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The diffusion of ICT's in Portugal: a way to reduce regional disparities or an unexpected contribute to reinforce territorial disintegration tendencies?

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Abstract

The advent of information and communication technologies (ICT´s) during the past decades, and their widespread use, is radically transforming the dynamics of communication and our understanding of spatial relationships, specially as a result of its potential role on the reduce of distances by the increase of accessibility to information and services.

The emergence of these virtual spaces, characterized by digital flows of information, are influencing and interacting with real places in a very complex and dynamic way. On the one hand, we gradually have the spatial proximity as a not so important factor for the location of functions. On the other hand, these information networks are mainly attracted to existing urban structures, supporting given centralities and enhancing traditional spatial disparities.

These suppositions are usually theoretical discussions, that need to be rigorously tested with empirical analysis and comparative perspectives. The main objective of this paper 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 Portuguese spatial disparities or, on the contrary, as an unexpected contribute to improve territorial disintegration tendencies, reinforcing existing patterns of physical communication rather than create new location opportunities for activities and jobs.

Keywords: Digital divide, Portugal, information and communication technologies, geographycal disparities, broadband access

1. Introduction

In order to help clarify the potential role of ICT as an instrument of local and regional development, we will use already existing elements as a frame of reference to explore the problem of infrastructure in Portuguese context, questioning the effective effects of the opening process of telecommunications sector to private competition. The aim of this paper is to evaluate how the competition between operators have been influencing the equipping of Portuguese territories in what respects to information flows by high-speed networks.

Rallet (2002, p. 180) argue that "the introduction of ICT as a tool of local development is not fundamentally a problem of infrastructure", specially in consequence of the increasing number

of alternative technologies, which will greatly reduce the areas of uncertainty. However, our analysis of the diffusion process of broadband access, provided by the most recent technological solutions (coaxial cable, SDL technology, fiber-optic cable, the WiFi access or the 3G/UMTS technology), clearly shows that competing operators develop market skimming strategies that leave aside the great majority of Portuguese municipalities, including entire towns.

Places that do not provide guarantees concerning the need of local information consumption, definitely represent an enormous risk in the private operator's investment strategies, specially in what respects the spatial configuration of their high-speed networks. As a direct consequence, we assist to the minimization of the ICT impact on the location of activities and jobs. But more worrying is the recognition of ICT as an instrument that contribute to improve geographical disparities and territorial disintegration tendencies. As we will demonstrate only the most developed and urbanized municipalities, those better served with physical communication networks, are currently benefiting from competition between different broadband access platforms, and consequently are the ones that can explore more efficiently the potentialities of ICT as a tool for local development.

This scenario represents a real risk of increasing inequalities between areas, specially if we think that on the Portuguese municipalities with the worst levels of physical accessibility, demographically and economically not so dynamic, there are few chances of take advantage from: (1) the relocation of activities and jobs through the use of ICT (for purposes of reducing transport costs, land and building costs or wage costs); (2) the creation of new activities and employment from the prospects offered by the new means of telecommunication (production of hardware, e-contents, informatics and consultant services,…); (3) or even from the appearance of new patterns of spatial organization of services with the development of distance networking co-ordination between units or individuals already separated geographically.

Undoubtedly the problem of inequality of ICT access as to do also with the ability to use it effectively, which is related with education, knowledge competences and citizens specific skills. Nevertheless it is our conviction that the connectivity with Internet-based networks is a basic prerequisite to further exploration of learning processes in ICT applications, and as a consequence, we should get a wider definition of the Telecommunications Universal Service in order to guide future negotiations between national bodies and private operators that provide Internet broadband access. The evolution of this concept is foreseen in Portuguese Law, and we will try to systematise relevant information to support such revision: "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).

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

Broadband, also known as high-speed 'always on' Internet access, support the almost instantly delivery of large volumes of data, reducing waiting time and improving efficiency for users. Technically it must be seen as a changeable concept, since what is called broadband today (defined as 256 kilobits per second downstream and 128 kbps upstream) will probably be narrowband tomorrow (Willis, 2002).

The high performance of Internet by the use of this technology, promotes the improvement of already existing web-services and the creation of new ones exploring the broadband ability for the delivery of new advanced e-contents and applications. However, broadband potential is not only related with the ability for a significantly faster speed, allowing the delivery of innovative interactive services, but also with 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' characteristic.

As a result of such potentialities and in spite of being in its nascent stages, governments world-wide are increasing realising 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).

Benefits of broadband include the economic productivity growth, as well as the rise of quality in the living standards of contemporary societies. From a wide spectrum of advantages from broadband penetration, we may point out its role as:

- an instrument for the economic productivity growth, as a direct consequence of the application of Internet solutions for the improvement of organizational readjustments in the existing business processes, the creation of new business opportunities; or the conquest of new markets. Like Willis (2002, p. 6) underline "fast connections allow businesses to save time and money and improve overall efficiency";
- a way to promote the re-organisation of working processes, with a more flexible workforce consequence from the increasing number of mobile workers benefiting from the on-line access to corporate applications;
- an enabling technology to improve human capital, providing an opportunity for skills upgrading with the encouragement of distance education solutions;
- a chance for healthcare progress with the use of videoconferencing in the diagnosis and patient treatment;
- a possibility to improve the efficiency of public administrations by the qualification of existing public services; the creation of new interactive solutions (information services, license renewals, tax submissions, voting…); the reduce of bureaucracy in governments interactions with citizens and businesses; or the stimulation of public participation and involvement in the policy process;

- a way to benefit from several entertainment options, such as video on demand, music downloading or chat groups.

To support these applications there are a wide range of technology options, with different characteristics, that have been developed (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, p. 6). Access networks are likely to evolve to architecture solutions, with fibre optic coming increasingly close to the premises, and high-speed cable, DSL, wireless links, or fibre optic itself connecting the final user.

Table 1. Available technologies to stimulate the 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 allow users to connect to a local area network through a wireless connection in a limited range, around 100 metres. In this solution 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)	Provide high data rates and allows Internet access on-the-move.
PLC technology (Powerline Communication) using existing electric power cables	In this solution the users share the available bandwidth, which quality is also distance-dependent. There are already some pilot experiences, however there still are some issues of operating frequencies and interference thresholds to be resolved.
FWA technology (Fixed Wireless Access) using digital radio technology	Provide always-on Internet connection at 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	Provide 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 solution, the signal is send 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 Commission of the European Communities, 2004

To speed up the application of these technical solutions, aiming the spatial diffusion of broadband network, the common strategy by many countries is to incite the investment that come from the private sector (by new entrants and incumbent operators), removing legislative barriers in order to ensure effective competition in local telecommunication networks, as well as generating 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). But, are governments applying these principles of universality and equality, ensuring that technical conditions are being improved in under-privileged areas and consenting a dissemination of broadband access by all citizens and firms?

3. 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. Such characteristic demands a detailed evaluation of which localities are exploring the opportunities of these connections and which locations are not.

Empirical work, that have been conducted at a local level, on Franklin County in Ohio State (USA), revealed the spatial manifestations of the inequities in the 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 to the type and quality of Internet access via DSL is explained by the physical architecture of the copper infrastructure, mainly the quality of cooper wiring as well as 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 expanded for all the Ohio State (Grubesic, 2003) and for all 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 higher incomes and educations are segments that

generate a significant level of demand for broadband service. Consequently, these investigations point out that urban areas and business districts are more attractive for broadband providers, because of both 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, contrasting to biggest cities where several broadband platforms are available, insuring more competitive prices and increasing quality of service.

Another study conducted in the United States reinforce that rural areas are lagging behind metropolitan regions where broadband access is concerned (Strover, 2003). This study reinforce that the absence of competitive access disproportionately affect services to rural populations, on the other hand the relatively lower income levels of rural populations addresses serious affordability issues concerning the subscribing to broadband services. Recognizing that Internet connectivity reached rural America at slower rates than elsewhere in the country, this study conclude that the existing policy approaches appear insufficient to achieve the goal of widespread rural deployment, since they could not assure that telecommunications services are roughly comparable across urban and rural areas.

In order to understand the magnitude and characteristics of the digital divide that are being traced inside developed countries, Barroso and Martínez (2004) conducted a study in Spain, inside the Community of Madrid. Considering the common characteristics of the municipalities served with broadband access by cable, they highlighted the conjunction 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 in the Community of Madrid with over than 20.000 inhabitants) can be justified because the extension of broadband accesses depends on the improvement of the initial infrastructure and in the Community of Madrid no cable television networks were deployed in the past. Under this circumstances the option was the implementation of DSL technology over the cooper telephone network, covering in 2003 more than 99% of the population, but excluding 68 municipalities which represents 27% of the surface in the Community of Madrid. From these results 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, p. 12).

All these studies confirm that these technologies are not widely available in all areas, and it seems like 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, consequently there is a "need for revaluating current policies seeking to promote equitable investment in telecommunication infrastructure" (Grubesic, 2003, p. 265).

4. The geography of the Portuguese broadband access

Recognising that the potential of information society to improve 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 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 is 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, p. 17).

This means that where private-sector investments is 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 of Portugal sets out specific targets to be achieved by 2005, in particular 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). If it seems to be difficult to materialize such ambitious objective, specially in the households penetration and according to recent data (Table 2), it is much more worrying the absence of a spatial dimension for the equitable application of this political goal.

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 SME's (1st quarter 2003)	26%	39% (13 Member States)

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

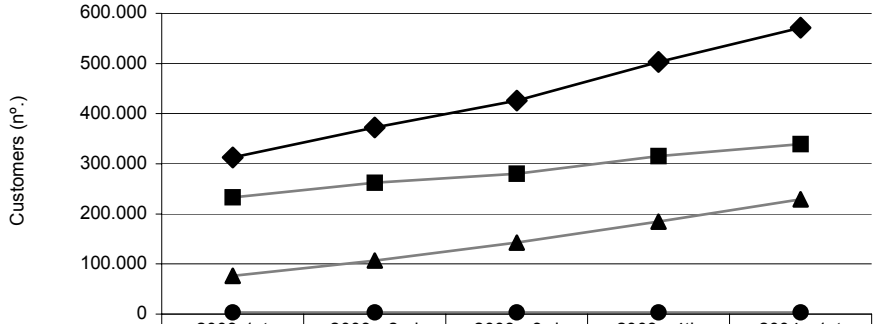
However, if the Portuguese Government recognise the primary role of the market for broadband development, there is also a recognition of the role of public policy in complementing the effective functioning of the market (Resolution of the Council of Ministers n.º 109/2003). In order to question how effective have been the policy instruments to correct market failures or complement the action of market forces, we will present some cartographic analysis with the intention of understanding 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, p. 23).

Broadband penetration in Portugal was 5% of the population in January 2004 (571.500 broadband access customers). Although Portugal is one of the very few countries in the European Union where the number of cable subscribers is greater than the number of DSL customers (59,4% and 40,1% respectively of the total broadband customers in the first quarter of 2004), the DSL has been showing the highest evolution rates concerning the conquest of new subscribers (201% between 2003 and 2004 against 46% of cable for the same period, Figure 1) 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 a quickly provision of broadband access by cable while it was necessary to invest in the implementation of DSL technologies over the cooper telephone network.

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



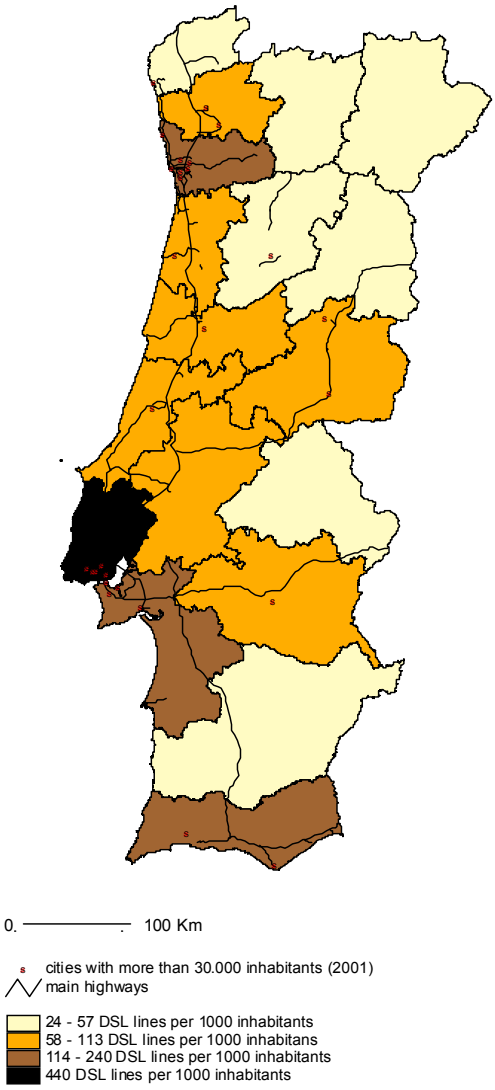
	2003-1st Quarter	2003 - 2nd Quarter	2003 - 3rd Quarter	2003 - 4th Quarter	2004 - 1st Quarter
Total	312.387	372.204	425.835	503.119	571500
Cable access customers	233.095	262.339	280.270	315.577	339.345
SDL access customers	76.135	106.793	142.503	184.344	229.045
Dedicated access customers (other broadband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

Source: Based on data from Anacom, 2004

Despite the absence of information by municipality and for the two autonomous regions (Madeira and Azores islands), we can state that none of the eighteen districts in Continental Portugal is unsupplied with SDL lines (Figure 2). Nevertheless, a relative analysis of the number of SDL lines per inhabitants show 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 opposition there were seven districts totalising 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 a tenth of the Lisbon rate).

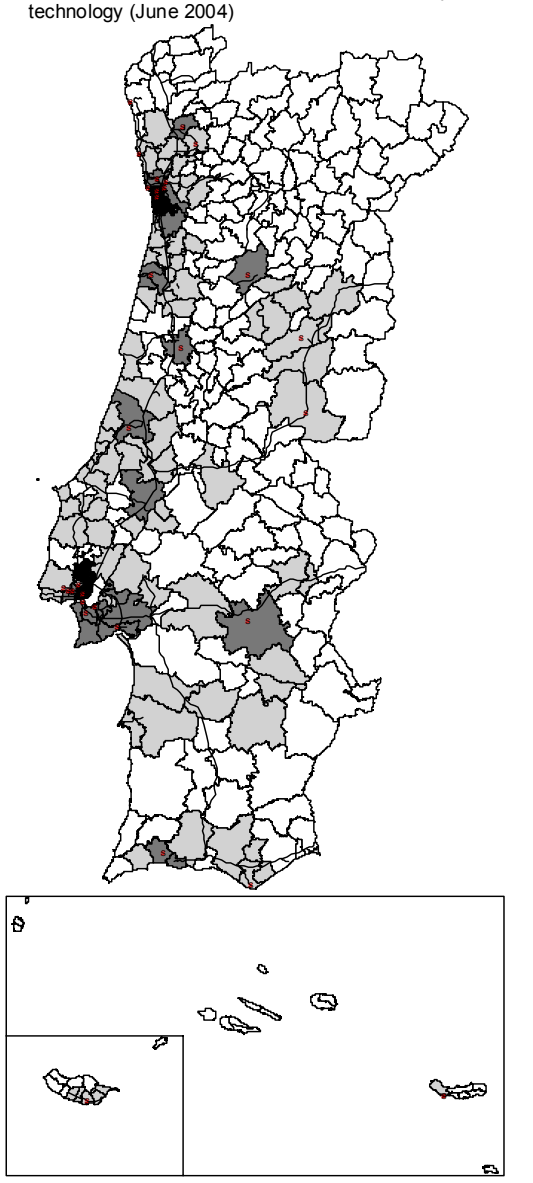
This geographical disparity is not only marked between urban and less populated areas, a detailed analysis shows also a huge discrepancy between Lisbon and the other Portuguese metropolitan area (Porto), which presented in 2003 less than a half of Lisbon SDL penetration rate (207 SDL lines per 1000 inhabitants)[2].

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



Source: Estimative of A. T. Kearney quoted from Resolution of the Council of Ministers nº. 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

This spatial pattern of SDL broadband connection, clearly demonstrate that market strategies of SDL ISP's (Internet Service Providers) gravitate towards the most profitable segments of the industry, services and population. In this case, the most profitable segments correspond to high-density urban markets, specially those urban areas that correspond to a high-quality density of demand (both residential and business demand), which is expected to be responsible for higher returns on infrastructure investments[3]. 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 services for industry, financial and administrative services, as well as cultural and recreational activities, whereas Porto agglomeration has a productive structure not so rich or diverse in terms of services, a more traditional industrial profile and their human resources are not so highly qualified in comparison with Lisbon.

Concerning the spatial distribution of broadband connection by cable[4] (Figure 3), one main conclusion is the non-existence of this broadband option in 199 municipalities in the mid-2004 (in a total of 308 municipalities in Portugal). Non-served municipalities correspond to almost 67% of Portuguese surface, but it is obvious that excluded areas from cable broadband deployment are larger, because coverage in most served municipalities is far from complete[5].

With the single exception of Viana do Castelo, the city that limits the north extension of the area institutionally, demographically and economically more dynamic in Portugal (close to the littoral border and stretching south as far as Setúbal Peninsula), all Portuguese cities with more than 30 thousand inhabitants benefit from Internet access with a speed significantly faster than dial-up connections. It is observable a clear correspondence between the municipalities served with the best levels of road accessibility and the cable broadband penetration, which emphasize the role of ICT's as a contribute to improve territorial disintegration tendencies, reinforcing existing patterns of physical communications.

Such conclusion is underlined by the analysis of the competition in broadband access by cable (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 placed in the central cores of the Lisbon and Porto metropolitan areas, are characterized by the presence of three cable ISP's. With two cable ISP´s there are only 26 municipalities, which can be found in the periphery of the two metropolitan areas or in the municipalities where are located the Portuguese middle-sized cities.

In spite of the benefits of broadband are particularly significant for remote and rural areas, as improved interactive services can address a variety of challenges posed by distance, cable ISP's do not find profitable to roll-out infrastructure in areas where expected demand is insufficient to ensure a positive return on investment (rural consumers generally have modest income and education levels). This consequence of the privatisation of telecommunications service is responsible for a much pronounced geographical digital divide in the broadband

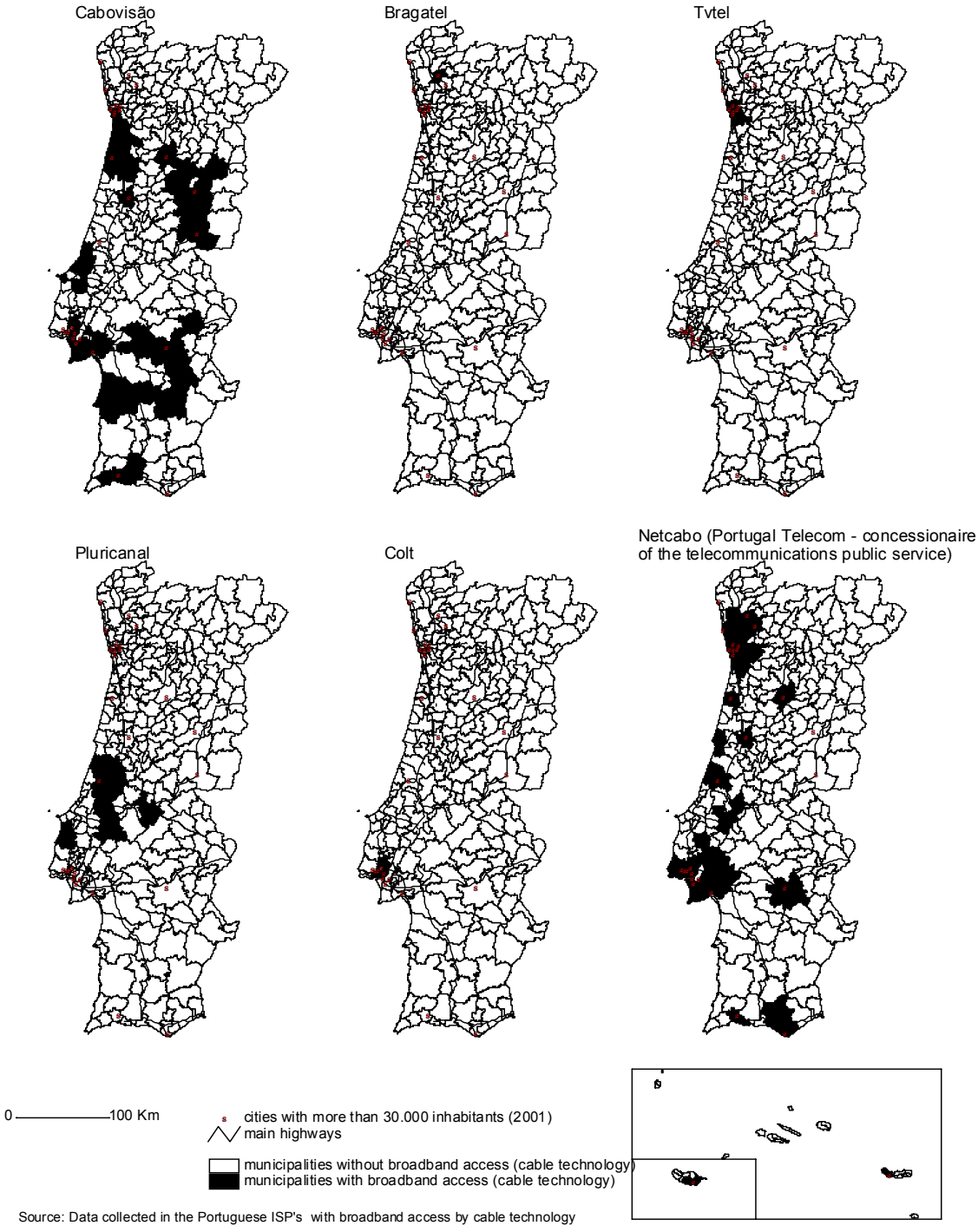
access by cable technology than in the SDL option. If SDL is present in all Portuguese districts, not a single cable ISP's provide service in four of the eighteen Portuguese districts: Viana do Castelo, Vila Real, Bragança and Portalegre. This observation may be explained by differences in the amount of investment required to upgrade the existent cooper telephone network or to provide totally new infrastructures in the municipalities without cable televisions networks.

The need for a substantial initial investment in the provision of new cable infrastructures, explain the reason why 4 in the 6 Portuguese cable ISP's (Figure 4) decided to provide their service in a local basis (Bragatel in the city of Braga; Tvtel in the central core of Porto Metropolitan Area and Colt in the central core of Lisbon Metropolitan Area), or with a supra-municipality coverage area (Pluricanal, which has an area of influence that extends from Pombal to Santarém, exploring also two other markets in the cites of Abrantes and Torres Vedras).

The Netcabo, which belongs to the Portugal Telecom (the incumbent operator and concessionaire of the telecommunications public service), reveal a market strategy that avoids the scarcely populated municipalities of Portugal. Being concentrated in the more developed and dynamic areas, Netcabo exposes a clear preference for the two metropolitan areas and its surrounding municipalities, as well as some of the Portuguese middle sized-cities. Cabovisão, the other cable ISP with an extensive cable infrastructure, presents a covering area that also include the most urbanised areas (with the exception of the north extension of the two metropolitan areas), and as a consequence of the ring configuration of its network it also provide access to some urban agglomerations do not covered by Netcabo (specially the Beira Interior urban system: Guarda-Covilhã-Castelo Branco) as well as some rural municipalities in the North Alentejo.

From all Portuguese cable ISP´s, Colt is the single one that provide broadband access with a network totally constructed with fiber optic technology (transmission of digital signal by the use of light waves, which is responsible for the maintenance of a huge bandwidth – Gigabits per second). Its network in Portugal (around 85 kilometres) is restricted to the municipalities of Lisbon, Oeiras, Amadora and Loures (all of them in the central section of Lisbon Metropolitan Area). The economic viability of such investment depends on a spatial concentration of enterprises with interest to transmit electronically huge amounts of information (from economic sectors as: financial, information technologies, informatics, media…). As a consequence, the implementation of such networks are restricted to the urban areas that concentrates those enterprises, according to market rules in search of profitable returns of initial investments. This prerequisite can be a clear contribute to an increasingly over-concentration of those units, specially because the accessibility to fiber-optic cable is becoming a new location factor for the implantation of firms that are currently emerging in these economic branches. This is a clear illustration how ICT impact on the location of activities can be a decisive contribute to improve already marked territorial disintegration tendencies.

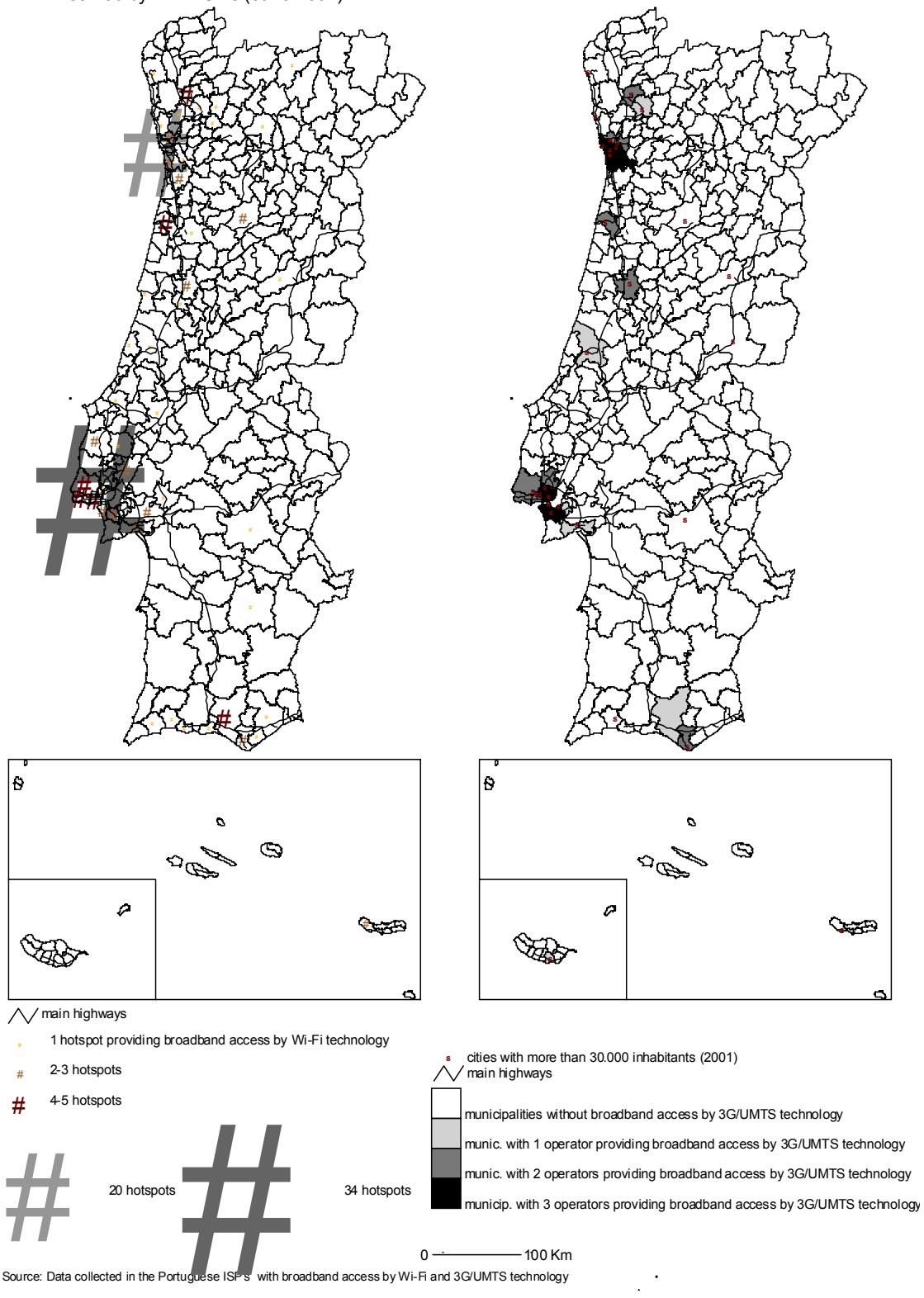
Figure 4. Portuguese municipalities served by ISP's (Internet Service Providers) providing internet broadband access by cable technology (coaxial cable and fiber-optic cable), June 2004



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)

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



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

This same conclusion is once again emphasized with the spatial distribution of the municipalities served by the most recent solutions available in Portugal for the broadband access, namely the WiFi and 3G/UMTS technology (Figure 5 and 6). Only the city of Lisbon with 34 hotspots and the city of Porto with 20 hotspots are reasonably covered in public or semi-public spaces (restaurants, hotels or shopping malls), specially 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. Concerning the broadband connection by 3G/UMTS technology, its appearance happened together with the Portuguese organization of the UEFA Euro2004, which was responsible for the decision of starting the access to this technology in the eight cities that hosted this European Championship (one of this private operators provided access in all this cities and the two others in some of them, resulting a higher competition in the central areas of the two metropolitan areas).

Trying to understand the expected evolution of the market in medium term, we decided to look at the spatial diffusion process that has been characterizing the expansion of broadband by cable access, provided by the operator (Netcabo) that belongs to the enterprise concessionaire of the telecommunication public service (Grupo PT – Portugal Telecom). From this analysis, and as expected, we should highlight the initialisation of this service in Lisbon Metropolitan Area, with a diffusiveness tendency throughout the most expressive Portuguese urban agglomerations, following an evident hierarchical pattern (Figure 7). But more important is the conclusion that in the last year (July 2003 to June 2004) only three municipalities have entered this list[6], whereas in previous years it was observed a yearly inclusion of about 13-16 municipalities. Therefore, the expansion has seriously slowed-down, which could be a signal of the future market strategy set forth by this operator.

The analysis of the cable penetration rate in served municipalities (Figure 8), allow us to say that many of them include areas without service (there has been a clear preference to provide higher penetration rates essentially in the two metropolitan areas) and, consequently, this operator still have considerable investment efforts ahead in the municipalities where it is already present (in June 2004 more than one third of all municipalities that benefit from the presence of this ISP had a percentage of cabled houses lower than 40%).

Therefore, and based in simply market rules, this recent expansion tendency, marked by an evident slow progress, makes it difficult to foresee the extension of the service to many new municipalities, specially those away from urban agglomerations, where a slowly adaptation of existing infrastructures (SDL solution), instead of developing new networks, is the actual base for expanding broadband accessibility.

Such deployment rhythm is an obvious threat to increase the Portuguese geographic digital divide, as well as the impact of competition that results from the urban concentration of the

variety of choices for broadband Internet access. All this cartographic analysis allow us to say that the diffusion of this technology is a clear market and profit driven process.

5. Conclusion

With this paper we tried to identify geographical gaps in Portuguese broadband accessibility. By doing so we presented some evidences that suggest a need for establish new policies, and revaluate current ones, seeking to promote equitable distribution of broadband infrastructure investment.

Although the privatisation of the telecommunication sector help us to understand the reason why almost all Portuguese broadband ISP's have chosen to serve exclusively the densest

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

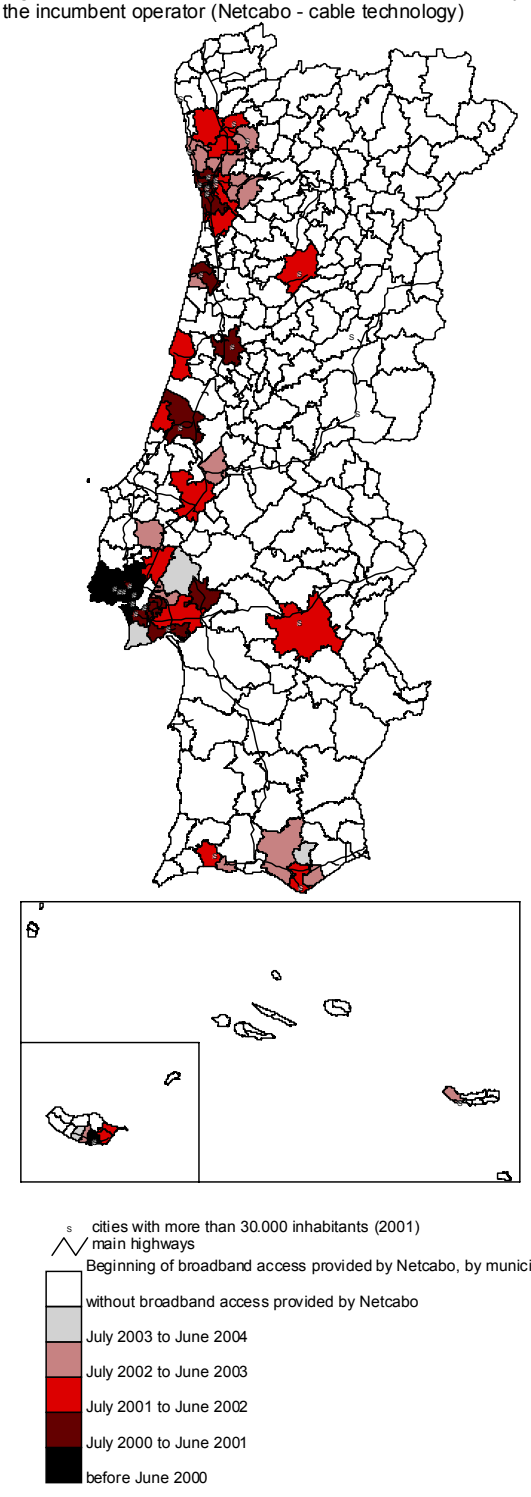
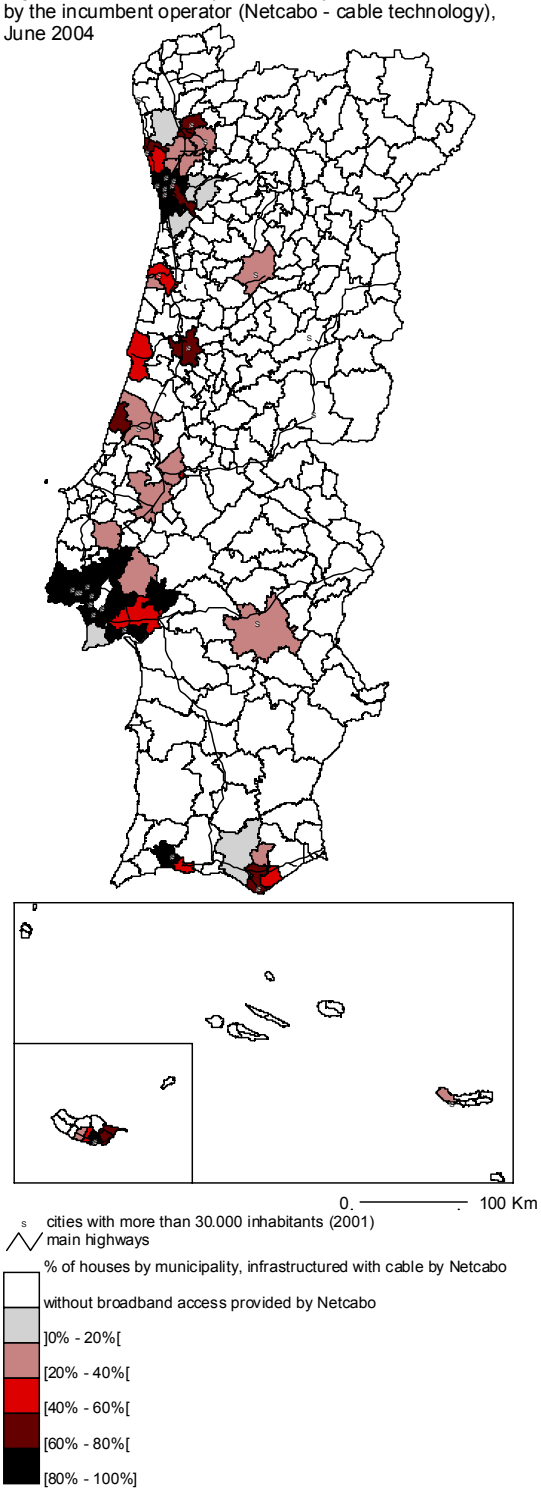


Figure 8. % of houses by municipality, infrastructured with cable by the incumbent operator (Netcabo - cable technology), June 2004



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

markets (or, in the case of SDL, to provide very low penetration rates outside the more lucrative urban markets), we believe that nearly ten years after the first phase of this privatisation process, the role of competition and deregulation should be revaluated, emphasizing the example of broadband access.

If private-sector investments are insufficient to ensure a widespread availability of these high-speed information networks[7], according to all political recommendations it was expected that the functioning of the market should had been complemented with effective public policies. In this paper we collected some empirical evidences from which we can deepen our understanding of the geographical extension of broadband accesses, and conclude the absence of such complementary actions.

Recognizing the importance of such actions, we present three steps to guide a public policy approach with the intention to achieve the goal of a widespread deployment of broadband access:

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

Updating the Telecommunication Universal Service concept

In our opinion, such pronounced spatial discrepancies that result from focusing broadband infrastructure investments in markets dense with customers, will be one more factor to concur for the gradual improvement of Portuguese territorial disintegration tendencies. This fact should be seen as an impulse to revise our concept of Telecommunication Universal Service[8] with the inclusion of Internet access by broadband technology as an important goal for Portugal. A new regulatory framework that extend the borders of this concept should be seen as a first step to legitimise adjustments in the concession contract of 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 of urban areas and in the excluded areas that also exist inside Portuguese cities.

It is important to remind that Portuguese legislation safeguard that the telecommunication universal service is an evolving concept, and in our conviction it is no longer possible to delay the recognition of broadband implications in a social and economic perspective, even if this access is not yet a recommendation of the European Commission (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, p. 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, with the intention of determine the exact spatial extent of broadband availability. With this paper we tried to give some contributions to this task, but such diffusiveness patterns and excluded areas must be formally identified (and continuously updated), as a preliminary condition to help the creation of more balances public policies concerning equitable access to advanced telecommunication infrastructure and services. It is extremely difficult to achieve this goal in Portugal, because the ANACOM (the National Authority for the Communications Sector) does not collect data geographically disaggregated (by municipality or zip codes) concerning the areas where each ISP's offer their high-speed service.

Public funding to guarantee a widespread availability of broadband access

The next step should the definition and application of a subsidy program to ensure that broadband access would be deployed efficiently and in an equitable manner. From a practical standpoint, if in spite of privatisation and its pro-competitive policies, some areas are lagging behind where broadband access is concerned, there can be no doubt that public policy efforts need to be directed to a more substantial infrastructure equity, as a prerequisite to help facilitate a widespread use and appropriation of advanced telecommunication services in lower density markets.

To correct 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, p. 8). For this purpose the European Investment Bank allow to member states the use of Structural Funds, with strict guidelines and criteria for the appraisal and selection of their broadband development projects:

- to commit projects that are part of an overall regional development strategy;
- to allocate funds towards areas where the investment costs are difficult to justify on purely commercial grounds (particularly rural and remote areas of geographic isolation and low population density, 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 do not distort competition rules (access for all operators at non-discriminatory conditions must be granted).

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

Table 3. Models for the ownership of EU subsidized 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 remain a facility 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 open 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 in Commission of the European Communities (2003, pp. 10-11)

Concerning the broadband coverage of under-served areas, the initial intention expressed on the National Broadband Initiative of Portugal (specifically the Community Networks Project), was drawn with a different approach: to develop infrastructures in order to provide broadband access in 15 underprivileged municipalities (Resolution of the Council of Ministers n.º 109/2003). This spatial limitation would have resulted in an arbitrary attempt to erase the Portuguese geographical digital divide, specially if we think in the actual territorial extension of broadband exclusion.

To sum up, in Portugal broadband technologies are not benefiting all areas equally. As we demonstrated the simply application of pro-competitive policies did not induced the widespread and timely rollout of advanced broadband Internet access. Hereby we defended that it should be promoted some complementary public policies to guarantee the equitable provision of high quality connectivity with internet-based networks. But if in this study we focused the effective functioning of the market addressing exclusively the supply side (infrastructure deployment in under-served areas, where market forces to not delivery the necessary investment), it is for us clear the importance of complementary strategies concerning the demand side of the market,

where public support should also stimulate the appropriation of these technologies with the development and adoption of better contents and interactive services.

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[2] The geographic limits of these two districts include the central cores of these two metropolitan areas but they do not correspond exactly with its the limits (excluding their south extensions and including other non metropolitan municipalities).

[3] It is not only important to have high densities but the guarantee that those areas contain people and businesses interested in using high-speed Internet connection.

[4] We will analyse both coaxial cable and fiber-optic cable because some Portuguese ISP's decided to provide a hybrid solution with the conjugation of both these two technical supports.

[5] It is considered as served municipalities those where one or more operators provide the service in at least some part of the municipality limits.

[6] Composed by 61 municipalities (in a total of 308 Portuguese municipalities) that have been progressively served by Netcabo since the last quarter of 1999.

[7] Because ISP´s are free to serve the areas they deem most profitable.

[8] Telecommunications Universal Service emerged in the past to provide the traditional telephone service to any citizen who expressed such aspiration. 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) provision of public pay phones, in a sufficient number, in public rights-of-way and public places; (3) provision of telephone directories and a directory enquiries service, which includes the telephone 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 of the telecommunications broadcast signal; (7) telegraph service. (Decree-Law n.º 458/1999 and Decree-Law n.º 31/2003).