 5. Portuguese municipalities served by WiFi ISP's (June 2004)

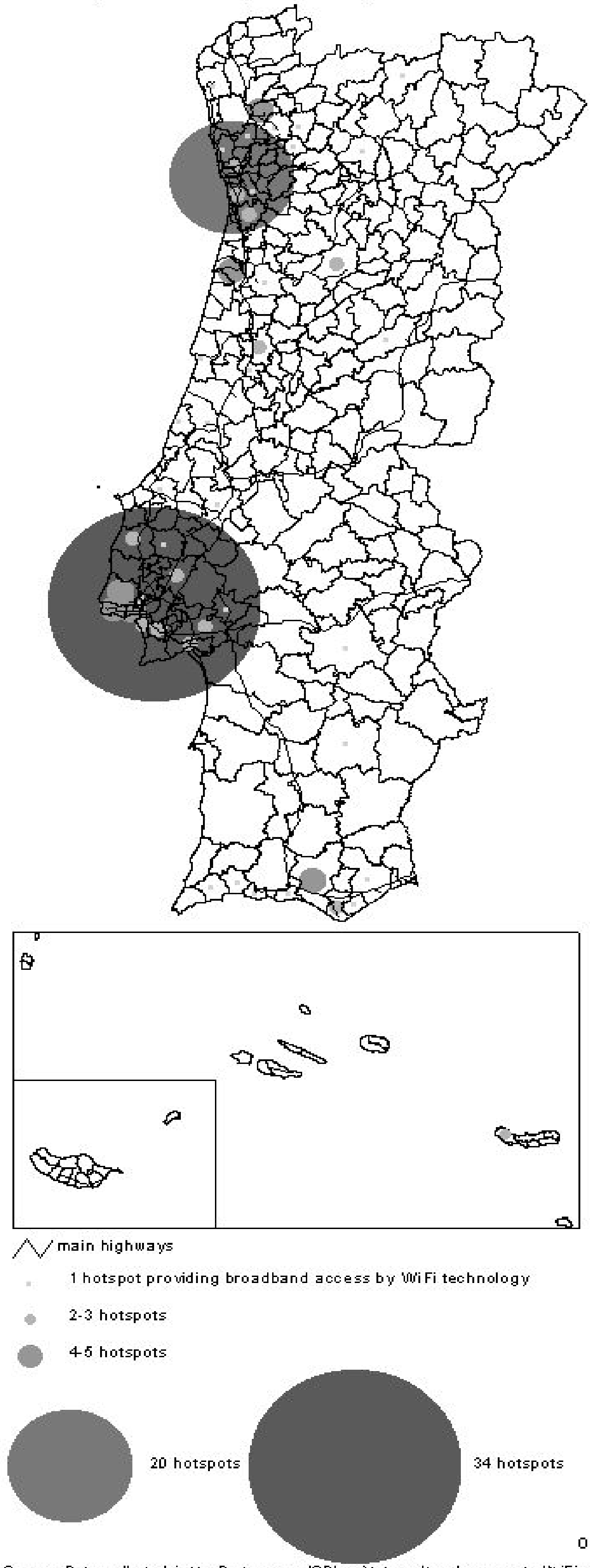
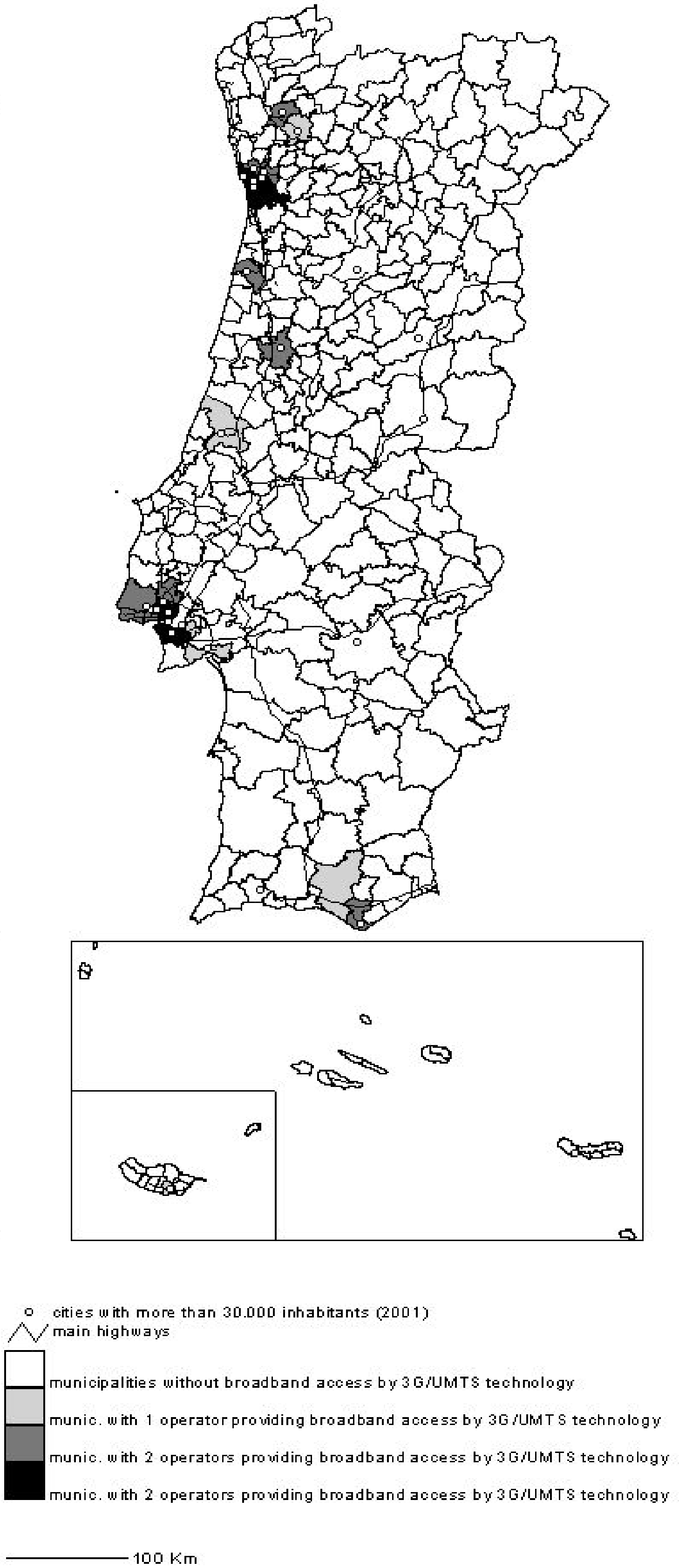


Figura 6. Portuguese municipalities served by 3G/UMTS ISP's (June 2004)



Source: Data collected in the Portuguese ISP's with broadband access by WiFi and 3G/UMTS technology

Figure 7. Spatial diffusion of broadband access provided by the incumbent operator (Netcabo - cable technology)

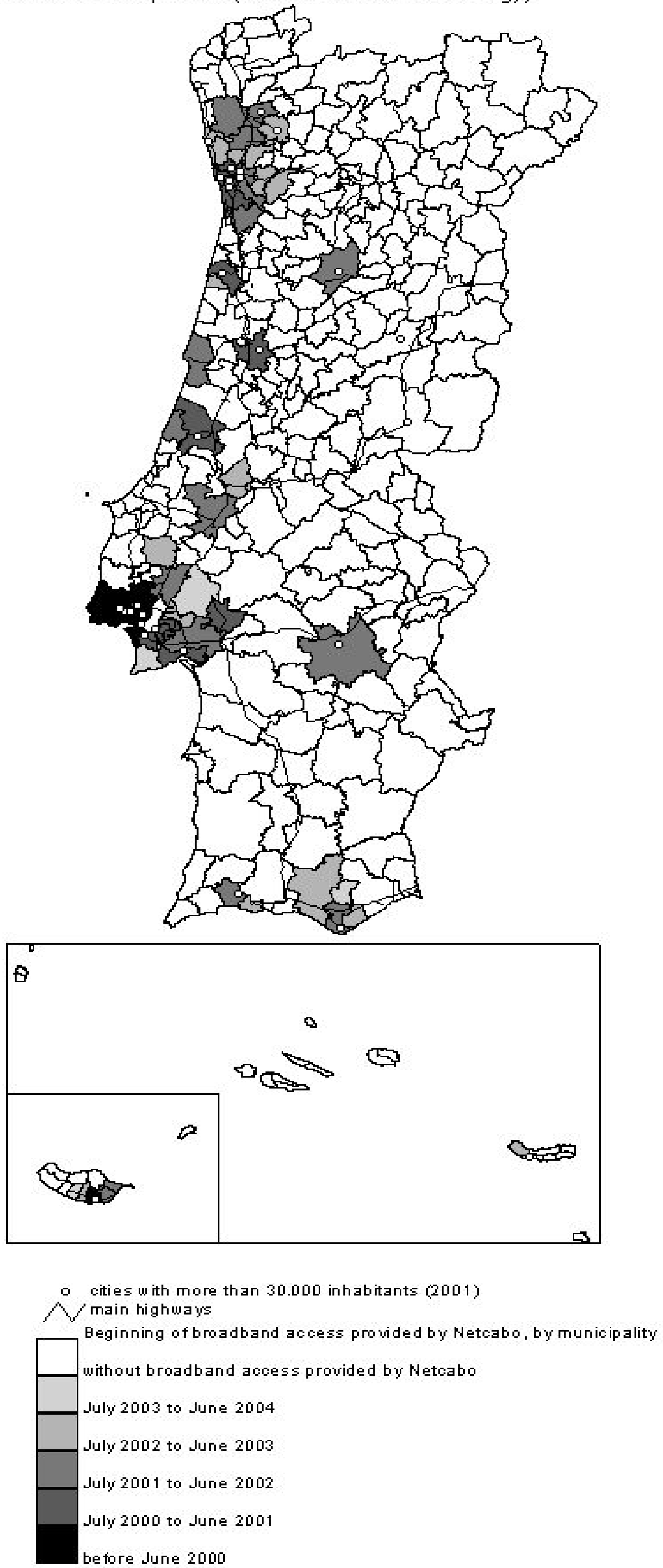
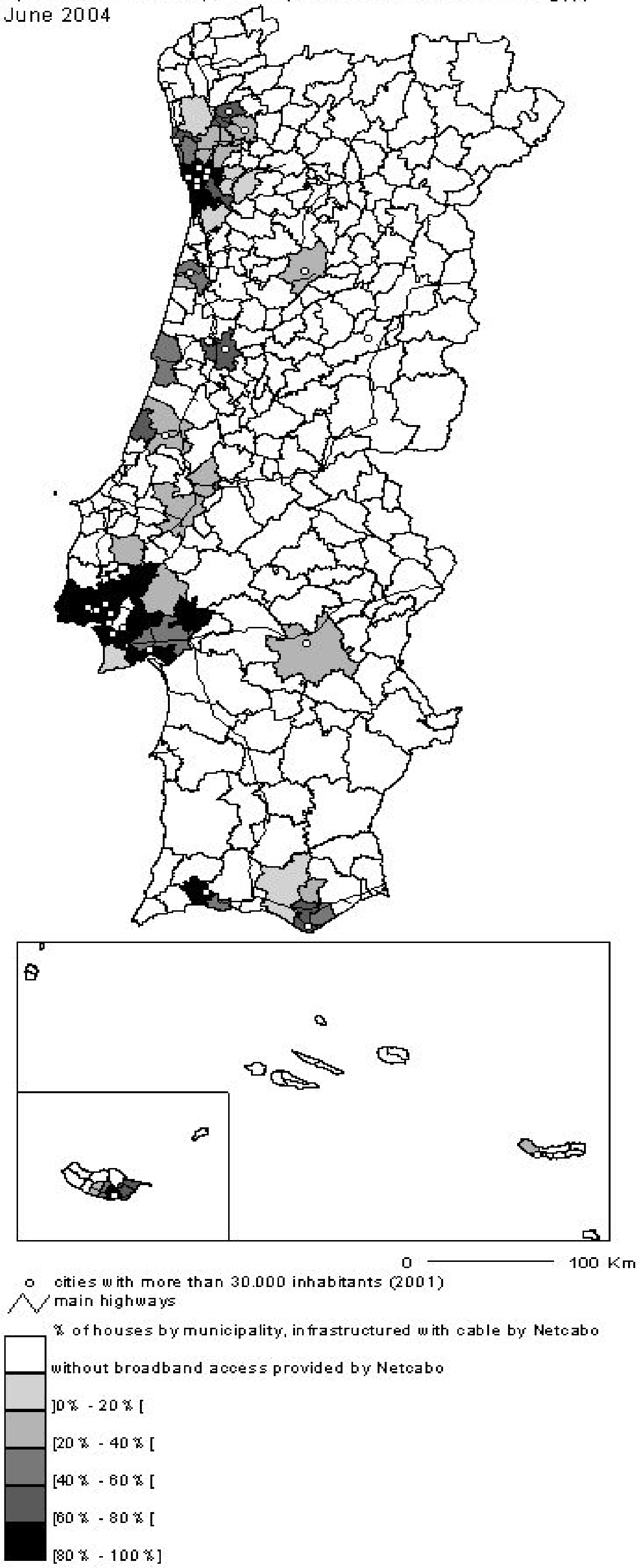


Figure 8. % of houses by municipality, infrastructured with cable by the incumbent operator (Netcabo - cable technology), June 2004



Source: Data collected in the Netcabo operator (Portugal Telecom - concessionaire of the telecommunications public service)

Notes

[1] The geographical limits of these two districts include the cores of these two metropolitan areas but they are not exactly the same, as the district does not include the south extensions of the metropolitan areas and, on the other hand, includes other municipalities.

[2] It is important not only to have high densities but also to guarantee that those areas include people and businesses interested in using high-speed Internet connections.

[3] We will analyse both coaxial cable and fibre-optic cable, because some ISPs decided to provide a hybrid solution with the combination of both these two technical means.

[4] Coverage implies that one or more operators provide the service in at least some part of the municipality.

[5] Composed by 61 municipalities (in a total of 308 Portuguese municipalities) which have been accessing Netcabo since the last quarter of 1999.

[6] Because ISPs are free to work in the areas they find most profitable.

[7] Telecommunications Universal Service emerged in the past to provide the traditional telephone service to any citizen who wished to have it. Nowadays, the Portuguese Telecommunications Universal Service includes the following services: (1) access to the fixed telephone service to all users who request such access; (2) public pay phones in public rights-of-way and public places; (3) telephone directories and a directory enquiries service, which includes the numbers of subscribers to the fixed and mobile telephone service; (4) fixed telex service; (5) fixed switched data transmission service; (6) broadcasting and distribution service for the telecommunications broadcast signal; (7) telegraph service. (Decree-Law n.º 458/1999 and Decree-Law n.º 31/2003).

[8] "The concept of telecommunications universal service must evolve to keep pace with advances in technology, market development and changes in user demand, its scope being altered where justified by the mentioned advances" (Law n.º 29/2002).