ESPON project 1.2.2 Telecommunication Services and Networks: Territorial Trends and Basic Supply of Infrastructure for Territorial Cohesion

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Telecommunication Services and Networks: Territorial Trends and Basic Supply of Infrastructure for Territorial Cohesion

This report represents the final results of a research project conducted within the framework of the ESPON 2000-2006 programme, partly financed through the INTERREG programme.

The partnership behind the ESPON programme consists of the EU Commission and the Member States of the EU25, plus Norway and Switzerland. Each partner is represented in the ESPON Monitoring Committee.

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Foreword

This is the Final Report of ESPON Project 1.2.2 “Telecommunications Networks and Services: Territorial Trends and Basic Supply of Infrastructure for Territorial Cohesion”. Project 1.2.2 is one of the first round ESPON projects and commenced in July of 2002. It is a ‘Thematic study’ and in common with other ESPON projects in this category, is concerned to explore the territorial effects of major spatial developments on Europe’s cities and regions. Over the past two years the study has sought to uncover, draw together and analyse the data on the supply of and demand for telecommunications, exploring both ‘mature’ and ‘leading edge’ technologies. This Final Report synthesises the findings of our study and presents what is probably the most comprehensive and detailed analysis of the territoriality of telecommunications infrastructure and services undertaken in Europe. The project team was drawn from four institutions.

- The study was lead by the Centre for Urban and Regional Development Studies (CURDS), based at the University of Newcastle upon Tyne in the UK. The project team comprised Ranald Richardson (Project Coordinator), Jonathan Rutherford, Andrew Gillespie, Simon Raybould, Ann Rooke, Amanda Lane and Sue Robson.

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- The School of Built Environment, Heriot Watt University, UK. The project team comprised Cliff Hague and Karryn Kirk.

The ESPON Programme was launched after the preparation of the European Spatial Development Perspective (ESDP), adopted by the Ministers responsible for Spatial Planning of the EU in May 1999 in Potsdam (Germany) calling for a better balance and polycentric development of the European territory. The programme is implemented in the framework of the Community Initiative INTERREG III. Under the overall control of Luxembourg, the EU Member States have elaborated a joint application with the title "The ESPON 2006 Programme – Research on the Spatial Development of an Enlarging European Union". The European Commission adopted the programme on 3 June 2002. See http://www.espon.lu for more details.

The views expressed in this report do not necessarily reflect the opinion of the ESPON Monitoring Committee.

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1.1 Introduction

This is the Final Report of the ESPON Project 1.2.2 'Telecommunications Networks and Services: Territorial Trends and Basic Supply of Infrastructure for Territorial Cohesion'. The project commenced in July 2002. In accordance with the requirements of the Lillehammer Guidance Paper, the Final Report is in three parts. Part 1 comprises:

- An Executive Summary (section 1.2),
- A 'Scientific' Summary (section 1.3)
- A short report on networking (section 1.4)
- A short report on further research issues and data gaps (1.5)

Part 2 of the report comprises five chapters which draw together the key findings from our First, Second and Third Interim Reports as well as the findings from new work undertaken over the past year, notably a detailed analysis of sub-national data from the INRA report, a key new data source.

- Chapter 2 provides an introduction to Part 2 of the report
- Chapter 3 considers the territorialities of 'mature' ICT technologies
- Chapter 4 explores the territorialities of 'leading edge' developments, namely broadband, e-commerce, and Internet backbone networks
- Chapter 5 deepens our contribution to the ESPON Common Platform, reflecting on how our findings relate to the key ESPON and ESDP concepts of polycentricity and territorial cohesion, and also presents a number of new typologies.
- Chapter 6 presents a number of policy options.

Part 3 comprises twenty annexes, including those requested in the Lillehammer Guidance Paper. References and the bibliography are included at the end of the report in line with reporting and publishing conventions and for the convenience of the reader rather than in a separate annex.

1.2 Executive summary

The combination of liberalisation of telecommunications markets in the 1980s and 1990s (a process which is continuing) and the development and deployment of new technologies has created a highly dynamic telecommunications environment in Europe. This remains true notwithstanding the downturn of the telecommunications market over the past couple of years. This dynamism means that the situation in respect of territorial patterns of investment and uptake are constantly changing. The patterns which we have uncovered in our study, therefore, represent a 'snapshot' of the current (or recent) situation. We have also, however, attempted to identify trends, both those which appear to point towards a more even spread of technology and those which point to continuing disparities. In this executive summary we draw out the key findings from our work as described in more detail in part 2 of this report. Where appropriate we refer the reader to the particular section (map, figure or table) in the report to which the key finding relates.

Our work suggests that it is important to consider a range of network technologies and services when exploring the complex patterns of telecommunications territorialities. This is necessary in order both to understand the different territorialities (and potential territorialities) of these technologies, but also to understand the close relationships and synergies between these technologies. The 'new' technologies often depend on previous rounds of investment for their cost effectiveness: commercially viable ADSL broadband, for example, may depend on the pre-existence of digitally enabled exchanges. Similarly, more 'revolutionary' technologies, such as wireless and satellite, often depend on previous investments in fixed backbone networks. At least from a developmental point of view, these technologies should, therefore, be seen as complementary rather than competitive technologies. We analyse, therefore, a range of technologies in our Final Report. We consider both 'mature' technologies – basic fixed voice telephony, mobile telephony, personal computers and the Internet, and more ‘leading edge’ technologies – broadband technologies and Internet backbone networks. We analyse in detail the territorialities of the most fully commercially developed broadband platforms (ADSL and cable modem), but also reflect on the potential for other broadband platforms such as wi-fi and satellite to alter existing patterns.

In section 1.2.1 we summarise the overarching territorial trends. We then (in section 1.2.2) provide a brief summary of the territorialities of each of the six technologies considered in this report. Finally, (in section 1.2.3) we outline the policy options which we discuss in detail in Chapter 6 of the report.

1.2.1 The territorialities of telecommunications in Europe: overarching findings

The overall message emerging from our report is that the shape of supply and demand for telecommunications in Europe is complex. This should not be surprising for a number of reasons. First, the number of countries we attempt to cover is bound to create complexity, notwithstanding attempts to create a single market for telecommunications, a common regulatory framework and a common basis for developing the information society across Europe (e.g., successive eEurope Action Plans). Second the wide range of socio-economic circumstances of these countries and of regions within these countries makes for complexity. Third, historical differences in patterns and trends in telecommunications development between different countries also lead to complexity. Examples of these different historical patterns include: different network ownership patterns, for example, prior to liberalisation the UK had a single national incumbent, whereas Finland had an additional set of small regional incumbents; different start points, rates of, and attitudes towards liberalisation, with some EU15+2 countries having begun the liberalisation process in the 1980s, whereas by contrast some N12 countries are only now instigating this process. Fourth, different technologies exhibit different geographical patterns and rates of rollout. Finally, individual countries have their own particular attitudes to intervention in the market. These factors taken together with other ‘cultural’ factors account for one of our key analytical findings namely that, *national specificities remain crucial in understanding territorial differences across the European space.* Despite these differences, though, some clear *general* territorial patterns do emerge.

At the macro-level

There is a 'north-south' divide across the EU15+2. The main factor in this pattern is the strength of the Nordic countries which lead the way in the uptake of almost all technologies (see maps 3.4, 3.7, 3.10, and 4.1). A number of other northern countries join the Nordic countries in the top cohort, but which particular countries do varies from technology to technology.

As implied by the previous point, *the European 'core-periphery' distinction* (which is apparent across many socio-economic indicators) *does not hold for telecommunications.* This is mainly due to the strength of the 'Nordic periphery', but in the case of mobile telephony, the 'Mediterranean' periphery also outpaces the 'core' (see map 3.4) and for broadband uptake Spain and Portugal have so far outpaced some core countries, notably the UK and France. The one area in which the core clearly leads is in access to Internet backbone networks for large corporate users and Internet Service Providers.

When we compare EU15+2 with N12 countries, we see that, *on average, there is a 'west-east' divide across all technologies considered and in respect of the development of e-commerce* (maps 3.4, 3.7, 3.10, and 4.1 and figure 4.16). There is, however, evidence of progress in the N12 countries. For example, digitisation of networks has now reached 80 per cent in all but four countries, the growth of several technologies, notably mobile telephony, is more rapid than in the EU15, though growth rates are not, at present, rapid enough to facilitate 'catch up' in the short-term. Furthermore, when we look beyond the average we see that some N12 countries are ahead of some EU15+2 countries on particular technologies and applications.

Just as there are significant differences between countries within EU15+2 there are differences between countries within the N12. There is no obvious group of countries within the N12 which consistently (over a number of years) is more advanced than other parts across all technologies and applications, as is the case for the Nordic countries in EU15+2, though the data does suggest that Malta, Slovenia and Estonia are ahead on the leading edge technologies and applications (broadband and e-commerce). Bulgaria and Romania can be identified as lagging across all technologies and applications.

At the meso-level

- When we turn to explore regional differences within and across the European territory it becomes clear, as mentioned briefly above, that national specificities remain crucial in understanding such differences. For example, many Nordic regions can be regarded as highly advanced telecoms regions (see Table 5.25 for a summary of regional categories). This point emerges again and again throughout our analysis and can be seen most clearly in our regional 'category spread' tables presented in chapters 3, 4 and 5. These demonstrate that inter-regional differences within each individual country are narrow compared with inter-country differences. This applies to all technologies save for broadband technologies which are in the early stages of roll-out (and Internet backbone networks, where such analysis is less appropriate). This leads us to posit the existence of distinctive 'national telecoms cultures', with some countries having, for example, high computing cultures, whilst others have high voice communications cultures (see section 3.5). Examples of these include:

    - Sweden and Finland – high communication, high computing cultures.
    - Greece, Italy and the Czech Republic – high voice communication cultures.
    - Netherlands and Denmark – high computing cultures.
    - Germany and France – low telecommunications cultures (with respect to both voice and the Internet).

In order to deepen our understanding of regional differences, beyond those associated with national specificities, we consider the data for NUTS 2 regions (available for EU15 only) against a number of socio-economic-geographic categories to see how significant these categories are as discriminants of telecoms uptake. The results of the analysis again reflect the complexity of telecommunications territorialities and there is no consistent message across the technologies. For example:

- In the case of PCs and the Internet, high uptake is generally associated with developmental status, with non-Objective 1 regions and those with higher GDP (which are clearly linked) performing best.

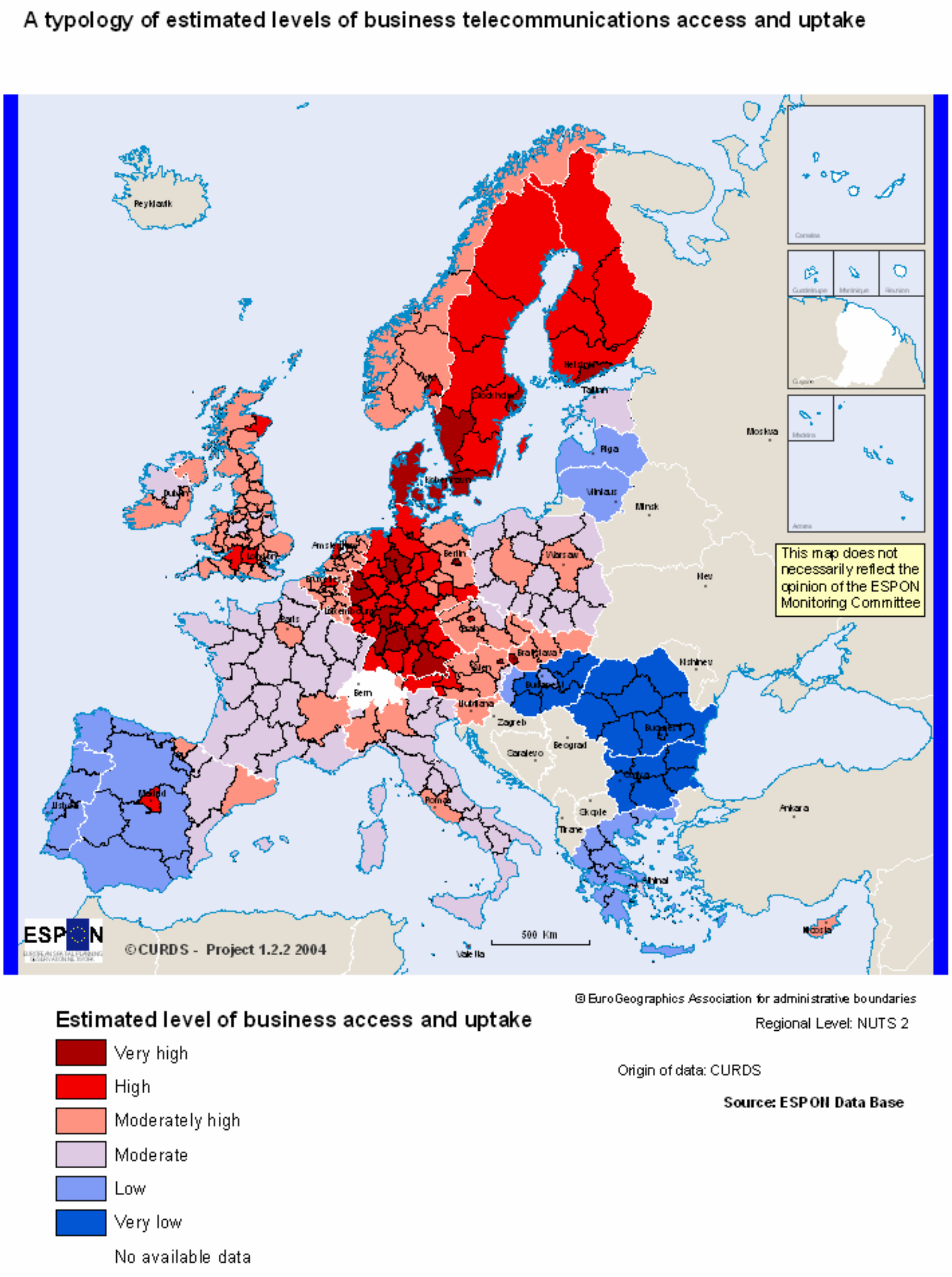
- In the case of broadband, high uptake is usually associated with non-Objective 1 status, relatively high levels of GDP, density of population, and position relative to the core (i.e. Pentagon regions).

- In the case of mobile technology the core-periphery distinction (Pentagon / non-Pentagon), was the most useful discriminant, though interestingly, the most marked distinction was the high levels of mobile telephony adoption in non-Pentagon regions (reflecting the 'Nordic' and 'Mediterranean' effects noted above).

These general findings are again complicated by national factors and specificities.

We have constructed a number of 'typology maps' using real and estimated data in order to 'fill in the gaps' where data is missing. We illustrate two of these below (for fuller details, see section 5.2 of the report). The first map (Map 5.2 in the report) shows the estimated levels of business telecommunications access and uptake. The clearest message is the high levels of uptake in a band stretching from Austria, up through Germany and Denmark into Sweden and Finland, with only small pockets of high levels outside this band.

A typology of estimated levels of business telecommunications access and uptake

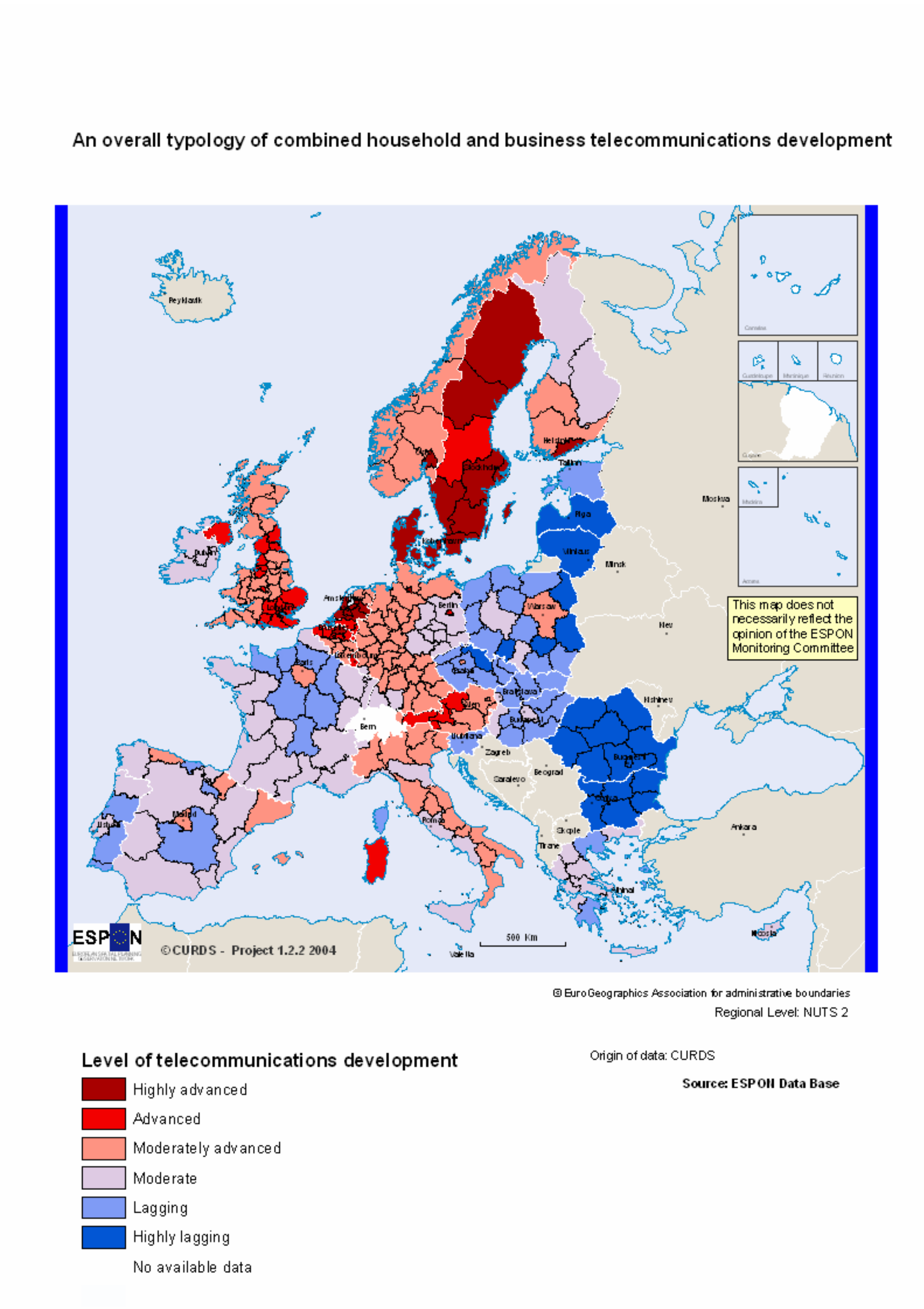


In order to illustrate the overarching territorialities of telecommunications across the ESPON space, we have created a typology which 'summarises' data for selected indicators for the range of technologies and applications considered in the report. It comprises both household and business usage indicators. These indicators are 'weighted' according to whether a particular technology is regarded as mature or 'leading edge'. The typology draws on regional data derived from surveys and from other sources, but also estimated data, derived from regression analysis. Map 5.4 (reproduced below) illustrates which regions are most advanced and which are most lagging across the European territory[1].

A summary overview of which regions fall into which category, from 'highly advanced telecoms regions' to 'highly lagging telecoms regions' is presented in tabular form below (table 5.25 in Part 2 of the report). Clearly the use of estimated data alongside 'real' data means that these findings should be interpreted with caution. In addition it should be remembered that in a fast moving environment such as telecommunications the situation can change rapidly. Nevertheless, we believe that this analysis provides a useful general overview of patterns of telecommunications territorialities in the ESPON space.

[1] A fuller analysis of description of how the typology is constructed appears in section 5.2 of the report and full description of the methodology in Annex 11.

An overall typology of combined household and business telecommunications development at the regional NUTS 2 level



An overall typology of combined household and business telecommunications development (see annex 12 for full typology table)

Typology category*	Regions in category
Highly advanced telecoms regions	Dutch and Nordic (particularly Swedish) regions, plus core city regions (Bruxelles, Antwerpen, Hamburg, Inner and Outer London).
Advanced telecoms regions	Numerous UK regions (northern and southern), other Benelux regions, three Austrian regions, the remaining Swedish region (Norra Mellansverige), plus Berlin and Sardegna.
Moderately advanced telecoms regions	The majority of German (west) and Italian regions, leading Spanish regions, remaining UK, Dutch, Belgian, Austrian and Nordic regions, plus Ile de France, Praha and Mazowieckie.
Moderate telecoms regions	The majority of French regions, other German (east), Spanish and Italian regions, some Greek regions, the two Irish regions, two remaining Finnish regions, two Portuguese, two Polish and two Hungarian regions, Kypros, Malta and Bratislavský.
Lagging telecoms regions	The majority of Czech regions, remaining French, Spanish, Greek, Hungarian and Slovak regions, other Portuguese and Polish regions, Eesti and Slovenija.
Highly lagging telecoms regions	All Bulgarian and Romanian regions, remaining Czech and Polish regions, Lietuva and Latvija, and Açores.

At the micro-level

At the micro-level our study suggests that there are disparities between metropolitan, urban and rural areas. If we first consider *roll-out*, it is clear that metropolitan areas have denser and better quality services. This is partly a function of the activities undertaken in large cities. So, for example, large cities have disproportionately high levels of installed telephone lines (Figure 3.7), host the nodes of Internet backbone networks (figure 4.16) and are first in line for technology updates such as network digitisation (see section 3.1.3). Most importantly in respect of current policy debates, our research shows that the currently most commercially developed forms of broadband technologies – ADSL and cable modem – are, as one would expect for technologies with nodal properties, following a hierarchical roll-out pattern, with areas of high density population being served first (section 4.1.1).

When we come to *uptake* of telecommunications, our analysis suggests different patterns of metro-urban-rural penetration for different technologies. For fixed line and mobile telephony there is no systematic difference by type of locality, though the situation varies between countries. However, a gap does open up when we look at Internet related technologies. This gap becomes very significant when we consider uptake of broadband. This pattern is reflected across all countries for which we have data, though the scale of the metro-urban-rural differentials varies. The broadband uptake gap can at least partly be explained by the differentiated roll-out pattern. The disparity in Internet uptake cannot be explained in this way, and may be more worrying and appears to have been sustained over time (see figure 3.24).

Index of technology penetration in households by locality type

Technology	*EU15 avge = 100*	*Metro*	*Urban*	*Rural*
Fixed[1]	100	100	100	100
Mobile	100	101	100	99
PC	100	104	104	96
Internet	100	109	103	91
Broadband Internet	100	160	100	60

Source: CURDS; elaborated from INRA (2004)

(note:1 includes traditional fixed, ISDN and or DSL)

Having considered the general patterns of the territorialities of telecommunications networks and services, we now turn to briefly consider in slightly more detail the territorialities of individual technologies.

1.2.2 The territorialities of mature technologies

Our analysis of 'mature' technologies (in Chapter 3) suggests complex territorial patterns and that the technologies examined do not display the same territorial disparities – fixed line and mobile telephony on the one hand, and PC and Internet adoption on the other, display distinctively different territorial disparities.

Fixed telephony

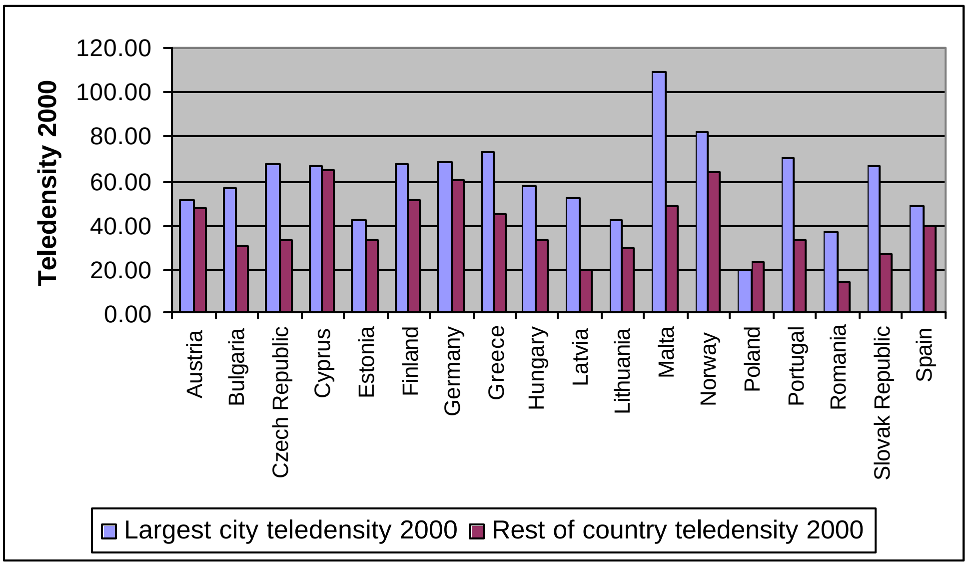
Fixed telephony is now a very mature technology, and penetration rates are actually declining in some EU15+2 countries and in some N12 countries. Nevertheless, it remains important, not only as *the* basic voice communications technology for many of Europe's citizens, but also a means of accessing the Internet and as a platform from which broadband DSL develops. A number of general territorial patterns can be identified:

At the macro-level, there is a west-east divide with the average for EU15+2 in terms of fixed lines being considerably higher than for N12. On the whole N12 growth rates were higher in the late 1990s, but recent evidence suggests a slowing of growth rates and, indeed, net regression in some countries. This suggests that fixed telephony will plateau at a lower level in N12 than in EU15. The quality of networks as measured by the degree of network digitisation is also lower in N12. Rates of growth of digitisation are rapid in most of the N12, with most countries above the 80 per cent level.

At the meso-level a very mixed pattern emerges across the European space with national effects being the most significant determinant.

At the micro-level our study suggests that there are disparities between metropolitan, urban and rural areas. If we first consider *roll-out*, it is clear that metropolitan areas have denser and better quality services. This is partly a function of the activities undertaken in large cities. So, for example, large cities have disproportionately high levels of installed telephone lines (Figure 3.7), host the nodes of Internet backbone networks (figure 4.16) and are first in line for technology updates such as network digitisation (see section 3.1.3).

Comparison of 'teledensity' between the largest cities and the rest of the country in European countries



(Data not available for other countries)

Source: ITU (2001), charted by CURDS

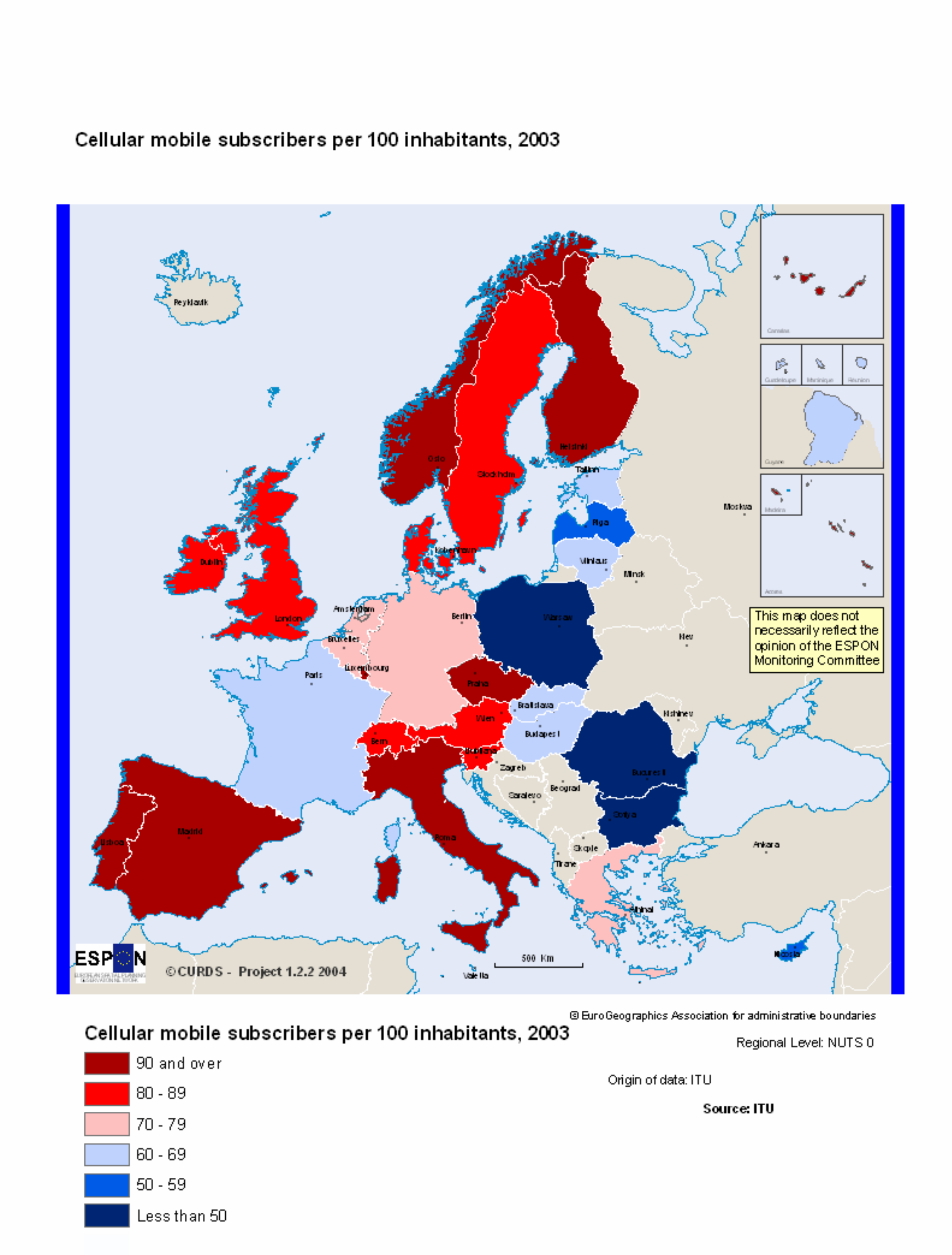
When we turn to analyse metro-urban-rural disparities in fixed line telephony penetration for *households*, however, we find no simple and consistent relationship. This finding relates to EU15 only, however, and the limited data we have for N12 countries suggests that a metro-urban-rural divide remains.

Mobile telephony

Although all technologies considered in this report have their own particularities, mobile telephony stands out as demonstrating significantly different territorial patterns and trends.

At the macro-scale, the territorialities of mobile telephony are highly distinctive, with the *Nordic periphery* (Norway, Finland and Sweden) and the *Southern periphery* (Italy, Greece, Spain and Portugal) displaying higher levels of household uptake than the European 'core'. The N12 countries (with the exception of the Czech Republic and Slovenia) have lower levels of uptake than the EU15, though their growth rates have been more rapid in recent years, suggesting a degree of 'catching up'.

Cellular mobile subscribers per 100 inhabitants 2003



At the meso-scale, the distinctiveness of mobile telephony is again markedly apparent, with many of the most advanced regions for mobile uptake being Objective 1, poorer in GDP per capita terms, of low population density, and peripherally located with respect to the European core. Conversely, all German and French regions (with the exception of Ile de France) are below the EU15 average, and these two countries together account for 45 of the lowest 50 EU15 regions in terms of household mobile penetration.

At the micro-scale, mobile networks have been widely deployed in Europe, with only particularly remote or mountainous areas, and some border areas, not being covered by the networks. Household penetration (i.e. uptake) levels within the EU15 reveal no clear distinction between metropolitan, urban and rural locations. In some other countries (Germany, Sweden and the UK), rural localities have higher penetration rates than metropolitan localities, albeit by small margins.

Personal Computers (PCs)

In terms of the development of the Information Society, in respect of mature technologies', it is the trends in PC and Internet adoption which are most significant. Our research identify the following disparities in respect of PC adoption:

At the macro-scale, Europe can be divided into two zones. Above average levels of PC penetration are found in northern and north-western Europe, with Sweden out in front, while below average levels are found in southern and eastern Europe, with the lowest levels of all found in Greece, Bulgaria and Romania.

At the meso-scale, regional variations in PC adoption levels within the EU15 are clearly related to developmental status (with Objective 1 regions having, on average, lower levels of PC penetration than non-Objective 1 regions); to GDP per capita; and, with a notable Nordic exception, to location with respect to the European core. At the NUTS 2 regional level, the highest levels of PC penetration (above 60%) in EU15 are found in Swedish regions, in Denmark, and in the leading regions of the Netherlands and Germany (Hamburg). At the bottom of the EU15 ranking (below 30%) are regions from Spain, Portugal, Greece and France.

At the micro-scale, there is some evidence for EU15 that household PC penetration levels in rural localities lag behind metropolitan and urban areas, but the lag is not particularly pronounced or consistent between countries. Interesting contrasts emerge between countries which are often assumed to be broadly similar. In Finland, for example, rural localities lag behind both urban and, particularly, metropolitan areas in their PC adoption levels, while in Sweden, there are no differences at all between metropolitan, urban and rural localities.

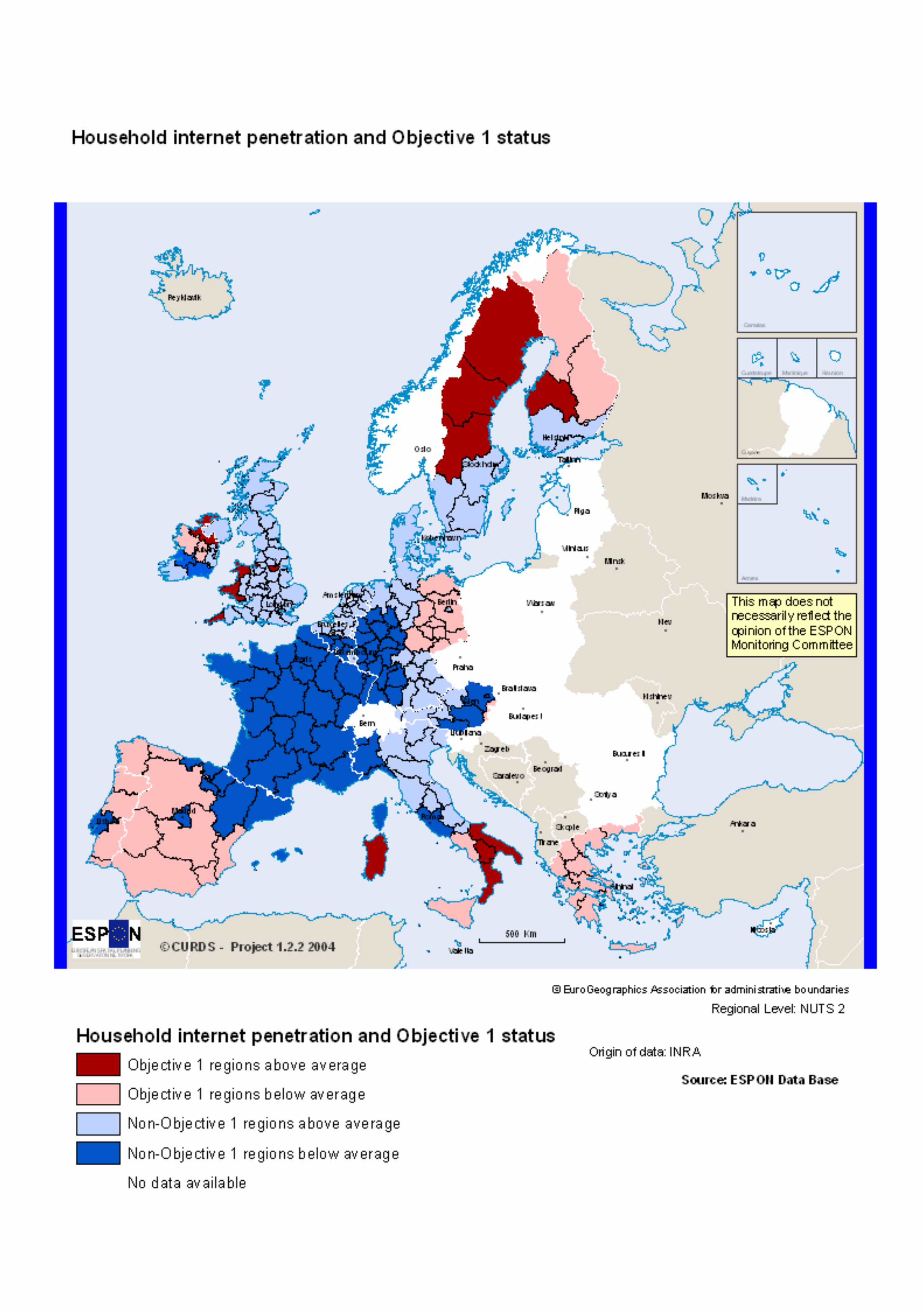
The Internet

The main findings with respect to the territorialities of household Internet adoption are as follows:

At the macro-scale, as with PC adoption, there are pronounced north-south and west-east divides within EU27+2, with the highest levels of Internet adoption occurring in the Nordic countries, followed by the Netherlands and the UK. The lowest levels of Internet adoption are found in southern (Greece and Portugal) and eastern (Bulgaria, Hungary and Romania) Europe.

At the meso-scale, regional variations in Internet adoption are positively related to the core as opposed to the periphery, more developed and higher GDP regions rather than less developed and lower GDP regions. Non-Objective 1 regions are more likely to be above the EU15 average than are Objective 1 regions, though, as Map 3.12 (reproduced below) demonstrates, several Objective 1 regions have above average penetration rates whilst several non-Objective 1 regions fall below that average. Again, national effects are clear with, for example, all Swedish regions, including Objective 1 regions being above the EU15 average and all French regions being below average.

Household Internet penetration and Objective 1 status



At the micro-scale, there are relatively pronounced differences between metropolitan, urban and rural localities in terms of their levels of household Internet adoption. In certain countries, notably Denmark, Finland and France, the 'metropolitan-rural' divide is particularly pronounced. It should be noted, however, that in a few cases, notably Sweden and the UK, there is no evidence at all for a metropolitan-rural divide in Internet adoption. At the general level, the evidence worryingly indicates that these disparities are being maintained over time (see section 3.4.3).

1.2.3 The territorialities of 'leading edge' technologies and applications

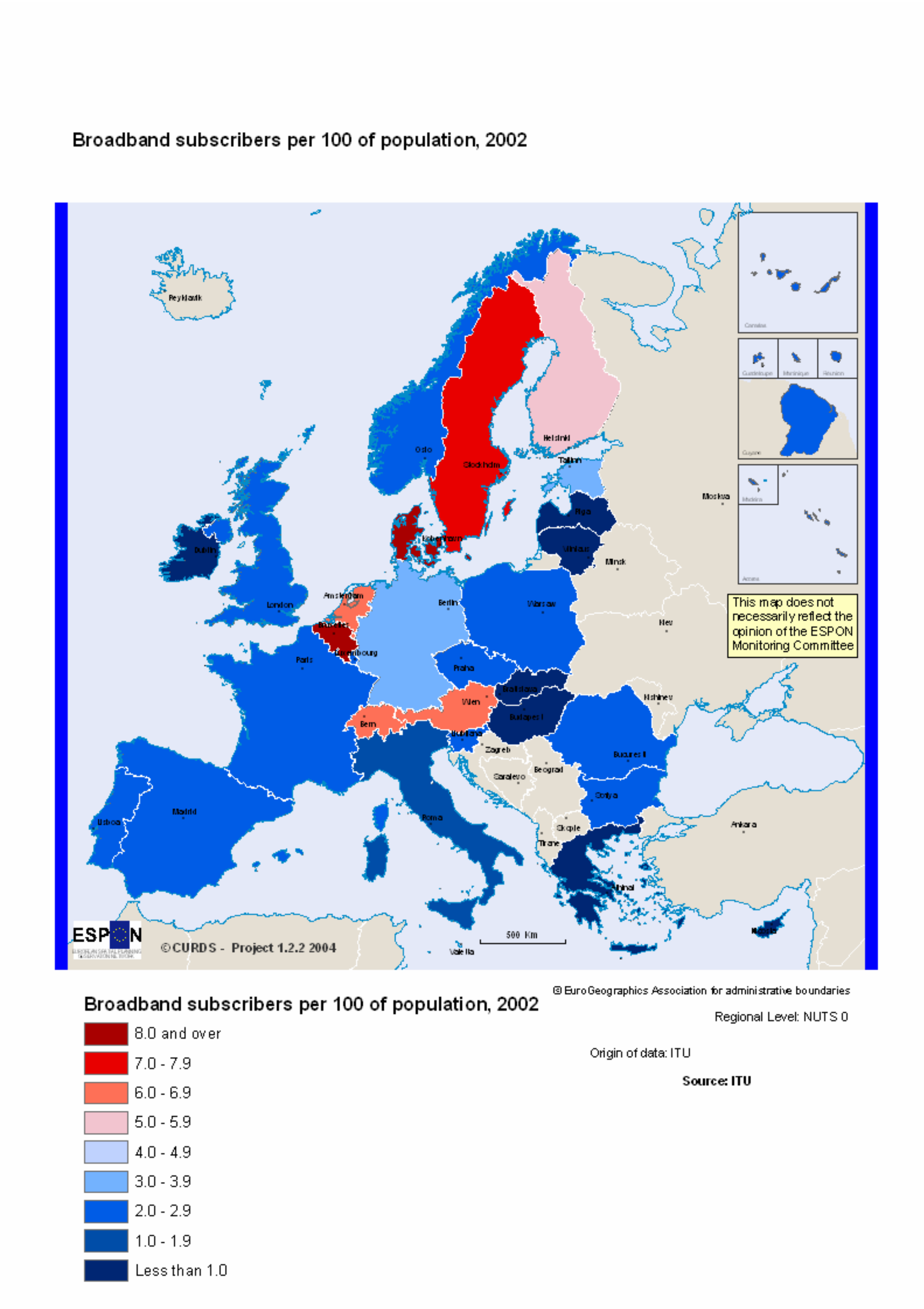
We now turn to consider what we describe as 'leading edge' technologies and applications. These are broadband, e-commerce and Internet backbone networks.

<u>Broadband</u>

At the macro-scale, a 'north-south divide' is evident in the degree of broadband penetration in the EU15+2, but not clear cut. While the Nordic and Benelux countries lead the way for broadband uptake, Spain and Portugal, for example, had higher penetration than France and the UK in 2002. There is variable performance in the N12 countries. Malta, Slovenia and Estonia have relatively high levels of broadband penetration, while in Bulgaria, the Czech Republic, Poland and Romania, broadband deployment had not yet commenced.

Our research suggests that at the macro level, when we consider *uptake*, there is a something of a 'north-south divide' at the European level, though, when the Nordic and Benelux countries are removed from the equation the situation is more even. In broad terms there is also a 'west-east divide'. Again, however, the situation is not clear-cut with some N12 countries more advanced than some EU15 countries. This is illustrated graphically in Map 4.1, reproduced below.

__Broadband subscribers per 100 of population 2002__



At the meso-level, our analysis suggests that, in terms of broadband *roll-out* or deployment, there are apparent territorial variations in terms of coverage within most countries. Roll-out generally occurs first in capital cities and other large towns, followed by other well populated areas and finally, if at all, in rural areas. The gap in coverage has been closed or almost closed in a few countries, but remains significant in most.

In terms of *uptake* at the meso level (for EU15 only) the Nordic and Benelux regions are most advanced. Our analysis of the relation between broadband and our socio-economic-geographic variables suggests that, on the whole, the European regions with the highest levels of broadband uptake tend to be non-Objective 1, have relatively high GDP levels, be quite densely populated with large urban centres, and core Pentagon regions, although there are several exceptions to this rule, notably the Swedish regions. The relationship between broadband and the four socio-economic variables is not as strong as for overall Internet access. There appears to be a greater level of regional variation within countries for Broadband Internet access than there is for the more mature technologies. The most likely explanation for this is availability disparities resulting from the deployment patterns described above.

When we look at broadband uptake at the micro-scale, there are clear disparities between metro, urban and rural areas. These disparities are greater proportionally than for the 'more mature' technologies. If we look at the individual countries in EU15 (see table 4.3), metro localities lead in all countries, generally by a significant margin, with uptake in urban areas generally taking second place. Only in two countries (Spain and Ireland) does urban uptake outstrip that in metro areas. Rural areas lag metro areas in all countries and surpass urban areas in only one country (Belgium).

E-commerce

Our analysis of the adoption of e-commerce at the macro scale shows that again there are significant variations between countries. EU15 countries are, on average, more advanced than N12 countries, though some N12 countries appear to be in advance of particular EU15 countries.[2] Northern countries again outperform Mediterranean countries. There are also significant differences within the N12.

At the meso-scale we estimate that northern regions again lead the way and southern and eastern regions lag[3]. The picture is complex, however, with, for example, the Praha and Bratislavský regions estimated to be amongst the leading European regions in terms of e-commerce, and with many Dutch, UK and French regions having relatively moderate levels of use of e-commerce.

Internet backbone networks

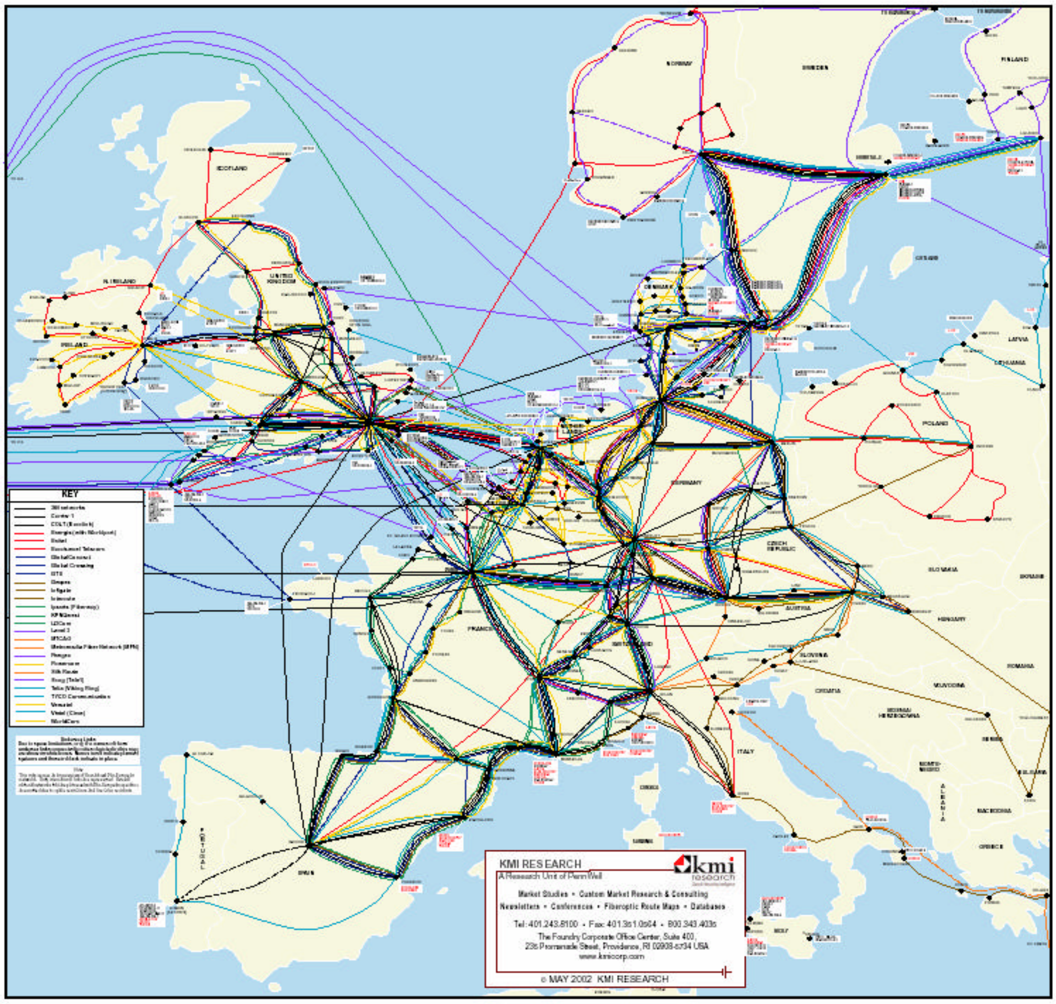
Our analysis of Internet backbone network provision suggests a number of interesting findings. At the macro scale, there is a 'three-level' core – intermediary region – periphery disparity, with the largest number of networks, biggest bandwidth links and most important Internet Exchange Points focusing on a highly concentrated Pentagon zone. Some networks also cover other areas just beyond the Pentagon, but there are only a small number of networks extending to the periphery (see figure 4.16).

At the meso-scale, with the exception of Germany which has fuller coverage, national capitals and metropolitan areas are the focus for these networks, with a relative paucity of networks in more peripheral regions within countries. Some positive trends are emerging in relation to more polycentric development. For example, the increasing importance of a number of 'gateway cities' (Praha, Budapest, København) beyond the core, through which these networks both pass to reach more peripheral regions of Europe, and interconnect to permit communications exchange between different networks. Some pan-European providers have concentrated on connecting more peripheral cities in regionally-focused networks. This has led both to some of these cities becoming more connected than certain cities in the core, and therefore, to differing levels of peripherality in access to backbone networks.

[2] It should be noted, however, that the data sets on which we rely are not directly comparable and findings should be regarded as indicative.
[3] Note that section 4.2.2 uses regression modelling to provide estimates of missing regional data.

KMI's map of pan-European backbone infrastructures

PAN EUROPEAN FIBEROPTIC NETWORK ROUTES PLANNED OR IN PLACE



Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

1.2.4 Policy issues

We consider two policy 'strands'. After a brief introduction in which we outline the policy context, we turn to explore ways in which European and national telecommunications regulation and institutions could be adjusted so that regulation could be used as a tool for regional development (6.2). We first look at three separate areas of regulation: licensing, local loop unbundling, and regulations which require incumbents to offer wholesale products to other telecommunications providers. We then go on to discuss in some detail the question of universal service requirements, one of the few areas where telecommunications regulation specifically addresses territorial issues. In the European context these requirements are currently embodied in the Universal Service Directive (USD) and at national level in Universal Service Obligation (USO) regulations. At present these relate only to narrowband technologies. We consider whether and how they might be extended to more advanced technologies in the current competitive environment. These regulatory options are mainly a matter for national governments and the Commission. In section 6.3 we consider what actions local and regional policymakers might take, though they will only be able to do so in a context of European and national level approval. We first discuss the potential of regional broadband aggregation, both public sector broadband aggregation and initiatives involving the private sector. In turn, we then consider the potential of direct public subsidies to telecommunications providers; the role of public-private partnerships, both partnerships between public authorities and telecommunications providers and partnerships between public authorities and locally based enterprises; the public sector construction and/or ownership of networks; and, policies aimed at creating attractive environments and ease of access for commercial providers. In each case we provide short illustrative ‘case studies’ of such policy interventions. In section 6.4 we argue that for intervention to succeed (whether ‘light touch’ or more detailed intervention) a greater symmetry of information between public authorities and private sector telecommunications providers needs to be developed. Finally, in section 6.5, we make a plea for an improved and harmonised data collection system covering the ESPON space. We argue that only through improved databases can truly evidence-based policymaking occur.

1.3 Scientific Summary – methodologies, concepts, typologies and indicators

The general methodological approach during the course of Project 1.2.2 involved trying to uncover quantitative data which was or could be made comparable at various territorial levels. This process involved collecting and analysing data from the Commission and Eurostat, from international agencies such as the OECD and the International Telecommunications Union (ITU), from specialist telecommunications consultants such as KMI, Telegeography and Point Topic, from other relevant European research projects such as BISER and SIBIS, and from regional observatories such as

Osservatorio Banda Larga. The data from these sources was brought together in our earlier reports, particularly in our Third Interim Report. Given the continually changing nature of the telecommunications environment we have continued where possible to update the information from these organisations in preparing our Final Report.

The key breakthrough in preparation of the Final Report was that the Commission eventually, more than a year after our initial request, provided data from a study carried out on its behalf by the consultants INRA. This was a study of the household penetration of telecommunications in EU15 at the sub-national level. The analysis of this data has been the key task in the closing months of our study. In addition to reproducing selected INRA data in an ESPON format, we have reanalysed the data using socio-economic-geographic categories in order to try and better understand the factors behind differential patterns of telecoms penetration. The uptake levels of regions for fixed line and mobile telephony, and PC, Internet and broadband adoption were compared to their developmental status (Objective 1 and non-Objective 1), level of GDP, their population density and degree of urbanisation, and core-periphery location (Pentagon vs non-Pentagon). We have carried out this exercise for all EU15 regions. The INRA data has also been useful in constructing a set of typologies.

A further strand to our search for harmonised empirical data was to contact relevant national and regional actors – ministries, regulators, regional organisations and telecommunications providers. This exercise was mainly carried out during the first year of the report. In terms of data gathering this exercise was very disappointing and little useful data was uncovered. We have reported in detail on the problems and issues with regard to this exercise in our earlier reports and will not comment further here. Interviews carried out during this process were valuable and have been used selectively in our report. In the final stage of the study we have undertaken more detailed analysis of individual countries. At the request of ESPON and the Commission we have also undertaken a more detailed analysis of the Universal Service concept in the changing telecommunications environment.

In our Third Interim Report we developed a number of typologies of telecommunications territoriality trends:

1. Mobile penetration / internet penetration (2x2) (national level)
2. Broadband penetration (3) (NUTS 2)
3. Introduction of competitive provision (2) (NUTS 2)
4. Broadband / introduction of competitive provision (3x3) (NUTS 2)
5. Telecoms supply and demand characteristics, based on core/periphery, urban/rural and core/periphery categorisations (2x2x2) (NUTS 2)
6. Network richness (3) (NUTS 2)
7. Network richness / head office concentration (3x3) (NUTS 2)

In our Final Report we introduce the typology or concept of 'spread of regional difference' and we illustrate this for EU15 countries. The 'spread' typology is helpful in illustrating the degree to which regional disparities are occurring in a particular territory for individual technologies or for groups of technologies.

We also provide typologies of NUTS 2 regions, including the regions of the N12 countries, as a method of producing comparisons of the degree of overall telecoms advancement of all regions across EU27+2. These typologies are based on composite indicators that we have constructed from the data, some of which (related to enterprise Internet use) are estimated values. We present four such regional typologies (see section 5.2 of this report):

1 A typology of levels of household telecommunications uptake
2 A typology of estimated levels of business telecommunications access and uptake
3 A typology comparing levels of household and business telecommunications uptake
4 An overall typology of combined household and business telecommunications development into a single index

We developed a wide range of indicators in our first report. We subsequently reduced the number of indicators to produce a core set of indicators. These indicators were reproduced in the Third Interim Report, with the core set of indicators in bold. Our research was unable to uncover *comparable* and *harmonised* data on any of the indicators listed in our study at the sub-national level for EU27+2. The reasons for this are detailed in our earlier reports.

Our research suggests that data on supply side indicators at the sub-national level will be extremely difficult to uncover. This information is mainly held by telecommunications providers and is generally regarded as commercially sensitive. Some key information could be collected by regulators to meet current policy concerns for a particular sub-national territory. For example, the proportion of exchanges which have been DSL-enabled and the number of homes passed by digital cable. From a practical (policy intervention) point of view, the question would be *which* exchanges are enabled and *which* homes passed rather than just the proportion. Doing this on a consistent and regular basis across the European territory may be difficult given the different starting points and attitudes of national regulators.

Suggested Indicators for Future Data collection

Indicators	NUTS 0	NUTS 1	NUTS 2	NUTS 3
Up-take and use of TN&S • Telephone subscribers per 100 inhabitants (i.e., fixed and mobile) • Percentage of households with a telephone • Percentage of households with PCs • Installed PCs with broadband access to the Internet • Cellular subscribers per 100 inhabitants • Proportion of households subscribing to Cable services • ISDN subscribers per 100 inhabitants • ADSL subscribers per 10,000 inhabitants • Proportion of households with Internet access • Proportion of households with broadband Internet access • Internet users per 1000 inhabitants (at work, at school or at home) Up-take and use by business • Proportion of firms with access to the Internet • Proportion of firms with own website • Proportion of firms making sales via e-commerce • Proportion of firms making purchases using e-commerce • Value of sales by businesses made via the Internet • Value of purchases made by businesses via the Internet • Use of broadband to access the internet by size of business • Level of business activity by type of internet access				

We would suggest, however, that the main focus in future research should be on the demand side. A revised table of indicators is set out above. These are a mixture of individual, household and business uptake and usage indicators. Such data is now being collected at the EU15 level, but from an ESPON perspective has limitations (see section 1.5, further research).

1.4 Networking

Networking and cooperation within Project 1.2.2 has been good, notwithstanding the complex demands placed on the project team.

In terms of networking more generally, we have been involved in general networking and exchanging ideas at all the ESPON seminars and at the Lead Partner meetings.

During the project we have networked with three TPGs in particular;

- TPG 1.1.1 where we have been involved in bilateral contacts regarding use of the FUA typology ahead of formal release, where they were very helpful. In addition, we discussed the use of TPG 1.1.1's Top 500 company database. In the end, this was not used, as the Amadeus database was found to be more relevant for our purposes.

- TPG 2.1.1 where we have developed a number of contacts to exchange data, to see what synergies could be developed, and to ensure that we were not duplicating work, particularly in relation to modelling. This process continued through the final phase of our work when we made available the INRA data to that project.

- TPG 2.1.4 regarding the acquisition and exchange of input/output tables.

- TPG 3.1 whom we have found to be most helpful, particularly in relation to mapping ideas. Beyond this we have had a number of useful conversations regarding developing some of the components of our work.

1.5 Further research issues and data gaps

There remain a number of research questions even from the narrow 'infrastructuralist' perspective which project 1.2.2 was obliged to adopt. Several of these relate to data collection and are covered in point 1.3 above. In short, supply-side data, beyond the indicative level or for particular small parts of the ESPON territory is not available. The situation of the demand side is more healthy, and a regular survey exercise by DG Information Society now seems to be underway. This exercise, however, is only undertaken at the level directly below national level. The territorial unit of analysis varies across countries (in the majority of cases NUTS 2, in other cases NUTS 1 or 3). Two key tasks from an ESPON perspective will be: a) to extend the INRA or similar surveys to the EU27+2; b) to harmonise the survey at an agreed NUTS level. One further key issue will be the cost (or the political will to fund the cost) of surveying sample sizes which are large enough to provide information at the spatial level that ESPON desires. If valid information for individuals or households is to be obtained at the level below NUTS 2 then larger (and therefore more expensive) surveys will be required. This may be even more of a problem with enterprise surveys where the population from which to choose is smaller.

The key question in our view, now that our report has *described* territorial disparities, within the constraints of the data available, is to *explain* these differences. We have attempted to uncover some of the explanatory relationships between telecoms uptake and other socio-economic-geographic variables. We have also pointed to the importance of 'national effects/specificities' and different 'telecommunications cultures'. We also undertook a number of national case studies. Unfortunately, however, the resources available to the project did not allow us to undertake the detailed qualitative research required to further explore why certain nations and regions are consistently in the lead while others consistently lag, or, indeed, why some regions have shown rapid growth. A study of selected regions identified in the present study which looked in detail at the institutional, socio-economic and policy circumstances bound up in their levels of telecommunications development would, in our view, be a useful exercise.

PART TWO

Chapter 2 – Introduction to Part 2

There is now a widespread perception that information and communications technologies are increasingly central to the functioning of modern societies. The explosive growth of mobile telephony and the rapid diffusion of the Internet, in both home and work environments, testify to the extent to which our daily lives are becoming dependent upon these technologies. So pervasive have these technologies become, and so quickly integrated into the fabric of daily life and business practices, that access to them is becoming almost a necessity for the full participation of citizens in society, and for the economic viability of enterprises. For individuals, these technologies potentially facilitate easier access to banking, shopping, leisure activities, multimedia forms of entertainment and government services, and present new possibilities for working at home, all of which are likely to become more important over the coming years. For enterprises, the impact has been even greater. We need only think of how, in a few short years, firms have come to depend on telecommunications networks within their competitiveness strategies:

- Email has become an essential tool of communication within enterprises and with external partners;
- Telephone call centres have become integral to customer service and marketing strategies for many consumer services;
- Websites have become a principal means of providing information to customers and a major marketing channel;
- Corporate broadband networks and so-called 'groupware' are making it possible to build 'virtual teams' of spatially-dispersed team members, with significant implications for the geography of human resources;
- Mobile digital telephony is enabling field and sales staff to have access to corporate information systems while at clients' premises or 'on the move';
- Business-to-Business ('B2B') e-commerce is radically altering the way supply chains function (for example, it is estimated as being worth over 200 billion € in 2002 in Europe, a fourfold increase from the previous year (Business Week, May 2003)).

From a territorial perspective, such developments offer enormous opportunities for reducing the 'friction of distance' and/or the problems of remoteness from which many peripheral regions and rural areas have suffered. At the same time, however, concerns are arising[4] over the territorial dimension to the so-called 'digital divide', whereby any deficiencies in access to the advanced networks, or geographically-defined limitations in the capabilities of enterprises and households to make use of these networks, could serve to exacerbate, rather then ameliorate, territorial development disparities.

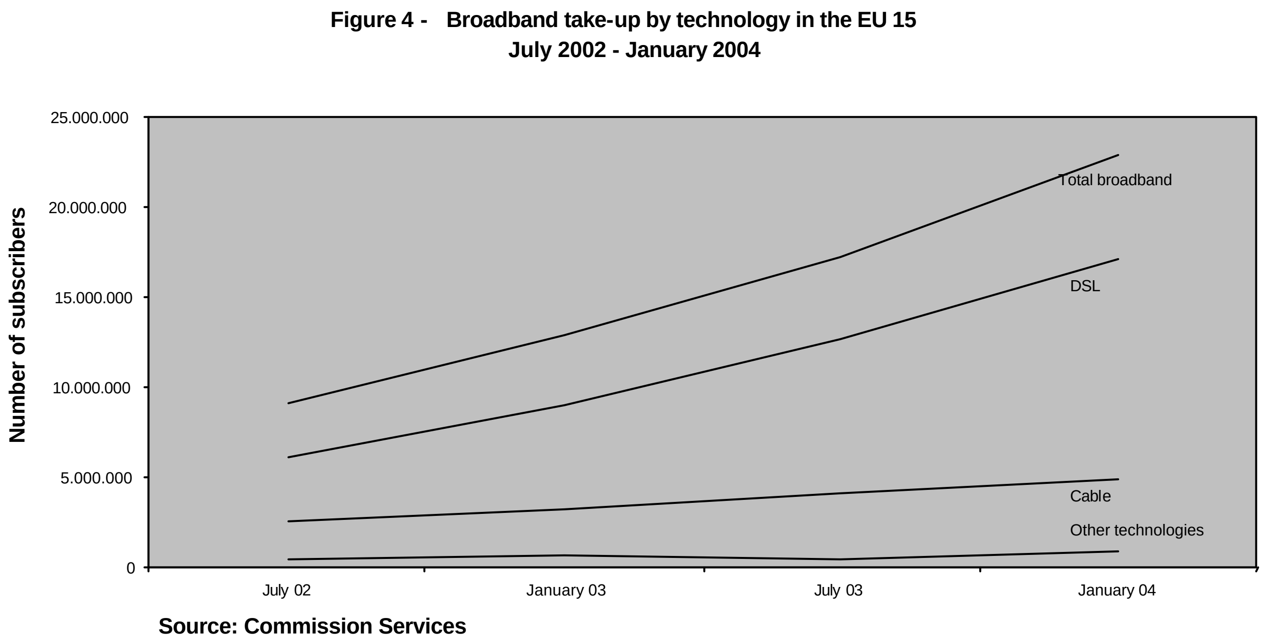
Within the context of enlargement, liberalised telecommunications markets, rapid technological change and the anticipated roll-out of next-generation digital mobile and broadband networks, there is a need to review the evidence concerning the extent to which the EU's diverse territories are sharing in the benefits of ICT uptake and usage. In this period of rapid change, is the 'digital divide' between favoured and less-favoured regions, or between cities and rural areas, widening or narrowing? The answers to these questions have considerable importance from a territorial development perspective, as it is difficult to overstate the significance of telecommunications networks and ICTs more broadly for development within a knowledge-based economy.

The telecommunications environment is one which is in a state of constant evolution. The pace of change in the period during which we have undertaken the current study has proved exceptionally rapid in several respects. We can illustrate this point by briefly looking at developments in three areas: changes in the field of the technology itself, changes in the attitudes of policymakers towards intervention in infrastructure provision, and changes in statistical bases for exploring territorial patterns of technology distribution.

[4] The extent of the 'gap' in ICT supply, adoption and usage between favoured and less-favoured regions of Europe has been a policy concern of the European Union since the mid-1980s. Community initiatives such as the STAR (Special Telecommunications Action for Regions; 1987-91) and TELEMATIQUE (1991-3) Programmes, and innovative actions such as the Regional Information Society Initiative (RISI) in the second half of the 1990s, are examples of policies to address regional telecommunications disparities, and have led to major efforts to 'mainstream' information society measures within the current round of the Structural Funds.

On the technology front, the past two years have seen a rapid growth in technologies known as broadband and particularly one form of broadband known as Asynchronous Digital Subscriber Lines (ADSL). Figure 2.1 illustrates the dynamism of this process, with the number of subscribers growing almost by one hundred and fifty per cent over a period coinciding with the first 18 months of this project.

Figure 2.1: Broadband take-up July 2002 – January 2004



Source: CEC (2004b)

The policy environment has also evolved during the period of our study, at least in recognition of the rapid growth of broadband and the need to ensure that certain types of territories are not disadvantaged by being unable to share in the benefits that broadband availability can confer to both citizens and businesses. So whereas at the start of our study the Commission was only gradually and, we would suggest, reluctantly moving towards the view that public sector funding could be used for the provision or direct stimulation of telecommunications infrastructure, we are now seeing a more permissive regime emerging, albeit one still underpinned by the notion that the market should provide[5]. In some respects it might be argued that this change represents one of tone rather than of underlying policy. Nevertheless, a number of Member States have now intervened using public funds to promote telecommunications networks in order to address territorial digital divides.

A third area where change is occurring is in respect of the availability of territorial data. From the beginning of our study it was clear that there was a paucity of *harmonised* data across the European territory at any level other than the national[6]. During the second half of our study (i.e. since our Third Interim Report), regional data has become available for EU15 for households and we carry out a detailed analysis of this data in the present report. We still lack regional data for the use of TN&S by enterprises. Comparable data for the N12 countries and for Norway and Switzerland at the regional level, for both enterprises and for individuals and households is also unavailable. There is, however, some prospect of progress in this area. In particular, a recent Regulation[7] seeks to establish a common framework for the systematic production of Community statistics on the information society for enterprises and individuals and households, including data at the regional level. Although it comes too late for this particular project, it may provide a resource to the ESPON process in the longer term.

This lack of harmonised data means that policy in relation to territorial digital divides has generally been based on limited and fragmented empirical evidence. More recently, EU-funded researchers sought to improve the evidence base[8]. The current study can be seen as part of this process. Whereas other studies have been rather diffuse ranging across a number of 'domains' of the information society, for example, e-health, e-governance and the e-economy, our focus has been on the telecommunications infrastructure and the services accessed through these. In this, our final report, we bring together and present the evidence which we have gathered over the past two

[5] See CEC (2003f) "Guidelines on Criteria and Modalities of Implementation of Structural Funds in Support of Electronic Communications" for the constraints on state funding.
[6] See in particular ESPON 1.2.2 Second Interim Report for a detailed analysis of the lack of harmonised data relating to telecommunications infrastructure and services in Europe.
[7] Regulation (EC) No 808/2004 of the European Parliament and of the Council of 21 April 2004 concerning Community Statistics on the information society.
[8] For example, the BISER project Benchmarking the Information Society: eEurope Indicators for European Regions. IS-2000-30187.

years in respect of territorial trends in telecommunications networks and services and set out a series of policy options based on our analysis.

As indicated above, the technological environment is changing rapidly with the 'latest' technologies soon being superseded by others. This makes life complicated for both analysts and policymakers, including those interested in the role of telecommunications as a tool for regional development. It is only a few years since ISDN (integrated services digital networks) was seen as the key 'must have' technology for regional economic competitiveness. In the event, ISDN did not prove to be a 'killer application'. Increasingly, broadband is seen as the essential technology (or rather, set of technologies) for economic competitiveness and development. In this report we explore recent developments in broadband technologies in detail, in line with policy concerns. We also stress, however, that it is important to consider a range of technologies and not just the latest ones. We focus, therefore, on five inter-connecting sets of telecommunications networks and services. These are:

- fixed telephony networks, which for most European citizens remain the primary means of accessing telecommunications services;
- mobile telephony, which has become increasingly important over the past 15 years or so and may come to challenge fixed telephony as the main delivery mechanism for some services;
- the Internet, which has a profound impact on the way we communicate and do business and has the potential to impact on the competitiveness of regions by allowing cheaper transmission of data (voice, text and pictures) using common formats;
- broadband, which has the potential to enhance both data and voice services by increasing the volume of information which can be transmitted across space and the speed of transmission;
- the underlying backbone network technologies to which all other networks are ultimately connected and which are particularly important as a carrier of Internet traffic.

The lack of harmonised data at the European level and the overall paucity of sub-national data means that we have had to draw on a range of data sources in compiling our report. In some cases the data is not directly comparable and is used indicatively. We indicate in the report where this the case and draw the reader's attention to any limitation of the data.

The rest of the report is divided into five chapters. Following this brief introductory chapter, we present four substantive chapters (chapters 3-6).

In chapter 3 we explore a set of technologies which can, in the context of the rapidly changing technological environment, be described as 'mature'. We consider, in turn, the territorialities of the following technologies: fixed line telephony (section 3.1), mobile telephony (section 3.2), personal computers (PCs) (section 3.3) and Internet access (section 3.4). We explore each of these technologies first from a 'macro' perspective, comparing the situation across the countries of the ESPON space. We then turn to consider territorial patterns at the meso level, exploring regional differences across Europe and within individual nation states. We consider the territorialities of each technology against the following set of regional socio-economic-geographic variables and categories – developmental status (Objective 1 v. non-Objective 1), level of GDP, a categorisation of regions according to their population density and presence or absence of urban centres, and core-periphery location (Pentagon v. non-Pentagon) – in order to explore whether, and to what extent, these variables and categories are related to variations in telecommunications development. Finally, we explore the technologies from a micro perspective, focusing on disparities between metropolitan, urban and rural areas.

In Chapter 4 we turn to look at those elements (infrastructures and applications) at the 'leading edge' of telecommunications developments, namely a) broadband technologies; b) e-commerce; and c) Internet backbone networks.

In section 4.1, after a brief discussion of the policy context, we describe and analyse the territorialities of broadband. We first consider patterns of broadband *roll-out* (section 4.1.1). We draw on a range of published sources and interviews from our field work to illustrate that, by and large, roll-out occurs in a hierarchical manner, with providers first investing in the most densely populated areas (moderated by the intensity of business activity and wealth). This pattern is replicated in all countries, although the speed with which the gap closes between urban and rural areas has so far varied between countries. We then turn to explore levels of *uptake* of the main commercially developed technologies, DSL and cable modem. We first explore the macro-scale perspective (section 4.1.2), before exploring broadband uptake from a meso-scale perspective (section 4.1.3). Here we consider the territorialities of broadband against the same regional socio-economic-geographic variables and categories employed in Chapter 3 in respect of more mature technologies. In section 4.1.4 we focus on a micro-scale view of broadband uptake, looking at disparities between metropolitan, urban and rural localities.

In section 4.2, we focus on the territorialities of e-commerce. It can be argued that, from an economic perspective, it is the uptake and usage of ICTs by enterprises, including SMEs, which is of prime importance in contributing to regional competitiveness. In section 4.2.1 we draw together the limited evidence available to reflect on the territorialities of e-commerce from a macro-scale perspective. We then turn to consider e-commerce from a meso-scale perspective (section 4.2.2). Unfortunately there is a dearth of data on regional variations in e-commerce. We therefore apply regression modelling to provide estimates of missing regional data.

In section 4.3, we focus on the territorialities of pan-European Internet backbone networks, which carry huge amounts of data communications for corporate clients and Internet Service Providers. These networks have emerged over the past ten years or so and represent a 'Europeanisation' of telecommunications investment. In this section we summarise the detailed analysis presented in our Second and Third Interim Reports, but also present some new analysis based on our recent research.

In Chapter 5 we further deepen our contribution to the ESPON Common Platform. To do so we undertake two separate but interconnected analyses. Firstly, we explore our study results in more detail specifically in the light of key territorial concepts which have been adopted by ESPON, notably the concepts of polycentric development and territorial cohesion (Section 5.1). Secondly, we further develop the typologies which we constructed in our Interim Reports and introduce new typologies, drawing on new data which was unavailable to us when writing the earlier reports (Section 5.2). A key objective in our construction of these typologies is to give an indication of which regions in the ESPON space (EU27+2) are most advanced and which are lagging. It should be borne in mind by the reader that the typologies are, in part, constructed as an attempt to fill some of the many gaps in European data sets in the area of telecommunications territorialities. They should, therefore, be seen as indicative of the situation in Europe, but also as offering a uniquely interesting overall perspective on telecommunications trends across the ESPON space. In a supplementary section 5.3, a set of national summaries of telecommunications territorialities is presented.

In Chapter 6 we address the question of what kinds of policies should be developed and what forms of intervention should be considered. We are aware that different Member States, as well as the non-member countries, have different histories and cultures, are at different stages in the deployment of ICTs and may have different attitudes towards regulation and intervention. We assume, however, that both the Union and all of the countries in the ESPON space have the objective of a more even territorial development and accept that more even deployment of telecommunications infrastructure will contribute towards this goal. We therefore present a 'menu' of policy options to stimulate infrastructure development.

Chapter 3 – Territorialities of 'mature' ICT availability and use

In this chapter we explore technologies which can, within the context of the rapidly changing technological environment, be described as 'mature'. We consider, in turn, the territoriality of the following technologies: fixed line telephony (section 3.1), mobile telephony (3.2), personal computers (PCs) (3.3) and Internet access (3.4), finally we draw out the main findings of our analysis of mature technologies (3.5).[9]

For each technology, we adopt first a 'macro' perspective comparing the situation across the countries of the ESPON space. Here, we draw primarily on data from the International Telecommunications Union (ITU).[10] We use the most recent data available from ITU (2003) thus updating the situation described in our Third Interim Report (TIR). We also draw on other studies not available when preparing our TIR, notably IBM's 4th Report on Monitoring of EU Candidate Countries (IBM, 2003) and the eEurope+ 2003 Progress Report (EU Acceding and Candidate Countries/CEC, 2004).[11]

We turn then to consider territorial patterns at the meso, or inter-regional level. We explore regional differences across the European space and within nation states. We consider the territoriality of each technology against the following set of regional socio-economic-geographic variables and categories — developmental status (Objective 1 v. non-Objective 1), level of GDP, a categorisation of regions according to their population density and presence or absence of urban centres, and core-periphery location (Pentagon v. non-Pentagon) — in order to explore whether, and to what extent, these variables and categories are related to variations in telecommunications development. In this 'meso level' section we rely primarily on the results of the INRA 2002 survey of households (INRA, 2004), drawing on the published survey and background data provided to us by the Commission since our TIR. This allows us to provide a richer and more nuanced picture in respect of inter-regional differences than in our previous

[9] see Annex 5 for analysis of household uptake of fixed and/or mobile.

[10] Our reasons for using ITU data are set out in detail in our three Interim Reports (see http://www.espon.lu – Project 1.2.2 First, Second and Third Interim Reports).

[11] This report was prepared by the Acceding and Candidate Countries with the assistance of the European Commission for the European Ministerial Conference on the Information Society "New Opportunities for Growth in an Enlarged Europe", Budapest, 26-27 February 2004.

reports. Unfortunately, the INRA survey covered only EU15. An extensive search suggests that no comparable studies have been carried out for the N12 countries. Our analysis of the regional territoriality of ICTs is therefore mainly confined to the old Member States (however, we do extend our analysis to the new member states and Norway and Switzerland through the use of typologies in Chapter 5 of this report).

Finally, within each of the technologies we consider, we examine the 'micro scale' territoriality of our selected technologies, in which our focus is on metropolitan, urban and rural areas. Primarily here we rely upon the INRA 2002 household survey, which included a categorisation of localities within each country into metropolitan, urban and rural. In consequence, our consideration of micro-scale territorialities is largely confined to the EU15, though we do provide examples from the N12 countries.

3.1 Territorialities of fixed line telephony

The first technology which we consider is fixed line telephony. This is clearly a mature technology and receives little attention in ICT policy debates, where the main focus now tends to be on broadband. However, fixed line telephony networks remain important in several respects. First, they are still an important means of accessing *voice* telephony. Second, these lines (when attached to modems) form the main conduit for data services for most European citizens. It is through these lines that most users currently access the Internet. Third, historical investment patterns in fixed telephone networks also have an impact on patterns of investment in newer technologies. For example, levels of availability of broadband ADSL will depend on the volume and nature of previous investment in fixed line networks, particularly the extent to which switching and transmission have been digitised. Having emphasised the continuing importance of this technology, the evidence presented in this report also suggests that fixed telephony is to some extent, and in some countries or regions, being challenged by other technologies, not least, mobile telephony.

3.1.1 A macro-scale perspective on fixed line telephony

Fixed telephony has reached high levels of penetration in most EU15+2 countries and the number of lines is actually declining in several. As we can see from Map 3.1, all EU15+2 countries have penetration rates of more than 40 fixed lines per 100 inhabitants, and most have penetration rates above 50 lines per 100 inhabitants. It should be borne in mind, however, that the relatively easy availability of fixed telephony is fairly recent in some EU15 countries[12]. When we look at the N12 countries, although significant progress has been made in extending the provision of installed telephone lines, there is still a 'deficit' in provision in some countries, with only Cyprus, Malta and Slovenia reaching 40 fixed lines per 100 inhabitants. Several N12 countries have fewer than 30 main telephone lines per 100 inhabitants (Lithuania, Latvia, Romania and Slovakia).

On the whole, the N12 had higher growth rates in the number of lines than did EU15+2 in the late 1990s, suggesting some 'closing of the gap'. The evidence for the period 2001 to 2003, however, suggests that there may be a slowing of growth rates in the N12 (UN Economic Commission for Europe, 2002b; IBM, 2003; ITU, 2003). Average growth rates for fixed main lines in the N12 over that period appear static. Indeed, several N12 countries saw significant net regression between 2001 and 2003, most notably Hungary, Latvia, Lithuania and Slovakia (EU Acceding and Candidate Countries/CEC, 2004). This is in line with trends in some EU15+2 countries[13], but if the slowdown in growth in the N12 continues then fixed telephony will plateau at far lower levels than in EU15 (UN Economic Commission for Europe, 2002b).

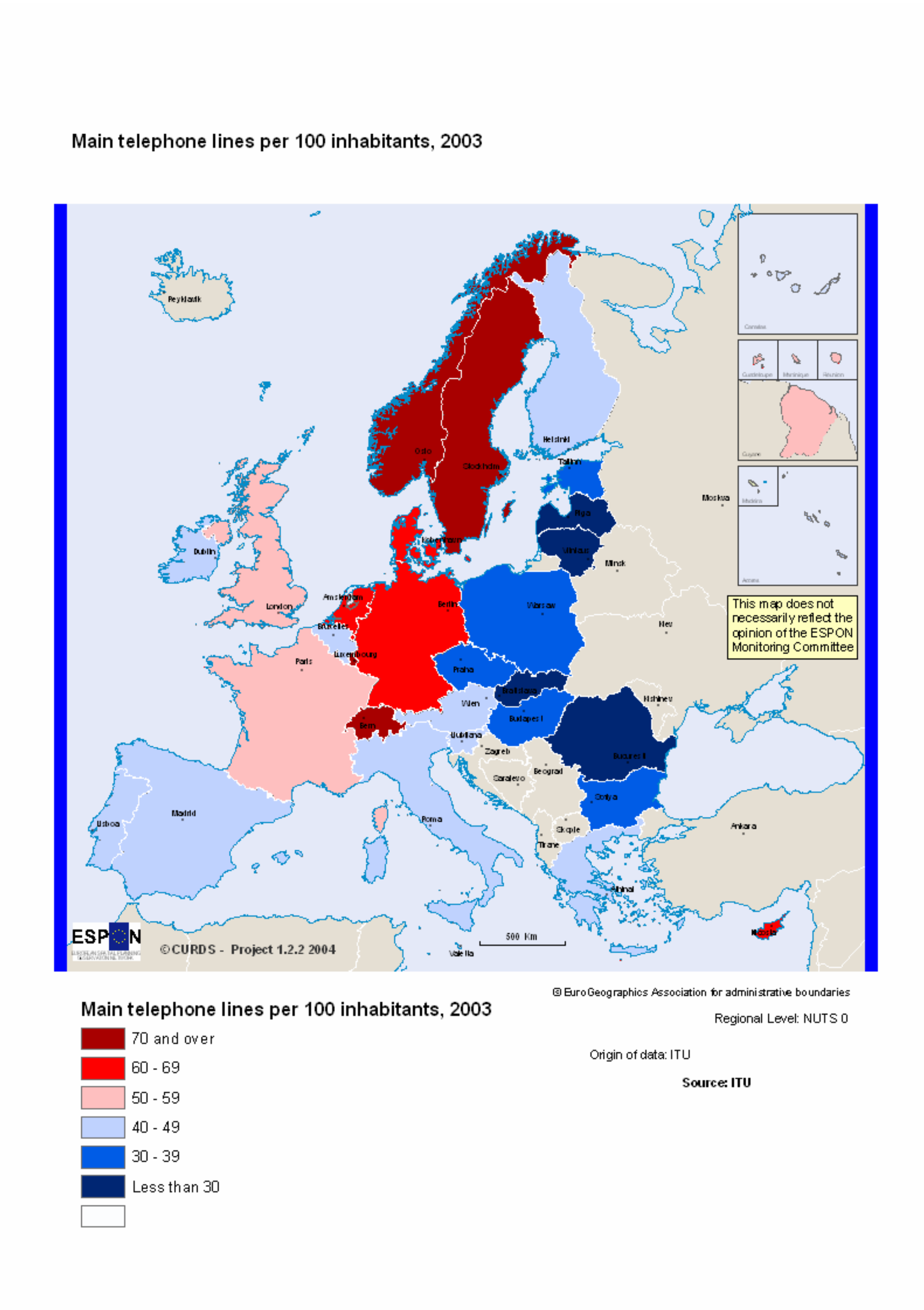
One factor which may explain the slowdown in fixed telephony growth rates is the development of mobile telephony. The majority of N12 countries saw rapid growth in mobile in the second half of the 1990s (see figure A4.1 in annex 4). As long as the growth in mobile continues, the stagnation of the growth in fixed telephony may not

[12] See chapter 3 of ESPON 1.2.2 Third Interim Report for more details.
[13] The following EU15+2 countries showed a decline in the number of fixed lines per 100 inhabitants between 2001 and 2002: Austria, Belgium, Finland. France, Greece, Italy, Norway, Portugal, Sweden and the UK. See section 3.3.1 of ESPON 1.2.2 Third Interim Report, particularly Table 3.1. Available at http://www.espon.lu.

necessarily be an issue for concern in respect of *voice* traffic[14]. In respect of data, however, the lack of fixed lines could act as an impediment to at least one form of broadband delivery – that based on ADSL, which involves upgrading existing fixed line connections. More positively, low levels of fixed lines could be seen as an opportunity for new entrants and new forms of broadband delivery which may be deterred in markets where fixed telephony is more dominant. This assumes, of course, that consumers have the disposable income to purchase such services.

[14] Though see section 3.2 regarding more recent trends in mobile telephony.

Map 3.1: Main telephone lines per 100 inhabitants 2003



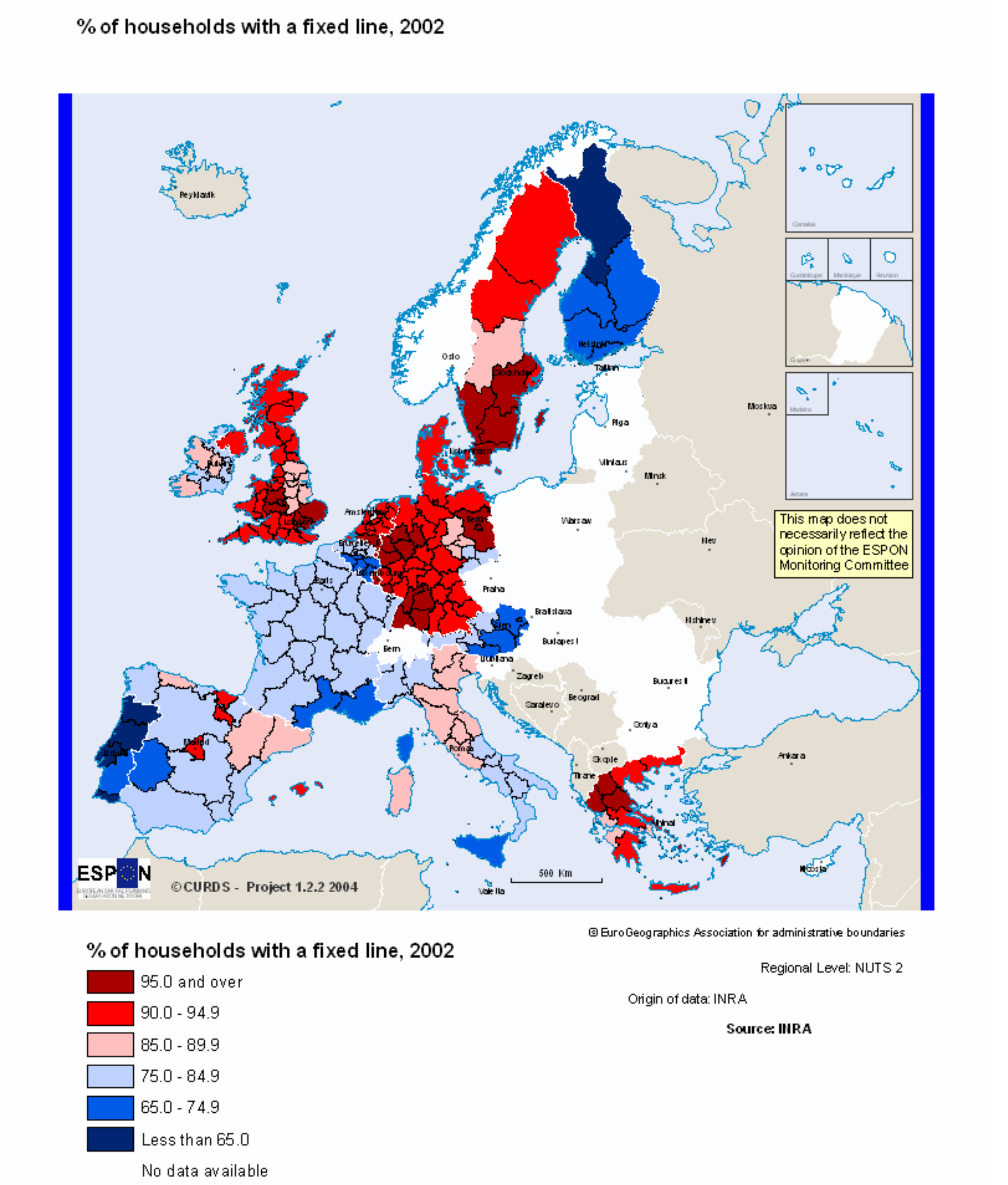
The above discussion focused on variations in the numbers of telephone lines installed, standardised by population. We can also examine the quality of the telephony infrastructure. The most important technological advance in telecommunications networks over the past 20 years has been the digitisation of switching and transmission, which has provided the basis for the wide range of advanced digital services with which we are now familiar. The first stage digitisation process had been completed in most, but not all, of the EU15 by 2001, with Greece, the Netherlands and Spain remaining to be completed[15].

Recent reports suggest that although overall network digitisation in the N12 lags EU15+2, progress has been made over recent years (IBM, 2003; EU Acceding and Candidate Countries/CEC, 2004). All countries bar two have network digitisation rates of over 80 per cent. The only two countries which fall below this level are Romania and Bulgaria. In Cyprus, the Czech Republic, Malta and Slovenia the networks are completely digitised, while Hungary and Lithuania have achieved over 90 per cent digitisation of their networks, with the latter growing from just over 60 per cent in 2 years. The main laggard in network digitisation is Bulgaria with just 22 per cent of the fixed network being digitised by mid 2003 (IBM, 2003). It is likely that Bulgaria will take some time to catch up to average N12 levels, let alone the completed digitisation levels of EU15+2 networks, without considerable investment. Current plans are to have 48% of the network digitised by 2005 (EU Acceding and Candidate Countries/CEC, 2004).

[15] See ESPON 1.2.2 Third Interim Report, section 3.4. Available at http://www.espon.lu

3.1.2 A meso-scale perspective on fixed line penetration levels

Map 3.2: % of households with a fixed line



Map 3.2 shows fixed line telephony uptake for EU15 regions according to the 2002 INRA household survey. The map reveals that there is no simple association between high levels of telephone penetration and levels of development. Thus, although advanced German and Swedish regions have household penetration of fixed line telephony above 95% (led by Västsverige, Sydsverige, Stuttgart, Karlsruhe, Freiburg, Tübingen, Saarland and Småland med öarna), this is also the case for four Greek regions (Dytiki Makedonia, Notio Aigaio, Ipeiros and Thessalia). Indeed, the only EU15 region with 100% household fixed line uptake is the Greek region of Dytiki Makedonia. Other regions with high household fixed line uptake include Luxembourg and six UK regions (East Anglia, Bedfordshire and Hertfordshire, Essex, Herefordshire, Worcestershire and Warks, Shropshire and Staffordshire, and the West Midlands).

By contrast, it is quite difficult to explain why Belgian and Austrian regions (particularly Bruxelles and Wien) have some of the lowest levels (below 70%), well below the EU15 regional average (85%) on this indicator. Beyond the possibility of sampling errors, we can only suggest that people in these regions have replaced their traditional fixed lines with mobile telephones to an appreciable extent.

Other regions with relatively low levels of household fixed line penetration include Portuguese regions (notably the Algarve which is the only EU15 region below 50%), Finnish regions (especially Pohjois-Suomi), Extremadura, the southern French regions of Languedoc-Roussillon, Provence-Alpes-Côte d'Azur and Corse, and Sicilia.

In summary, nearly two thirds of EU15 regions are above the overall average for fixed line penetration, demonstrating that there is a much larger spread in the levels of those regions which are below average.

In order to try and derive a better understanding of the factors which underpin the regional variations in the INRA survey fixed line uptake data, we now disaggregate the data into the socio-economic-geographic categories introduced above. The results suggest that there are weak associations between regional fixed line penetration levels in EU15 and Objective 1 status, GDP per capita and Pentagon location, and that there appears to be no clear association at all with the settlement structure characteristics of regions.[16]

[16] The data at NUTS 2 level for all four of these variables is drawn from the ESPON Database. Objective 1 status and Pentagon/non-Pentagon location are simple binary variables. In order to obtain GDP categories, regions have been sub-divided into six categories according to their GDP level (above 35,000 euros; 26,000-34,999; 21,500-25,999; 17,000-21,499; 12,000-16,999; below 12,000). The six category settlement structure typology of NUTS 2 regions in the ESPON Database (very densely populated with large centres; densely populated with large centres; densely populated with large centres; densely populated without large centres; less densely populated with centres; less densely populated without centres) shows the difficulties in classifying sometimes large regions by population density and 'urban' or 'rural' status on a comparable basis across Europe. Most NUTS 2 regions contain both densely and less densely populated areas, and both urban and rural areas.

Map 3.3: Household fixed line penetration and Objective 1 status

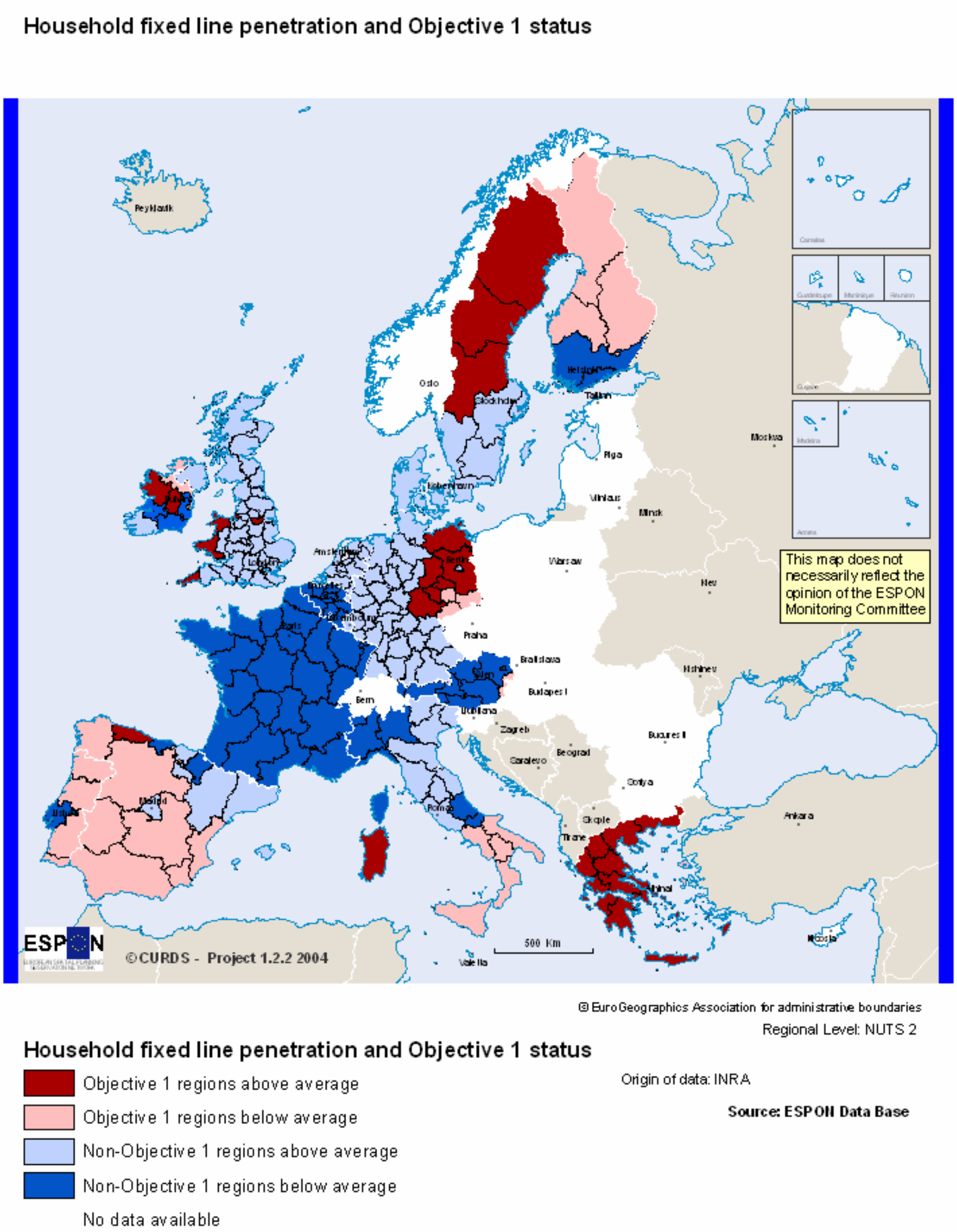
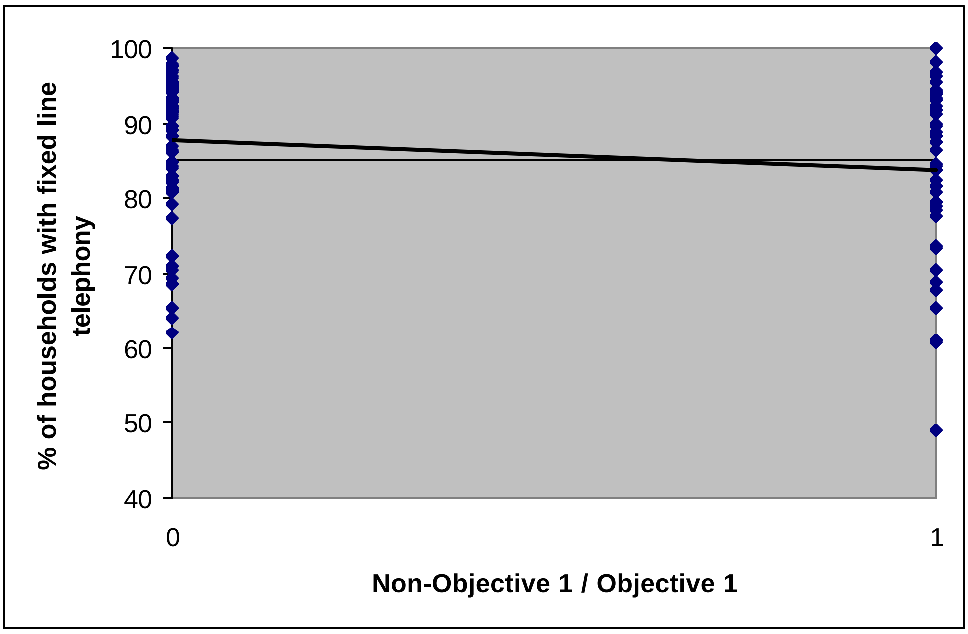


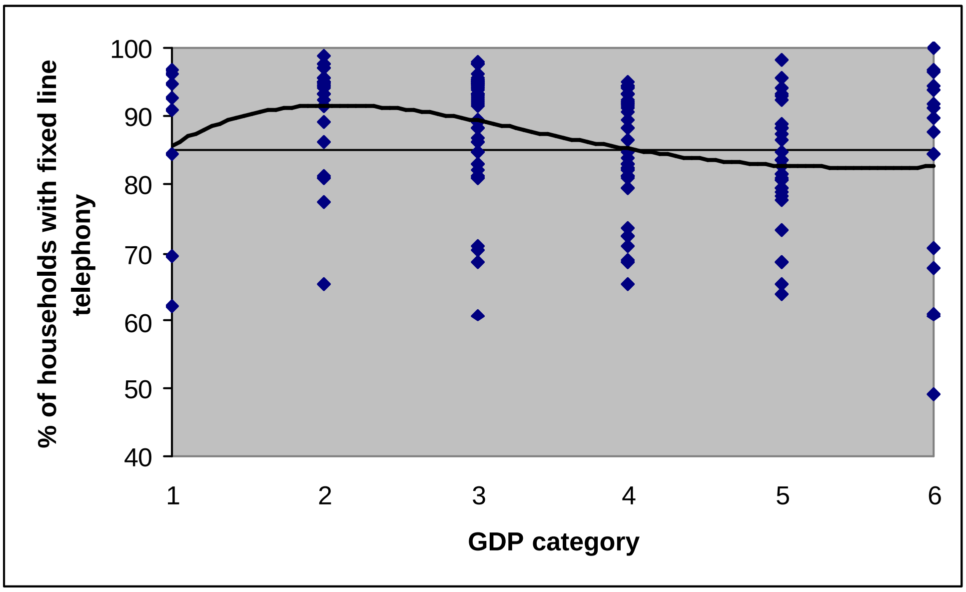
Figure 3.1: The relationship between fixed line uptake and Objective 1 status in EU15 regions (mean = 85.1)



Source: CURDS; based on data drawn from INRA (2004)

Map 3.3 and figure 3.1 shows that there is a distinction between Objective 1 (on the right-hand axis) and non-Objective 1 regions (on the left-hand axis), in terms of fixed line uptake, but that the distinction is not at all strong. The average uptake for Objective 1 regions is 83.8%, while for non-Objective 1 regions it is 87.9%. Around two thirds of non-Objective 1 regions have above the EU average rates of fixed line penetration, with those below being primarily Belgian and Austrian regions with uptake below 70%. *More than half of EU Objective 1 regions have above average fixed line uptake*, including 12 of the 13 Greek regions (Voreio Aigaio is the exception), most German and UK Objective 1 regions, the 3 Swedish Objective 1 regions, Sardegna and Principado de Asturias. The Mediterranean regions of Italy, Spain and Portugal constitute the majority of those Objective 1 regions below the EU average rate of fixed line penetration, together with 3 East German regions and 3 regions of Finland.

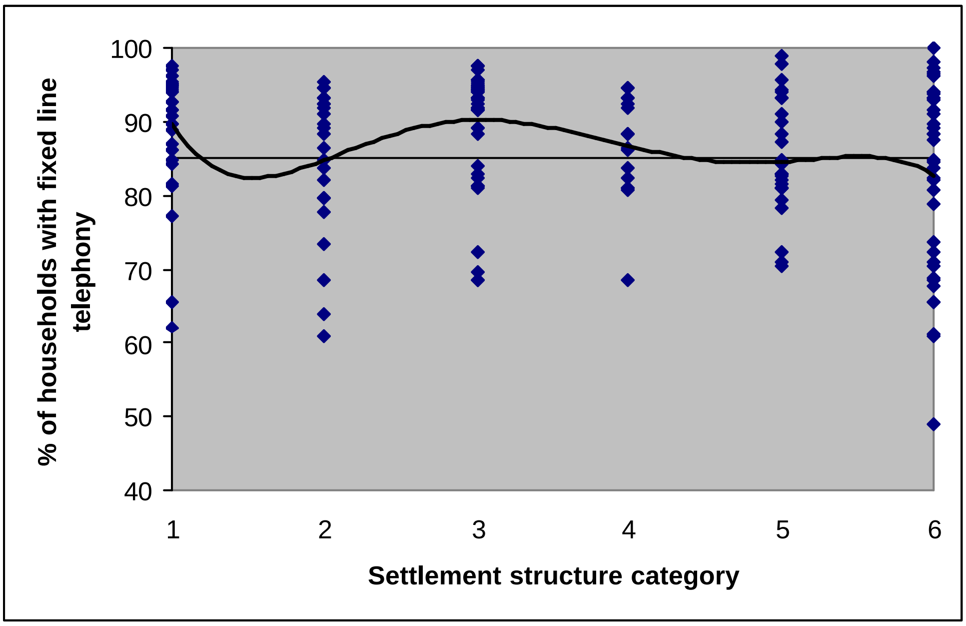
Figure 3.2: The relationship between fixed line uptake and GDP category in EU15 regions (mean = 85.1)



Source: CURDS; based on data drawn from INRA (2004)

When we turn to look at the relationship between fixed line uptake and GDP at NUTS 2 level, figure 3.2 shows that GDP per capita is not a useful predictor of household fixed line penetration, with the relationship being both weak and non-linear. The regions in Europe with the highest GDP levels (i.e. category 1 in the graph) have average fixed line telephony penetration levels only just above the overall European average, due to low penetration in Bruxelles and Uusimaa (Helsinki). The second and third highest GDP categories do have average fixed line penetration levels well above the European average, though with notable exceptions (such as Wien, Kärnten, Etelä-Suomi, Brabant Wallon and Pohjois-Suomi), but the lowest three GDP categories have average penetration levels only marginally below the European average. The lowest category of all (i.e. 6 on the graph) has a very wide range of penetration levels represented, from the highest in Europe (100% in Dytiki Makedonia) to the lowest (less than 50% in Algarve).

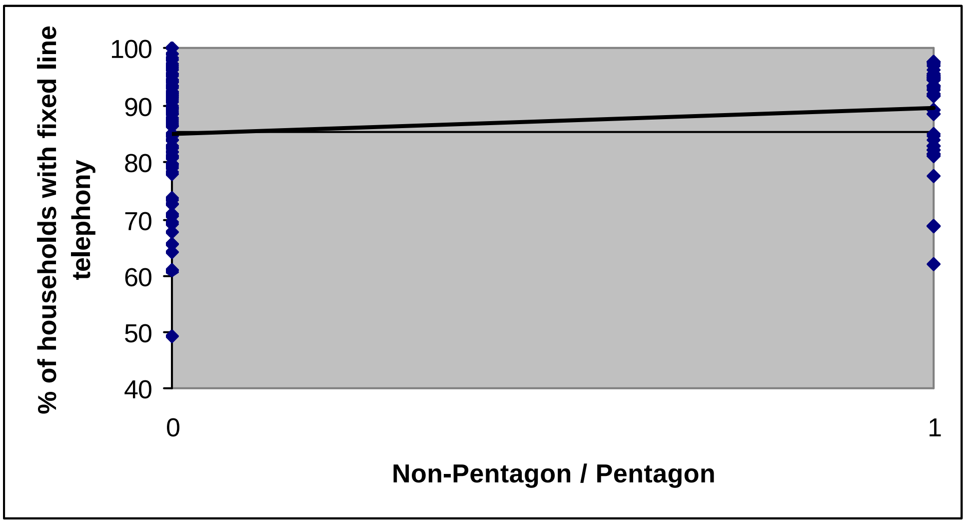
Figure 3.3: The relationship between fixed line uptake and population density/urban status in EU15 regions (mean = 85.1)



Source: CURDS; based on data drawn from INRA (2004)

Figure 3.3 shows that there is no simple or consistent relationship between the type of region in terms of its settlement structure and its fixed line telephony penetration. Although it is true that nearly 80% of the most densely populated regions in EU15 have above average fixed line penetration (indeed, the densely populated regions with large urban centres in Germany and the UK dominate those regions with both high fixed line telephony rates and positions at the top of the European settlement structure), there are also Greek and Swedish regions with high fixed line uptake, but which are less densely populated and without major urban centres. This contributes to the fact that *exactly half the regions in the 'bottom' category of the settlement structure classification (ie less densely populated regions without major urban centres) have above average fixed line penetration*. Conversely, Bruxelles, Wien and Lombardia are densely populated regions with large centres, but have relatively low levels of fixed line uptake. Other Austrian, Portuguese and Finnish regions conform more to expectation as being less densely populated without centres and having relatively low fixed line penetration.

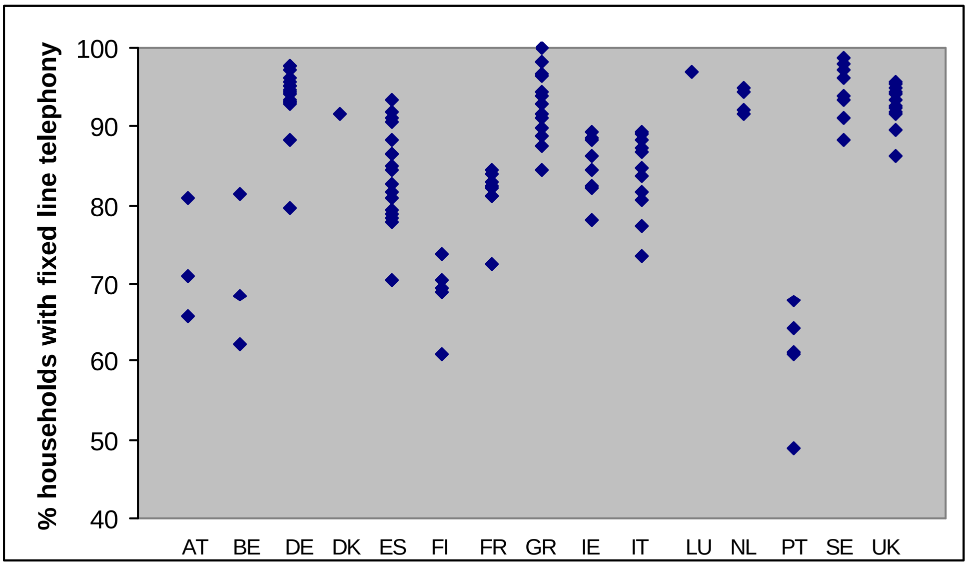
Figure 3.4: The relationship between fixed line uptake and Pentagon location in EU15 regions (mean = 85.1)



Source: CURDS; based on data drawn from INRA (2004)

When we turn to consider the relationship between fixed line telephony and Pentagon location, we see (Figure 3.4) that the broad core-periphery distinction (i.e. regions located inside the Pentagon constituting the core, and regions outside it constituting the periphery) is not a useful predictor of regional levels of fixed line household penetration, though the average for Pentagon regions is slightly higher than for non-Pentagon regions (89.4% and 85.1% respectively). Overall, a higher proportion of the Pentagon regions are above the EU average than is the case for non-Pentagon regions (70% and 55% respectively), but because they are more numerous, there are more non-Pentagon regions with above EU average levels of household fixed line penetration than there are Pentagon regions. The non-Pentagon regions with above average levels are primarily in Greece, Sweden and the UK, with above average Pentagon regions being primarily German, Dutch and the core parts of the UK.

Figure 3.5: The level of 'national effect' in fixed line uptake in EU15 regions



Source: CURDS; based on data drawn from INRA (2004)

If our broad geographic, wealth and settlement structure categorisations are not particularly useful discriminants of regional levels of household fixed line uptake, figure 3.5 reveals, by plotting the regions in their country groupings, the continuing importance of national influences. Countries in which all, or nearly all, of their regions are above the EU average include Germany, Greece, the Netherlands, Sweden and the UK, while countries with all of their regions below the EU average are Austria, Belgium, Finland, France and Portugal. Countries with a mix of regions above and below the EU average are Spain, Ireland and Italy.

The differences between countries, and the extent to which their regions display similar levels of fixed line penetration, is summarised in Table 3.1. The six categories shown are those that are mapped in Map 3.2, and for each country in the analysis (i.e. EU15) it shows the spread of categories its regions are found in. Interesting contrasts are revealed between the Netherlands and Belgium — in which the lowest level of regional penetration in the former country is one clear category above the leading Belgian region — and Spain and Portugal, in which the lowest level of penetration in a Spanish region is above the highest regional penetration in Portugal. Likewise, the lowest level of uptake in a UK region is above the highest regional uptake in France.

Table 3.1: Extent of 'spread' of regional differences in fixed line uptake at the meso national level

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
AT				■	■	
BE				■	■	■
DE	■	■	■	■		
DK*		■				
ES		■	■	■		
FI					■	■
FR				■	■	
GR	■	■	■	■		
IE			■	■		
IT			■	■	■	
LU*	■					
NL	■	■				
PT					■	■
SE	■	■	■			
UK	■	■	■			

* Countries which are NUTS 2 at national level

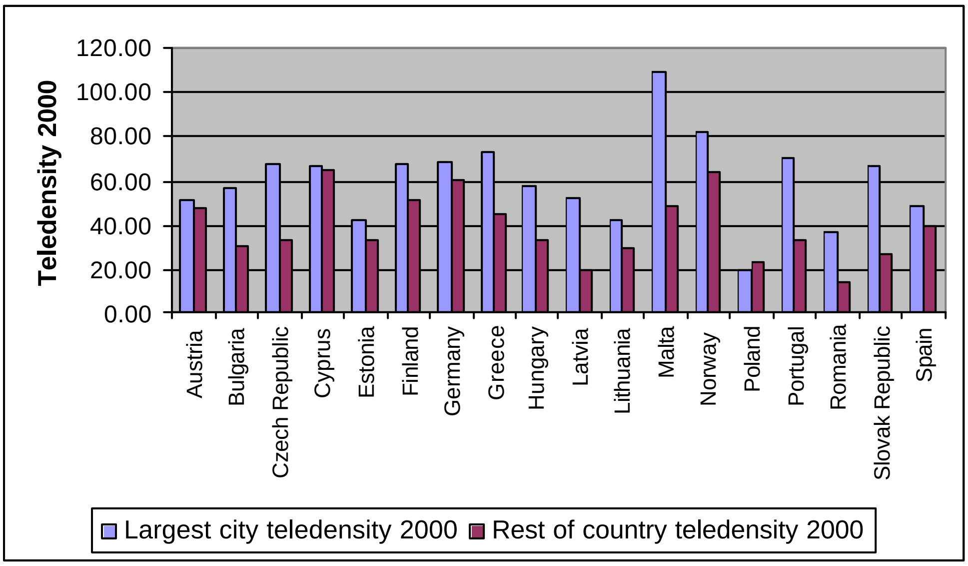
Source: CURDS; based on data drawn from INRA (2004)

In summary, therefore, our attempts to relate regional variations in fixed line penetration at the household level to broad location (core-periphery), to wealth (GDP), to developmental status (Objective 1), or to the density and urban status of regions have not proven particularly successful. Rather, it seems that *national* differences (reflecting varying policy and cultural contexts) are the main determinants of variations in *regional* penetration levels across the European space.

3.1.3 A micro-scale perspective on fixed line telephony

At the micro, or locality scale, there are some differences within countries in respect of the penetration of fixed line telephony. One clear pattern is the difference between the largest cities and the rest of the country in the case of the number of fixed lines installed. Figure 3.6 shows levels of 'teledensity' of the largest cities in a number of European countries compared with the rest of the country. In each of the countries shown, with the exception of Poland, the largest city has a higher teledensity than the rest of the country. In some countries – notably Slovakia, Romania, Portugal, Malta and Latvia – the differential is substantial, with the largest city having a teledensity more than twice that of the rest of the country. The significant systematic differences between the largest cities and the rest of their countries will to a large extent reflect the higher concentration of businesses and large institutions, which tend to require large numbers of telephone lines, in the largest cities.

Figure 3.6: Comparison of 'teledensity' between the largest cities and the rest of the country in European countries



(Data not available for other countries)

Source: ITU (2001), charted by CURDS

Other indicators of how advanced places are in terms of telecommunications are the digitisation of exchanges and the proportion of lines which are digitised as a proportion of all lines. We have only limited information on the territorial spread of digital exchanges within those countries where not all exchanges are digitised. We do know from experience in EU15 that exchanges tended to be digitised first in urban areas and that those in rural areas were often only digitised several years later. Research in the UK in the mid-1990s, for example, showed that digitisation of exchanges in rural areas was not a priority for the incumbent telecommunications companies as there tended to be no alternative suppliers in these areas (Richardson and Gillespie, 1996). The limited evidence we do have for N12 countries suggests a similar pattern. For example, we showed in our TIR[17] that ISDN lines were more widely available in urban areas than in rural areas of Hungary. A recent report suggests that Bulgaria, which is the least developed of the N12 countries in terms of digitisation, demonstrates similar patterns (EU Acceding and Candidate Countries/CEC, 2004). Attempts are being made to accelerate the network digitising process by laying digital trunks operating over fibre optics. This has resulted in some metropolitan centres and larger towns becoming 100 per cent digital. Many rural exchanges, however, still rely on analogue exchanges (EU Acceding and Candidate Countries/CEC, 2004).

Although the teledensity data in Figure 3.6 above suggested that the largest cities have a disproportionately high share of installed telephone lines, even in the more developed countries (such as Germany, Norway and Finland), in the EU15 there is no evidence for any such systematic variations in terms of *household* level adoption of fixed line telephony. Data presented in the INRA report measuring fixed telephony household penetration (INRA, 2004), for example, distinguishes between metropolitan, urban and rural locality types[18]. For the EU15 as a whole there is no difference at all in penetration rates across these locality types, being 85% in each case. If we look at the situation in individual countries there are differences across these locality types, but, in some countries (including Greece, France, the Netherlands and Austria), the highest penetration rates are in rural areas, whereas in others, the highest are in metro or urban areas (see table 3.2). In conjunction with our analysis of the INRA data accompanying figure 3.3, above, which used a more harmonised density and settlement structure categorisation of NUTS 2 regions, we can conclude that there is no simple or consistent relationship, at least for the EU15, between urban status and levels of fixed line telephony penetration.

[17] See Section 3.4 of our Espon Project 1.2.2 Third Interim Report (available at http://www.espon.lu).
[18] The definition of Metro-urban-rural in the INRA report is not standardised across the European territory and differs between Member States. From an ESPON perspective, therefore, the findings must be seen as indicative and treated with caution. For details see Annex II of INRA report (INRA, 2004).

Table 3.2: Proportion of fixed line household penetration by locality type (figures in brackets express the data as an index of the national figure)

% of households	TOTAL	TYPE OF LOCALITY		
		Metro	Urban	Rural
EU 15	**85 (*100*)**	**85 (*100*)**	**85 (*100*)**	**85 (*100*)**
Belgium	76 (*100*)	72 (*95*)	79 (*104*)	76 (*100*)
Danmark	92 (*100*)	96 (*104*)	87 (*95*)	91 (*99*)
Deutschland	94 (*100*)	96 (*102*)	92 (*98*)	95 (*101*)
Ellada	91 (*100*)	89 (*98*)	91 (*100*)	94 (*103*)
Espana	84 (*100*)	89 (*106*)	84 (*100*)	83 (*99*)
France	82 (*100*)	82 (*100*)	78 (*95*)	86 (*105*)
Ireland	86 (*100*)	88 (*102*)	84 (*98*)	86 (*100*)
Italia	84 (*100*)	86 (*102*)	83 (*99*)	84 (*100*)
Luxembourg	97 (*100*)	97 (*100*)	94 (*97*)	98 (*101*)
Nederland	93 (*100*)	88 (*95*)	94 (*101*)	95 (*102*)
Osterreich	71 (*100*)	61 (*86*)	68 (*96*)	77 (*108*)
Portugal	62 (*100*)	62 (*100*)	62 (*100*)	62 (*100*)
Finland	69 (*100*)	76 (*110*)	65 (*94*)	71 (*103*)
Sverige	95 (*100*)	94 (*99*)	95 (*100*)	95 (*100*)
United Kingdom	93 (*100*)	92 (*99*)	93 (*100*)	93 (*100*)

Source: CURDS; elaborated from INRA (2004)

We have little data on the situation regarding disparities by locality type in N12 countries in respect of fixed telephony penetration, but the eEurope+ 2003 Progress Report does provide data for Estonia and Lithuania which suggests significant metro-urban-rural disparities. Whereas 79 per cent of metropolitan households have a fixed line telephone, only 48 per cent of urban households and only 30 per cent of rural households do (EU Acceding and Candidate Countries/CEC, 2004)[19].

[19] These figures are calculated from data which appears on page 11 of the eEurope+ Report in the graph "Digital Divide: An example for Estonia and Lithuania % of Households with/without fixed line telephones". The report does not provide figures for Estonia and Lithuania separately. Nor does it provide figures for any form of intra-country differentiation for other N12 countries. The data is based on a Telecommunications Operator Survey. It comments that "Quantifying the telecommunications divide, as far as fixed line telephony is concerned, requires that telecommunications operators are able to identify how many residential customers they have in metropolitan, urban and rural areas and that the number of households in each of these areas are clearly identifiable. This data, regrettably, has not always been

3.1.4 Summary of the territorialities of fixed line telephony

In summary, the main findings with respect to the territorialities of fixed lines are as follows:

- at the macro-scale, the main distinction is between the EU15+2 countries, in which high levels of installed lines have been achieved, with switching and transmission almost entirely digitised, and the N12 countries, in which lower levels of installed lines, and lower levels of network digitisation, have been achieved. Although the digitisation of networks in the N12 countries is rapidly progressing (except in Bulgaria and Romania), it is evident that the installation of fixed lines in the N12 is likely to plateau at lower levels than in the EU15+2. Although this may well reflect the importance of mobile telephony in providing a substitute for fixed line telephony (in some of the more telecoms advanced countries, such as Finland, the number of fixed lines is falling), there remain some issues over whether the slowing of the rate of installing fixed lines in the N12 countries could inhibit their deployment of DSL technology and, hence, their adoption of broadband services for households and small businesses.
- at the meso-scale, regional variations in the penetration of fixed line telephony at the household level seems to be only in small part attributable to core-periphery location (Pentagon/non-Pentagon) within the European space, or to developmental status (Objective 1 versus non-Objective 1), or to GDP variations, or to the density/urban status of regions. The main discriminant appears to be *national*, with most or all of the regions within Germany, Greece, the Netherlands, Sweden and the UK having relatively *high* levels of fixed line penetration, and most or all of the regions in Austria, Belgium, Finland, France and Portugal having relatively *low* levels of fixed line penetration.
- at the micro-scale, for the EU15 at least there is no clear or consistent relationship between the metropolitan-urban-rural characteristics of localities and

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possible to attain in all countries". An alternative approach, of course, would be to extend the INRA survey to N12 countries.

levels of fixed line penetration. For this 'mature' technology, there is no evidence at all that households in rural areas lag behind the adoption levels of their metropolitan or urban counterparts. The greater incidence of installed lines in urban areas will reflect rather their concentrations of business and institutional users of telecommunications services. The limited available evidence does, however, suggest that in the N12 countries, substantial urban-rural variations in levels of household fixed telephony penetration may well persist.

3.2 Territorialities of mobile telephony

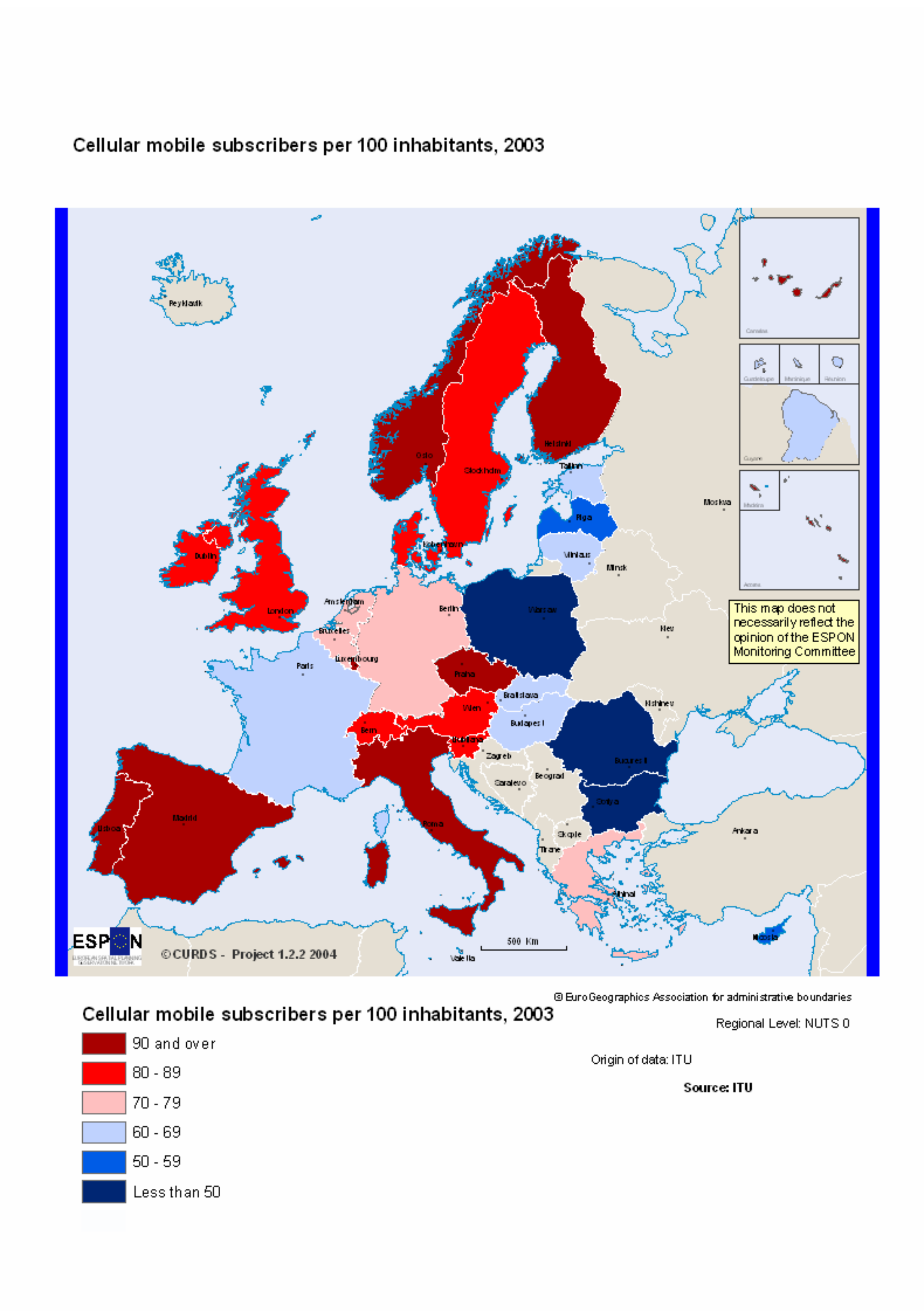
3.2.1 A macro-scale perspective on mobile telephony

The growth of mobile telephony has been one of the most notable developments in ICT technology over the past 15 or so years. As with the other technologies discussed in this report, there are significant disparities in the levels of penetration of mobile technologies across Europe (Map 3.4), but the pattern of these disparities in the case of mobile telephony displays some distinctive features. If we look first at EU15 plus Norway and Switzerland, we can see that by the year 2003 mobile telephony markets were rather mature, with all countries except France having over 75 subscribers per 100 inhabitants. Six countries had penetration rates of over 90 per cent. Interestingly, all but one of those countries (Luxembourg) are located in the 'periphery'. As is the case with nearly all technologies discussed in this report, this is partly explained by the strength of the Nordic countries: Norway and Finland both have penetration rates above 90 per cent (Sweden falls just below). Interestingly, however, three southern European countries – Italy, Spain and Portugal – had penetration levels at least on a par with the Nordic countries, with Italy, with 102 subscribers per 100 inhabitants, exhibiting a significantly higher rate. By contrast, four out of the five countries which fall below the 80 per cent penetration rate – Belgium, France, Germany[20] and the Netherlands – are traditionally thought of as being in the 'core' of Europe (Greece being the other). Patterns of mobile telephony penetration clearly, then, do not reflect traditional core-

[20] Germany's 'lagging' position is mainly a result of low penetration in the eastern Länder (see section 3.2.2 below).

periphery conventions and the strength of the periphery, apparent in relation to other ICTs in respect only of the northern periphery, stretches to the southern periphery.

Map 3.4: Cellular mobile subscribers per 100 inhabitants 2003



When we turn to consider the relative positions of EU15+2 and the N12 countries, we see that overall penetration rates are higher in the former (Map 3.4). There are exceptions, however, with the Czech Republic (category 1) and Slovenia (category 2) having penetration rates on a par with the more advanced EU15+2 countries. By contrast Bulgaria and Romania have penetration rates of around only a third of the EU15+2 level. General growth rates have been more rapid in the N12 in recent years[21] (IBM 2003), suggesting some level of catch up. One recent report suggests that further growth can be expected in the N12 countries with lower levels of penetration, although it also suggests that growth in the more advanced N12 countries will be limited (IBM, 2003).

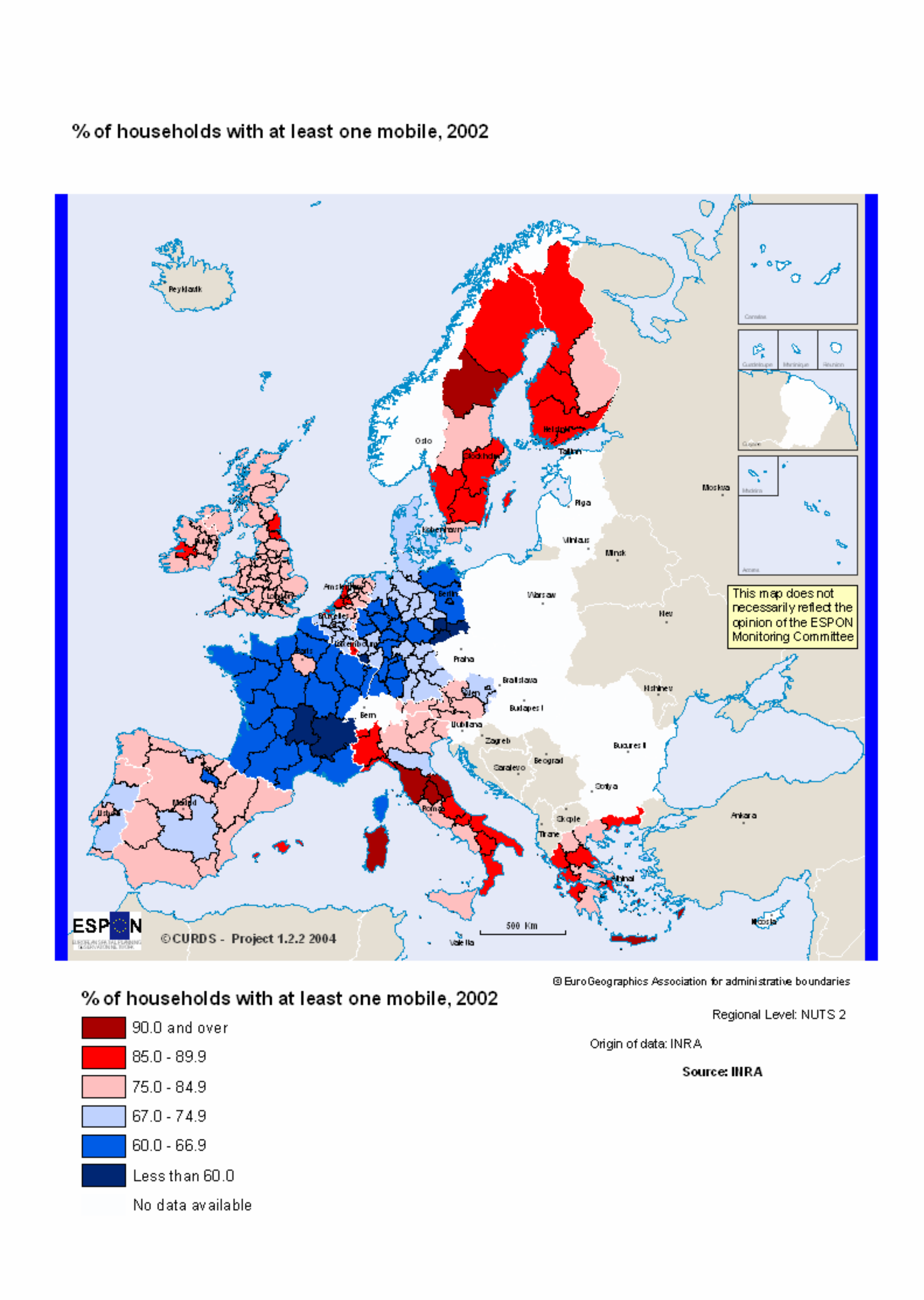
We can conclude from this discussion that mobile is a technology which is (a) widely diffused in a very short space of time; (b) is not confined to the more 'prosperous' countries; and (c) is facilitating a 'catch up' process in those countries which have lagged in the provision and adoption of previous telecommunications services.

To date, mobile has mainly been used for voice and, increasingly, text messaging. With the advent of third generation (3G) UMTS mobile technologies, the use of mobile for data transfer and for multimedia applications, including higher-speed access to the Internet, will increase[22]. If 3G roll-out patterns are similar to those of second generation mobile, then 3G could provide a widespread platform for broadband access. As is discussed in the broadband section of this chapter, however, this cannot be taken for granted.

[21] See section 3.5 in our TIR.
[22] Transmission speeds are expected to range from 384 kbit/s to 2 mbit/s.

3.2.2 A meso-scale perspective on mobile telephony penetration

Map 3.5: % of households with at least one mobile 2002



Map 3.5 shows mobile telephony uptake for EU15 regions according to the 2002 INRA household survey. We can suggest that some evidence of mobile telephony bypassing fixed lines is provided by the number of Italian and Finnish regions near the top of the classification. There is an increasing culture in these regions of mobile replacing the need to have a fixed telephone line. Swedish, UK and Dutch regions are also prevalent for above average household mobile penetration. In the case of the UK, it is notable that two regions of North East England (which are amongst the most socially disadvantaged regions in the UK) have the highest national uptake.

At the other end of the scale, the relative reluctance of the German and French populations to fully embrace mobile telephony is shown by the prevalence of their regions at the bottom of the classification. Forty five of the fifty EU15 NUTS 2 regions with the lowest levels of mobile uptake are French or German. Indeed, Ile de France is the only French or German region which has above EU average mobile uptake.

In summary, nearly 55% of EU15 regions are above the overall average (77%) for household mobile penetration, showing that there is a relatively even spread of regions both above and below average.

When we disaggregate these regional uptake figures into our socio-economic-geographic categories, we can suggest that there exists little or no relationship between household mobile penetration levels and any of the four socio-economic-geographic categorisations.[23] *What trends do exist suggest a reversed relationship from that predicted, with many of the most advanced regions for mobile uptake actually being Objective 1, poorer, rural with low population density and/or peripherally located within Europe.* Thus, mobile uptake does not appear to follow the same socio-economic-geographic patterns as other telecommunications technologies (particularly the Internet-related technologies we consider below), with rural and especially peripheral regions sometimes having comparable, or even greater, levels of demand than core-located and urban regions.

[23] See footnote 16 for details of the origin of these variables.

Map 3.6: Household mobile penetration and Objective 1 status

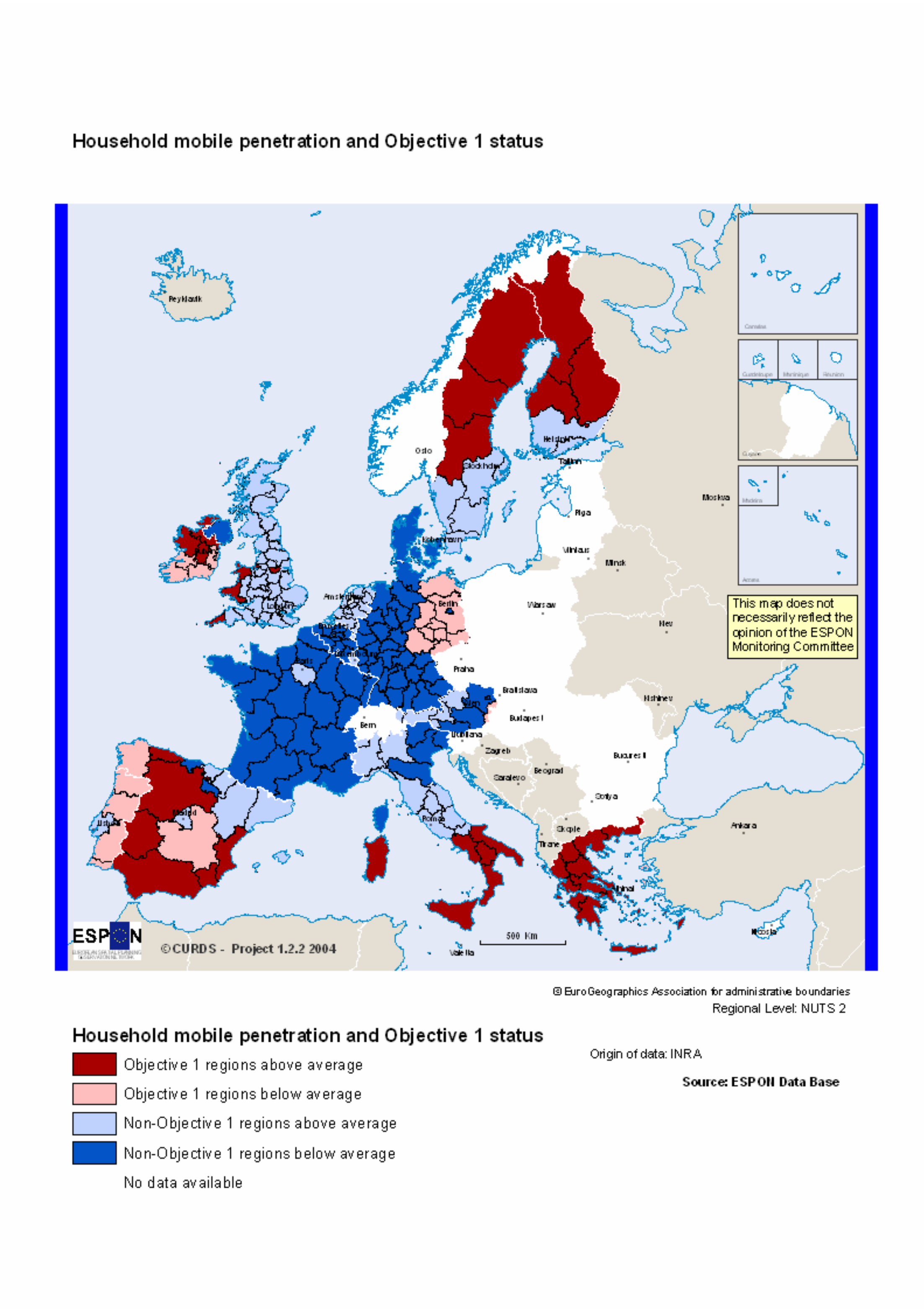
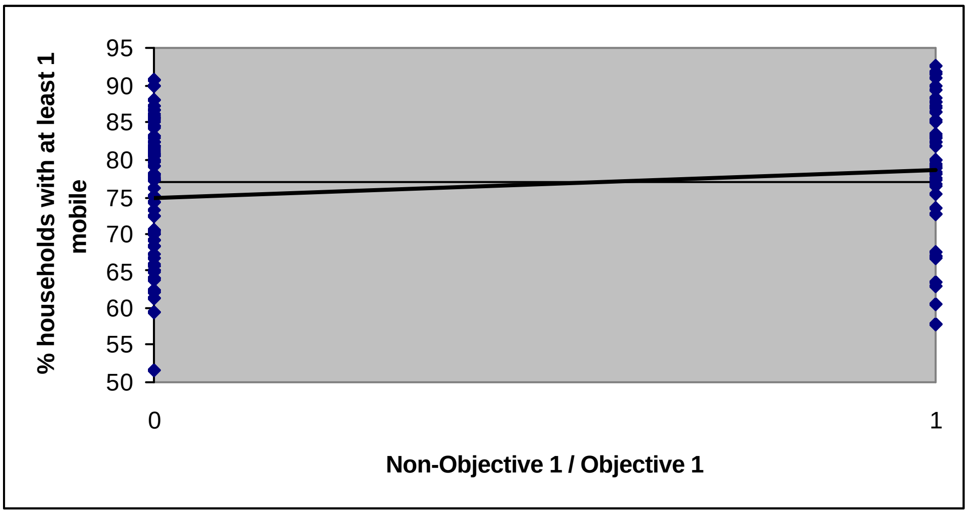


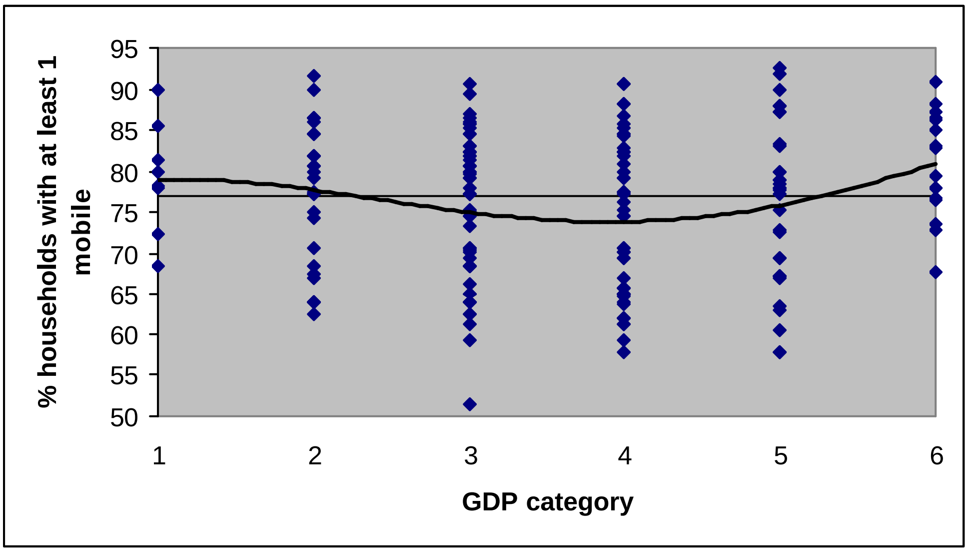
Figure 3.7: The relationship between mobile uptake and Objective 1 status in EU15 regions (mean = 77)



Source: CURDS; based on data drawn from INRA (2004)

As Map 3.6 and Figure 3.7 show, the average household mobile telephony up-take for Objective 1 regions is actually higher than for non-Objective 1 regions (means of 78.6% and 75.0% respectively). *The four regions in EU15 with the highest mobile penetration are all Objective 1 regions*: Notio Aigaio, Sardegna, Mellersta Norrland and Kriti. The non-Objective 1 regions with the highest mobile uptake are led by the Italian regions of Toscana, Umbria and Marche. Similarly, the bottom 10% of regions on mobile uptake are dominated by non-Objective 1 German and French regions with penetration rates around only the 60% mark. The lowest Objective 1 regions are also German, particularly former east German länder.

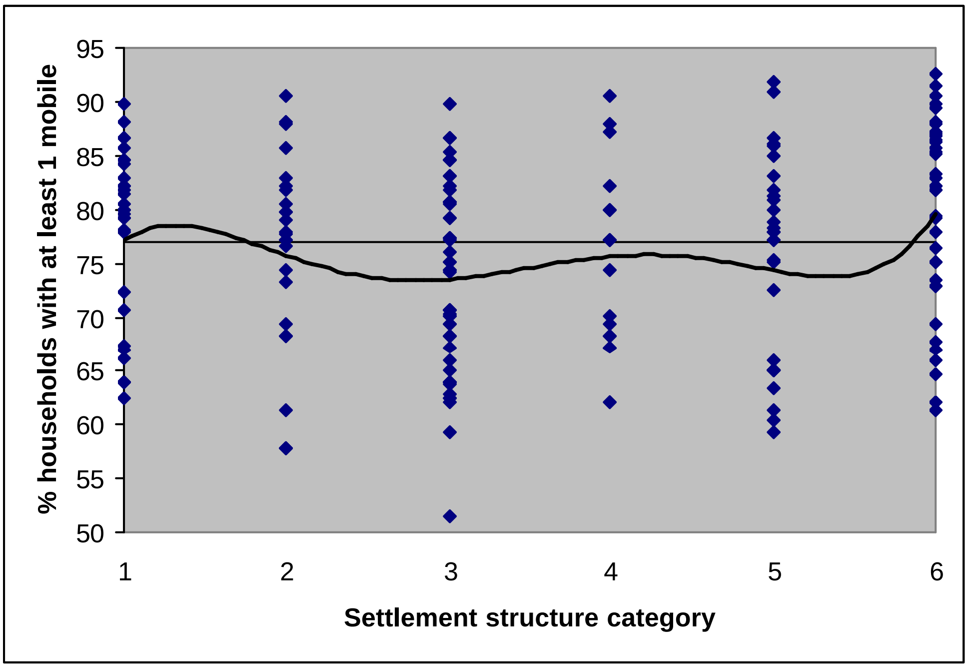
Figure 3.8: The relationship between mobile uptake and GDP category in EU15 regions (mean = 77)



Source: CURDS; based on data drawn from INRA (2004)

Figure 3.8 shows that *many of the regions with the highest mobile uptake are regions which have relatively low GDP levels*. The presence of numerous Greek and southern Italian regions here demonstrates this. The lowest GDP per capita category (i.e. category 6) has a higher average uptake (80.8%) than any of the other GDP categories. Only 1 of the top 30 regions for mobile penetration (Uusimaa in Finland) is also classed in the top GDP category. Similarly, none of the bottom 30 regions for mobile penetration is classed in the bottom category for GDP. Most of the regions with the lowest mobile uptake have moderate GDP levels (with the exception of the poorest German länder).

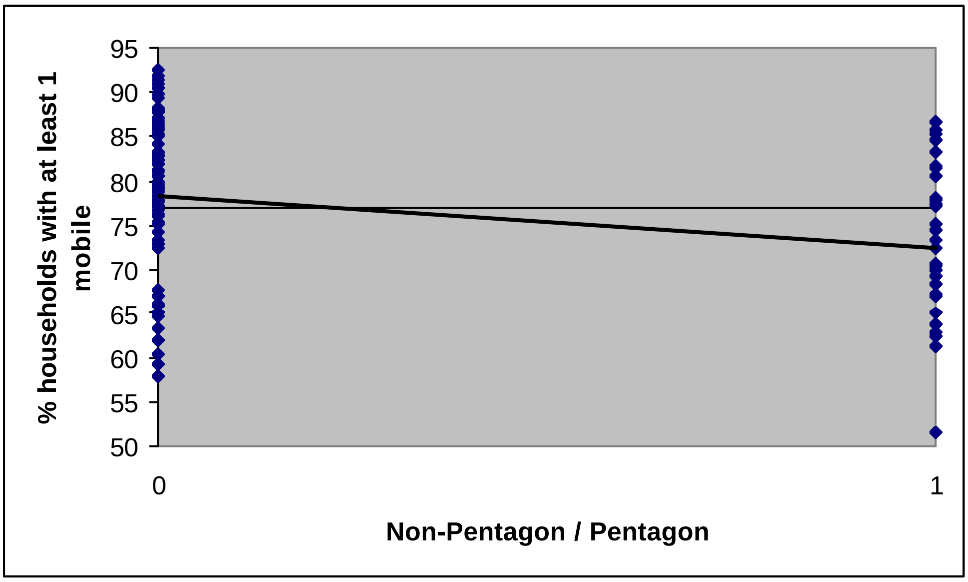
Figure 3.9: The relationship between mobile uptake and population density/urban status in EU15 regions (mean = 77)



Source: CURDS; based on data drawn from INRA (2004)

The distinctively different nature of mobile telephony uptake is further suggested in Figure 3.9, which shows that *eight of the top 12 mobile uptake regions in EU15 are also among the least densely populated regions* (bottom two categories of the settlement structure typology), including Greek and Swedish regions, plus Sardegna and Umbria. Only Attiki and Toscana have both high mobile penetration levels and are more densely populated with large centres. Many of the German regions with the lowest mobile uptake are actually relatively densely populated regions with large centres (Chemnitz, Dresden, Leipzig). There are relatively few less densely populated regions among those with low mobile uptake (rural French regions such as Auvergne, Franche-Comté and Poitou-Charentes are exceptions).

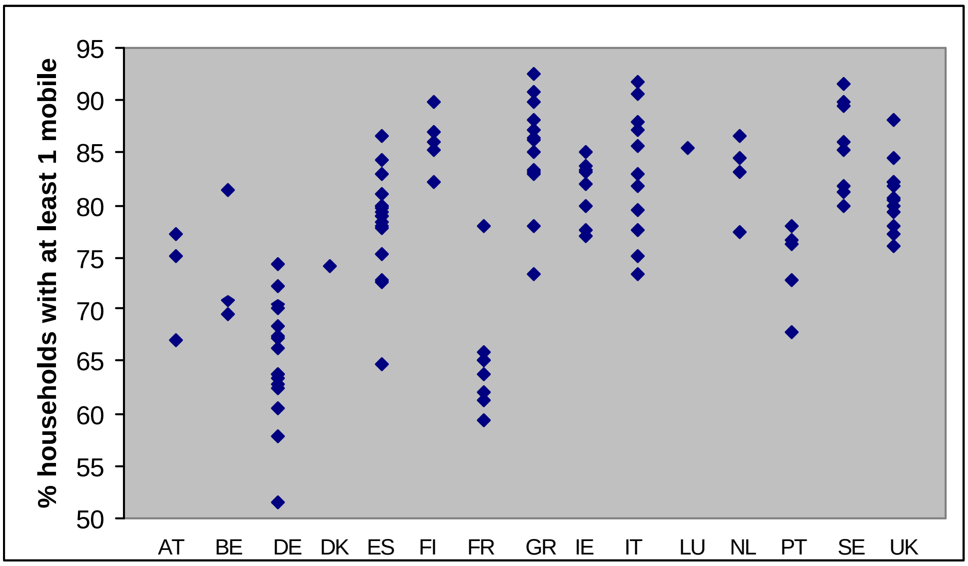
Figure 3.10: The relationship between mobile uptake and Pentagon location in EU15 regions (mean = 77)



Source: CURDS; based on data drawn from INRA (2004)

Regions located in Europe's 'core' — the Pentagon — have average levels of mobile penetration which are appreciably *lower* than peripherally-located regions (means of 72.5% and 78.3% respectively). *Strikingly, the top 20 regions for mobile uptake are all outside the EU Pentagon*. Regions from both the southern periphery (Greek) and northern periphery (Swedish) are represented. It is Dutch and UK regions (with Piemonte and Luxembourg) which class highest among Pentagon regions. Many of the German and French regions at the bottom of the mobile uptake table are located within the Pentagon (Saarland, for example, has a mobile penetration rate barely above 50%). It is other less central German and French regions which are also lowest among non-Pentagon regions for mobile uptake, again demonstrating the highly national specificities on this telecoms indicator (the German and French populations as a whole have been much slower to adopt mobile telephony than the Greeks or Italians).

Figure 3.11: The level of 'national effect' in mobile uptake in EU15 regions



Source: CURDS; based on data drawn from INRA (2004)

This latter point is emphasised in Figure 3.11, which presents the regional mobile telephony data from a national perspective by plotting the regions in their country groupings. This clearly illustrates the continuing national influence on telecommunications territoriality, as regional uptake of different technologies still frequently takes on a 'national shape' and reflects national policy and cultural contexts. Thus all of the German and French (with the exception of Ile de France), regions are below the EU average and these two countries together account for 45 of the lowest 50 regions in terms of household mobile penetration. At the other extreme, as we have seen, many of the highest levels of mobile penetration in Europe are found in Greece and Italy, most of whose regions (but not all) lie above the EU average. Finnish and Swedish regions also cluster at or near the top of the rankings (indeed, all of their regions are above the EU average). These variations seem to be best understood by differences in 'national mobile telephony cultures' in the absence of more usual explanatory variables such as wealth, centrality or urban status. In this spirit, we can identify two 'cultures' which seem positively associated with mobile uptake, a 'Nordic' one and a 'Mediterranean' one. The Franco-German heart of Europe, however, seems to share a culture in which household mobile telephony penetration levels are noticeably low.

Certainly we must conclude that regional variations in mobile telephony penetration in EU15 are particularly distinctive. As the summary table 3.3 emphasises, it is highly unusual to see the highest values for a variable (whether a telecoms variable or not) being found in Greece, Italy and Sweden, and the lowest values being found in France and Germany.

Table 3.3: Extent of 'spread' of regional differences in mobile uptake at the meso national level

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
AT			■	■		
BE			■	■		
DE				■	■	■
DK*				■		
ES		■	■	■	■	
FI		■	■			
FR			■	■	■	■
GR	■	■	■	■		
IE		■	■			
IT	■	■	■	■		
LU*		■				
NL		■	■			
PT			■	■		
SE	■	■	■			
UK		■	■			

* Countries which are NUTS 2 at national level

Source: CURDS; based on data drawn from INRA (2004)

3.2.3 A micro-scale perspective on mobile telephony

When we examine, at a micro-scale, the territoriality of mobile network *coverage* (i.e., availability) across Europe, the situation is largely positive, reflecting the rapidity with which mobile networks have been rolled out across national territories. In all countries which we are considering in this report, most of the territory is covered, with the exceptions being very remote and mountainous areas and some border areas[24].

[24] Maps for individual countries and operators can be found at: http://www.cellular-news.com/coverage

When we consider *uptake* of mobile telephony, as opposed to network coverage, the general picture for EU15 is one of limited disparities between types of localities. As table 3.4, based on INRA data, suggests, the proportion of households with at least one mobile subscription for EU15 stands at 77 per cent, with the proportions for metropolitan, urban and rural areas respectively being 78, 78 and 76 (INRA, 2004). In some countries, however, significant disparities between metro and rural localities are apparent. For example, in France there is a twelve percentage point gap between metro (69 per cent) and rural localities (57 per cent), and in Greece and Finland there are seven percentage point gaps between metro and rural localities. By contrast, in Germany, Sweden and the United Kingdom, rural localities outperform metro localities, albeit by smaller margins[25]. Italy displays a different pattern again, with urban localities having higher levels of household mobile penetration than either metropolitan or rural localities.

[25] One difficulty we have in interpreting the data is that the INRA report does not use a common definition of Metropolitan, Urban and Rural across EU15. So, for example, at one extreme, a rural locality in Ireland is defined as having less than 1,500 people, whereas, at the other extreme, a rural locality in Spain is defined as having a population of less than 100,000.

Table 3.4: Proportion of mobile telephony household penetration by locality type (figures in brackets express the data as an index of the national figure)

% of households with at least one mobile subscription	TOTAL	TYPE OF LOCALITY		
		Metro	Urban	Rural
EU 15	**77 (*100*)**	**78 (*101*)**	**78 (*101*)**	**76 (*99*)**
Belgium	71 (*100*)	76 (*107*)	67 (*94*)	71 (*100*)
Danmark	74 (*100*)	77 (*104*)	74 (*100*)	71 (*96*)
Deutschland	66 (*100*)	65 (*98*)	66 (*100*)	66 (*100*)
Ellada	87 (*100*)	90 (*103*)	88 (*101*)	83 (*95*)
Espana	79 (*100*)	82 (*104*)	82 (*104*)	77 (*97*)
France	66 (*100*)	69 (*105*)	69 (*105*)	57 (*86*)
Ireland	82 (*100*)	87 (*106*)	80 (*98*)	81 (*99*)
Italia	83 (*100*)	80 (*96*)	87 (*105*)	81 (*98*)
Luxembourg	85 (*100*)	90 (*106*)	84 (*99*)	84 (*99*)
Nederland	85 (*100*)	89 (*105*)	82 (*96*)	85 (*100*)
Osterreich	72 (*100*)	73 (*101*)	74 (*103*)	71 (*99*)
Portugal	76 (*100*)	80 (*105*)	79 (*104*)	74 (*97*)
Finland	86 (*100*)	91 (*106*)	87 (*101*)	84 (*98*)
Sverige	84 (*100*)	83 (*99*)	84 (*100*)	85 (*101*)
United Kingdom	81 (*100*)	78 (*96*)	82 (*101*)	81 (*100*)

Source: CURDS; elaborated from INRA (2004)

3.2.4 Summary of the territorialities of mobile telephony

In summary, the main findings with respect to the territorialities of mobile telephony are as follows:

- at the <u>macro-scale,</u> the territoriality of mobile telephony is highly distinctive, with the *Nordic periphery* (Norway, Finland and Sweden) and the *Southern periphery* (Italy, Greece, Spain and Portugal) displaying higher levels of household uptake than the European 'core'. The N12 countries (with the exception of the Czech Republic and Slovenia) have lower levels of uptake than the EU15, though their growth rates have been more rapid in recent years, suggesting a degree of 'catching up'.

- at the <u>meso-scale</u>, the distinctiveness of mobile telephony is again markedly apparent, with many of the most advanced regions for mobile uptake being Objective 1, poorer in GDP per capita terms, of low population density, and peripherally located with respect to the European core. Conversely, all German and French regions (with the exception of Ile de France) are below the EU15 average, and these two countries together account for 45 of the lowest 50 regions in terms of household mobile penetration.
- at the <u>micro-scale</u>, mobile networks have been widely deployed in Europe, with only particularly remote or mountainous areas, and some border areas, not being covered by the networks. Household penetration (i.e. uptake) levels within the EU15 reveal no clear distinction between metropolitan, urban and rural locations; the largest differential is in France (a 12% gap between metropolitan and rural localities, in favour of the former), though Greece and Finland also display higher metropolitan than rural penetration rates for mobile telephony. In some other countries (Germany, Sweden and the UK), rural localities have higher penetration rates than metropolitan localities, albeit by small margins.

3.3 Territorialities of PC penetration

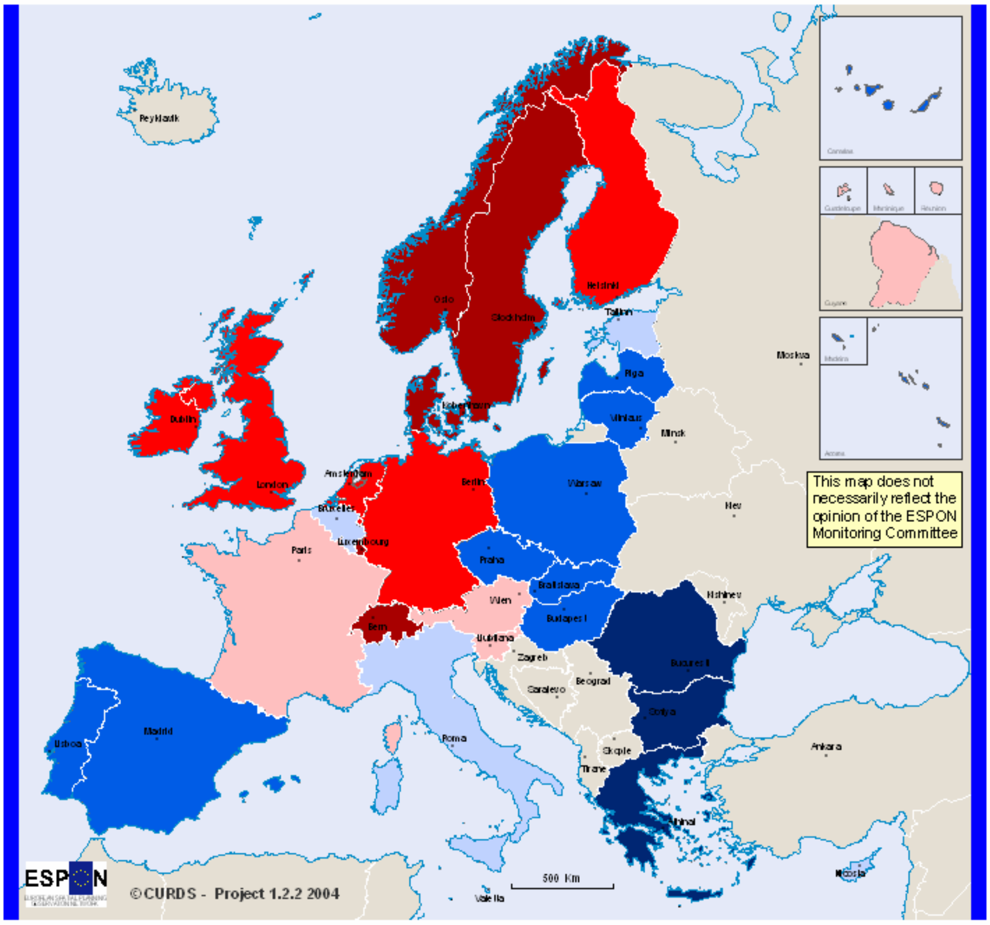
3.3.1 A macro-scale perspective on PC penetration

When we turn away from mobile telephony to a computing-based user environment the more conventional territorial differentiation between countries within the European territory re-asserts itself. There are several devices through which the Internet can be accessed. These include mobile phones or digital television, but the most widespread device for accessing the Internet at present is the personal computer (PC).

The estimated number of PCs per inhabitant when measured at national level (Map 3.7), divides Europe into two territorial blocks. In broad terms, above average levels of per capita PC adoption are found in northern and north-western Europe, with the Nordic countries, plus Luxembourg and Switzerland, leading the way, while below average levels are found in southern and eastern Europe. The exception to this pattern is Belgium (only category 4). All the southern countries and, with the exception of Slovenia, all N12 countries, fall into the bottom three categories. The lowest levels of PC adoption are found in Greece, Bulgaria and Romania.

Map 3.7: Estimated PCs per 100 inhabitants 2003

Estimated PCs per 100 inhabitants, 2003



© EuroGeographics Association for administrative boundaries

Regional Level: NUTS 0

Origin of data: ITU

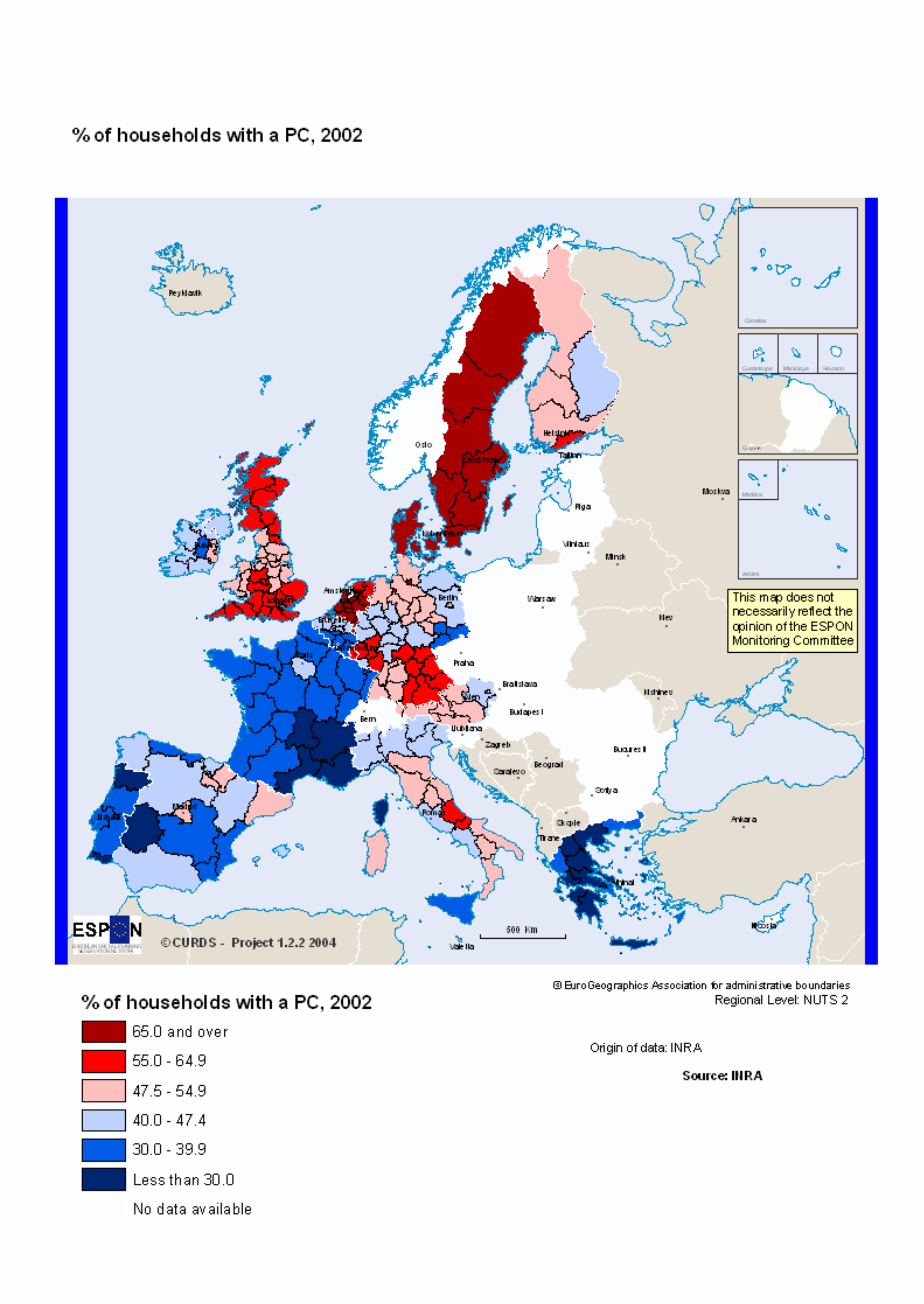
Source: ITU

Estimated PCs per 100 inhabitants, 2003

- 50 and over
- 40 - 49
- 30 - 39
- 20 - 29
- 10 - 19
- Less than 10

3.3.2 *A meso-scale perspective on PC penetration*

Map 3.8: % of households with a PC 2002



Map 3.8 shows PC penetration for EU15 regions according to the 2002 INRA household survey. There is a clear dominance of Swedish regions in the PC uptake classification (filling six of the top seven places) — with these including 3 Objective 1 regions, and regions which are not among the richest European regions, and which tend to be rural and less densely populated, and are peripheral. Beyond the Swedish case, however, the overall pattern does appear to be that *household PC penetration is more likely to be greater in regions which are richer, urban and central (Dutch, German and UK regions notably), than in poorer, rural and peripheral regions.* The (numerous) exceptions to this tendency highlight, nevertheless, how national policy and culture specificities must be seen as the most important factor in promoting PC (and in turn, Internet) uptake.

Most of the less advanced PC regions are southern European (Greek, Portuguese and a few Spanish regions), tend to be Objective 1, with lower GDP, are less densely populated, and are peripheral. The exception here are French regions, which, although sometimes less densely populated and non-centrally located, are non-Objective 1 and have above average GDP levels.

When we disaggregate the EU regional uptake data into our socio-economic-geographic categories[26], we can suggest that a number of the categorisations usefully discriminate between PC adoption levels although, again, the density/urban structure categorisation is apparently of more limited use in differentiating between regions on this indicator.

[26] See footnote 16 for details of the origin of these variables.

Map 3.9: Household PC penetration and Objective 1 status

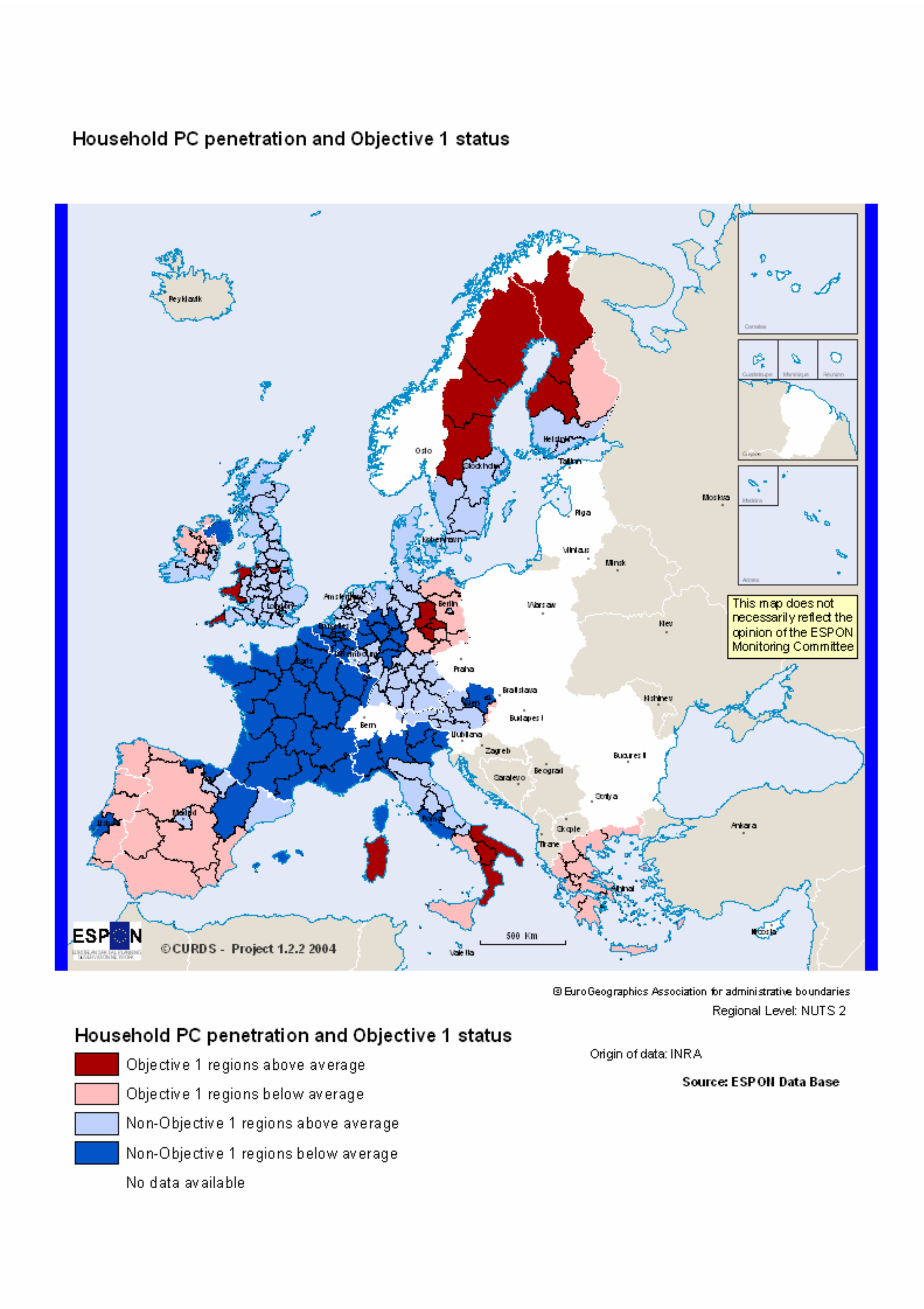
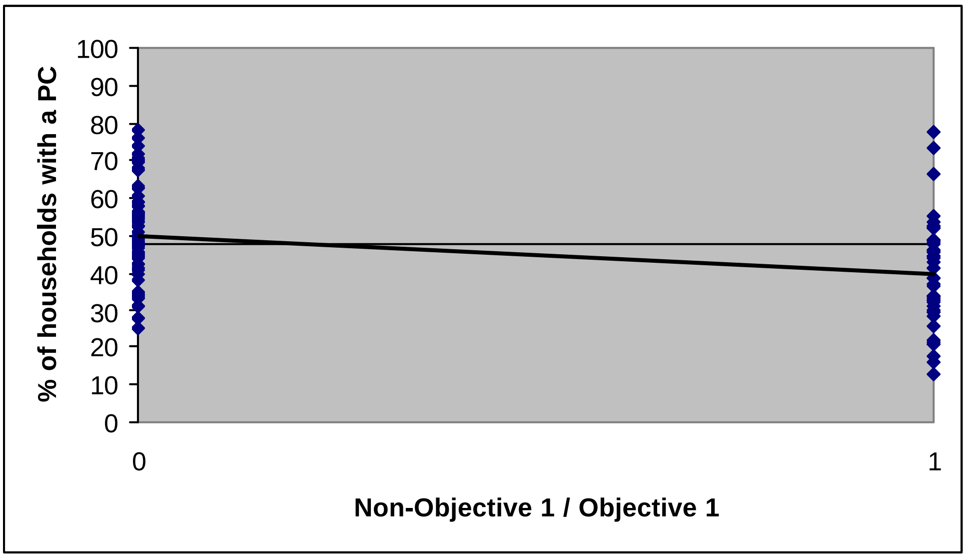


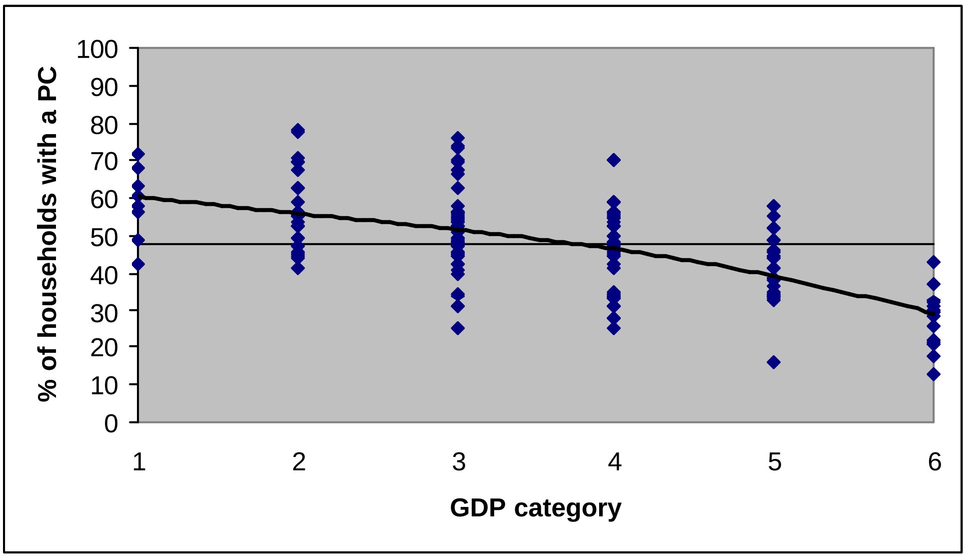
Figure 3.12: The relationship between household PC penetration and Objective 1 status in EU15 regions (mean = 47.9)



Source: CURDS; based on data drawn from INRA (2004)

For the first time in the analysis, the Objective 1/non-Objective 1 distinction appears of real importance in differentiating between regional adoption levels, with a 10 percentage point difference between the two categories (means of 40.0% and 50.2% respectively). Map 3.9 and figure 3.12 show that the vast majority of EU15 regions with the highest PC penetration levels are non-Objective 1 regions. *Only 30% of Objective 1 regions have above EU average PC uptake rates, compared with over 60% of non-Objective 1 regions*. The major exceptions to the rule are the Swedish Objective 1 regions of Mellersta Norrland, Övre Norrland and Norra Mellansverige, underlining the fact that 6 of the top 8 regions in EU15 for PCs are in Sweden. Hamburg, Dutch regions and Danmark follow closely. Greek Objective 1 regions dominate the bottom of the classification for PC uptake. In particular, there are 7 Greek regions with PC uptake rates of less than 25%. Nevertheless, just above these Greek regions, French non-Objective 1 regions can be highlighted as having rates of only around 30%. Even the French capital region Ile-de-France at 42.4% lies well below the EU15 average for this indicator.

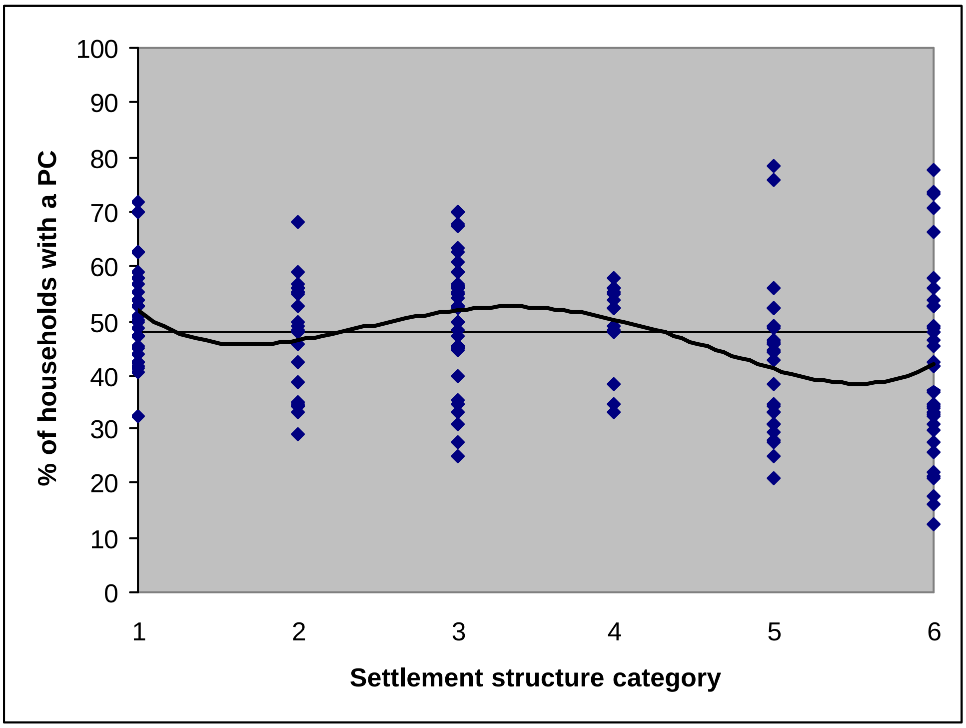
Figure 3.13: The relationship between household PC penetration and GDP category in EU15 regions (mean = 47.9)



Source: CURDS; based on data drawn from INRA (2004)

Figure 3.13 shows that, unlike the earlier technologies considered, there is quite a clear and broadly linear relationship between PC penetration and GDP levels in EU15 regions. The means for the top three GDP categories all lie above 50% PC penetration, while the bottom three categories have means of 44.5%, 42.3% and 27.0% respectively. Ile-de-France is the only region from the top GDP category with a below EU average PC uptake level. Similarly, *all regions in the bottom GDP category are below the EU average for this indicator*. These regions with the lowest PC uptake and low levels of GDP are dominated by Greek, Spanish and Portuguese regions.

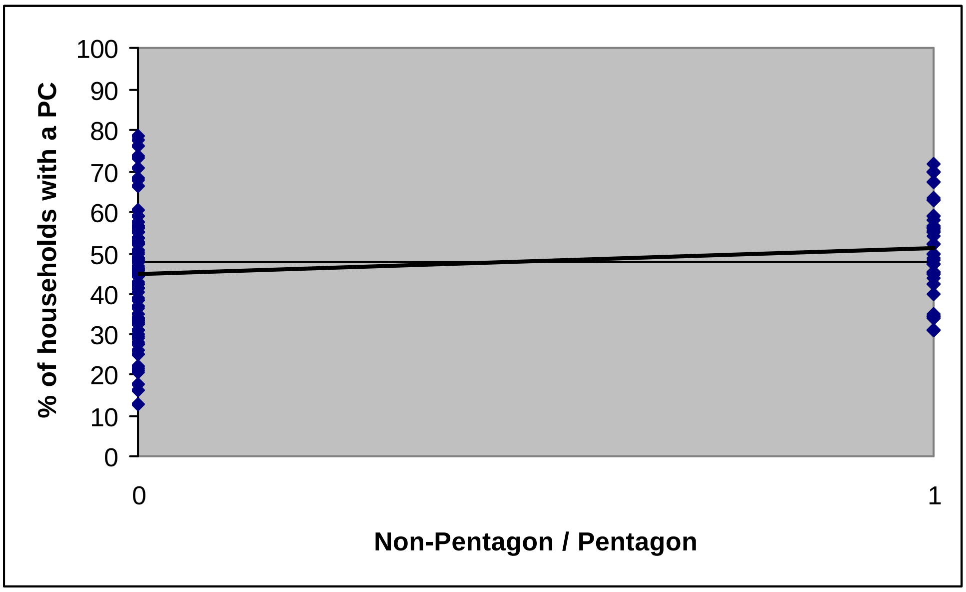
Figure 3.14: The relationship between household PC penetration and population density/urban status in EU15 regions (mean = 47.9)



Source: CURDS; based on data drawn from INRA (2004)

Figure 3.14 shows that there is a varying and inconsistent relationship between PC penetration and settlement structure in EU15 regions. Whilst the top Swedish regions are less densely populated (usually without urban centres), there are several very densely populated regions with large centres also with high PC uptake (Hamburg, southern UK regions, Noord-Holland, Zuid-Holland). At the other end of the PC penetration table, however, it is predominantly the less densely populated regions of Greece, Spain and Portugal (and even France). The main exceptions here are the Portuguese Norte region, which is more densely populated, and the very densely populated Attiki region, both of which have low levels of PC penetration.

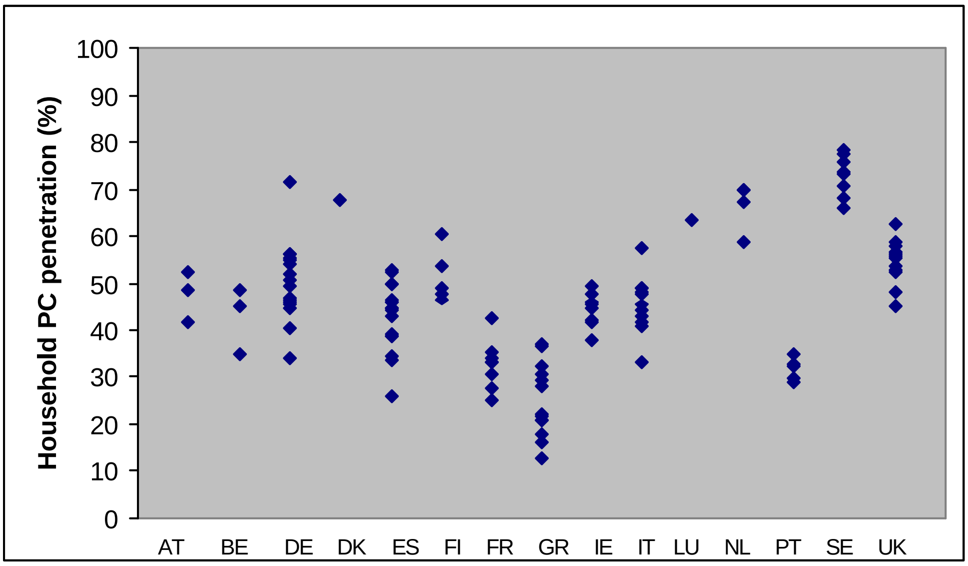
Figure 3.15: The relationship between household PC penetration and Pentagon location in EU15 regions (mean = 47.9)



Source: CURDS; based on data drawn from INRA (2004)

Figure 3.15 shows that while regions located in the Pentagon do have a higher mean PC penetration level than non-Pentagon regions (51.2% and 45.0% respectively), they display a much narrower range of variation around this mean. As a result, it can be seen that *many of the regions with highest PC uptake rates are not in the Pentagon* (Swedish regions, Danmark, Uusimaa, Tees Valley and Durham, Northumberland and Tyne and Wear). Pentagon regions such as Hamburg, southern UK regions and Dutch regions are, however, also present in the top echalons of PC penetration. Overall, nearly 60% of Pentagon regions have above average PC penetration, compared with just under half of all non-Pentagon regions. *The regions with the lowest PC penetration levels are almost completely outside the Pentagon* (in Greece, Spain and Portugal, and southern France), with only a number of northern French Pentagon regions having relatively low PC uptake rates.

Figure 3.16: The level of ‘national effect’ in PC uptake in EU15 regions



Source: CURDS; based on data drawn from INRA (2004)

Figure 3.16 explores the regional PC penetration data from a national perspective by plotting the regions in their country groupings. There are slightly more regional variations within countries for PC penetration than for mobile telephony. German, Spanish, Greek and Italian regions, in particular, can be seen to vary quite widely in their penetration rates. In contrast, the high rates of all Swedish regions can also be observed quite clearly.

Table 3.5 provides a summary of these national ‘spreads’ across the six PC uptake categories. At the top of the distribution (i.e., Category 1), the highest levels of PC penetration are found in Denmark, all of the Swedish regions, and a few of the leading Dutch and German regions. At the tail of the distribution (i.e., Category 6), the lowest levels of PC penetration comprise Spanish, French, Greek and Portuguese regions.

Table 3.5: Extent of ‘spread’ of regional differences in PC uptake at the meso national level

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
AT			■	■		
BE			■	■	■	
DE	■	■	■	■	■	
DK*	■					
ES			■	■	■	■
FI		■	■	■		
FR				■	■	■
GR					■	■
IE			■	■	■	
IT		■	■	■	■	
LU*		■				
NL	■	■				
PT					■	■
SE	■					
UK		■	■	■		

* Countries which are NUTS 2 at national level

Source: CURDS; based on data drawn from INRA (2004)

3.3.3 A micro-scale perspective on PC penetration

Although the differences between metropolitan, urban and rural localities are slightly more marked for PC penetration than for the previous telephony up-take levels considered, the differences are still not particularly pronounced. In the EU15 as a whole, rural localities, at 46% PC penetration, lag a little behind metropolitan and urban localities, both of which stand at 50% penetration. Again there are differences between countries, but in twelve of the fifteen countries the metro locality has the highest (in two cases they share equal highest position) penetration rates. In five countries, Germany, Luxembourg, the Netherlands, Sweden and the UK, rural localities outpace urban areas, and in three countries, Austria, Portugal and the UK, they outpace metro areas. Only in the UK do rural areas have a higher proportion of households with a PC than both metro and urban areas.

Table 3.6: Proportion of PC household penetration by locality type (figures in brackets express the data as an index of the national figure)

% of households	TOTAL	TYPE OF LOCALITY		
		Metro	Urban	Rural
EU 15	**48 (*100*)**	**50 (*104*)**	**50 (*104*)**	**46 (*96*)**
Belgium	42 (*100*)	44 (*105*)	42 (*100*)	41 (*98*)
Danmark	68 (*100*)	74 (*109*)	67 (*99*)	61 (*90*)
Deutschland	50 (*100*)	52 (*104*)	49 (*98*)	52 (*104*)
Ellada	27 (*100*)	32 (*119*)	29 (*107*)	20 (*74*)
Espana	44 (*100*)	48 (*109*)	46 (*105*)	42 (*95*)
France	33 (*100*)	37 (*112*)	32 (*97*)	27 (*82*)
Ireland	45 (*100*)	49 (*109*)	45 (*100*)	43 (*96*)
Italia	44 (*100*)	45 (*102*)	45 (*102*)	43 (*98*)
Luxembourg	63 (*100*)	70 (*111*)	57 (*90*)	63 (*100*)
Nederland	68 (*100*)	72 (*106*)	65 (*96*)	71 (*104*)
Osterreich	46 (*100*)	44 (*96*)	47 (*102*)	47 (*102*)
Portugal	32 (*100*)	29 (*91*)	37 (*116*)	31 (*97*)
Finland	52 (*100*)	66 (*127*)	51 (*98*)	47 (*90*)
Sverige	73 (*100*)	73 (*100*)	72 (*99*)	73 (*100*)
United Kingdom	56 (*100*)	53 (*95*)	56 (*100*)	57 (*102*)

Source: CURDS; elaborated from INRA (2004)

3.3.4 Summary of the territorialities of PC penetration

In summary, the main findings with respect to the territorialities of PC penetration are as follows:

- at the macro-scale, above average levels of PC penetration are found in northern and north-western Europe, with Sweden out in front, while below average levels are found in southern and eastern Europe, with the lowest levels of all found in Greece, Bulgaria and Romania.

- at the meso-scale, regional variations in PC adoption levels within the EU15 are clearly related to developmental status (with Objective 1 regions having, on average, lower levels of PC penetration than non-Objective 1 regions); to GDP per capita; and, with a notable Nordic exception, to location with respect to the European core. At the NUTS 2 regional level, the highest levels of PC penetration in EU15 are found in Swedish regions, in Denmark, and in the leading regions of the Netherlands and Germany (Hamburg). At the bottom of the EU15 ranking are found regions from Spain, Portugal, Greece and France. The latter regions have levels of PC penetration below 30%, compared with those at the top of the distribution with penetration levels above 60%.
- at the micro-scale, there is some evidence for EU15 that household PC penetration levels in rural localities lag behind metropolitan and urban areas, but the lag is not particularly pronounced or consistent between countries. Interesting contrasts emerge between countries which are often assumed to be broadly similar. In Finland, for example, rural localities lag behind both urban and, particularly, metropolitan areas in their PC adoption levels, while in Sweden, there are no differences at all between metropolitan, urban and rural localities. In addition to Finland, Greece and France also have pronounced metropolitan-rural differentials in PC adoption.

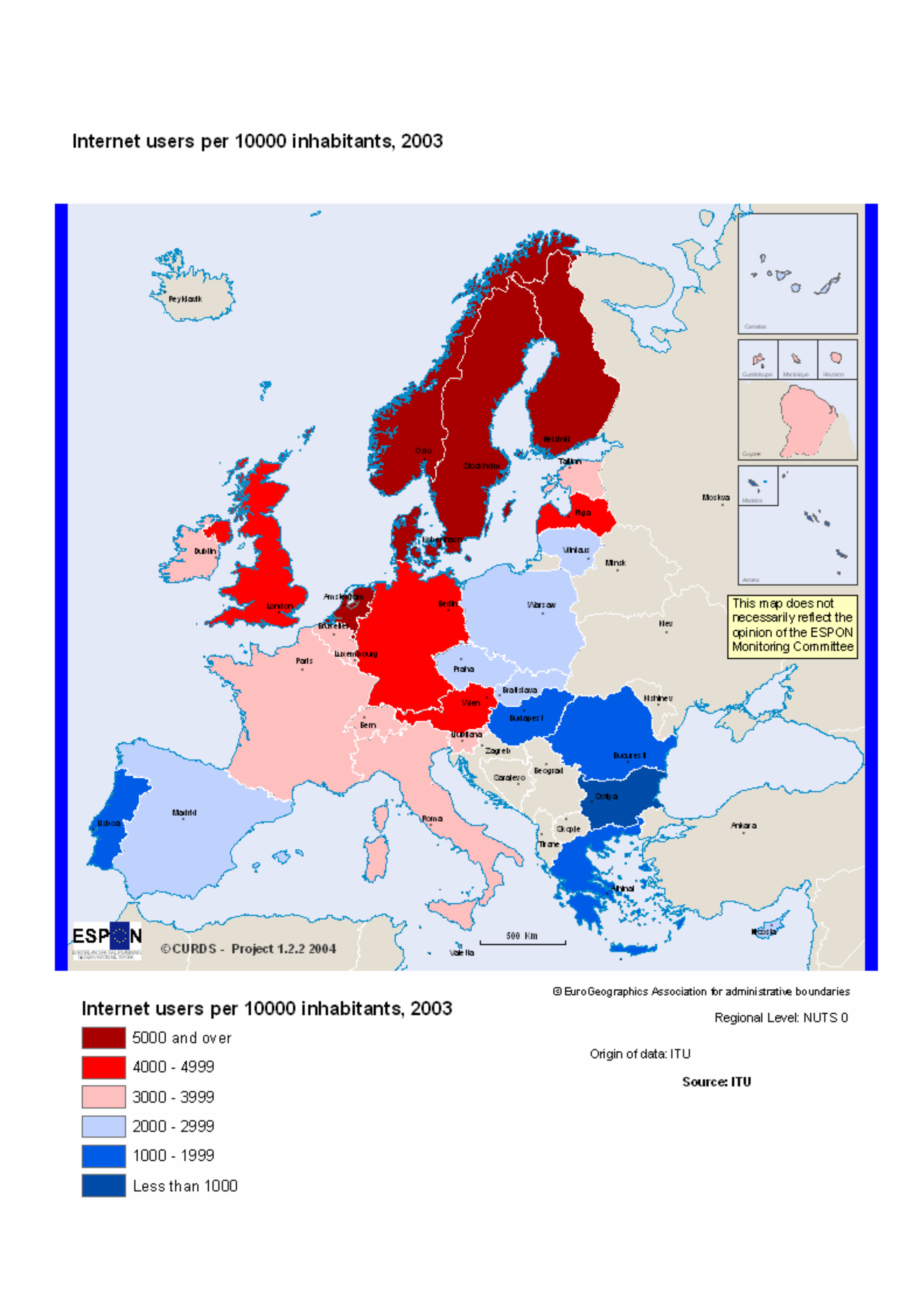
3.4 Territorialities of Internet uptake

3.4.1 A macro-scale perspective on Internet uptake

Perhaps the most important current differentiator of Information Society (IS) participation is *usage of the Internet*. Map 3.10 shows the number of Internet users per 10,000 inhabitants in 2003, at the national level for EU27+2. Yet again the Nordic countries are most advanced in terms of Internet usage, with all those countries having usage rates of above 5,000 users per 10,000 inhabitants. Outside the Nordic countries only the Netherlands falls into this top category. The least advanced countries with regard to Internet usage are again located in southern (Greece and Portugal) and eastern (Bulgaria, Hungary and Romania) Europe. While Bulgaria lags significantly behind all other countries on this indicator with only just over 800 Internet users per 10,000 inhabitants, Romania has overtaken Hungary between 2002 and 2003 and now has an Internet uptake level only just below that of Portugal. The major surprise, however, comes from Latvia, which now ranks 9th overall in EU27+2 for Internet uptake at just over 4,000 users per 10,000 inhabitants. This level places it above such countries as France, Italy and Switzerland, with a growth rate between 2002 and 2003 of over 300 per cent according to ITU data.[27]

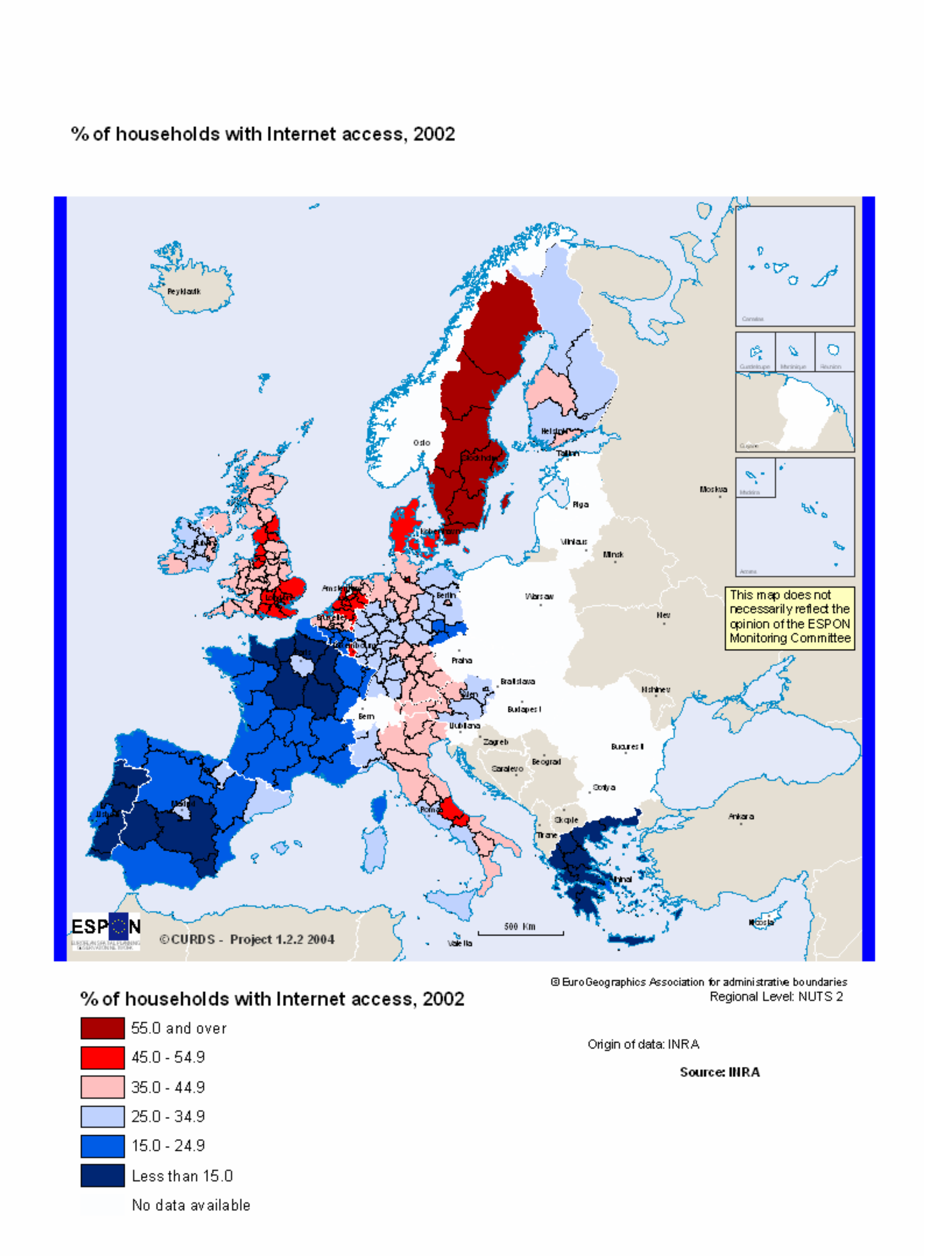
[27] We contacted ITU to verify the Latvian figure, but did not receive any response. The eEurope+ report gives much lower 2003 Internet penetration figures for Latvia, with their household survey suggesting that 10% of households have Internet access. Even accounting for a possible slightly higher percentage of Internet users (those with access at work or school, etc), this ITU figure should, nevertheless, be viewed as subject to verification.

Map 3.10: Internet users per 10,000 inhabitants 2003



3.4.2 A meso-scale perspective on Internet uptake

Map 3.11: % of households with Internet access 2002



Map 3.11 maps household Internet uptake for EU15 regions according to the 2002 INRA household survey. Although there is a clear dominance of Swedish regions in the Internet access classification (filling eight of the top ten places), the overall main trend is that *household Internet access is more likely to be greater in regions which are richer, urban and central (UK and Dutch regions notably), than in poorer, rural and peripheral regions.* The (numerous) exceptions to this trend highlight, nevertheless, the importance of national policy and cultural specificities in influencing Internet uptake. In particular, we can suggest quite clearly that Swedish policy and/or culture has greatly favoured Internet uptake across the country, irrespective of geographical or socio-economic variations.

Most of the less advanced Internet regions are southern European (Greek, Portuguese and Spanish regions), tend to be Objective 1, with lower GDP, are less densely populated, and are peripheral, although many French regions are only just ahead of these southern regions for Internet uptake. *The high levels of mobile uptake in southern European regions are therefore not replicated for Internet access*, suggesting limited Internet policies and cultures thus far, as well as a possible relationship between the relative lack of fixed lines (replaced by mobile) and therefore lack of access to dial-up Internet?

When we disaggregate these regional uptake figures into the general socio-economic-geographic categories, it is apparent that the categorisations are rather useful in discriminating between regional Internet uptake levels, certainly much more useful than the categorisations proved to be for fixed and mobile telephony uptake.[28]

[28] See footnote 16 for details of the origin of these variables.

Map 3.12: Household Internet penetration and Objective 1 status

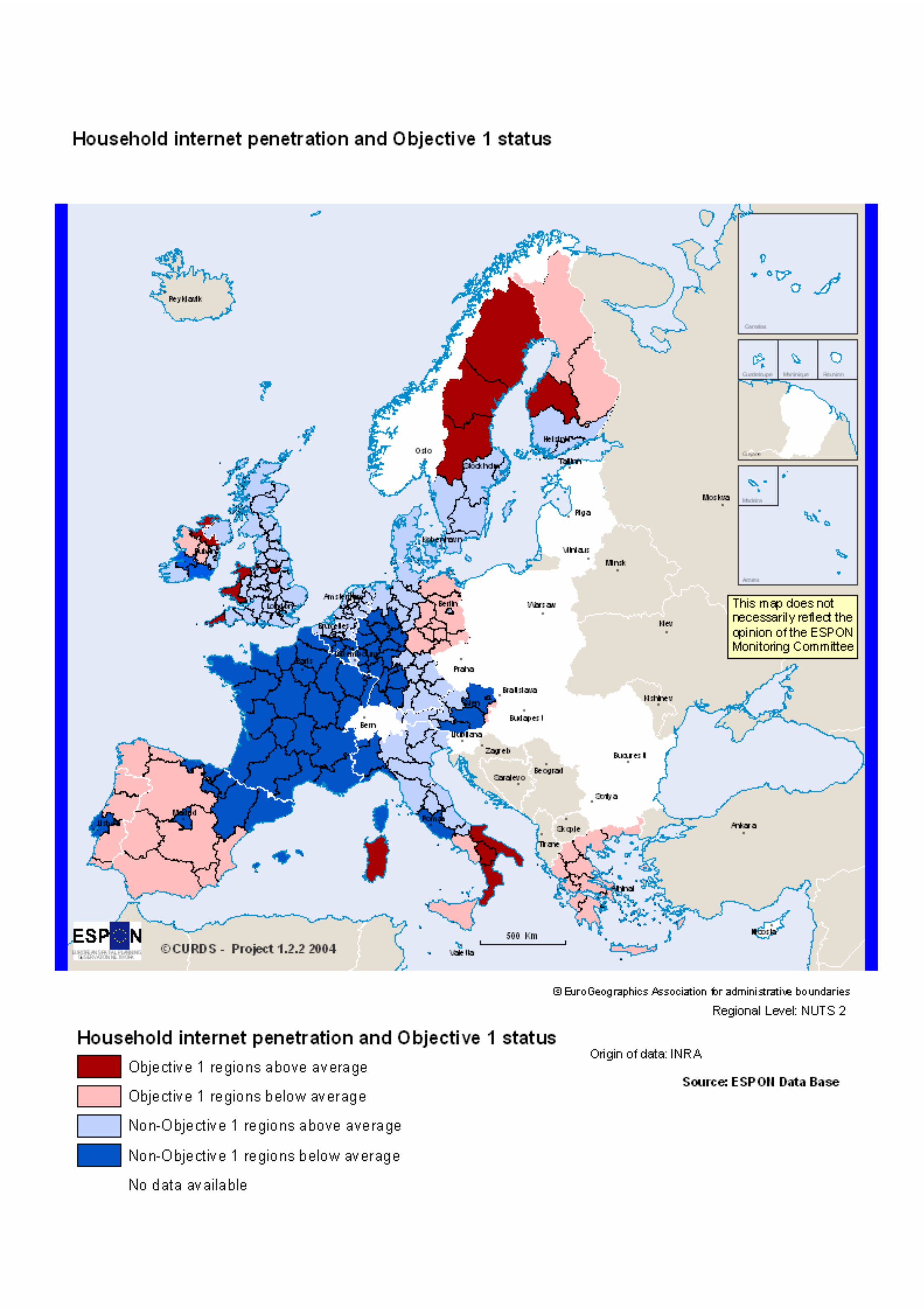
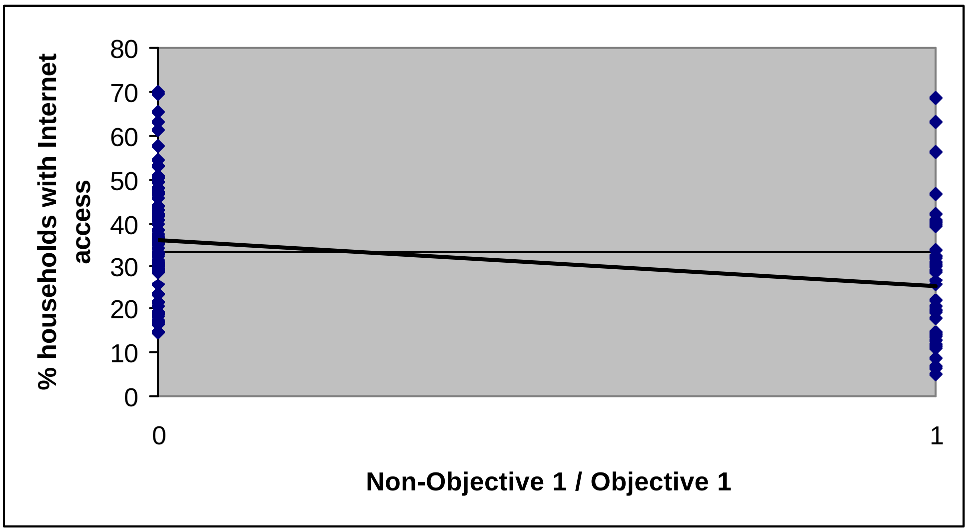


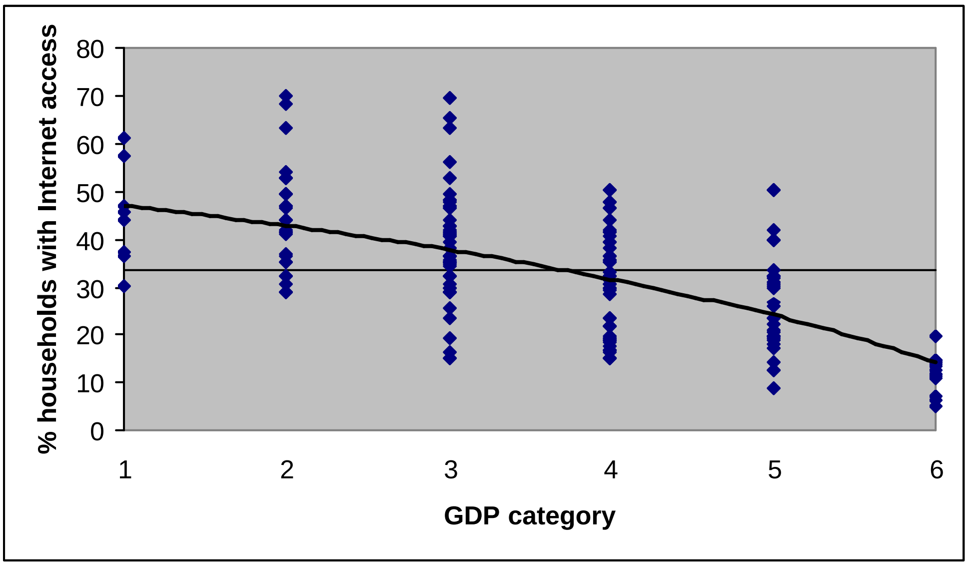
Figure 3.17: The relationship between household Internet access and Objective 1 status in EU15 regions (mean = 33.6)



Source: CURDS; based on data drawn from INRA (2004)

The developmental status of regions appears to be an important differentiator of Internet uptake, with Objective 1 regions having much lower average uptake levels than non-Objective 1 regions (25.3% and 36.1% respectively). Map 3.12 and figure 3.17 show that the vast majority of EU15 regions with highest Internet use are non-Objective 1 regions. The major exceptions to this are the Swedish regions of Mellersta Norrland, Övre Norrland and Norra Mellansverige, underlining the fact that 8 of the top 10 regions in EU15 for Internet use are in Sweden. Hamburg, Danmark, and a number of UK and Dutch regions follow, although we should note the presence of Abruzzo and Molise among higher Internet use regions. *19 of the bottom 20 regions for Internet use are Objective 1 regions* (located in Greece, Spain and Portugal). In particular, there are 4 Greek regions with Internet use rates of less than 10%. Among non-Objective 1 regions, numerous French regions can be highlighted as having rates of less than 20%.

Figure 3.18: The relationship between household Internet access and GDP category in EU15 regions (mean = 33.6)

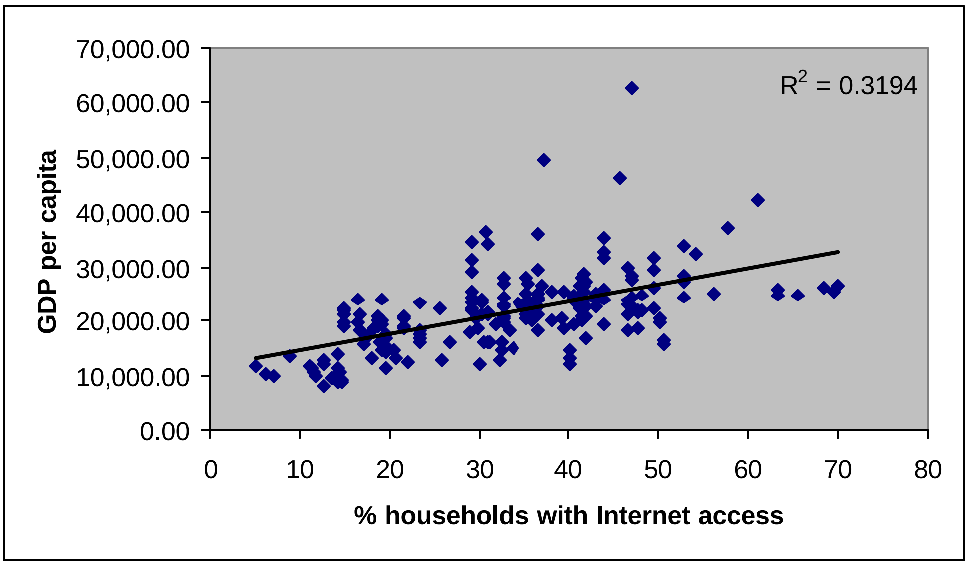


Source: CURDS; based on data drawn from INRA (2004)

Although there is clearly a relationship between GDP and Internet adoption (the mean levels of Internet usage decline successively through the GDP categories), Figure 3.18 shows that in detail there is a rather varying relationship between Internet use and GDP levels in EU15 regions. Apart from Hamburg and Stockholm in the top 10, for example, other regions in the top GDP category are quite a way down the Internet use table. The other Swedish regions with highest Internet use are in the second and third categories for GDP level. Nevertheless, *there are very few 'poor' regions with high Internet use* (Abruzzo and Molise are in the fifth GDP category), and in the lowest GDP category (Category 6 in the Figure) none of the regions achieve a household Internet penetration above 20%.

Most of the regions with the lowest Internet use also have low levels of GDP (Greek, Spanish and Portuguese regions), though it is notable that the French regions of Champagne-Ardenne, Haute-Normandie and Rhône-Alpes have relatively low Internet use and moderate GDP levels. Further, richer German regions such as Karlsruhe, Stuttgart and Darmstadt (in the second largest GDP category) might have been expected to have higher levels of Internet use (just under 30%).

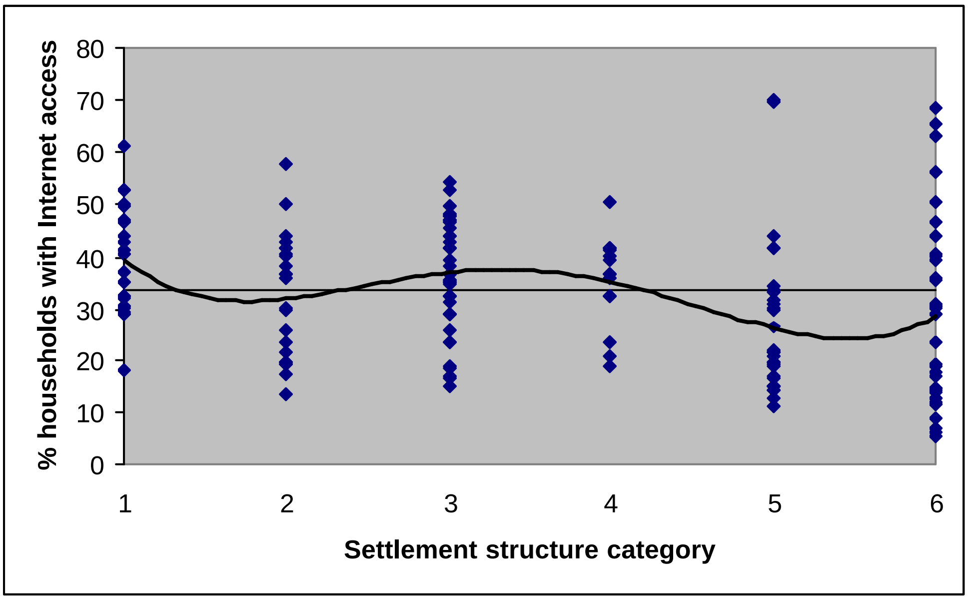
Figure 3.19: The correlation between household Internet uptake and GDP per capita



Source: CURDS; based on data drawn from INRA (2004)

The moderate relationship between household Internet uptake and GDP per capita can also be seen in figure 3.19 which compares regional Internet uptake and GDP levels. The relationship is of course positive, although the gradient of the line is not that steep, and the regions are quite well spread out above and below the line (the R^2 is 0.3194). We can see that several prosperous regions in GDP terms (above 30,000 euros per capita) are not among the most advanced Internet regions, and in particular that the six most advanced Internet regions (above 60%) all have lower levels of GDP per capita than suggested by the overall relationship.

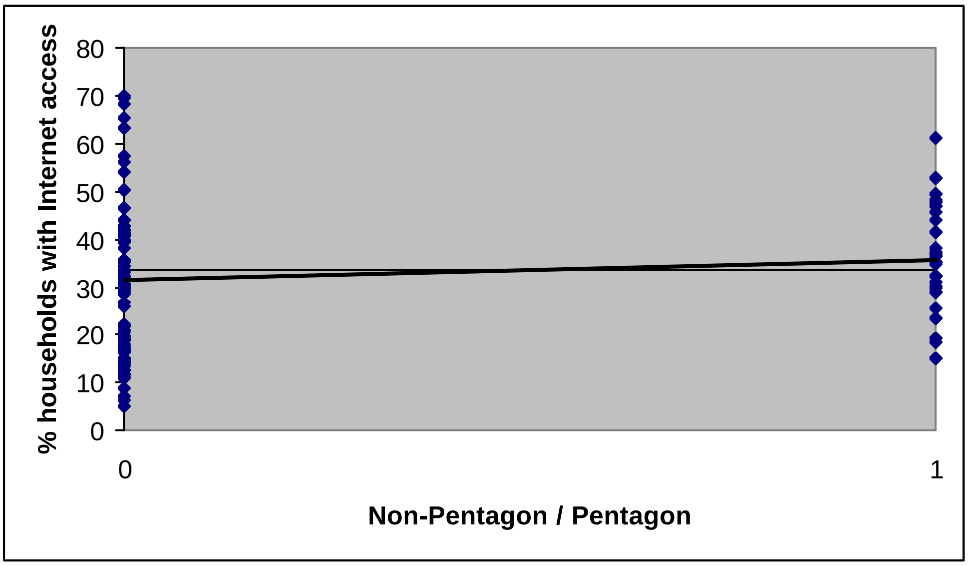
Figure 3.20: The relationship between household Internet access and population density/urban status in EU15 regions (mean = 33.6)



Source: CURDS; based on data drawn from INRA (2004)

Figure 3.20 shows that, as with the other technologies we have examined, there is no clear or consistent relationship between regional density/urban structure and Internet adoption. Whilst the top Swedish regions are less densely populated (usually without centres), there are several very densely populated regions with large centres also with high Internet use (Hamburg, southern UK regions, Noord-Holland, Zuid-Holland). At the other end of the Internet use table, however, it is predominantly the less densely populated regions of Greece, Spain and Portugal (and even France). The main exceptions here are the Portuguese Norte region, which is more densely populated, and the very densely populated Attiki region.

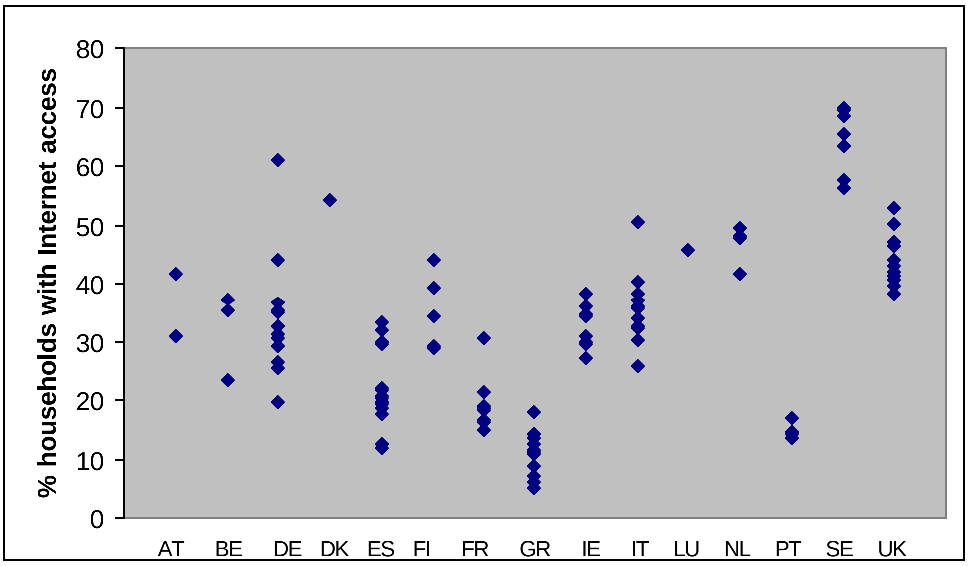
Figure 3.21: The relationship between household Internet access and Pentagon location in EU15 regions (mean = 33.6)



Source: CURDS; based on data drawn from INRA (2004)

Of the categorisations used in the analysis, location with respect to the European core (i.e. the Pentagon) is the least useful in differentiating between regional Internet uptake levels. Figure 3.21 shows that *many of the regions with highest Internet use rates are not in the Pentagon* (Swedish regions, Danmark, Abruzzo, Molise, Tees Valley and Durham, Northumberland and Tyne and Wear). Pentagon regions such as Hamburg, southern UK regions and Dutch regions are, however, present in the top echalons of Internet use. *The regions with lowest Internet use are almost completely outside the Pentagon* (in Greece, Spain and Portugal), with only a number of northern French Pentagon regions having relatively low Internet use rates.

Figure 3.22: The level of 'national effect' in Internet uptake in EU15 regions



Source: CURDS; based on data drawn from INRA (2004)

Figure 3.22 and table 3.7 explore the regional Internet uptake data from a national perspective by plotting the regions in their country groupings. Once again, this clearly demonstrates the importance of national influence on telecommunications territorialities.

Swedish regions all have extremely high levels of Internet uptake, while it is notable that all UK and Dutch regions lie above the EU average. At the opposite end of the spectrum, most of the very lowest levels of Internet adoption are occupied by Greek regions, while Spain, Portugal and France have all of their regions lying below the EU15 average. In the middle of the distribution, Italian, Irish, Finnish, German and Belgian regions straddle the EU average.

The 'spread' of regions within a country is notable in the cases of Spain and, particularly, Germany, with the latter having one region (Hamburg) in the highest of the six Internet adoption categories, but also having regions in the second lowest category.

Table 3.7: Extent of 'spread' of regional differences in Internet uptake at the meso national level

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
AT			■	■		
BE			■	■	■	
DE	■	■	■	■	■	
DK*		■				
ES				■	■	■
FI			■	■		
FR				■	■	■
GR					■	■
IE			■	■		
IT		■	■	■		
LU*		■				
NL		■	■			
PT					■	■
SE	■					
UK		■	■			

* Countries which are NUTS 2 at national level

Source: CURDS; based on data drawn from INRA (2004)

3.4.3 A micro-scale perspective on Internet uptake

When we turn to look at the territoriality of Internet penetration at the micro-scale, we see that there is a significant gap for the EU15 as a whole between metro and urban areas and rural localities. The INRA data survey of household penetration suggests that the proportionate gap at the European level is wider than for fixed telephony, mobile telephony or personal computers (see table 3.8). The EU average for Internet access at home is 34 per cent. Metro localities (37 per cent) and urban localities (35 per cent) are each above the average. By contrast rural localities fall below the average (31 per cent). At one level, the picture is similar across the EU15 with metro localities leading in all countries except for Portugal, where urban localities have slightly higher penetration rates (17 per cent) than metro and rural localities (both on 15 per cent); Sweden, where all localities have the same penetration rates; and the UK, where rural localities have higher penetration rates followed by urban and then metro areas. Nevertheless, the 'gradient' of the 'metropolitan-rural divide' does vary substantially. In some countries (including Belgium, Germany, Ireland, Italy, the Netherlands and Austria) the differential is relatively small, while in others (notably Denmark, France, Greece. Spain and Finland), the metropolitan-rural divide in Internet uptake is pronounced.

Table 3.8: Proportion of Internet household penetration by locality type (figures in brackets express the data as an index of the national figure)

% of households	TOTAL	TYPE OF LOCALITY		
		Metro	Urban	Rural
EU 15	**34 (*100*)**	**37 (*109*)**	**35 (*103*)**	**31 (*91*)**
Belgium	32 (*100*)	33 (*103*)	32 (*100*)	31 (*97*)
Danmark	54 (*100*)	63 (*117*)	55 (*102*)	46 (*85*)
Deutschland	33 (*100*)	39 (*118*)	33 (*100*)	32 (*97*)
Ellada	14 (*100*)	18 (*129*)	15 (*107*)	9 (*64*)
Espana	23 (*100*)	28 (*122*)	25 (*109*)	20 (*87*)
France	20 (*100*)	25 (*125*)	17 (*85*)	15 (*75*)
Ireland	33 (*100*)	36 (*109*)	32 (*97*)	32 (*97*)
Italia	34 (*100*)	37 (*109*)	34 (*100*)	34 (*100*)
Luxembourg	46 (*100*)	57 (*124*)	38 (*83*)	44 (*96*)
Nederland	48 (*100*)	53 (*110*)	45 (*94*)	50 (*104*)
Osterreich	33 (*100*)	34 (*103*)	34 (*103*)	32 (*97*)
Portugal	15 (*100*)	15 (*100*)	17 (*113*)	15 (*100*)
Finland	36 (*100*)	53 (*147*)	33 (*92*)	32 (*89*)
Sverige	64 (*100*)	64 (*100*)	64 (*100*)	64 (*100*)
United Kingdom	45 (*100*)	44 (*98*)	45 (*100*)	47 (*104*)

Source: CURDS; elaborated from INRA (2004)

We are not aware of any study focusing on intra-country territorial disparities of Internet uptake having been undertaken for the N12 countries. Where we were able to find evidence in our individual national studies, however, it did tend to show territorial disparities in Internet use, with rural areas following behind urban.

A recent report by the United Nations on Bulgaria, for example, (UN Economic Commission for Europe, 2002a) suggests there is uneven penetration rate of Internet use according to location (as well as income levels and age). The report states that:

> "There are substantial regional disparities and a growing 'digital divide' both in terms of access to ICT infrastructure and provision of Internet-related services. The overwhelming majority of Internet users are young, well educated and live in large cities….Internet use is highest among residents of larger cities. Access is limited in rural areas and small towns….and fewer than 3 per cent of Internet users were residents of small towns" (p.15).

In Hungary too, recent research suggests that there are significant spatial variations between regions for Internet use. The capital region Közép-Magyarország has a much higher rate of Internet use (37%) among the population than any other Hungarian region, with only Közép-Dunántúl (30%) also having an Internet use rate above the national average (25%). Four of the other five regions of Hungary (in the eastern and southern part of the country) have rates which are well below the national average. In metropolitan-rural terms, while Budapest has an Internet use rate of 40% of its population, the average rate for Hungarian villages is only 15% (Ministry of Informatics and Communications, 2003)[29].

Finally, in Slovakia, there is also evidence of territorial disparities in relation to the Internet (Plintovicova, 2003). Three divides are identified:

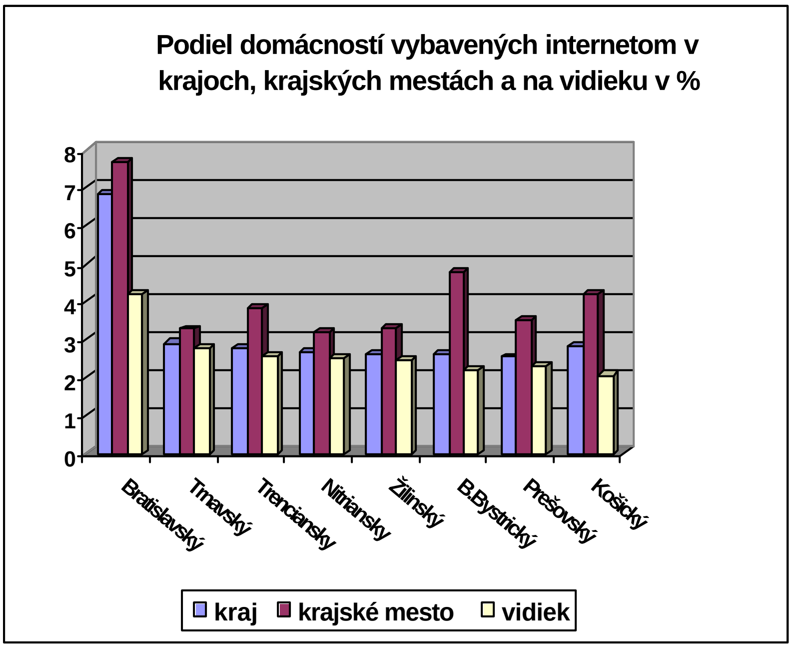
- a capital city region/rest of country divide;
- a major-city/other city divide; and,
- an urban-rural divide.

Figure 3.23 shows that households in the Bratislava region – the capital – are far more likely to have Internet access than those in other parts of the country. Bratislava is followed by the growth pole Banska Bystrica and by the second largest city Kosice. Interestingly, those three cities have been selected for the initial roll-out of ADSL, suggesting that regions leading in the use of one set of technologies will be the first to

[29] See section 5.3 for a summary of territorial trends of telecommunications networks in Hungary.

gain subsequent technologies, thus reinforcing existing advantages. It is noticeable that even households in Bratislava's 'rural hinterland' are more likely to have Internet access than those in all but one of the rest of Slovakia's cities. There is also an urban/rural divide with households in regional capitals being more likely to have Internet access than their rural hinterlands.

Figure 3.23: Proportion of households with Internet access in Slovak regions (by region and by degree of urbanisation)[1]



[1](kraj = region; krajske mesto = regional capital; vidiek = rural hinterland)

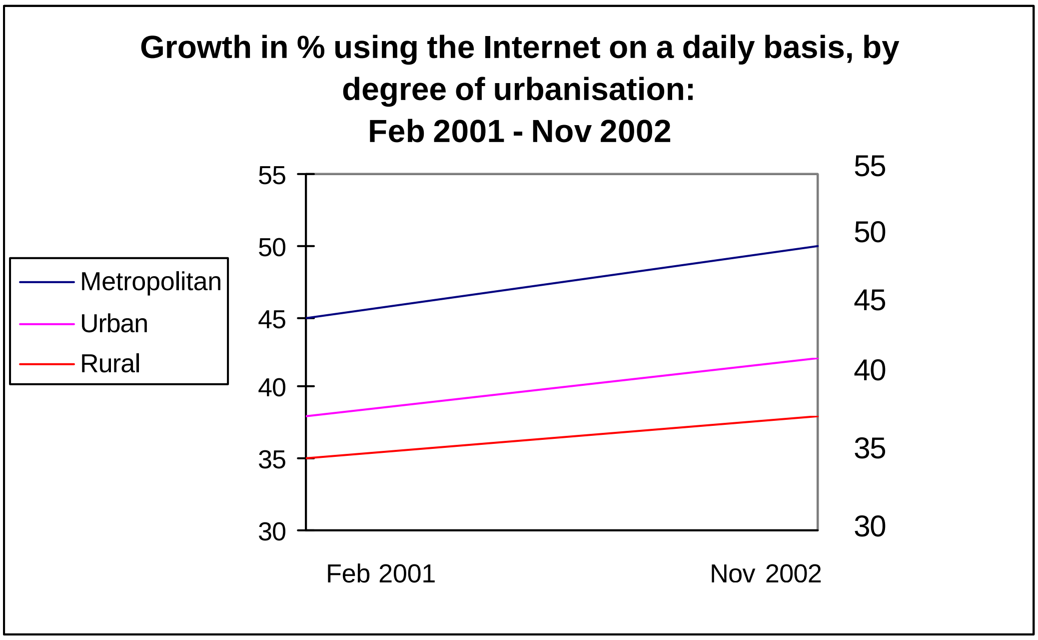
Source: Plintovicova (2003, p.105)

The INRA data and the evidence from the N12 countries thus broadly supports the findings reported in our TIR which suggested that rural areas lag behind metropolitan and urban areas in respect of Internet access and use. This gap is not new. In EU15, a lag in take up of the Internet between urban and rural areas of about 1 year persisted through the second half of the 1990s[30]. The results of a Eurobarometer Flash survey on the Internet carried out in 2002 point to the more limited competition in the provision of Internet services in rural areas (CEC, 2002f), and this may also be a factor. This urban-

[30] CEC (2000) "The situation of telecommunications services in the regions of the European Union: Residential Survey". Report prepared for DG Information Society by EOS Gallup. This is discussed in more detail in our SIR.

rural gap may be exacerbated by differential roll-out of broadband which national studies suggest are currently favouring, and are likely to continue to favour (in the absence of suitable public policies) urban areas[31]. In addition, as figure 3.24 shows, inhabitants of metropolitan and urban areas are more likely to use the Internet on a daily basis than those in rural areas, and this gap in uptake is actually widening over time rather than narrowing (CEC, 2002f)[32].

Figure 3.24: Intensity of use of Internet: growth in daily use by degree of urbanisation



Source: Based on CEC (2002f)

3.4.4 Summary of the territorialities of Internet uptake

In summary, the main findings with respect to the territorialities of household Internet adoption are as follows:

- at the macro-scale, as with PC adoption, there is a pronounced north-south divide within EU27+2, with the highest levels of PC adoption occurring in the Nordic countries, followed by the Netherlands and the UK. The lowest levels

[31] See chapter 4.
[32] A new report is due from INRA/DG Information Society later in 2004. It will be interesting to see whether that report confirms this continuing lag.

of Internet adoption are found in southern (Greece and Portugal) and eastern (Bulgaria, Hungary and Romania) Europe.

- at the meso-scale, regional variations in Internet adoption are positively related to the core as opposed to the periphery, more developed and higher GDP regions rather than less developed and lower GDP regions, and, more tentatively, to densely populated urban regions rather than low density, non-urban regions. Swedish regions very notably 'break all of these rules', however, occupying the highest places in the ranking of regions despite their peripherality, moderate GDP status and, in many cases, low population densities. French regions 'break the rules' in the opposite direction, having much lower levels of Internet adoption than would be expected given their location, GDP levels and, in many cases, urbanisation status.
- at the micro-scale, there are relatively pronounced differences between metropolitan, urban and rural localities in terms of their levels of household Internet adoption. In certain countries, notably Denmark, Finland, Greece, Spain and France, the 'metropolitan-rural' divide is particularly pronounced. It should though be noted that in a few cases, notably Sweden and the UK, there is no evidence at all for a metropolitan-rural divide in Internet adoption.

3.5 Conclusions on the territorialities of 'mature' telecommunications networks and services

In this chapter, we have considered the territorialities of more mature telecommunications networks and services, namely fixed line (voice) networks, mobile telephony, PCs and the Internet, all at macro, meso and micro levels. The available data suggests a complex and evolving picture, but a number of patterns, do emerge.

1. Territorial disparities

The technologies examined do not display the same disparities – fixed line and mobile telephony on the one hand, and PC and Internet adoption on the other, display distinctively different territorial disparities.

In our estimation, it is the disparities in PC and Internet adoption that are most worthy of policy consideration (because of their possible influence on future knowledge economy development paths). The main disparities we have identified here are:

- Southern Europe lags substantially in PC and Internet adoption.
- The N12 countries lag substantially behind the EU15 in PC and Internet adoption. (Although there is evidence that suggests slightly higher growth rates in both technologies in the N12 in 2000/1, the starting gaps were so substantial as to mean that the gap will have widened in percentage point terms, rather than narrowed[33].)
- Rural localities lag behind metropolitan localities in PC and, particularly, Internet adoption (see table 3.9 below).

Table 3.9: Index of 'mature' technology penetration in households by locality type

Technology	*EU avge = 100*	*Metro*	*Urban*	*Rural*
Fixed[1]	100	100	100	100
Mobile	100	101	100	99
PC	100	104	104	96
Internet access	100	109	103	91

Source: CURDS; elaborated from INRA (2004)

(note:1 includes traditional fixed, ISDN and or DSL)

[33] See Eurostat (2002) "Information Society Statistics: Data for Candidate Countries: Statistics in Focus, Theme 4 – 17/2002, author Richard Deiss.

2. Drivers/Explanations

In order to try and understand the drivers behind the territorial disparities we have identified, we were able to disaggregate data for EU15 NUTS 2 regions into a number of socio-economic-geographic categories. First, the main results of how significant these categories are as discriminants of telecoms uptake are:

- We found that developmental status (Objective 1 – non-Objective 1) and GDP (which are clearly linked) are particularly useful discriminants of PC and Internet adoption. This is confirmed by an analysis of variance which demonstrates that there are significant differences between Objective 1 and non-Objective 1 categories and GDP categories for PC and Internet adoption (see annex 7 for a table of analysis of variance results).
- The only other categorisation which proved a particularly useful discriminant of technology adoption was the core-periphery distinction (Pentagon / non-Pentagon), though interestingly, the most marked distinction was the high levels of mobile telephony adoption in non-Pentagon regions (reflecting the 'Nordic' and 'Mediterranean' effects noted above) (see annex 7 for a table of analysis of variance results).

Second, in terms of the technologies we have focused on in this chapter, the main overall findings are:

- For telephony, particularly mobile telephony, the 'usual expectations' are reversed: high mobile uptake is positively, rather than negatively, associated with Objective 1 status, with peripherality (both Nordic and Mediterranean), and with low GDP.
- For PCs and the Internet, the more usual pattern re-asserts itself: high PC and Internet adoption are positively associated with non-Objective 1 status, with centrality, with higher levels of GDP and, more tentatively, with density/urbanisation – however, there is a very strong 'Swedish exception' to all of these rules.

- The importance of *national* specificities emerges very strongly, leading us to invoke the existence of distinctively different ‘national telecoms cultures’. Examples of these include:

    - Sweden and Finland – high communication, high computing cultures.
    - Greece, Italy and the Czech Republic – high voice communication cultures.
    - Netherlands and Denmark – high computing cultures.
    - Germany and France – low telecommunications cultures (with respect to both voice and the Internet).

Chapter 4 – Territorialities of broadband, e-commerce and Internet backbone networks

In chapter 3 we examined the territorialities of more 'mature' telecommunications technologies. In this chapter we turn to look at those elements at the 'leading edge' of telecommunications developments: a) broadband technologies; b) e-commerce; and c) Internet backbone networks.

In section 4.1, after a brief discussion of the policy context, we describe and analyse the territorialities of broadband. We first consider patterns of broadband *roll-out* (section 4.1.1). We draw on a range of published sources and interviews from our field work to illustrate that, by and large, roll-out occurs in a hierarchical manner, with providers first investing in the most densely populated areas (moderated by the intensity of business activity and wealth). This pattern is replicated in all countries, although the speed with which the gap closes between urban and rural areas has so far varied between countries. We then turn to explore levels of *uptake* of the main commercially developed technologies, DSL and cable modem. Here we follow the template developed in chapter 3. We first explore the macro-scale perspective (section 4.1.2) by drawing on ITU data from 2002[34], supplemented by data produced by the Commission for 2003, but which relates only to EU15. We then explore broadband uptake from a meso-scale perspective (section 4.1.3), drawing on data from the INRA report. Here we consider the territorialities of broadband against the same regional socio-economic-geographic variables and categories employed in chapter 3 in respect of more mature technologies. In section 4.1.4 we focus on a micro-scale view of broadband uptake, drawing principally on the metro-urban-rural locality data from the INRA report.

In section 4.2, we focus on the territorialities of e-commerce. It can be argued that, from an economic perspective, it is the uptake and usage of ICTs by enterprises, including SMEs, which is of prime importance in contributing to regional competitiveness. In section 4.2.1 we draw together the limited evidence available to reflect on the

[34] At the time of writing, data on broadband for 2003 had not been published by ITU and we were unable to obtain any updated data through correspondence with the organisation.

territorialities of e-commerce from a macro-scale perspective. We then turn to consider e-commerce from a meso-scale perspective (section 4.2.2). Unfortunately there is a dearth of data on regional variations in e-commerce. We therefore apply regression modelling to provide estimates of missing regional data.

In section 4.3, we focus on the territorialities of pan-European Internet backbone networks, which carry huge amounts of data communications for corporate clients and Internet Service Providers. These networks have emerged over the past ten years or so and represent a 'Europeanisation' of telecommunications investment. In this section we summarise the detailed analysis presented in our Second and Third Interim Reports, and also present some new findings based on our recent research. We draw on data obtained from telecommunications consultants, as well as strategy documents of individual telecommunications companies.

In section 4.4 we draw out the main territorial patterns uncovered in this chapter.

4.1 Territorialities of broadband[35]

The importance of broadband to economic development is being stressed by policymakers across the world's advanced economies[36]. Particular attention is paid to its role in improving competitiveness. Europe, as a whole, lags behind some other advanced economies, including South Korea, Canada, Hong Kong and Taiwan, though Europe's leading countries in terms of broadband uptake (Denmark, Sweden, Belgium, Austria and the Netherlands) are ahead of the United States and Japan[37].

In Europe the importance of broadband has been recognised by the Commission as well as by most Member State governments. The Barcelona European Council called upon the Commission to draw up an eEurope action plan focusing on the widespread availability and use of broadband networks throughout the Union by 2005.

[35] There is no universally accepted definition of broadband. There is for example considerable debate as to what level of bandwidth constitutes broadband. We consider this issue in Annex 8.
[36] See OECD (2001a) 'The Development of Broadband Access in OECD Countries', for a review of developments and the position of European countries in a global context.
[37] See ITU (2003) Top economies by broadband penetration, 2002. http://www.itu.int/home/

Subsequently, the eEurope Action Plan 2005 suggested that "the widespread availability of broadband access at competitive prices" is an essential enabler in meeting the Plan's main objectives which are: to provide a favourable environment for private sector investment and for the creation of new jobs, to boost productivity, to modernise public services, and to give everyone the opportunity to participate in the global information society. The expectations of broadband are that it will support (and stimulate) a range of services including videoconferencing, high speed data transfer and instant and cheap access to pictures, music and text (multimedia) over the Internet. Stimulating these services, however, is not straightforward, as is recognised in the Action Plan:

> Developing new services needs significant investment, most of it from the private sector. But there is a problem: funding more advanced multimedia services depends on the availability of broadband for these services to run on, while funding broadband infrastructure depends on the availability of new services to use it (CEC, 2002e, p.2).

In addition to the stimulation of content, competition is seen as a key factor in creating markets for broadband (OECD, 2001a; 2003). There is also recognition, however, that there are likely to be territorial disparities in access to broadband if left solely to the market. The Action Plan specifically addresses the question of broadband access in less favoured regions stating that:

> 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) (CEC, 2002e, p.17).

Recent guidelines from the Commission have stressed the importance of geographical targeting and suggest that the main focus of intervention should be rural and remote areas[38].

4.1.1 A meso-micro scale perspective on broadband roll-out

Looking first at broadband supply, it is possible to draw a relatively clear *general* picture of early roll-out trends, with common patterns evident across most countries. With the exception of a couple of countries, however, we were not able to access the data which would allow us to explore the fine-grained patterns which we know exist in respect of these new technologies, particularly DSL. Here, the key question is which exchanges have had DSLAMs (Digital Subscriber Line Access Multiplexers) installed, or in other words, have been DSL-enabled.

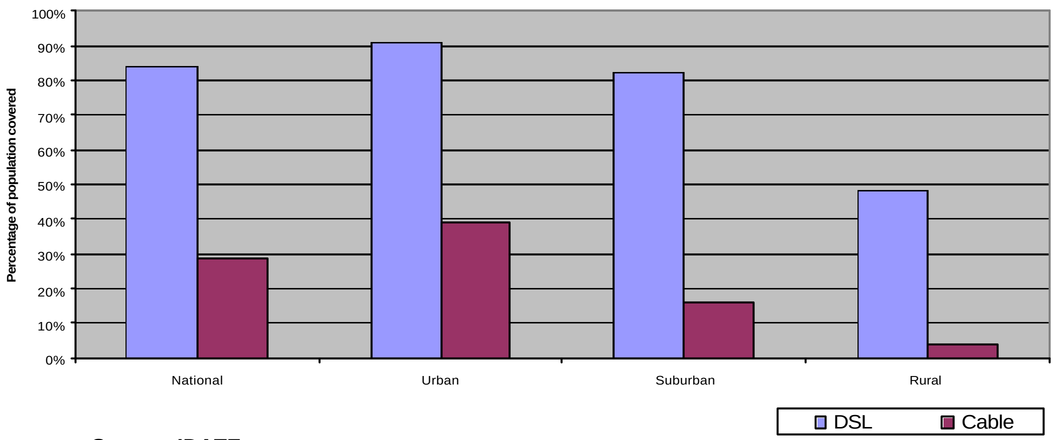
Table A9.1 in annex 9 is based on our analysis of a report by the consultant Point Topic, supplemented by our own interviews and analysis of other data derived from our national studies. It covers incumbent roll-out of DSL (initially the dominant providers of DSL) and in a few cases competitor networks. The table shows that, *by and large, and as we would anticipate, the incumbent first invests in the largest urban areas and then rolls out upgrades in smaller cities and towns*. In some places firms are targeted first. New entrants follow a similar strategy, targeting firstly the unbundled exchanges of the main cities. Thus, in the French case, local loop unbundling has so far largely reflected the dominance of key cities and their large business users as the main (initial) drivers behind the development of telecommunications networks and services, being mostly restricted to Paris, Lyon and Marseille, "although we have succeeded nevertheless in creating a kind of ADSL dynamic, which looks like it will continue" (Guillaume Gibert, ART, personal interview, June 2003; see also Rutherford, 2004, for analysis of the situation in Paris).

[38] Guidelines for discussion were recently put forward by the Commission: CEC (2003f) Guidelines on Criteria and Modalities of Implementation of Structural Funds in Support of Electronic Communications: Commission Staff Working Paper (SEC (2003) 895), Brussels 28.7.2003.

The table gives a general view of the rollout process and indicates that new technologies with nodal properties will follow a hierarchical roll out pattern. Our interview and survey work largely confirmed this trend and it was generally acknowledged that rollout was occurring in areas of high density population. In France, for example, the development of broadband access has been concentrated in dense, urban areas. This is shown by the fact that the 74% of the population which do have access to broadband live on only 21% of the French territory, and that these areas have a population density of 330 inhabitants per square kilometre, whereas the national average is only 95 inhabitants per square kilometre. The 26% of the population without broadband access live in zones where the density decreases to only 32 inhabitants per square kilometre (ORTEL, 2003).

Figure 4.1: DSL and cable modem coverage by locality in EU15

Figure 1 - DSL and cable modem coverage in the EU 15
December 2003



Source: IDATE

NOTE: Calculations are based on the following definitions

Urban areas: areas with population density > 500 inhabitants/Km²

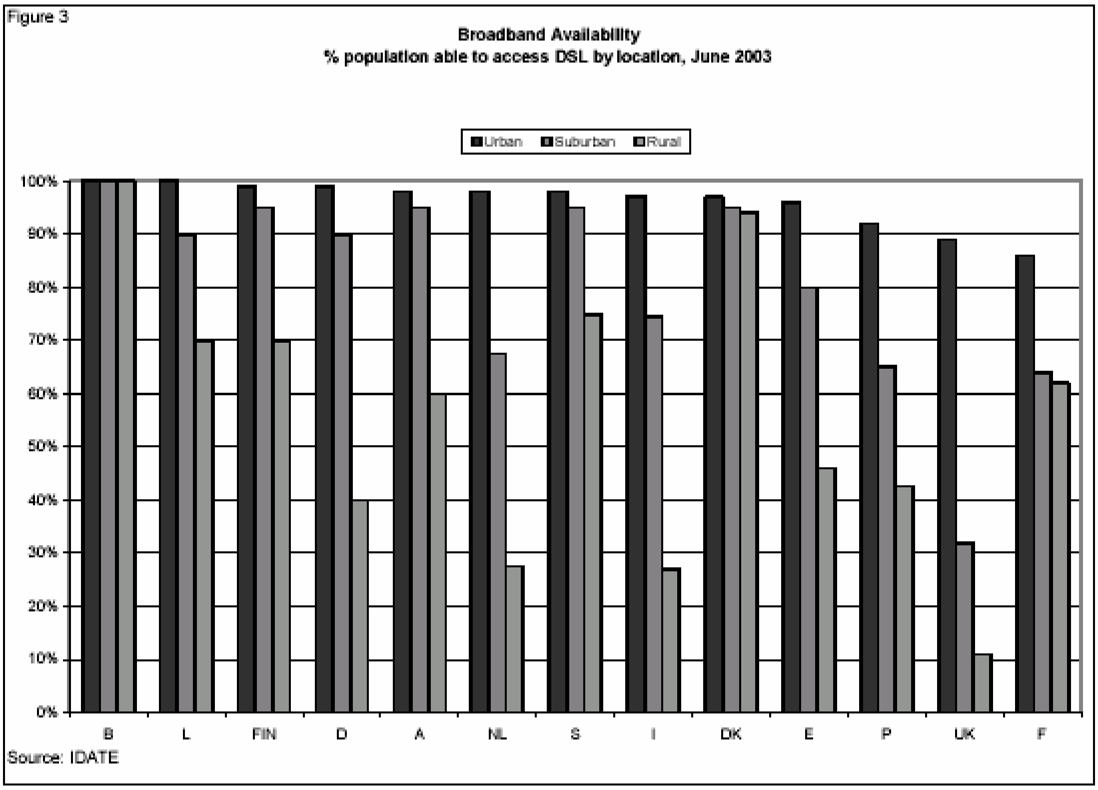
Suburban areas: areas with population density between 100 and 500 inhabitants/Km²

Rural: areas with population density < 100 inhabitants/Km²

Coverage: percentage of population in each area depending on switches equipped for DSL (include those living too far away from the switch to be reached) and/or living in houses passed by an upgraded cable.

Source: CEC (2004b)

Figure 4.2: Broadband DSL availability by locality in EU15 member states

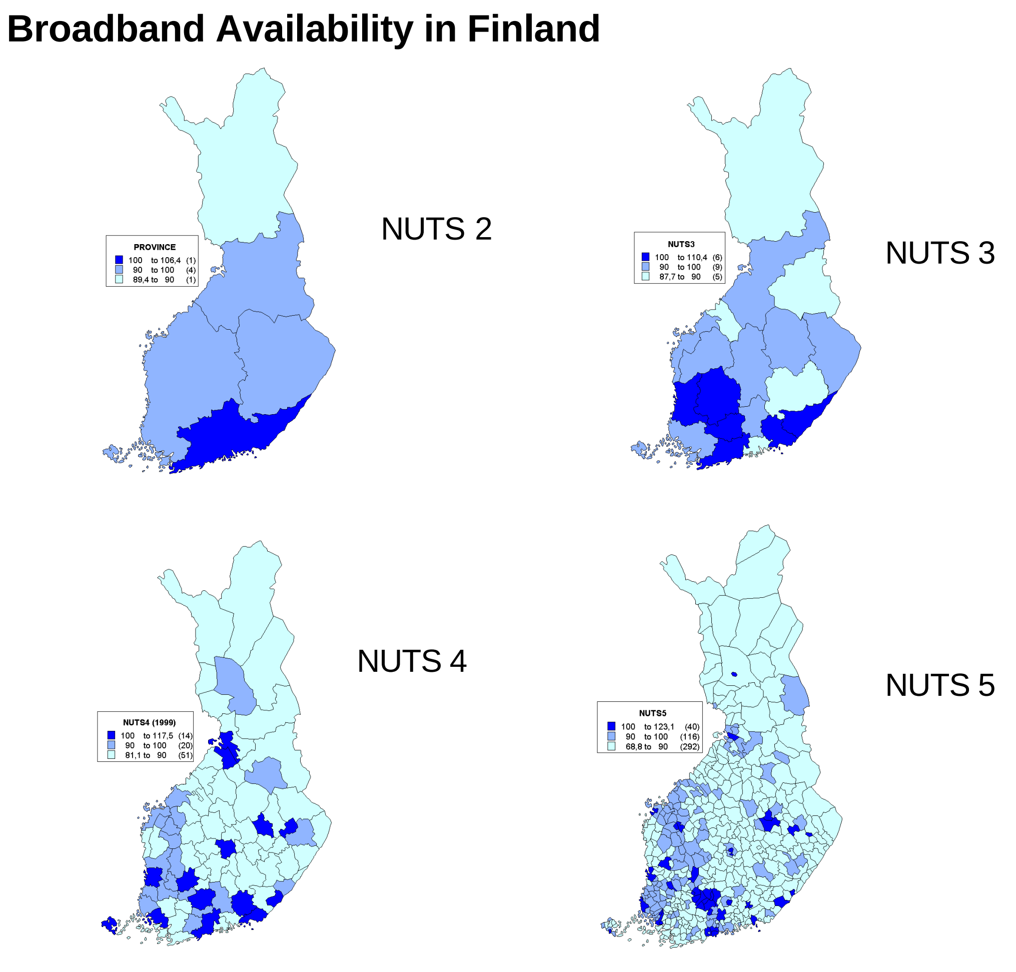


Source: CEC (2004a)

Figures 4.1 and 4.2 provide further evidence for the 'urban bias' of broadband roll-out to date. In figure 4.1, on an EU15 level, both DSL and cable modem can be seen to cover urban areas more than rural areas, although DSL is also widely available in suburban areas. In figure 4.2, all countries except Belgium have a higher proportion of their populations covered by DSL in urban areas compared to suburban and rural areas. Generally, however, the gap between urban and rural areas in DSL coverage varies between countries. In Belgium, DSL covers 100% of the population, so there is no urban-rural divide in DSL availability. The gap is very small in Denmark, while in Sweden, Luxembourg and Finland, at least 70% of the population living in rural areas is covered by DSL. In contrast, the urban-rural gap is widest in the UK, Italy and the Netherlands, with less than 30% of the population living in rural areas in these countries having DSL access (indeed, the figure is only just above 10% for the UK), compared to almost or above 90% of the population in urban areas.

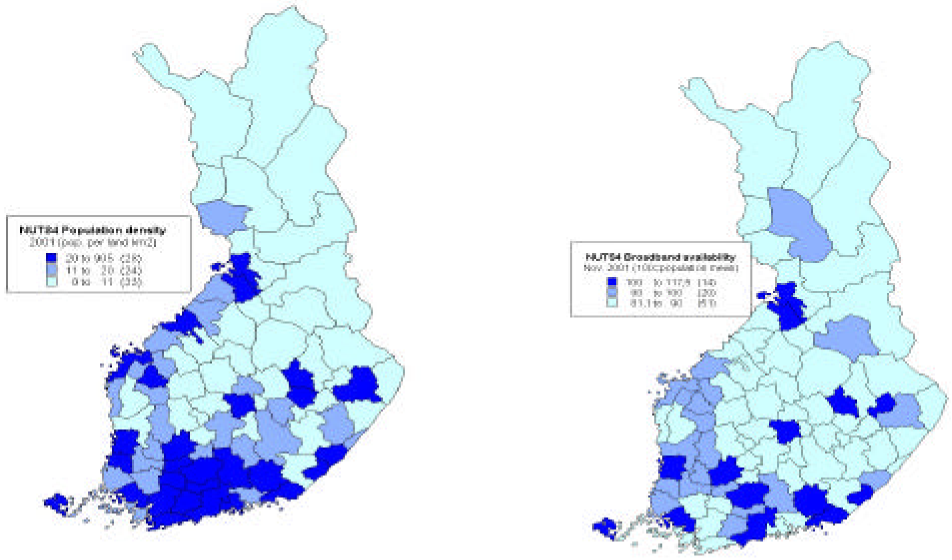
Figure 4.3 shows the importance of considering telecommunications territoriality at the lowest possible spatial scale. The figure maps data for broadband availability (not uptake) for ADSL, cable modem, fibre and WLAN in Finland. When mapped at NUTS 2 level (Province), three regional bands are shown with highest penetration in the south. When mapped at NUTS 5 level, however, it becomes clear that there is no generalised regional effect at all, and that densely populated areas fare better than more sparsely populated areas in all regions. In fact, the roll out of broadband follows the network of cities in Finland (see figure 4.4). Apparent regional variations in broadband coverage are, therefore, explained primarily by their different composition of urban and rural areas. This is supported by our findings from other countries (see figures A4.2-A4.4 in annex 4).

Figure 4.3: Broadband availability in Finland (mapped at NUTS levels 2-5)



Source: Finnish Ministry of Transport & Communications Survey (2001); mapped by Karelian Institute

Figure 4.4: Population density (left) and broadband availability (right) in Finland at NUTS 4 level



Source: Finnish Ministry of Transport & Communications Survey (2001); mapped by Karelian Institute

For technical and cost reasons, ADSL and cable technologies are unlikely to reach all areas of Europe in the foreseeable future. It may be that the territorial coverage of these services can be increased as costs fall and new technologies develop. On the public subsidy side, a number of initiatives are under way. These are considered in chapter 6 on policy. For some rural places, however, DSL and cable may not be the most suitable technologies.

Alternative broadband technologies

As suggested above, the current most commercially-developed technologies have been primarily rolled out in urban or densely populated areas. Some commentators have argued that another group of technologies – wireless-based technologies – will be the answer to providing broadband to those areas which are unlikely to be covered by ADSL and cable modem, and that if supply side intervention is to occur it would be better directed at these technologies. Wireless technologies include Fixed Wireless Access (FWA), wi-fi (wireless fidelity) or RLAN (radio local area network), satellite and

UMTS. One of the main arguments for investment in these wireless technologies is that they are in some ways cheaper to roll-out than ADSL and cable modem. Notably, they do not incur the expensive engineering costs which the latter technologies require. It should be noted, however, that wireless networks are based either on satellite or terrestrial infrastructure. In the latter case, they do ultimately rely on access to fixed networks and a ‘full-cost’ model would have to take this into account. In the case of satellite, the costs of launch and maintenance would also have to be factored in. We turn now to briefly explore three of these alternative technologies – satellite, Fixed Wireless Access (FWA) and wi-fi – and their potential to bring broadband to underserved areas[39]. These technologies can be seen as complementary rather than necessarily competing.

Satellite technology remains the type of communications infrastructure theoretically most adapted to serving the most remote areas, transmitting communications over extremely long distances, and covering large geographical areas, with rural areas falling within their ‘footprint’ as well as urban areas. Although use of the current ‘geostationary’ satellites for telecommunications remains limited for reasons of cost, new low Earth orbit satellite networks (Skybridge and Teledesic) should offer more potential and lower costs for broadband communications access in zones where other types of network are infeasible. Satellite technologies allow businesses and domestic consumers to download information (e.g., from the Internet) via a satellite. In effect, the satellite broadcasts the information and a decoder filters out the information not required by the consumer. Satellite provides high bandwidth access to information, with download capacities of up to around 2 Mbit/s, though again access is offered on a shared basis and real speeds may be much slower. Further, the consumer must still rely on a fixed line (analogue modem, ISDN, ADSL, or cable modem) or increasingly a wireless (wi-fi) connection for outward communications, i.e., communicating with their ISP.

Fixed Wireless Access (FWA), or the wireless local loop, is a form of radio communication like mobile telephony, but connects two fixed locations rather than offering mobile access, thus normally guaranteeing a certain level of bandwidth. This

[39] Examples of local strategies using these technologies can be found in section 4.4 of our TIR – http://www.espon.lu

infrastructure has tended to be targeted so far at (small) business users, frequently in urban areas, largely because of the cost of network deployment, which has restricted extension to residential users. In Canada, however, the government has released large amounts of spectrum, which together with the enthusiasm of remote rural communities to embrace FWA, is expected to lead to growth in residential users (ITU, 2003).

Wi-fi (wireless fidelity) or RLAN (radio bcal area network) is a local wireless network using the 2.4 GHz frequency and requiring a multidirectional antenna, connection equipment and an access point. 10-12 users (per access point) with wi-fi cards in their computers can thus obtain bandwidth of 6-7 Mbit/s. Although the network range is initially limited to a few hundred metres, interconnecting local networks is possible via another antenna with a range of up to 30 kilometres. Nevertheless, wi-fi still necessitates a connection between the local network and a broadband backbone, which may limit its potential for territorial development. In France and in Ireland[40], there are examples of where satellite access has been used to provide this broadband connection, particularly for rural and mountainous zones.[41]

Private sector rollout of wireless infrastructure has either taken the form of fixed network providers extending their network and service coverage through the creation of wireless LANs, or new Wireless Internet Service Providers (WISPs) developing their own fixed wireless networks to compete with DSL and cable modem services (OECD, 2004). A recent OECD report on broadband access in rural and remote areas argues that the emergence of these WISPs has been so 'vigorous' that it is challenging traditional paradigms concerning the high cost and lack of demand obstacles to rural telecommunications provision and suggests that there are examples of wireless broadband offers in rural areas in many countries which are providing relatively inexpensive and high performance broadband access (OECD, 2004). As a result, the report argues, public sector intervention becomes increasingly unnecessary. It is not clear, however, that all these WISPs are operating on a pure market basis. For

[40] See, for example, the South West Broadband initiative discussed in chapter 6.
[41] Emerging WiMAX (Worldwide Interoperability for Microwave Access) technology is being seen as a good complement and extension to wi-fi by offering backhaul of hotspots and WLANs to the Internet, and a wireless alternative to DSL and cable modem for broadband access in the last mile. It is a wireless Metropolitan Area Network offering high data rates, with a range of up to 50 kilometres, and not requiring the user to be in direct line of sight of a base station.

example, several of the WISPs discussed in the UK section of the report[42], are or have been subsidized, at least in part, by the public purse. We would suggest, therefore, that it is far too early to assume from limited evidence that the market, buoyed by technological alternatives, is 'working' in remote and rural areas in providing multiple broadband services. In chapter 6, we provide examples of policy intervention in this domain of wireless infrastructure in remote or rural regions which have resulted from lack of market broadband offers. Alternative wireless broadband technologies do hold out hope for remote and rural areas, but demand stimulation and public intervention are still likely to play an important role in their development in a majority of these areas at least initially.

4.1.2 A macro-scale perspective on broadband uptake

In the previous section we described the early patterns of broadband roll-out, that is to say, *supply*, in Europe, which, to date, has mainly involved DSL and cable modem technologies, and considered how other technologies may impact on these patterns. In this section and the following sections (4.1.3 and 4.1.4) we consider the patterns of broadband uptake at the macro, meso and micro scales in line with our analysis of mature technology adoption in Chapter 3.

Overall rates of broadband penetration remain relatively low in comparison to other more mature technologies. There are, nevertheless, already significant differences in the degree of broadband penetration across Europe. As can be seen in map 4.1, *there is a rough north-south divide, with northern countries taking the first four places. There is also a west-east divide.* The situation is, however, complex. Not all northern countries come in the top cohort and it is notable that the southern (cohesion) countries Spain and Portugal had higher penetration than France and the United Kingdom in 2002. Similarly, some new Member States have higher rates of penetration than certain EU15 countries. Malta, Estonia and Slovenia outstrip France, the UK and Italy, whilst Cyprus, Hungary, Lithuania and Latvia all have higher levels of penetration than Ireland and

[42] Four of the six companies listed in table 3 on page 46 of the report which we could locate had received public sector support.

Greece. The N12 countries for which ITU did not provide data in 2002 (Bulgaria, Czech Republic, Poland and Romania) had not yet rolled out DSL or cable modem broadband or had begun to do so only shortly before the 2002 data was published. All would have less than 1 per cent penetration. Based on figures from 2001 we would expect Norway to be in the mid-range.

Map 4.1: Broadband subscribers per 100 of population 2002

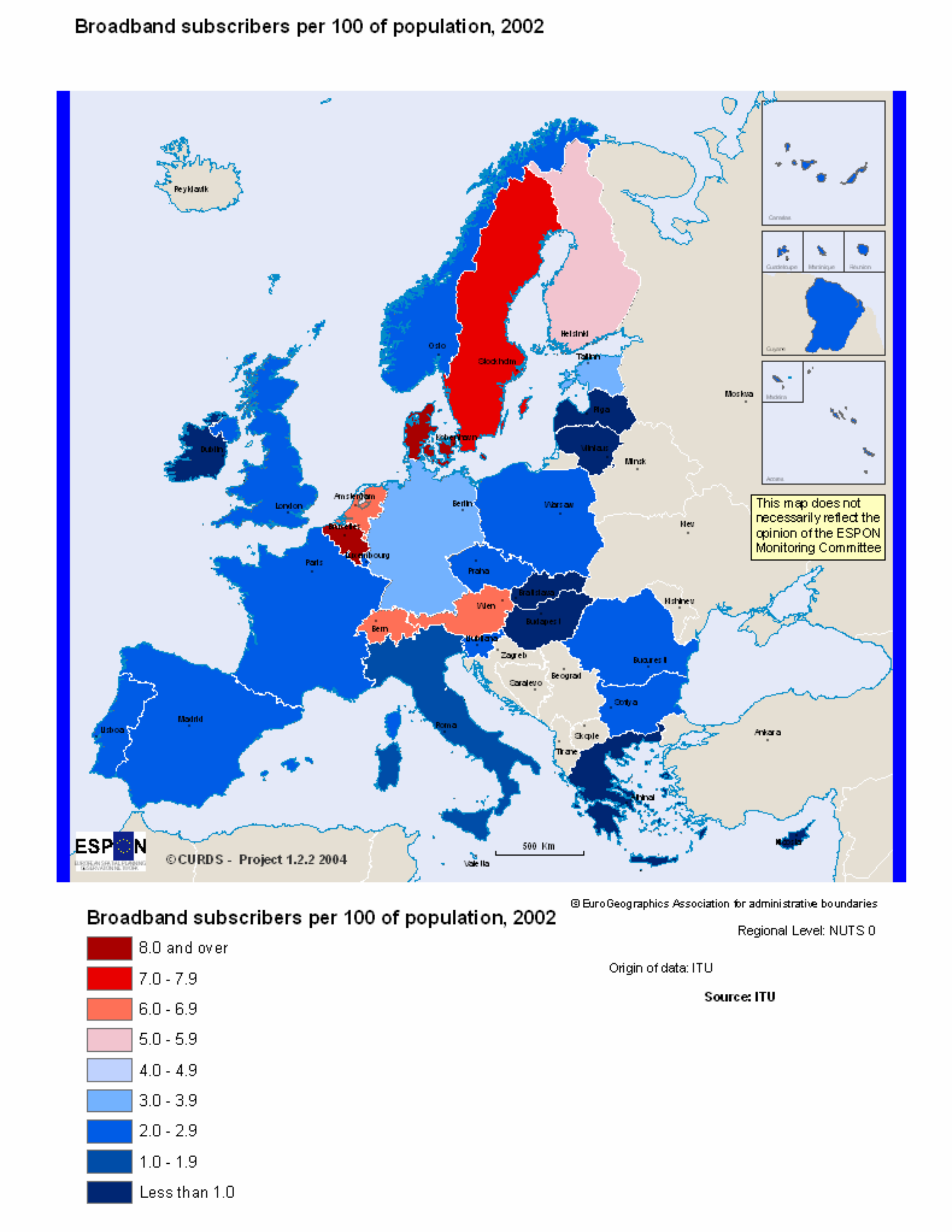
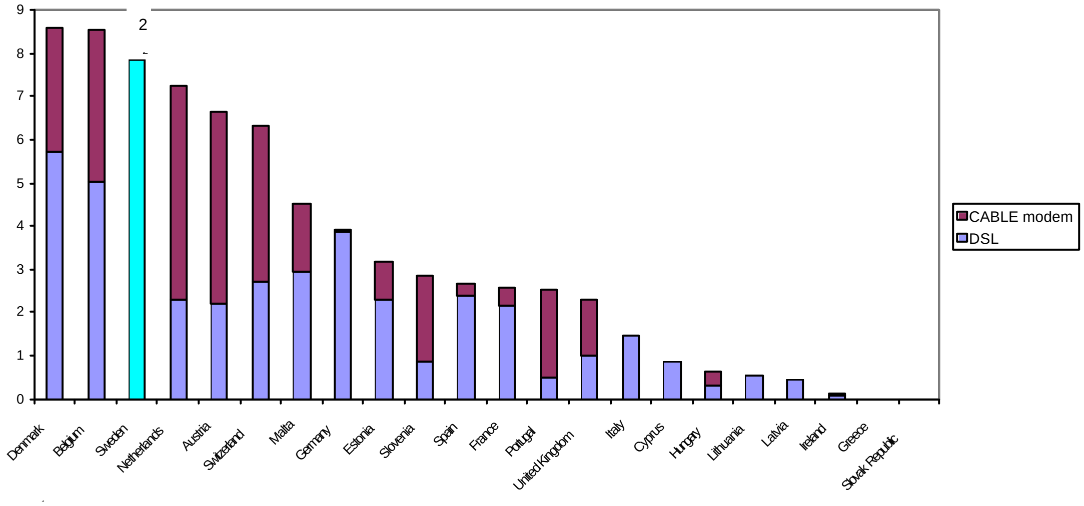


Figure 4.5 distinguishes between DSL and cable modem and shows that they have different degrees of penetration within individual countries. In the Netherlands, Austria

and Switzerland, for example, the relatively high rates of broadband penetration are associated primarily with cable modems rather than DSL. The ITU data from 2002 suggests that cable modem has a significant presence in most countries. Recent evidence suggest that for EU15, at least, DSL is growing more rapidly than cable modem, with DSL representing 74% of total connections and cable accounting for 22% of connections (CEC, 2004b).

***Figure 4.5: Proportion of population subscribing to broadband (DSL & cable modem) in European countries in 2002*[1]**



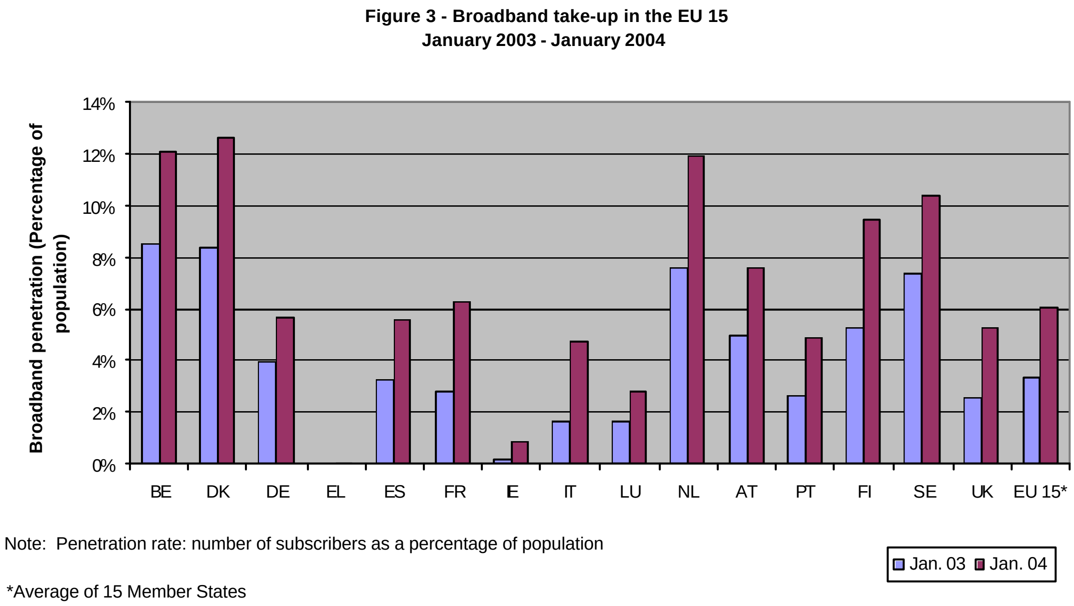
1 No figures available for Finland, Bulgaria, Czech Republic, Luxembourg, Norway, Poland, Romania.

2 Figures for Sweden are not broken down by technology and represent all broadband subscribers (DSL & cable modem). In 2001, 68% of total was accounted for by DSL.

Source: Data supplied by ITU through personal correspondence, charted by CURDS

Although we do not have more recent figures from ITU to allow us to compare growth rates across EU27+2, recent preliminary figures issued by the European Commission, based on e-benchmarking surveys suggest that penetration rates are continuing to grow at least in EU15 (Figure 4.6) and that broadband had begun to take off in those countries which had low or zero penetration (Ireland and Greece) in 2002. The figures are not directly comparable to the ITU data, but show similar patterns.

Figure 4.6: Growth in broadband take-up in the EU15, January 2003 – January 2004



Source: CEC (2004b)

4.1.3 A meso-scale perspective on broadband uptake

Turning to look at the uptake of broadband at the meso level, we are now able to draw on data from the INRA (2002) household survey to explore the situation for the EU15 countries. This survey measured both the proportion of households with Internet access and broadband Internet access, and the principal means of these households of accessing the Internet (dial-up, DSL, cable, etc.).[43] The data broadly confirms the territorial patterns from the ITU data with Nordic and Benelux countries, plus Austria being the most advanced, with Greece and Ireland the least advanced.

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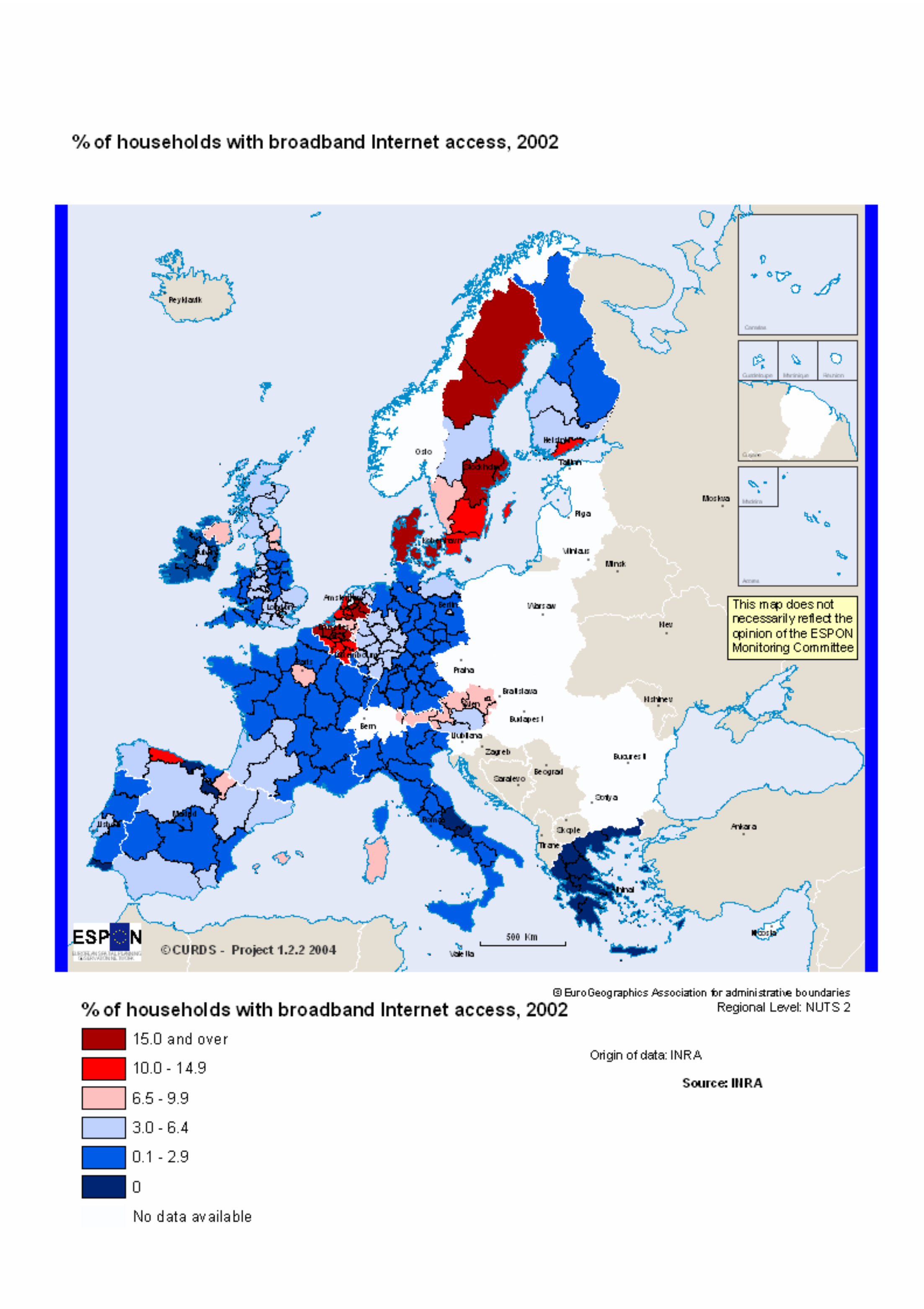
[43] see Annex 5 for analysis of household uptake of broadband DSL and broadband cable.

Map 4.2: % of households with broadband Internet access 2002



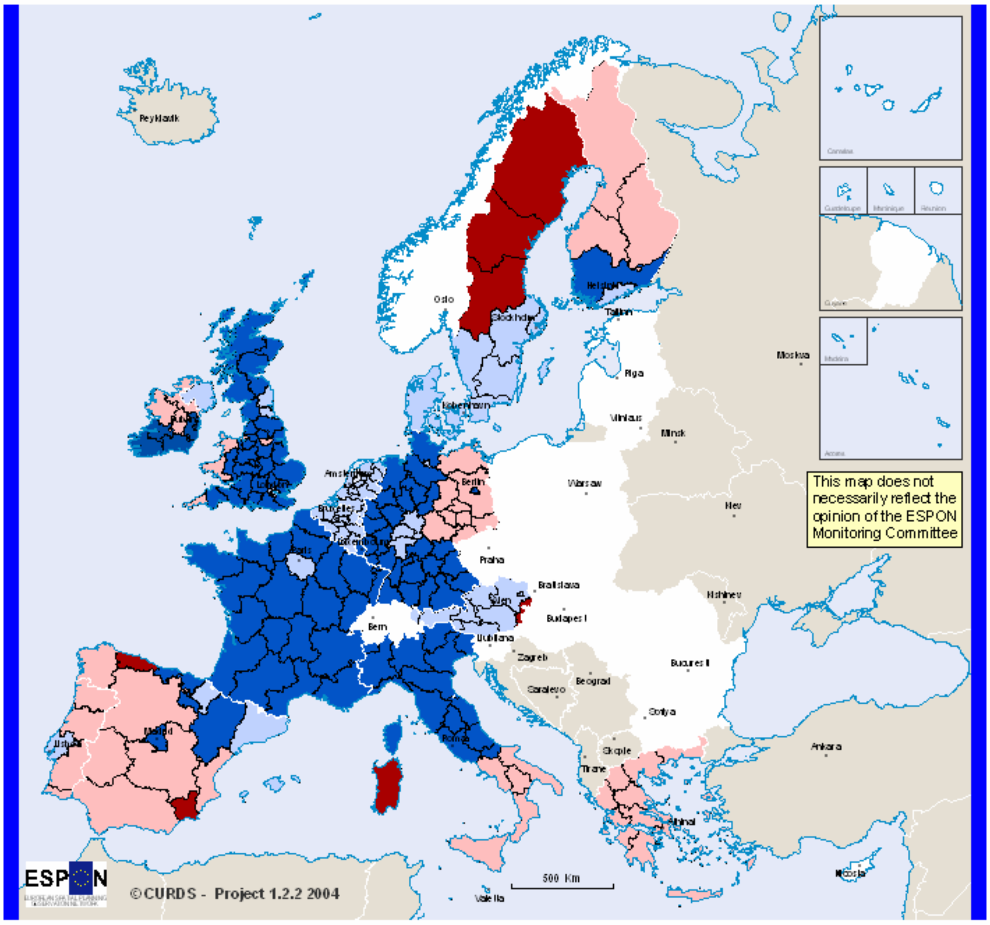
Map 4.2 shows broadband Internet access for EU15 regions according to the 2002 INRA household survey. The major pattern is that broadband uptake shows a Benelux and Nordic focus, conforming to general views of these two regions as the most advanced telecoms regions of Europe. As for Internet access, southern regions (particularly Greek) are lagging for broadband uptake. There is therefore a clear north-south European split in 'Internet and broadband culture' which must be addressed if a certain level of territorial cohesion is to be achieved.

When we plot these regional uptake figures against particular general socio-economic-geographic variables[44], we can suggest that, as for Internet access, on the whole, *the European regions with the highest levels of broadband uptake tend to be non-Objective 1, have relatively high GDP levels, be quite densely populated with large urban centres, and core Pentagon regions, although Swedish regions again form the primary exception to the rule*. The graphs below suggest, nevertheless, that the relationship between broadband and the four socio-economic variables is not as strong as for overall Internet access. In addition, very few of the top broadband regions are in the top GDP category, while peripheral, non-Pentagon Nordic regions are also prevalent near the top of the broadband classification.

[44] See footnote 16 in chapter 3 for details of the origin of these variables.

Map 4.3: Household broadband penetration and Objective 1 status

Household broadband penetration and Objective 1 status



© EuroGeographics Association for administrative boundaries
Regional Level: NUTS 2

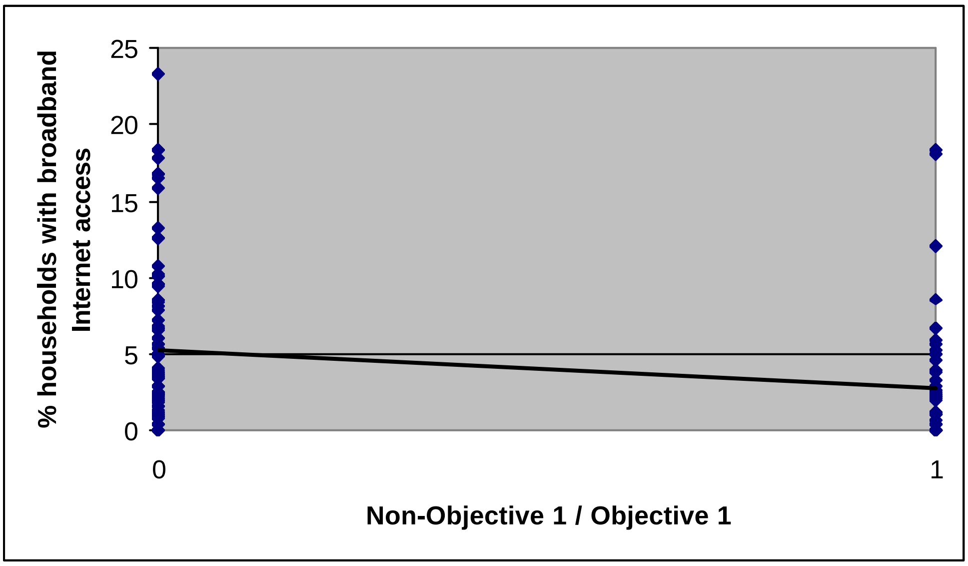
Origin of data: INRA

Source: ESPON Data Base

Household broadband penetration and Objective 1 status

- Objective 1 regions above average
- Objective 1 regions below average
- Non-Objective 1 regions above average
- Non-Objective 1 regions below average
- No data available

Figure 4.7: The relationship between broadband Internet access at home and Objective 1 status in EU15 regions (mean = 5)

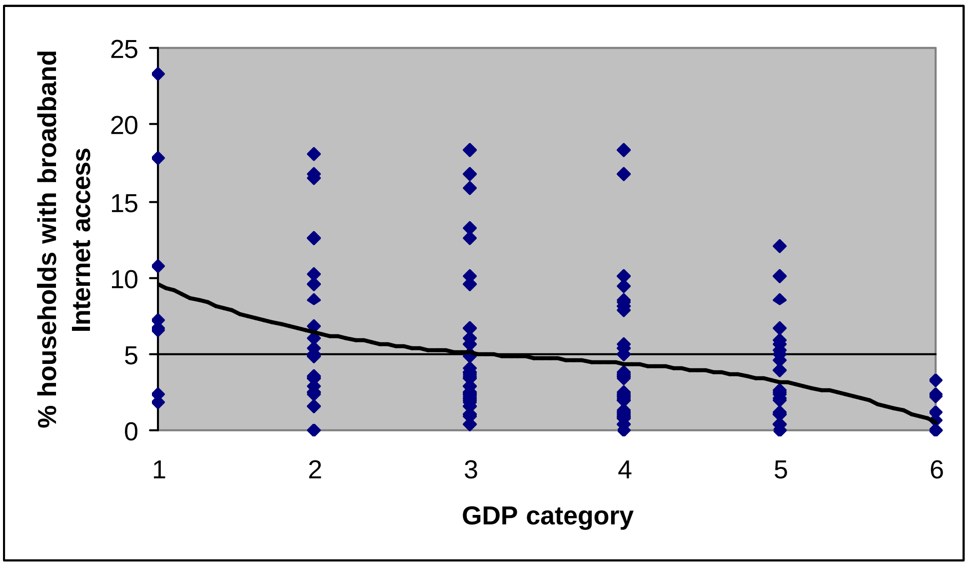


Source: CURDS; based on data drawn from INRA (2004)

Map 4.3 and figure 4.7 show that *the majority of regions with highest broadband penetration are non-Objective 1 regions*. The main exceptions to this are the two Swedish regions of Övre Norrland and Mellersta Norrland (2nd and 6th respectively) and the Spanish region of Principado de Asturias (20th).

At the other end of the table, although it is not surprising to find Greek, Italian and Portuguese Objective 1 regions with broadband penetration rates of either 0% or less than 1%, there are almost as many non-Objective 1 regions with similar rates – Abruzzo and Molise, which have high Internet use, have 0% broadband penetration; Cantabria and La Rioja in Spain; and, most surprisingly (and probably due to an error in the data), Bremen.

Figure 4.8: The relationship between broadband Internet access at home and GDP category in EU15 regions (mean = 5)

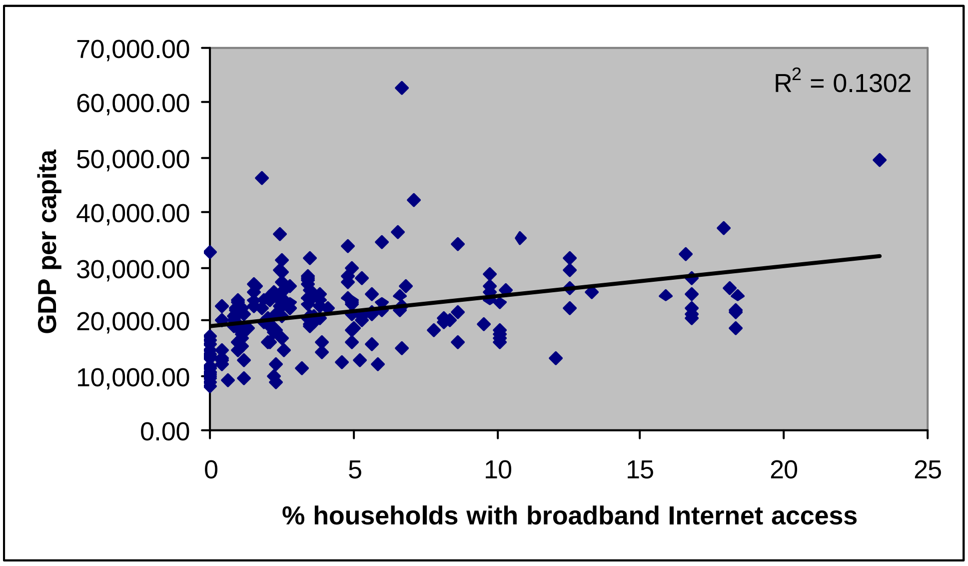


Source: CURDS; based on data drawn from INRA (2004)

Figure 4.8 shows that although there are few regions with low GDP amongst those with the highest broadband penetration, there are also few regions with the highest GDP levels here. Bruxelles, Stockholm and Uusimaa are the only three of the top 30 broadband regions in the top GDP category. Principado de Asturias and the two Belgian regions of Namur and Hainaut also have broadband penetration above 10%, whilst having relatively lower GDP levels.

Most of the regions with the lowest broadband penetration rates also have the lowest GDP levels (Greek, Portuguese and southern Italian regions), although Bremen has a relatively high GDP and 0% broadband penetration. Luxembourg, with broadband penetration of just 1.8%, is the lowest top category GDP region on the broadband indicator.

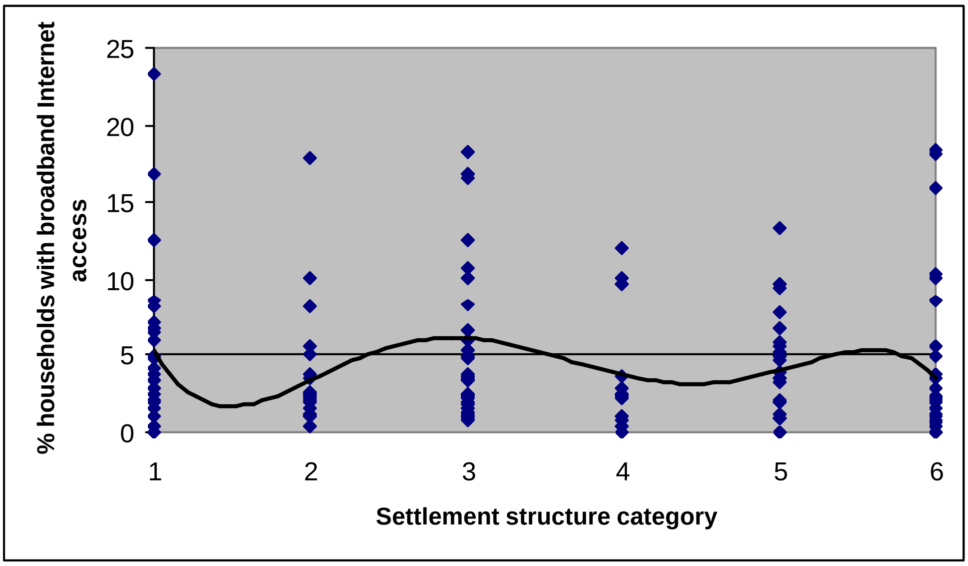
Figure 4.9: The correlation between household broadband penetration and GDP per capita



Source: CURDS; based on data drawn from INRA (2004)

The rather limited relationship between household broadband penetration and GDP per capita can be seen in figure 4.9 which compares regional broadband and GDP per capita levels. Although the trend line suggests a positive relationship, the gradient of the line is only slight, and the regions are spread out well above and below the line. We can see that several of the most prosperous regions in GDP terms are not among the most advanced broadband regions, while there are also several less prosperous regions with broadband uptake rates of between 15-20%. The low R^2 value reflects the weakness of the relationship, and should be compared with a higher R^2 value for the relationship between Internet access and GDP per capita (in chapter 3 earlier).

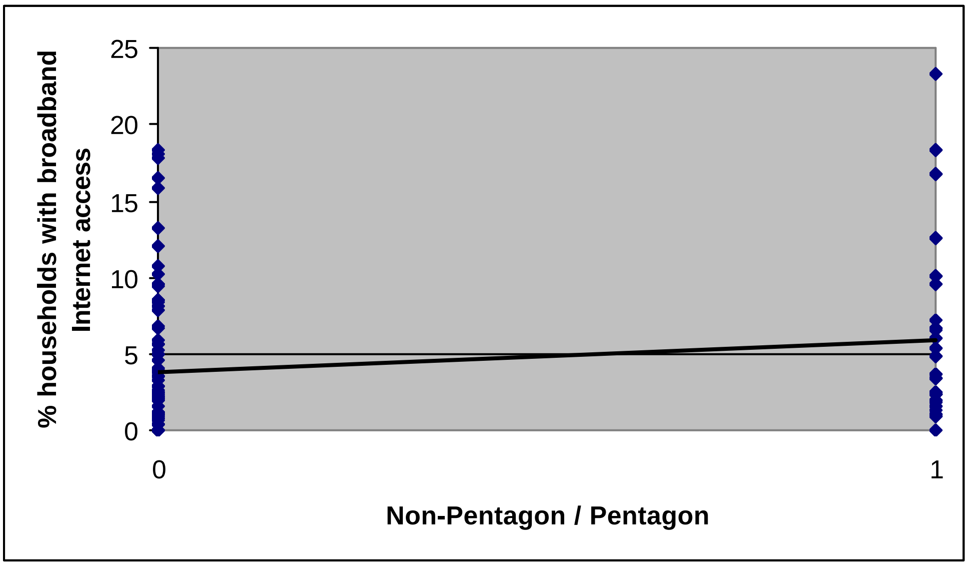
Figure 4.10: The relationship between broadband Internet access at home and population density/urban status in EU15 regions (mean = 5)



Source: CURDS; based on data drawn from INRA (2004)

Figure 4.10 shows that the regions with the highest broadband uptake range from very densely populated regions with large centres (Bruxelles, Antwerpen, Noord-Holland, Zuid-Holland) to less densely populated regions without centres (Swedish regions, plus the Belgian region of Luxembourg). The Benelux dominance here means that many are quite densely populated nonetheless. Most of the regions with lowest broadband uptake are less densely populated regions in southern Europe, although the presence in this group of the very densely populated regions of Bremen, Attiki, Lazio and Campania is quite surprising.

Figure 4.11: The relationship between broadband Internet access at home and Pentagon location in EU15 regions (mean = 5)

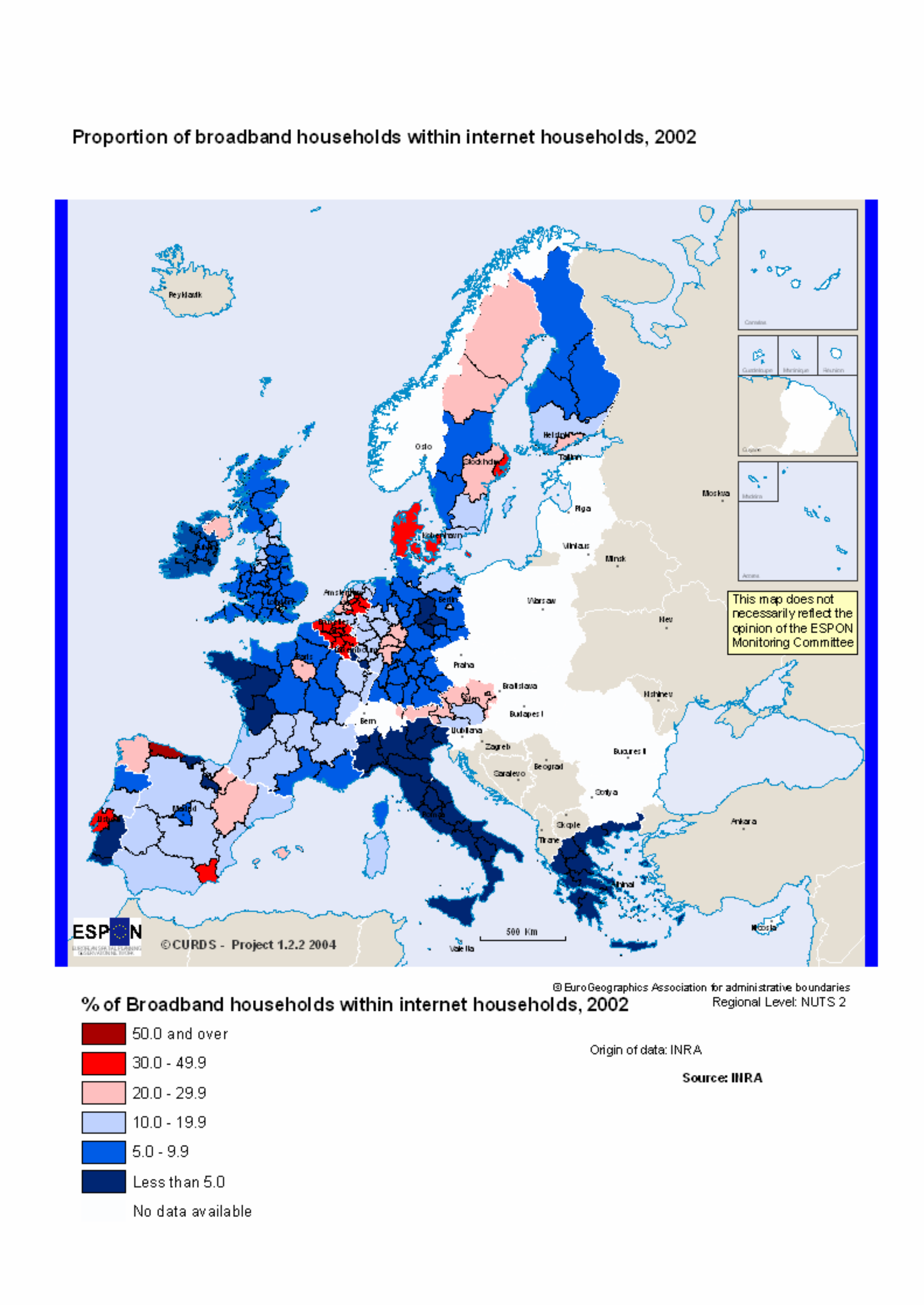


Source: CURDS; based on data drawn from INRA (2004)

Figure 4.11 shows that although there are many Benelux regions among those with highest broadband uptake, and thus many Pentagon regions, there are also a number of non-Pentagon regions with broadband penetration above 10% - Swedish regions, Danmark, Principado de Asturias, Uusimaa.

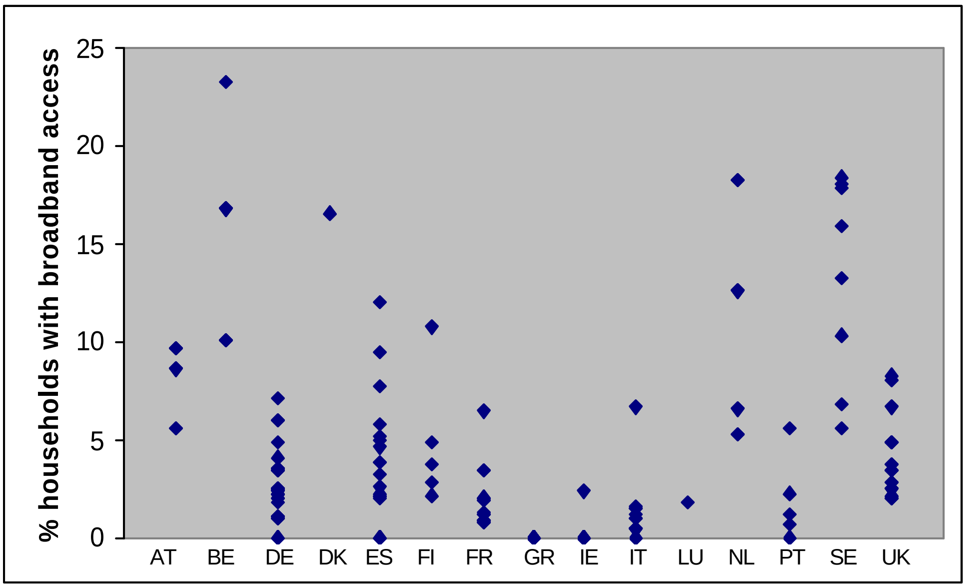
By contrast, given the southern European dominance of regions with low broadband uptake, only Bremen and the French regions of Champagne-Ardenne, Picardie, Haute-Normandie and Bourgogne represent Pentagon regions with less than 1% broadband penetration.

Map 4.4: Proportion of broadband households within Internet households 2002



By comparing the INRA figures for overall Internet access at home and *broadband* Internet access at home, we obtain an indication of which EU15 regions have the highest and lowest levels of broadband Internet connections as a proportion of all Internet connections (map 4.4). Two regions stand out as having very high proportions of broadband Internet access in relation to total Internet access, indicating a high level of broadband awareness/uptake amongst their populations – Bruxelles and Principado de Asturias. In both these regions, well over half the people who access the Internet at home do so via broadband connections. Other Belgian regions, together with Région de Murcia and the Dutch regions of Overijssel, Gelderland and Flevoland follow on this indicator. At the other end of the scale, whilst Abruzzo and Molise have high Internet access at over 50% of the population, 0% of this access takes place through broadband. Other Italian regions appear to have similar difficulty in upgrading much of their Internet access to broadband Internet access – only around 1% of Internet access in Puglia, Basilicata and Calabria is broadband.

Figure 4.12: The level of 'national effect' in broadband Internet uptake in EU15 regions



Source: CURDS; based on data drawn from INRA (2004)

Figure 4.12 and table 4.1 explore the regional broadband Internet uptake data from a national perspective by plotting the regions in their country groupings. *Broadband Internet access appears to be the indicator on which there is the greatest level of regional variation within countries, in comparison with the technologies considered in chapter 3*, perhaps reflecting the significant urban-rural and large city-rest of country divides which have tended to emerge initially in the relatively early stages of broadband roll-out. Even Sweden does not escape this territorial variation this time, although paradoxically, the largest country in EU15, Germany, has much less regional variation for broadband access than other countries and compared to its wide variations on more mature technologies discussed in chapter 3.

Despite some level of emerging relationship, our socio-economic-geographic categorisations did not prove to be particularly useful discriminants of regional broadband uptake, at least not when compared to the analysis of variance results for PC and Internet adoption (see annex 7 for a table of analysis of variance results). Regional broadband uptake to date seems to reflect more a combination of the spatial focus of initial supply-side roll-out and the above national policy and cultural contexts.

Table 4.1: Extent of 'spread' of regional differences in broadband Internet uptake at the meso national level

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
BE	■	■				
DK*	■					
DE			■	■	■	■
GR						■
ES		■	■	■	■	■
FR			■	■	■	
IE					■	■
IT			■	■	■	■
LU*					■	
NL	■	■	■	■		
AT			■	■		
PT				■	■	■
FI		■	■	■	■	
SE	■	■	■	■		
UK			■	■	■	

* Countries which are NUTS 2 at national level

Source: CURDS; based on data drawn from INRA (2004)

4.1.4 A micro-scale perspective on broadband uptake

Unsurprisingly given our observations above on early broadband roll-out patterns, *when we look at broadband uptake at the micro-scale there are clear disparities between metro, urban and rural areas. These disparities are greater proportionally than for the 'more mature' technologies discussed in chapter 3*, as table 4.2 shows.

Table 4.2: Index of technology penetration in households by locality type

Technology	*EU avge = 100*	*Metro*	*Urban*	*Rural*
Fixed[1]	100	100	100	100
Mobile	100	101	100	99
PC	100	104	104	96
Internet	100	109	103	91
Broadband Internet	100	160	100	60

Source: CURDS; elaborated from INRA (2004)

(note:1 includes traditional fixed, ISDN and or DSL)

Looking first at the aggregate data, 5 per cent of all households in EU15 have broadband Internet access, with 8 per cent of households in metro areas having broadband. Five per cent of households in urban areas have broadband Internet, in line with the EU15 average, but only 3 per cent of rural households do. Although the percentage point differences are still relatively small given the early stage of roll-out, table 4.2 emphasises that when these differences are expressed as indices of the EU average, the metropolitan-rural distinction is very pronounced in relative terms.

If we look at individual countries (see table 4.3), metro localities lead in all EU15 member states, generally by a significant margin, with uptake in urban areas generally taking second place. Only in two countries (Spain and Ireland[45]) does urban uptake outstrip that in metro areas. Rural areas lag metro areas in all countries and surpass

[45] Little can be read into the Irish figure. When the INRA study was undertaken only 0.4 per cent of households in Ireland accessed the Internet via broadband. All these households were in urban areas. Urban areas mainly comprise 'urban towns of over 1500 people', but also 'Rest of Dublin'. The figures may, therefore, reflect a publicly-funded pilot project in an urban town (or towns) or early commercial investment in a prosperous Dublin 'suburb'.

urban areas in only one country (Belgium). There appears to be no *systematic* relationship between degree of roll-out in a country and equality of access by locality type (see table 4.3).

Table 4.3: Proportion of broadband household penetration by locality type (figures express the data as an index of the national figure)

% of households	Broadband uptake position in EU15	TOTAL	TYPE OF LOCALITY			
			Metro	Urban	Rural	Metro -rural gap
EU15		**5 (*100*)**	**8 (*160*)**	**5 (*100*)**	**3 (*60*)**	**100**
Danmark	1	17 (*100*)	21 (*124*)	15 (*88*)	14 (*82*)	42
Belgium	2	15 (*100*)	17 (*113*)	14 (*93*)	15 (*100*)	13
Sverige	3	13 (*100*)	17 (*131*)	16 (*123*)	7 (*58*)	73
Nederland	4	12 (*100*)	19 (*158*)	12 (*100*)	5 (*42*)	116
Österreich	5	8 (*100*)	14 (*175*)	9 (*112*)	4 (*50*)	125
Finland	6	6 (*100*)	14 (*233*)	5 (*83*)	2 (*33*)	200
United Kingdom	7	4 (*100*)	7 (*175*)	4 (*100*)	2 (*50*)	125
Espana	7	4 (*100*)	4 (*100*)	6 (*150*)	3 (*75*)	25
Deutschland	9	3 (*100*)	4 (*133*)	3 (*100*)	2 (*66*)	67
Portugal	9	3 (*100*)	7 (*233*)	3 (*100*)	2 (*66*)	167
France	9	3 (*100*)	5 (*166*)	1 (*33*)	0.1 (*3*)	163
Luxembourg	12	2 (*100*)	3 (*150*)	2 (*100*)	1 (*50*)	100
Italia	13	1 (*100*)	2 (*200*)	2 (*200*)	1 (*100*)	100
Ireland	14	0.4 (*100*)	0 (*0*)	0.4 (*100*)	0 (*0*)	-
Ellada	15	0 (*100*)	0 (*0*)	0 (*0*)	0 (*0*)	-

Source: CURDS; elaborated from INRA (2004)

4.1.5 Summary on the territorialities of broadband

In summary, the main findings with respect to the territorialities of broadband deployment and uptake are as follows:

- At the macro-scale, a 'north-south divide' is evident in the degree of broadband penetration in Europe, but not clear cut. While the Nordic and Benelux countries lead the way for broadband uptake, Spain and Portugal, for example, had higher penetration than France and the UK in 2002. There is variable performance in the N12 countries. Malta, Slovenia and Estonia have relatively high levels of broadband penetration, while in Bulgaria, the Czech Republic, Poland and Romania, broadband deployment had not yet commenced.

- At the meso-scale high levels of broadband *uptake* are usually associated with non-Objective 1 status, relatively high levels of GDP, more densely populated regions, and core locations – although Swedish regions are very much exceptions to these rules, being at the forefront of broadband uptake in Europe. Broadband uptake varies rather widely between regions within countries, probably reflecting the relatively early stage in the deployment of broadband networks.
- At the micro-scale it is clear that the *deployment* of broadband usually begins in the largest urban areas, followed by smaller cities and towns. Apparent regional variations in broadband coverage within a country seem to reflect primarily the composition of regions in terms of metropolitan, urban and rural areas. For rural areas, satellite and wireless-based alternatives to DSL or cable broadband offer interesting possibilities. A micro-scale perspective on broadband *uptake*, suggests metropolitan-urban-rural disparities are greater than for the mature technologies examined in chapter 3.

4.2 Territorialities of e-commerce

Although the household and population uptake of technologies such as the Internet are very significant in terms of participation in the Information Society, it can be argued that from an economic development perspective it is the uptake and usage of ICTs by *enterprise*s, including SMEs, that is of prime importance in contributing to competitiveness. Although there is a distinct lack of regional level data, Eurostat began to undertake comparable pilot surveys of e-commerce at the Member State level for EU15 in 2001[46], and there have been two further pilot surveys, which include Norway

[46] See Eurostat's Statistics in Focus, Industry, Trade and Services, Theme 4 -12/2002 for a discussion of these surveys, in which 13 Member States participated, and for preliminary results. It should be noted that the survey is of enterprises with 10 employed persons or more, and thus misses out the very smallest enterprises. The results of this survey were reported in ESPON 1.2.2 Third Interim Report, section 3.7 Territorial variations in the business use of ICT. This report is available at http://www.espon.lu. The survey was undertaken again in 2002 and 2003. The results for 2002 were reported on in E-commerce and the Internet in European businesses (2003). Selected results for 2003 have been reported in

and Iceland[47]. These studies, of course, do not cover the N12 countries, nor do they cover Switzerland. Data has emerged since our Third Interim Report which allows us to explore the growth in the use of ICTs by enterprises in the N12 countries (EU Acceding and Candidate Countries/CEC, 2004), and we do so below. As the data is drawn from different sources using different methods and approaches, however, comparisons presented here should be seen as indicative and care should be taken when drawing conclusions.

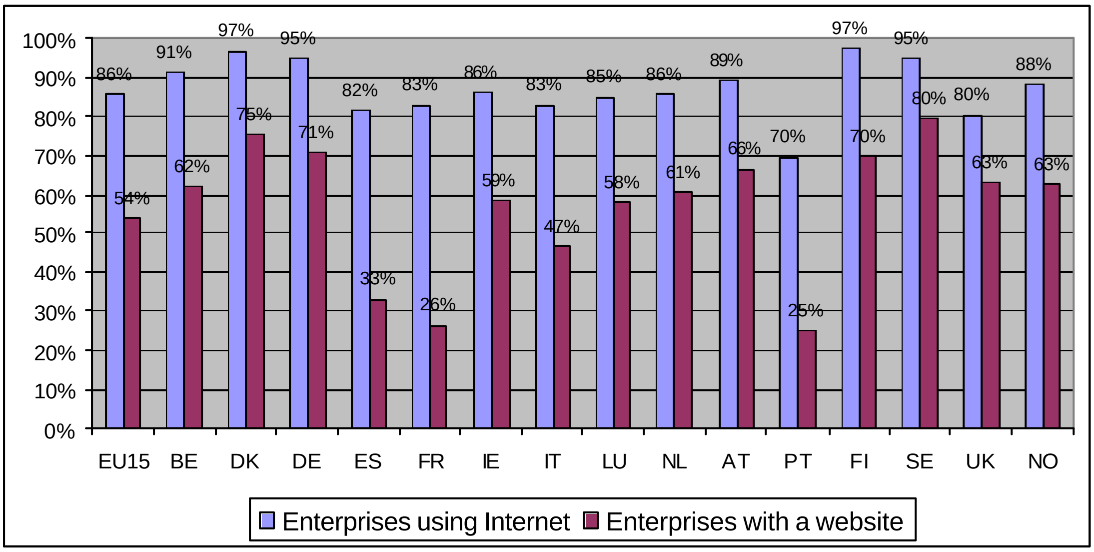
E-commerce can be defined as the trading of goods and services over computer-mediated networks, such as the Internet. Because e-commerce uses an electronic interface for exchanging and processing information, it offers the possibility at least of overcoming some of the geographically-defined obstacles to commerce in peripheral or low density regions. Although much of the focus of media interest in e-commerce has been on so-called 'business-to-consumer' (B2C) applications, with the on-line bookseller Amazon.com being one of the exemplars and indeed survivors from the dot.com crash of the late 1990s, it is actually in the field of 'business-to-business' (B2B) e-commerce that the most significant growth in markets has been demonstrated.

Eurostat's Statistics in Focus, Industry, Trade and Services, Theme 4 -16/2004. The studies were designed to cover EU15 and then were extended to include Norway and Iceland.

[47] We wish to thank Morag Ottens from Eurostat for providing us with additional data not included in the reports mentioned in footnote 46 above.

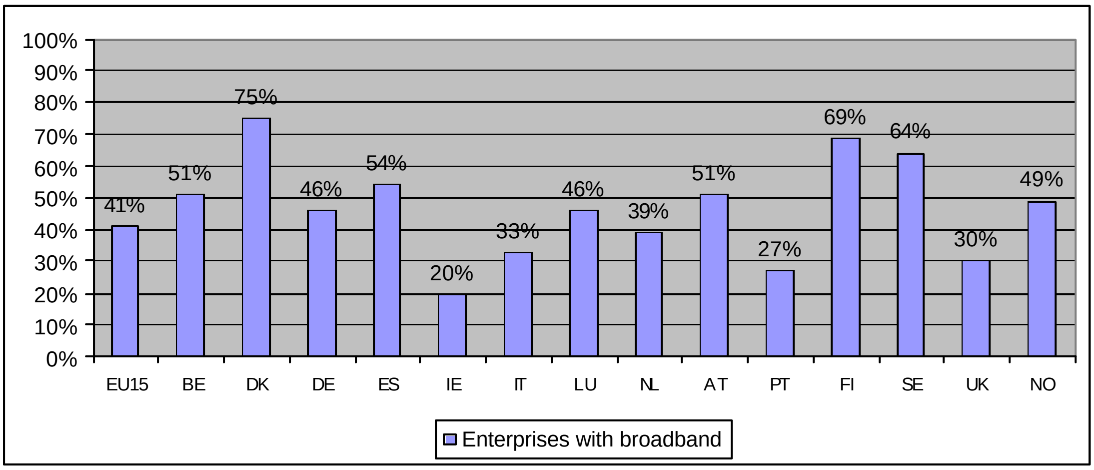
4.2.1 A macro perspective on e-commerce

Figure 4.13: Internet and website penetration in EU15 enterprises



Source: Eurostat personal communication. No data for GR.

Figure 4.14: Broadband penetration in EU15 enterprises



Source: Eurostat Statistics in Focus Theme 4 – 16/2004. No data for FR and GR.

Looking first at the situation in EU15 in figures 4.13 and 4.14, we can see that at the end of 2002, 86% of enterprises had Internet access and 54% had their own website[48],

[48] Internet access and firms with own website exclude Greece which, based on figures for 2002, we would expect to reduce the EU15 average.

whilst 41% of enterprises had broadband access (Ottens, 2004)[49]. These European averages disguise considerable variation between member states. In summary, the following patterns can be discerned:

- The highest levels of enterprises *using the internet* were found in Finland, Denmark, Sweden, and Germany, all well above 90 per cent. The lowest levels were found in Portugal, which, at 70%, is well below the level of the next lowest country, the UK at 80% (see Figure 4.13)[50];
- The highest levels of enterprises with their *own websites* were found in Sweden, Germany, Denmark and Finland, while very low levels were recorded in Spain, Italy, France and Portugal (see Figure 4.13);
- The highest level of firms with *broadband* were found in Denmark, Finland and Sweden. Interestingly, these countries are followed (at some distance) by Spain, which outperforms most northern EU15 countries. The lowest levels were found in Ireland, Italy, Portugal and the UK (see figure 4.14).

When we turn to look at firms having implemented e-commerce, figures for the end of 2001 (CEC, 2003d)[51] show that in the preceding year 30% of enterprises which used the Internet had implemented e-purchasing, via the Internet, and 13% had made sales via the Internet.

- The highest incidence of *e-purchasing* was found in Sweden, Finland, Denmark, the UK and Germany, while the lowest levels were in Greece, Italy and Spain;
- The highest incidence of *e-sales* was found in Denmark, the Netherlands, Austria and Ireland, with the lowest in Italy, Greece, Spain and Portugal.

The pattern that emerges is remarkably consistent across the different categories and usages of e-commerce: the Nordic countries and Germany are making the fullest use of

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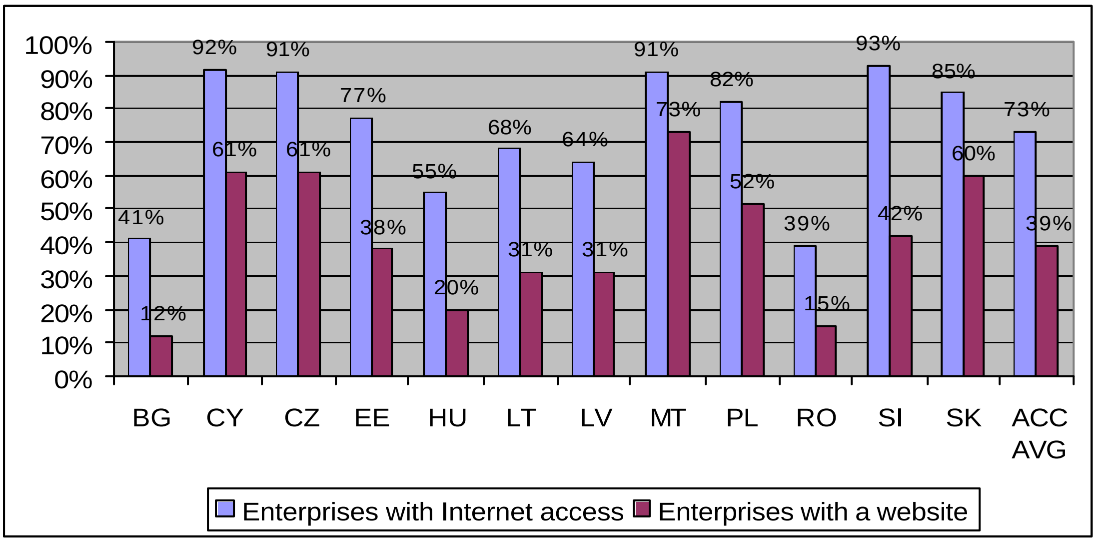
[49] Supplemented by personal communication with Eurostat (see footnote 47).

[50] Figures for Greece are not included. Based on data from previous years, we would expect Greece to have low levels of penetration.

[51] A separate measure is included in the E-commerce survey, namely, enterprises where e-commerce accounts for at least 1% of total. The result of this change is that the figure for firms purchasing over the internet was 12% and for those purchasing was 7%. See Eurostat's Statistics in Focus, Industry Trade and Services, Theme 4 – 16/2004 'Internet usage by individuals and enterprises'.

e-commerce as a tool of business competitiveness, while firms in Greece, Italy, Portugal and Spain are making very limited use of the new opportunities. There is then *evidence of a pronounced 'digital divide' between countries in EU15 in terms of their business usage of the Internet*, which is likely to have significant implications for regional development disparities.

Figure 4.15: Internet and website penetration in N12 enterprises



Source: EU Acceding and Candidate Countries/CEC (2004)

We now turn to briefly look at e-commerce in the N12 countries. If we first consider the indicators of Internet penetration and web-site presence and compare figures 4.15 and 4.13, it would appear that overall, as would be expected, the average rate for the N12 countries is below that of EU15, though the figures presented derive from different surveys and comparisons can only be regarded as indicative. As with EU15 there are significant differences across the N12. Indeed the spread is wider in N12 than in EU15. The leading N12 countries in terms of Internet penetration rates for enterprises, notably Slovenia, Cyprus, the Czech Republic and Malta, have rates above the EU15 average. At the other end of the scale Bulgaria and Romania have very low rates of penetration. A similar picture emerges in relation to website presence.

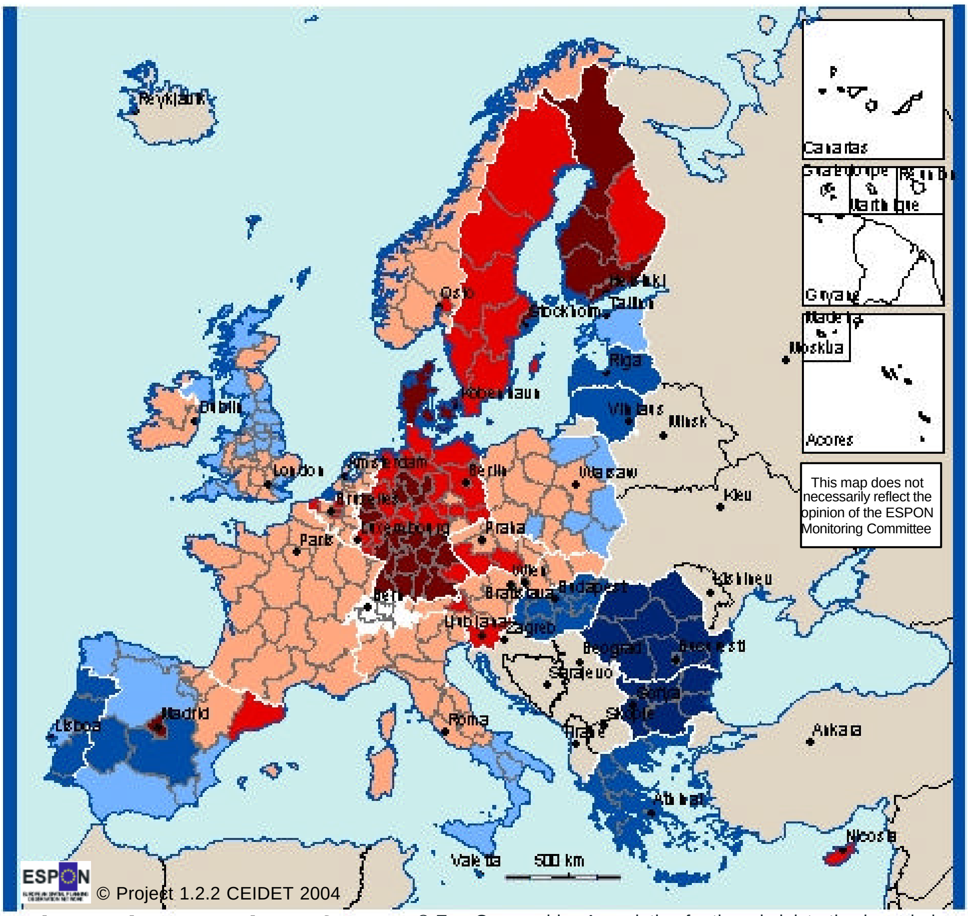
As indicated above, extreme care must be taken in making comparisons between the figures 4.13 and 4.15. Bearing this caveat in mind, the overall conclusion of the data presented in this section is that there are *clear north-south and east-west divides when it comes to the use of e-commerce by enterprises in Europe*. Within EU15 there are some northern countries, notably the UK, which fare poorly on some indicators, but the *clearest divide is between the northern (particularly the Nordic countries) and the Mediterranean countries*. Several N12 countries also appear to be outpacing the southern EU15 countries and indeed challenging other EU15 countries. So, although the N12 average falls well below EU15 on both indicators employed here, and although the least advanced countries are located within N12, the east-west divide is not altogether clear cut.

4.2.2 A meso perspective on e-commerce

Unfortunately, below the national level, there is a dearth of information available concerning regional variations in business usage of the Internet. In order to provide at least an indication of the regional patterns, we have applied regression modelling to provide estimates of missing regional data, using what data we have been able to collect, mainly at national levels, to calibrate the model. Using the proportion of firms with their own website as the dependent variable, 63.7% of the variance is explained by the independent variables, suggesting a reasonable basis for estimating the missing regional data (see annex 10 for a full methodology of this modelling exercise). Map 4.5 maps the estimated proportion of firms with Internet access for all of EU27+2 at NUTS 2 level.

Map 4.5: Estimated proportion of firms with Internet access

Estimated proportion of firms with Internet access 2003



© EuroGeographics Association for the administrative boundaries

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Estimated proportion of firms with Internet access 2003 (%)

- **More than 95**
- **90 to 94.99**
- **80 to 89.99**
- **70 to 79.99**
- **50 to 69.99**
- **Less than 50**
- **Data not available**

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Map 4.5 shows the estimated proportion of firms with Internet access for all of EU27+2 at NUTS 2 level. The highest estimated incidence of firms with Internet access (in excess of 95% of total firms) is to be found in the following regions: Bruxelles; Praha; four of the five Finnish regions (the exception being Itä-Suomi); around half of German regions led by Oberbayern, Hamburg, Darmstadt, Bremen and Stuttgart; Stockholm; Comunidad de Madrid; Danmark; and Bratislavský.

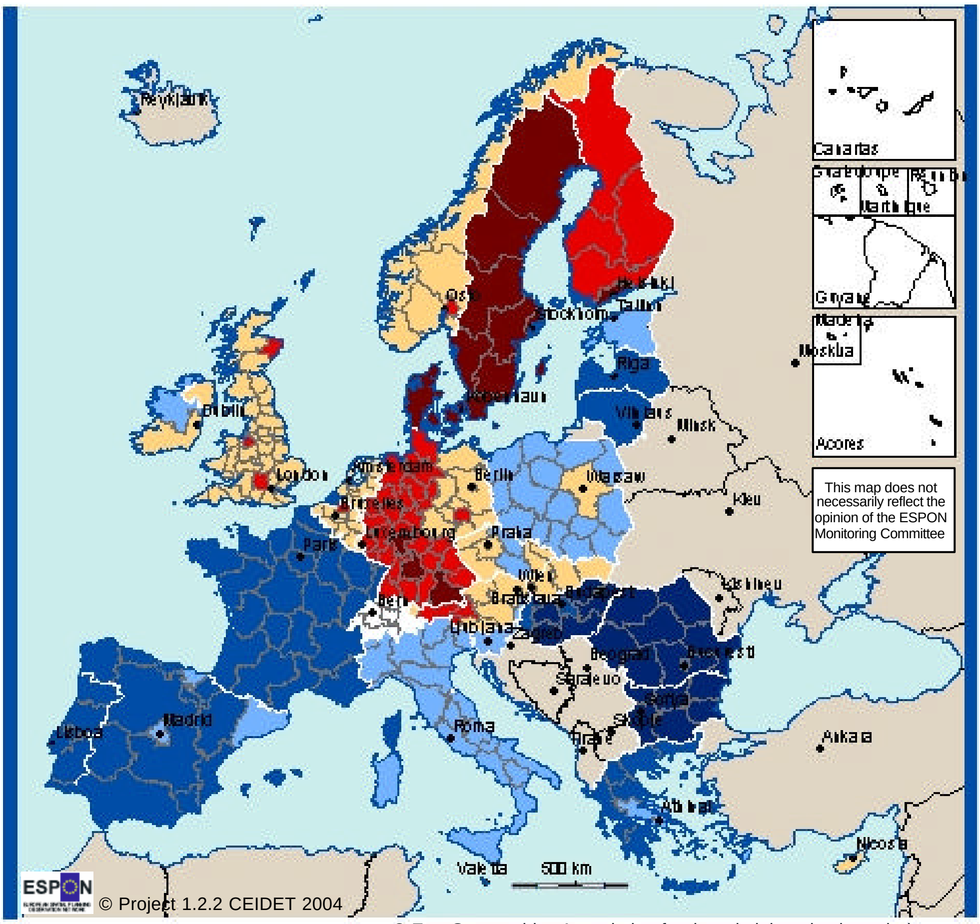
In the next category, with between 90% and 95% of firms estimated as having Internet access, are found: remaining German regions with the exceptions of Chemnitz and Dessau; Itä-Suomi; the seven remaining Swedish regions; the Belgian regions of Antwerpen, Vlaams Brabant, Brabant Wallon and West-Vlaanderen; Slovenija; Oslo Og Akershus; Kypros; Malta; the Czech regions of Jihozápad and Jihovýchod; Cataluña; and Salzburg.

Although there are, then, a wide range of regions represented in the top two categories of map 4.5, there are few regions represented from the southern 'periphery' (Italy, Greece and Portugal), apart from Comunidad de Madrid and Cataluña, and no regions from France, Ireland, the Netherlands or the UK. The absence of Dutch regions is particularly surprising, given their high household telecommunications penetration scores in the INRA survey. In spite of this, it is notable that there are some regions from N12 countries in these categories (Praha, Jihozápad and Jihovýchod from the Czech Republic; the Slovak region of Bratislavský; Slovenija; Kypros; and Malta).

The lowest estimated incidence of firms with Internet access (less than 50%) is found exclusively in all Bulgarian and Romanian regions. Just above these highly lagging regions in the second bottom category (50-70%) are all Hungarian regions; all Greek regions; five Portuguese regions (Algarve, Norte, Alentejo, Centro and Açores); the Spanish regions of Extremadura and Castilla-la Mancha; Lietuva; and Latvija. The relatively lagging status of many eastern and southern European regions for enterprise Internet access is, therefore, notable. Of the N12 countries, the Czech Republic, Slovakia, Slovenia, Cyprus, Malta, Poland and Estonia tend to display a higher estimated incidence of firms with Internet access than do Latvia, Lithuania, Hungary, Romania and Bulgaria (see annex 10 for the full results).

Map 4.6: Estimated proportion of firms with their own website

Estimated proportion of firms with own website 2003



Estimated proportion of firms with own website 2003 (%)

- More than 75
- 65 to 77.99
- 55 to 64.99
- 35 to 54.99
- 20 to 34.99
- Less than 20
- Data not available

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Map 4.6 shows the estimated proportion of firms with their own website for all of EU27+2 at NUTS 2 level. The highest estimated incidence of firms with their own websites (in excess of 75% of total firms) is to be found in the following regions: the Czech region of Praha; all 8 Swedish regions (Stockholm, Västsverige, Mellersta Norrland, Småland med öarna, Sydsverige, Norra Mellansverige, Östra Mellansverige and Övre Norrland); the German regions of Hamburg, Oberbayern, Darmstadt, Bremen and Stuttgart; the Slovak region of Bratislavský; the Finnish region of Uusimaa; the UK region of Inner London; and Danmark.

In the next category, with between 65% and 75% of firms estimated as having their own website, are found: the majority of remaining German regions led by Mittelfranken, Karlsruhe and Düsseldorf; the Belgian metropolitan regions of Bruxelles and Antwerpen; Malta; the Austrian regions of Tirol, Wien and Salzburg; the four remaining Finnish regions (Etelä-Suomi, Pohjois-Suomi, Väli-Suomi and Itä-Suomi); the Norwegian region of Oslo Og Akershus; and three other UK regions (Berkshire, Bucks and Oxfordshire, North Eastern Scotland and Cheshire). Although there are, then, a wide range of regions represented in the top two categories of map 4.6, there are no regions represented from the southern 'periphery' (Italy, Greece, Spain and Portugal), France, Ireland, the Netherlands, or any of the N12 plus Bulgaria and Romania, besides the Czech Republic, Slovakia and Malta. The absence of Dutch regions again is surprising.

The lowest estimated incidence of firms with their own websites (less than 20%) is found exclusively in the majority of Hungarian regions (with the exceptions of Közép-Magyarország and Nyugat-Dunántúl) and all Romanian and Bulgarian regions. It is also notable that all French regions (including Ile-de-France) are present only in the second bottom category, with estimated enterprise website presence of less than 30%. This is a marked difference from enterprise Internet access where all French regions were estimated as having moderately high scores. Of the N12 countries, the Czech Republic, Slovakia, Malta, Cyprus, Poland, Slovenia and Estonia tend to display a higher estimated incidence of firms with their own websites than do Latvia, Lithuania, Hungary, Romania and Bulgaria (see annex 10 for the full results).

4.2.3 Summary of the territoriality of e-commerce

In summary, the main findings with respect to the territorialities of e-commerce are as follows:

- at the macro-scale, in EU15 countries, a majority of enterprises have Internet access, over half have their own website, and almost half have access to broadband. There are, however, significant variations between countries, with the Nordic countries and Germany having the highest levels of e-commerce use and Mediterranean countries (Greece, Italy, Portugal and Spain) having the lowest levels. In N12 countries, on average, nearly three quarters of enterprises have Internet access and just over a third have their own websites, but there are also variations between countries, with Slovenia, Cyprus, the Czech Republic, Malta and Slovakia showing the highest levels, and Bulgaria and Romania the lowest levels. Overall, then, there are north-south and east-west divides in the use of e-commerce by enterprises, although some N12 countries appear to be challenging EU15 countries.

- at the meso-scale, the highest estimated proportion of firms with Internet access was found in the majority of German and Finnish regions, Danmark and major European city regions such as Bruxelles, Stockholm and Madrid (but not London or Paris), as well as Praha and Bratislavský. Dutch, UK and French regions were noticeably absent from the top categories here. The lowest estimated incidence of firms with Internet access was found in Bulgarian and Romanian regions, with Hungarian, Greek and Portuguese regions only just ahead of these. The highest estimated proportion of firms with their own websites was found in all Swedish regions, a number of German regions, Denmark, and a number of city regions (Inner London, Uusimaa, Praha and Bratislavský). Dutch and French regions were again noticeably absent. The lowest estimated incidence of firms with their own websites was found again in Bulgarian, Romanian and Hungarian regions, with all French regions surprisingly only just ahead of these.

4.3 Territorialities of pan-European fibre backbone access[52]

One of the most important shifts in telecommunications network development in competitive market environments across Europe in the last decade has been that from a predominant reliance on the national backbone networks of traditional incumbent operators to the emergence of a number of alternative infrastructures constructed by new entrant carriers, many on a 'pan-European' scale. This represents nothing less than a significant 're-scaling' of telecommunications in Europe, away from the dominance of inter-connected national networks run by individual national companies (or state-led incumbents), to a much more integrated mesh of pan-European networks run by multinational companies now looking to make their profits on a global scale rather than solely in their home base. This 'Europeanisation' of telecommunications, which resembles what was long the goal of EU telecommunications policy, has been driven, not only by the liberalisation of national telecommunications markets, but also by the emergence and rapid expansion of the Internet as the major means of transmitting the vast quantities of data communications which now make up a far larger proportion of all tele-communications than voice[53]. These pan-European networks allow, therefore, providers to offer their corporate and financial sector clients tailored and fully seamless, end-to-end telecommunications services between office locations in different countries, as well as either their own Internet service for business and/or domestic customers, or the possibility of selling wholesale bandwidth on their networks to major Internet Service Providers (ISPs) or indeed to other service providers which do not have the same network routes.

Our reasons for studying these infrastructures are two-fold. First, they reveal the territoriality of Europe from the perspectives of private sector infrastructure providers. These pan-European backbone infrastructures are deployed in largely liberalised environments, without territorial coverage obligations, and, as such, they reveal the demand for pan-European telecommunications services, as interpreted by the supply

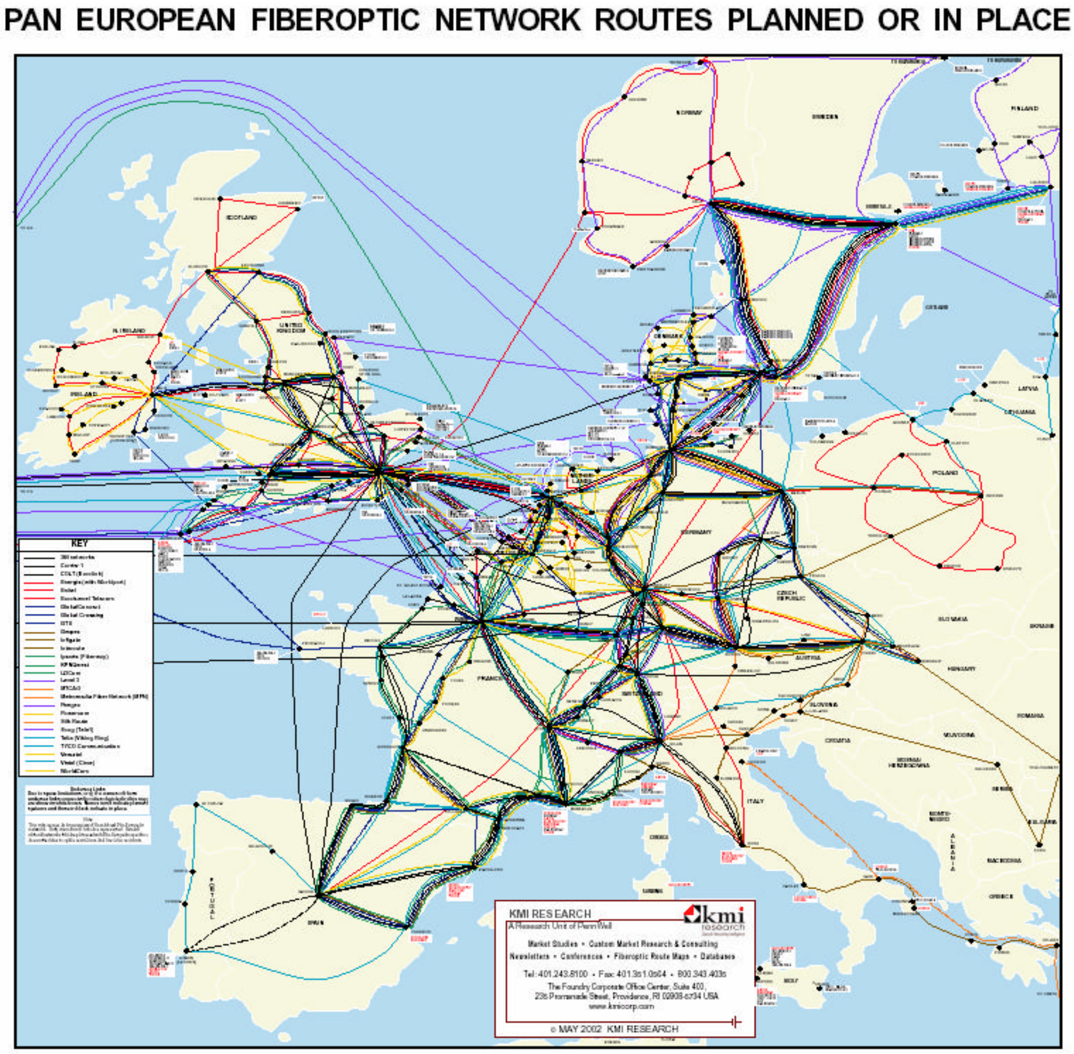
[52] More detailed analysis of the territorial trends of this form of network provision can be found in Chapter 5 of our Second Interim Report and Chapter 5 of our Third Interim Report.

[53] Internet communications over long distances are almost certain to travel much of the way on these new backbone infrastructures, with different proprietary networks inter-connecting at Internet Exchange Points located in the largest cities in each country.

side operators. Second, given the predilection of major companies for obtaining the greatest choice, highest quality and lowest cost of telecommunications services, the location and extent of this type of infrastructure clearly has significant territorial implications for the economic development and relative competitive advantage of the regions and urban centres of Europe. It is unlikely, for example, that a region without access to pan-European infrastructure would be able to attract substantial economic investment, because major companies are unlikely to locate in such a region. The presence of multiple networks offers firms direct access to the globally integrated networks and services of the biggest operators, offering higher quality and more secure infrastructure, and faster data communications. Equally importantly, higher levels of competition in infrastructure provision (through the presence of multiple networks) are likely to lead to reduced telecommunications costs. For those firms based in places where there is less choice of networks, or no networks at all, the converse is likely to be the case.

4.3.1 Territorial trends in access to pan-European networks

Figure 4.16: KMI's map of pan-European backbone infrastructures



Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

Figure 4.16 illustrates how non-incumbent telecommunications operators have rolled out (or intended to roll out) their pan-European networks[54] in recent years[55]. We can summarise the main territorial *disparities* emerging from this map as follows[56]:

[54] "KMI's definition of pan-European network includes those service providers that installed their own fiberoptic cable in more than one European country" (Personal communication from Patrick Fay, KMI Research, 21 March 2003).

[55] The map, produced by KMI, covers actual roll-out and intended roll-out by key pan-European network providers as of 3rd quarter 2001. The downturn in the telecommunications market a couple of years ago

- Most notably, we can identify that there is a broad 'three-level' core – intermediary region – periphery distinction at the macro scale with the largest number of networks focusing on a highly concentrated Pentagon zone roughly delimited by London, Paris, the Ruhr and Hamburg. Some of these networks also cover the wider Pentagon and other areas just beyond, but there are only a small number of networks extending to the periphery. It can clearly be seen that Greece, southern Italy, Portugal, Scotland, northern regions of the Nordic countries and eastern Europe (beyond Praha and Budapest) have little representation (see figures A4.7 and A4.8 in annex 4).

- Similar territorial patterns emerge at the meso scale, with the primacy of capital cities, such as London, and other large urban cities and regions, such as Milano, which host high level functions, set against the paucity of networks in peripheral regions such as the Highlands of Scotland or the Mezzogiorno. Germany would be an exception to this as its broad distribution of important cities across the national territory ensures fuller coverage (see figure A4.9 in annex 4). This suggests that new fibre optic telecommunications networks reinforce existing spatial patterns as companies seek to address large scale markets hosting large corporate users.

- At a micro level, spatial differences in accessibility to pan-European telecommunications infrastructure become frequently very stark indeed, dependent upon the regional presence of an urban node on one or more of these networks to avoid being subject to the 'tunnel effect'. The maps illustrate how gaping regional holes are left in the pan-European telecommunications 'web' by the deployment of networks along specific city-to-city infrastructure routes (e.g., motorways, railways) – for example, central France, central Sweden (see figure

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may mean that some of these networks were not built or the fibre not lit, although the situation has improved to some extent in recent months. The map does, however, give a clear indication of the territorial pattern of private sector investment in telecommunications by (mainly) non-incumbents during a period when the 'market was working'.

[56] The following network trends are largely confirmed by the maps of the Telegeography consultancy of total bandwidth capacities deployed between European cities (see figures A4.5 and A4.6 in annex 4). For more detailed analysis of inter-city bandwidth in Europe, see our Third Interim Report.

A4.10 in annex 4), and even central Germany (see figure A4.9 in annex 4). Other long distance networks might pass through regions, but without connecting nodes, because they have been customised to link two particular cities and not the places in between – for example, the Energis network between Madrid and Stockholm appears to stop only at Frankfurt am Main, and transatlantic networks being run from the USA into London do not connect cities in the south of Wales or western England. In this way, they are more like high speed trains or airline networks in terms of their network configurations than roads.

In addition to these general trends of territorial disparity, we can, however, also highlight some potentially more positive trends, which offer *opportunities* for promoting more polycentric development in Europe:

- Operators are also investing in cities outside the traditional European core, presumably as they see these cities as new or potential nodes capable of generating international traffic and perhaps as 'gateways' to other parts of the expanded European Union and beyond. Examples of such cities are Praha, Budapest and København (see figure A4.11 in annex 4). Potentially, these patterns of new investment may contribute towards the policy goal of a more polycentric space, at least at the level of cities.

- Some more regionally focused pan-European networks have concentrated on connecting more peripheral cities, e.g., Grapes and Silk Route in southern Italy and Greece, Infigate in eastern Europe, and Song (Tele 1) in the Nordic countries.

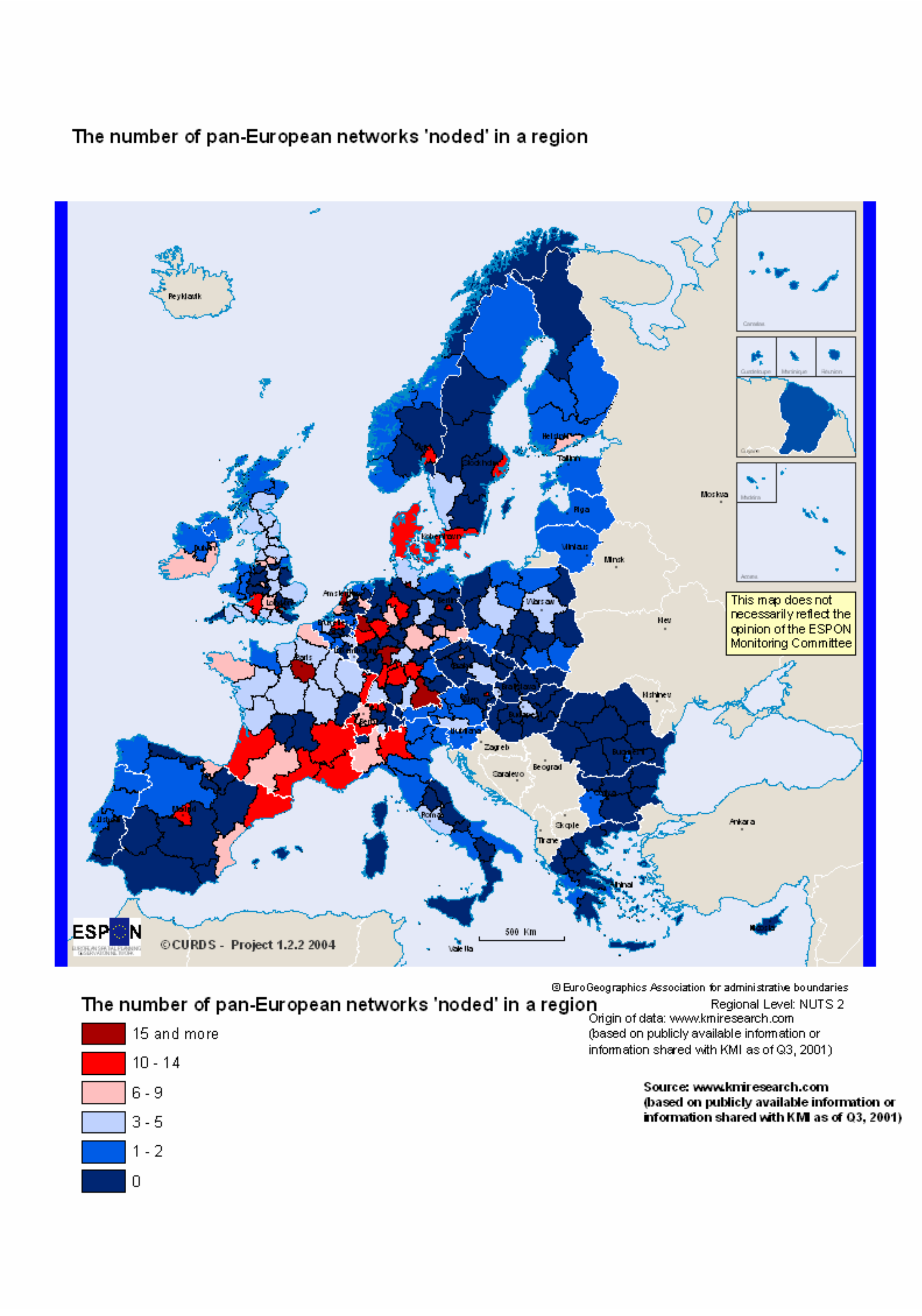
- Other pan-European companies have combined the deployment of a very extensive network infrastructure with a series of particular regional or national network loops which link up a number of more peripheral cities to this overall infrastructure, e.g., Telia in the Iberian peninsula, Energis in Poland (see figure A4.12 in annex 4), WorldCom in Ireland.

4.3.2 Analysis of the territorial implications of pan-European network distribution

A) The 'nodedness' of pan-European networks

Map 4.7 offers a cartographic summary of the trends described above, from a NUTS 2 regional perspective. Below, we discuss the 'nodedness' of European regions and the implications for territorial cohesion. This is followed by the highlighting of some key points emanating from this territorial analysis of fibre backbone infrastructure, which moderate simplistic core-periphery observations.

Map 4.7: The number of pan-European networks ‘noded’ in a region



Map 4.7 illustrates primarily a general core-periphery pattern at a European level, with the regions which have most networks ‘noded’ in them to be found in a concentrated core area (Hamburg, London, Düsseldorf, Ile de France, Noord-Holland, Darmstadt,

Bruxelles, Oberbayern and Bremen), and the regions with fewest, or indeed no, 'noded' networks mainly in the peripheral regions of southern and eastern Europe and northern regions of the Nordic countries.

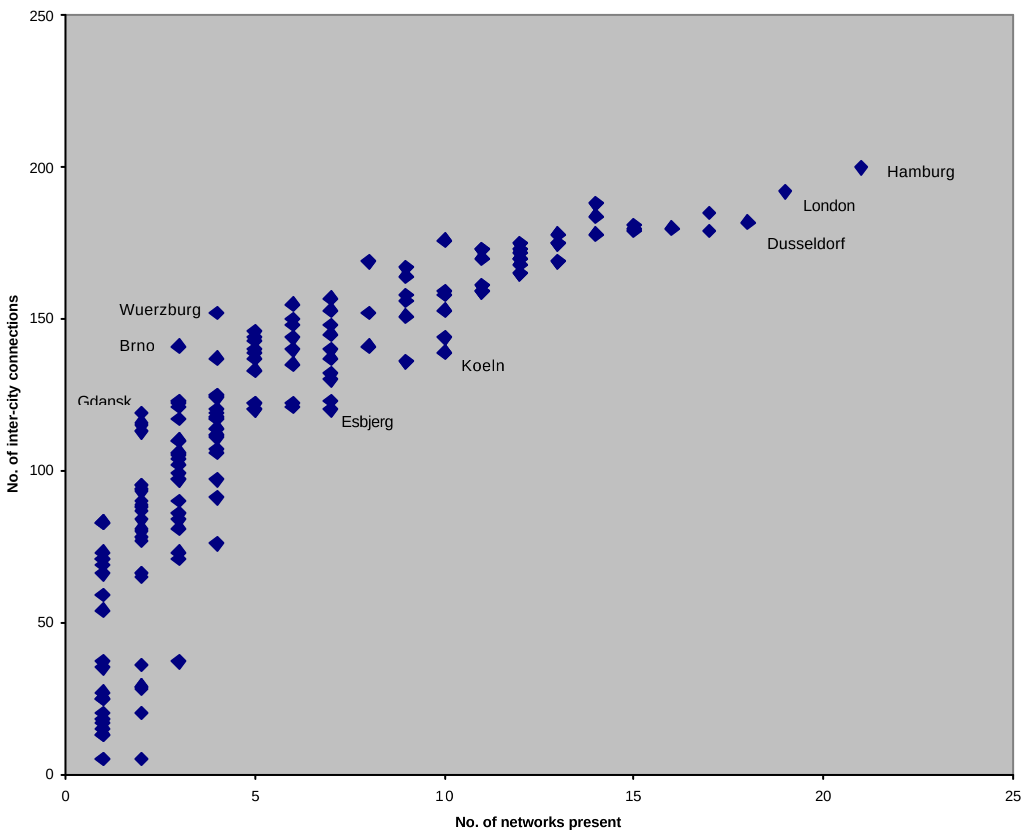
Other relatively well 'noded' regions include the major city regions of the Nordic countries (Stockholm, Oslo Og Akershus, Sydsverige, Danmark), and most notably, a roughly Mediterranean-bordering telecommunications 'development corridor' extending from Cataluña through all the regions of southern France to Piemonte and Lombardia in northern Italy and Région Lémanique and Zürich in Switzerland. This axis can also be extended up through Alsace and into the German regions of Karlsruhe, Stuttgart and Mittelfranken, as a number of pan-European operators already present in the concentrated core area have looked to extend their deployments towards the south and into the Iberian peninsula. The 'orienting' or 'crossroads' role of the Rhône-Alpes region can be highlighted here as, through its main node Lyon, many pan-European networks are deployed towards southern France, northern Italy and Spain.

Very well or relatively well 'noded' regions are, thus, to be found in a reasonably wide territorial distribution, which clearly includes many core regions, but also the Iberian Peninsula (Comunidad de Madrid, Cataluña), the Nordic countries (Stockholm, Oslo Og Akershus, Danmark) and central Europe (Berlin, Leipzig, Wien). Nevertheless, the relative lack of well 'noded' regions in eastern and south eastern Europe is apparent. Although the likes of Praha, Bratislavský and Közép-Magyarország show signs of beginning to attract and concentrate pan-European networks (being in the third category), as a few operators look to serve new, opening markets (using Berlin, Leipzig and Wien as gateways through which to roll out their infrastructure), the 'nodedness' of these regions remains currently lower than western and north western regions. Depending on the evolution of the telecommunications market, as eastern European countries increasingly liberalise their own markets, there may be increased possibilities for pan-European operators to deploy networks and services there. However, Italy has liberalised markets, but evidently only limited attraction for pan-European infrastructure, as map 4.7 illustrates that only Piemonte and Lombardia are relatively well 'noded'. Beyond this, a kind of 'shadow effect' appears to come into operation, as few operators judge it to be worthwhile extending their networks to central and southern regions. The importance of Milano and Torino as the major Italian business centres, together with their relative geographical proximity to main network routes, explains much of this observation.

B) Positive implications for polycentric territorial development?

1. *Lower network presence in some cities does not necessarily mean less extensive territorial connectivity.*
   Some more peripheral cities and regions are more connected than some core cities and regions.

Figure 4.17: Comparing the number of pan-European networks present in Functional Urban Areas with the number of inter-city connections from Functional Urban Areas



Source: CURDS; based on data drawn from KMI Research map

Figure 4.17 plots the number of pan-European telecommunications networks present in the Functional Urban Areas (FUAs) against the number of other places which a particular FUA is connected to via those networks. As we would expect, the basic pattern is one generally characterised by the more networks present in a FUA, the more connections to other places that FUA will have.

The ‘core’ FUAs of Europe tend to exhibit an almost homogenous pattern of territorial connectivity, with some of them approaching 200 network connections to other places, and nearly all the others having more than 150 links. There are, nevertheless, a few exceptions – Koln in Germany has 10 networks passing through it, yet only 139 links to other FUAs, which actually makes it less linked than Brno and Bratislavský.

However, the gradient of the plotted points on the graph tends to even itself out as we move along the ‘x’ axis, which suggests that FUAs which are on more networks are only connected to a relatively smaller number of additional places compared to FUAs on fewer networks. In turn, this suggests firstly that there are a small number of very extensive pan-European networks which inter-link a large number of FUAs. This would explain how Gdansk has 119 connections to other FUAs by being on only 2 of the 27 networks, and Brno has 141 connections from only 3 networks. Both these FUAs are on the networks of Energis and Telia, and Brno is also on that of Carrier 1. Secondly, we can also suggest that beyond this small number of extensive networks, there is a larger number of networks which are either somewhat less extensive or simply replicate the routes followed by other networks. This would explain why being on the majority of the 27 networks featured on the KMI map does not lead to a FUA having many more inter-city connections. For example, while Hamburg and London appear on six or seven times more networks than Brno, they are linked to only 50 or 60 extra FUAs. In conclusion then, the density of networks in a FUA does not necessarily appear to closely correlate to significantly greater territorial connectivity on a wider scale. The differences between FUAs must therefore emerge in the quality and quantity of network connections between the same places, i.e. the number of networks offering the same route and the amount of overall bandwidth present on that route.

2. *There are different territorial peripheralities in telecommunications network provision*

Still looking at figure 4.17, the overall situation is much different when we analyse our data for more peripheral FUAs. For example, a Greek or southern Italian city present on 1 or 2 networks is thus only linked to 5 other places, e.g., Attiki, Patrai, Napoli and Bari. Meanwhile, however, other peripheral cities both in Poland (Bydgoszcz, Krakow, Rzeszow) and the 'Celtic fringe' (Dundalk, Cardiff, Aberdeen, Inverness) are also only present on 1 network, but that network connects them to 83 other places. We must clearly, therefore, distinguish both between telecommunications networks in terms of connectivity and territorial extensiveness (in the first case, the Grapes and Silk Route networks serving Greece and southern Italy are very limited in extent compared to the Energis network serving Poland and the 'Celtic fringe'), and between peripheral regions across Europe in terms of access to telecommunications infrastructure as there is evidently more than one form of peripherality in European telecommunications territoriality.

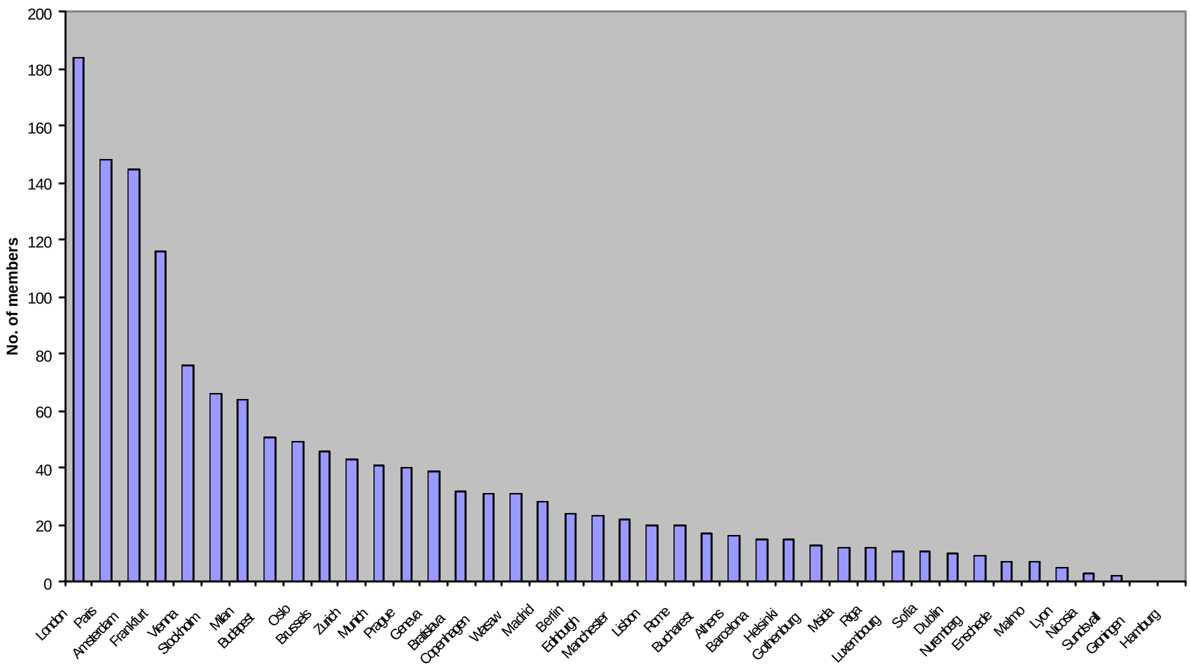
3. *The emergence of 'gateway cities' and 'new network cities' beyond the European core can be identified (networks and IEPs)*

There is an emerging importance of urban centres outside the core area of the EU for attracting bandwidth connections (eg. Praha, Toulouse, Leipzig, and, to a slightly lesser extent, Dublin, Oslo og Akershus). These city regions might have the potential to become viewed as both new network cities which surpass some traditionally larger city regions, and a crucial part of a more polycentric European urban system. In addition, some of these emerging urban centres may be viewed as 'gateway cities' for telecommunications bandwidth connections, in the way in which they act as links between the core area and more peripheral areas eg. København for the Nordic region, Berlin for Poland, Wien and Praha for south eastern Europe.

Internet exchange points in core cities and emerging 'gateway cities'

Internet exchange points (IEPs) "are services created to facilitate on-site interconnection between independent or third-party Internet networks [or] neutral meeting grounds for traffic exchange" (Telegeography website – http://www.telegeography.com). They are, therefore, a crucial element in the global Internet infrastructure, as they permit communications to pass between different backbone networks. Consequently, the locations of these points in Europe help us to uncover the territorial dynamics of Internet backbone networks. In particular, it allows us to assess which European city regions are 'accessible' and 'central' for network interconnection, and are therefore well served by these networks, at least potentially offering good infrastructural access to Internet communications.

Figure 4.18: The number of Internet exchange point members in European city regions



Source: CURDS; based on data drawn from Telegeography Inc. website (http://www.telegeography.com)

On one level, figure 4.18 supports the evidence which we have already presented in this section regarding the primary importance of city regions such as London, Paris, Frankfurt and Amsterdam for pan-European telecommunications networks. These city regions also have the largest numbers of Internet exchange point members, which is clearly a related development, as many of these members are likely to be providers or users of the pan-European networks.

Beyond this, however, we can note the presence of certain city regions in figure 4.18 which seem to be more important as Internet exchange points than the earlier discussions of pan-European networks might have led us to believe. This is the case for the capitals of N12 countries such as Budapest, Praha, Bratislavský and Warszawa, which are apparently more important exchange points than the likes of Madrid, Berlin, Barcelona or Helsinki. The need of telecommunications and IT companies for network interconnection locations in eastern Europe appears to be growing. These eastern European Internet 'centres' may be viewed as crucial 'regional integration zones', allowing the more peripheral cities and regions of eastern Europe to develop links to the key 'global integration zones' of western Europe.

4. Pan-European telecommunications providers have differing territorial strategies

The similarities and differences in the networks and strategies of pan-European telecommunications companies illustrate that, as stated by the KMI consultancy in section 4.3.1, even within the concept of 'pan-European', there exist strategic differences which are founded on territoriality. In section 5.4 of our Second Interim Report, we looked at the examples of Cable & Wireless and Sonera in particular to differentiate between territorially extensive and territorially focused pan-European strategies[57].

In the case of Cable & Wireless, operations have moved well beyond their traditional 'home' market in the UK, even if the density of their UK network illustrates how this country can still be viewed as the territorial foundation to their wider pan-European (and

[57] More in-depth discussion and comparison of the territorial strategies of these and other telecommunications companies can be found in section 5.4 of our Second Interim Report.

global) strategy. Cable & Wireless has a presence in 21 countries of the ESPON territory, but their need for trans-Atlantic cable links to US networks means that their network operations are still turned towards the west, and have not yet been extended into eastern Europe and key 'gateway' nodes such as Praha and Budapest (Cable & Wireless website).

In contrast, Sonera is the Finnish incumbent operator, which has since merged with Telia, the Swedish incumbent, to form TeliaSonera, which is now the leading telecommunications group in the Nordic and Baltic region. However, the company continues to operate as Sonera in Finland. The strategy of Sonera in recent years, and probable future strategy of TeliaSonera, is a good illustration of a territorially focused pan-European operation, centred on the Baltic Sea region, compared to the more extensive pan-European strategies of companies such as Cable & Wireless. In this way, 'pan-European' does not necessarily have to be equated to territorial extensiveness. Instead, Sonera have worked on the principles of developing partnerships and network interconnection agreements with providers in countries where they do not have their own network presence, thus 'virtually' extending their territorial operations through key 'gateway' interconnection points (Sonera website).

4.3.3 Summary of the territoriality of Internet backbone networks

In overall conclusion, the main findings with respect to the territorialities of access to Internet backbone networks are as follows:

- at the <u>macro scale</u>, there is a 'three-level' core – intermediary region – periphery disparity, with the largest number of networks, biggest bandwidth links and most important Internet Exchange Points focusing on a highly concentrated Pentagon zone. Some networks also cover other areas just beyond the Pentagon, but there are only a small number of networks extending to the periphery.
- at the <u>meso-scale</u>, with the exception of Germany which has fuller coverage, national capitals and metropolitan areas are the focus for these networks, with a relative paucity of networks in more peripheral regions within countries.

- more positive trends are emerging, however, with the increasing importance of a number of ‘gateway cities’ (Praha, Budapest, København) beyond the core, through which these networks both pass to reach more peripheral regions of Europe, and interconnect to permit communications exchange between different networks.
- some pan-European providers have concentrated on connecting more peripheral cities in regionally-focused networks. This has led both to some of these cities becoming more connected than certain cities in the core, and therefore, to differing levels of peripherality in access to backbone networks.

4.4 Conclusions on the territorialities of leading edge technologies and applications

In this chapter, we have considered the territorial trends and implications of more ‘leading edge’ telecommunications technlogies and applications, namely broadband deployment and uptake, e-commerce, and access to Internet backbone networks. Again, findings suggest a complex and evolving picture, though we can identify a number of emerging patterns.

The main disparities we have identified are:

- The Nordic and Benelux countries have a substantial lead in the adoption of broadband Internet, with southern and eastern European countries (but also northern EU15 countries like France and the UK) tending to lag behind. The Nordic countries and Germany have the highest levels of e-commerce use, with Mediterranean countries having the lowest levels.
- While some N12 countries have not started, or only just started, broadband deployment, others (Malta, Slovenia and Estonia) had levels of uptake similar to, or even above, some EU15 countries. This also appears to be the case for use of e-commerce by enterprises.

- Rural localities lag behind metropolitan and urban areas for broadband adoption, but this reflects, above all, the later and less extensive level of provision deployed in rural areas compared to their urban counterparts.
- While access to Internet backbone networks shows a major core and periphery disparity at all levels, this is tempered by the emergence of specific ‘gateway cities’ beyond the core, through which some networks pass to gain access to peripheral cities and regions.

Macro scale, regional, and metropolitan-urban-rural disparities are (even) more pronounced for these ‘advanced’ technologies and applications than for the more mature technologies considered in chapter 3. In the case of broadband deployment and uptake, which is most worthy of policy consideration (because of its importance for contributing to the shaping of future knowledge economy development paths), this is likely to be heavily related to the relatively early stage at which we are in the roll-out process, whereby network provision has initially been focused on the largest cities (where demand is greatest) before descending the settlement hierarchy. Although the situation is constantly moving on, this should still be a concern for policymakers at all levels, as we need to ensure that these disparities do not widen or become entrenched, otherwise there will undoubtedly be deleterious consequences for the development of peripheral / low density areas. The other major factor differentiating levels of broadband uptake is likely again to be the importance of national specificities and types of telecoms cultures invoked in the conclusion to chapter 3.

Chapter 5 – An analytical perspective on telecommunications territorialities in Europe

The aim of this chapter is to further deepen our contribution to the ESPON Common Platform. To do so we undertake two separate but interconnected analyses. Firstly, we explore our study results in more detail specifically in the light of key territorial concepts which have been adopted by ESPON, notably the concepts of polycentric development and territorial cohesion (Section 5.1). Secondly, we further develop the typologies which we constructed in our First, Second and Third Interim Reports and introduce new typologies, drawing on new data which was unavailable to us when writing the earlier reports (Section 5.2). A key objective in our construction of these typologies is to give an indication of which regions in the ESPON space (EU27+2) are most advanced and which are lagging. It should borne in mind by the reader that the typologies are, in part, constructed as an attempt to fill some of the many gaps in European data sets in the area of telecommunications territoriality. They should, therefore, be seen as indicative of the situation in Europe, but also as offering a uniquely interesting overall perspective on telecommunications trends across the ESPON space. In a supplementary section 5.3, a set of national summaries of telecommunications territorialities is presented.

5.1 Polycentric development and telecommunications territoriality trends

It is widely considered that telecommunications hold the potential to enhance polycentric development by acting as a 'connecting tissue' between settlements, thus allowing 'networks' of towns and cities at various spatial levels, to act as cohesive economic units. Similarly, it is widely assumed that telecommunications present the opportunity for less developed European regions to access services and markets in core regions, such access potentially providing a stimulus to economic and social development and creating 'a more even playing field'. Clearly, there is considerable debate as to what the terms 'polycentric' and territorial cohesion mean. There is also considerable debate regarding the extent to which ICTs can successfully address the policy concerns which these terms seek to encapsulate. Minimally, a series of 'translations' beyond simple investment in ICTs (education and training, entrepreneurship, inter-firm networking) would have to take place before these assumptions could begin to hold true. In this section we limit, therefore, our discussion to describing and analysing the *distribution* of telecommunications networks and services to consider whether the patterns of distribution at least form a base from which ICTs could begin to make an impact on these key territorial policy goals.

A key point is that the core-periphery distinction as defined by proximity to the Pentagon does not hold in respect of most technologies. It should, however, be clear from both our Interim Reports and the preceding chapters of this report that current patterns of telecommunications territoriality across Europe (at macro, meso and micro scales) offer differing levels of support to the goal of a more balanced, polycentric form of development. Section x highlighted that there is perhaps more evidence for polycentric development at the macro scale than the meso and micro scales, even if we uncovered some evidence in the latter cases of moves in the right direction towards a more polycentric form of telecommunications territoriality. Nevertheless at a European level, there is evidence of north-south, west-east, EU15+2-N12, and core-periphery divides in supply and demand for telecommunications networks and services. At a sub-national level, there are a number of territorial disparities. The most marked of these are capital city-rest of country, major cities-other cities and urban-rural divides.

Table 5.1: A summary of macro, meso and micro level disparities and polycentric elements in supply and demand of TN&S

Spatial level of analysis	*Key territorial disparities (threats)*	*Key elements of polycentricity (opportunities)*
Macro (European)	North-South (Nordic-Mediterranean)	Regional capitals
	West-East (EU15-N12)	Advancing N12 countries. Development of major cities and regions in East.
	Core-Periphery (Pentagon-non Pentagon)	Advanced northern periphery. Gateway cities and regions for access to periphery, and development corridors.
Meso (national)	Capital or major city-Rest of country	Secondary cities coming to the fore.
	North-South / West-East / Core-Periphery (see individual cases)	Development of 'growth poles'
Micro (regional)	Urban-Rural	Market towns in rural areas
	Urban core-Urban periphery	Peri-urban development

Table 5.1 provides a basic summary of the main territorial disparities in access to and uptake of telecommunications networks and services at three European spatial scales, as well as other emerging territorial trends and elements which may be contributing to a more polycentric development of telecommunications at each level. For example, although there is some evidence of core-periphery disparities in telecommunications at the macro level, the Nordic periphery is the most advanced area in Europe, in terms of provision and take-up. Similarly, although there is a clear West-East disparity, some countries, notably Estonia and Slovenia, have uptake levels for some technologies which are comparable to some EU15 countries.

5.1.1 The territorial dynamics of network roll-out

Unlike other network technologies, such as the road or rail system, or energy distribution networks, all of which are relatively stable and change only slowly and incrementally, either growing or shrinking over time, telecommunications networks are considerably more dynamic, fuelled by the rapid pace of technological innovation. The key dynamic of telecommunications networks, therefore, concerns the *roll-out of new technologies*, both within existing networks and in order to launch new networks. Importantly from an ESPON perspective, network roll-out is an inherently territorial process, in which new network technologies are deployed over time in a spatially uneven manner, some areas being early in the 'roll-out queue', and others late.

The evidence we have examined throughout this project suggests there is a distinctive logic or pattern in the territoriality of network roll-out, explained primarily by the strong influence of market forces in telecommunications investment. Simply put, the roll-out of a new network, or of new technology within an existing network, will occur first where the perceived returns on the investment are greatest, in relation to the costs of that investment. Practically, this means that this rollout more or less follows the population distribution of a country, modified by variations in wealth (and hence the size of the market) and by concentrations of corporate business users, who provide an important element of most telecommunications operators' revenues. Thus, usually the technology is first launched in the biggest cities, due to the concentrated markets they offer, and is then gradually rolled out down the urban hierarchy. Certainly, our study findings have shown that this is very much the pattern for DSL roll-out.

The spatial organisation of telecommunications infrastructure can be viewed as inherently polycentric in the way in which it focuses on a series of exchanges for the deployment of local lines and the 'diffusion' of services (or base stations in the case of mobile networks). The steady enabling of these exchanges for the provision of DSL services by operators within different countries (even if they have concentrated on those of major cities first) is creating a renewed polycentric broadband territoriality by offering businesses and consumers access to DSL services at various 'equal' points within a particular country. The DSL coverage and population and GDP distribution maps of Hungary, France, Italy and the UK (see figures A4.2-A4.4 in annex 4) provide a good illustration of this point. Even in Hungary, France and the UK, where capital city regions concentrate population and GDP, regional 'pockets' of relatively high population and GDP distribution have also driven a good level of DSL roll-out in many of these areas, thus supporting the move towards a more polycentric broadband territoriality. Inversely, in regions with lower population and GDP, such as south west Italy, the Highlands of Scotland, central rural France and northern Finland, DSL coverage is much lower suggesting that there are limits to polycentrism.

In section 4.3, we showed how the broad 'hub and spoke' geographies of alternative backbone infrastructure deployment have a crucial 'polycentric' component. It is clear, for example, that while pan-European telecommunications companies have traditionally viewed the 'global' cities of London and Paris as a crucial territorial foundation to their overall pan-European strategies, other cities and network links have almost become as important – the 'sub-global' centres of Hamburg, Düsseldorf and Amsterdam are more or less the equals of London and Paris in terms of network presence.

It is also possible to identify a number of 'regional capitals' in terms of telecommunications network provision. Madrid, København and Wien, for example, could all be said to be the leading urban centres for telecommunications in part of the

European territory (Iberian peninsula, Nordic gateway, central Europe and eastern European gateway respectively).

We also highlighted the ways in which alternative backbone infrastructures are increasingly being extended out beyond the European core through 'gateway cities' such as Berlin, Wien and København and along 'development corridors' to more peripheral cities, thus offering areas of eastern Europe some level of seamless connectivity to major nodes acting as 'global integration zones', and narrowing, at least to some extent, the 'infrastructure gap'. Thus, this increasing multi-nodality of pan-European telecommunications networks has potentially favourable implications for polycentric development and cohesion through improving territorial connectivity, which may in turn promote further economic development by offering better networking possibilities to businesses located in 'peripheral' cities.

5.1.2 The territorial dynamics of telecommunications uptake

A polycentric development of telecommunications uptake across the European territory is a desired aim for broader social cohesion and economic development goals. A truly European information society will emerge only if the citizens and enterprises of all states and regions are participating in it, through more advanced levels of uptake of the key technologies of the information society – mobile telephony, the Internet and broadband. If uptake of these technologies remains concentrated or centralised in just a few 'highly advanced' regions, with great territorial disparities dominating at all levels, then much of the EU27+2 will continue to live and work on the wrong side of the digital divide.

Whilst this study has highlighted the major territorial disparities that exist across Europe (at macro and meso-micro levels) in telecommunications uptake, and which require policy consideration and attention, we can also focus on a number of trends which may suggest the emergence of a polycentric development of telecommunications uptake.

One of our major conclusions, the importance of (continuing) 'national effects' in the uptake of telecommunications technologies, can be seen to have mixed implications for polycentric development. At the macro level, the fact that we emphasise again and again the advance of Nordic countries (particularly Sweden and Denmark) for many of the technologies we have considered signifies that other EU15 countries (particularly in the south) have not yet managed to match Nordic technological diffusion rates, although the Netherlands (and the Benelux region more generally) is not far behind on most counts. One positive element of this, however, with polycentricity implications, is the fact that typical core-periphery territorial distinctions do not really hold in telecommunications uptake. The Nordic advance illustrates clearly that regions do not need to be located in the core of Europe to develop high telecommunications demand. Nevertheless, a more widespread macro level telecommunications polycentricity would involve at least a handful of countries in the south and east of Europe beginning to show signs of being able to reach the uptake levels of Nordic countries. With the notable exception of mobile telephony (in which Greece and Italy are among the leading states), this is not yet the case. We should note, nevertheless, the potential of the new Member States of Estonia and Slovenia, which, according to 2002 ITU figures, were ahead of the UK and France for broadband penetration, although the latter have since seen rapid progression. Nevertheless, the way in which demand growth in N12 in general appears to be often at least the equal of EU15 for a number of technologies may bode well for the promotion of a more balanced European information society in the future.

At the meso-micro level, the implications of national effects in telecommunications uptake for polycentric development depend, inevitably, upon the relative advance of each country. However, it is significant that broadband penetration shows the greatest level of regional variation within most countries, probably reflecting the urban-rural and large city-rest of country divides which have tended to emerge initially in the relatively early stages of broadband roll-out. A polycentric territoriality of broadband clearly requires both time to develop and a promotion of wider technological access in non-urban regions. Nevertheless, in Sweden, for example, the fact that all regions are highly advanced for most technologies, and therefore that there is little apparent territorial variation between regions (although this may become evident at a more detailed level than NUTS 2) or on a metropolitan-urban-rural level, suggests a highly polycentric and balanced territoriality of telecommunications. On the other hand, within a comparison of EU27+2, even if no detailed data was available for them, all regions of Bulgaria and

Romania can be seen to currently lag for all technologies. The issue for these countries should perhaps then not be framed so much as the promotion of polycentric development (as there is little development to start with), but as broad stimulation of demand throughout these countries. Once technological uptake begins to take off here, though, we would expect to see similar roll-out and uptake patterns to elsewhere (capital/metro focus etc), which would then necessitate a promotion of polycentric development. Within other countries, such as France, we can observe a highly centric territoriality of telecommunications uptake, with one or two regions in advance of all the others. Developing polycentricity here by promoting uptake in other regions to balance the capital or major metropolitan region is likely to be a major challenge, which cannot be dissolved from reshaping the territorial development of these countries as a whole.

Another aspect of polycentric development in telecommunications uptake is the balancing out of existing metropolitan-urban-rural disparities, in which, in particular, rural areas are experiencing lower levels of uptake than urban areas. The INRA household survey highlighted that households in metropolitan and urban areas have higher penetration rates for Internet access and broadband connections than rural areas (see table 4.2 in chapter 4, re-presented at the end of this section for the convenience of the reader), although interestingly this disparity no longer holds for either fixed or mobile telephony.[58] Up to now, then, mobile has had a different territorial uptake pattern to the Internet and broadband. Whether this is to some extent a question of maturity, meaning that, in time, and with a further expansion in rural areas of supply-side access to the Internet, and to broadband Internet in particular, urban-rural disparities in Internet and broadband uptake will disappear or be reduced is unclear, as the key issue is whether the level of demand among rural households (and businesses) is of similar proportion to that among urban households (and businesses). In any case, evidence of predominantly rural areas which do seem to be relatively advanced in terms of uptake of certain technologies has been identified.

The clearest evidence of this concerns mobile telephony, a technology with usually few network access constraints as operators have covered the majority of the European

[58] These observations are supported by a range of other research reported on in our Third Interim Report.

territory. Figure 3.9 in Chapter 3 showed that many of the leading EU15 regions for mobile uptake are also among the least densely populated regions without large urban centres. Indeed, nearly two thirds of the regions present in the lowest category of the settlement structure typology have mobile uptake above the overall EU15 regional average. Notio Aigaio in Greece, Mellersta Norrland in Sweden and Umbria in Italy have household mobile penetration of more than 90%.

In terms of household Internet uptake, five of the top ten EU15 regions are Swedish regions in the lowest settlement structure category. Molise in Italy and the Highlands and Islands of Scotland also have household Internet uptake rates well above 40%. The same predominantly rural regions of Sweden are also among the leading regions for household broadband penetration. This illustrates how, despite the fact that Internet access and broadband connections are more prevalent in urban areas, some rural regions have experienced levels of uptake similar, or even surpassing, those of urban regions. Polycentric telecommunications development need not, therefore, necessarily be concerned solely with the promotion of alternative urban areas to the advanced capital or major metropolitan region. At a meso-micro level, stimulating demand and uptake in rural areas can also help in balancing telecommunications development across a national territory.

The observation that 'mobile telephony appears to break with the conventional pattern of a rich-poor disparity' as there are increasingly high levels of penetration across N12 as well as EU15 and in some more peripheral regions as well as core regions of Europe, suggests that take-up of this particular technology is already proceeding in a more territorially balanced manner than fixed telephony has done. Many regions of southern and eastern Europe have similar, or sometimes higher, levels of penetration than Nordic or core regions. At a sub-national level, in France, for example, the island region of Corse, not usually a traditionally dynamic region for telecommunications development, has one of the top three mobile penetration levels in the whole country.

The fact that regional level of GDP per capita has, more generally, far from a perfect relationship with regional household uptake data (although more so than, say, settlement structure) is also advantageous for the promotion of polycentric telecommunications development. This means, at least, that it is not always the richest European regions which dominate the telecommunications uptake hierarchy. The high mobile penetration levels of peripheral regions of southern Europe illustrate this point very well, but equally, many of the regions with the highest levels of Internet penetration are not among the leading GDP regions. Only Hamburg and Stockholm could be counted amongst the richest European regions as having high household Internet uptake. This was even more the case for broadband penetration, with only Bruxelles, Stockholm and Uusimaa representing the richest regions among the top thirty broadband regions in EU15, even if poorer southern regions (particularly Greek) can be seen as lagging behind other regions on this indicator.

The territorial development of wireless broadband technologies such as satellite and wi-fi may also very well promote a more balanced form of telecommunications supply and uptake, and facilitate a closing of the ‘infrastructure gap’ by offering broadband solutions to rural and remote regions where competition in fixed broadband networks is unlikely to emerge. In many cases up to now, it has been regional and local authorities which have taken a lead on developing wireless access solutions to households and enterprises in rural and remote regions, and, as we suggest in the next chapter, this needs to be encouraged and facilitated on a wider European level. Wireless could be a very useful tool for developing a more polycentric broadband territoriality in rural and remote regions of eastern Europe, but this is likely to require a policy lead.

At least on one level, then, polycentric telecommunications territoriality in Europe seems to require the development and promotion of multiple technological solutions, through which (before cultural and institutional factors are taken into account) peripheral, rural, less prosperous regions have at least the opportunity of playing on a relatively level mobile, Internet and broadband field with core, urban and more prosperous regions.

However, probably the clearest trend in telecommunications developments in Europe currently, with substantial implications for polycentric development more generally, is the continuing influence of relative national policy contexts and technology cultures. If Swedish regions are most emblematic of polycentric telecommunications territoriality in EU27+2 at both macro (growth poles in the Nordic periphery) and meso-micro levels (‘rural’ regions counterbalancing Stockholm; ‘rural’ areas counterbalancing urban areas within regions), it is primarily because Swedish national policy and regulation (promoting broadband roll-out and uptake across the whole country) and the Swedish culture of rapidly and enthusiastically embracing communications technologies has promoted this. In contrast, if certain regions of southern and eastern Europe lag significantly behind the majority of EU27+2 regions, and cannot be viewed as polycentric ‘poles’ of telecommunications development either on a macro or meso-micro level, it is primarily because their national policies and cultures are not stimulating or encouraging sufficiently telecommunications uptake. Greece illustrates this point very well, because it evidently has a well-established ‘culture’ of mobile telephony use, yet its regions are among the lowest for broadband penetration (with relatively low levels of PC and Internet use too), because national policy has not (yet) begun to seriously promote the importance of broadband, and there is evidently a very limited computing and Internet culture. In summary, then, the national level remains the territorial arena within which telecommunications policy should be developed to set the example for, and act as a driver behind, the promotion of territorially balanced and polycentric national telecommunications access and uptake. Macro level polycentric telecommunications development will then only be achieved fully if EU27+2 states promote these national ‘information society’ policies in parallel.

Index of technology penetration in households by locality type

Technology	*EU avge = 100*	*Metro*	*Urban*	*Rural*
Fixed[1]	100	100	100	100
Mobile	100	101	100	99
PC	100	104	104	96
Internet access	100	109	103	91
Broadband Internet	100	160	100	60

Source: CURDS; elaborated from INRA (2004)
(note:1 includes traditional fixed, ISDN and or DSL)

The above table (table 4.2 in chapter 4) shows the situation regarding the take-up of the technologies we have focused on by type of locality – metro-urban-rural – aggregated to the EU15 level. *The key point here is that the more recent the technology, the more pronounced are territorial differences.* The table suggests that the aggregate penetration of fixed telephony is not affected by type of locality. There are some differences across EU15 countries, however, and in several countries rural rates of fixed telephony penetration are higher than metropolitan and/or urban areas.

For each of the other technologies considered, metro and urban areas have higher rates of penetration. The narrowest gap occurs in mobile telephony. This supports the other evidence presented in the report that the uptake of mobile has been relatively uniform. Again, however, there are variations between countries. In some countries, metropolitan localities are significantly ahead of rural areas. In others, penetration rates are higher in rural areas.

When we turn to look at technologies generally associated with the Internet, the proportionate gap between metro/urban and rural widens. There is also greater consistency across individual EU15 countries. There are only a handful of countries in which rural penetration of personal computers or the Internet is higher than metro or urban areas and here differences are small. The proportionate gap is largest for broadband, the most recent technology. In all but one country broadband had highest penetration rates in metro localities. In Spain, urban areas had the highest penetration rates. This supports the other evidence presented in the report which suggests that rural areas tend to lag in respect of new technologies.

5.1.3 Explaining sub-national telecommunications territoriality trends: regulation, geography, culture and institutions

We have seen how there are likely to be a host of parallel and interlinked factors bound up in patterns of telecommunications territoriality within countries, and that the relative importance of these will differ significantly in each case. The national regulatory context will be likely to exert a crucial influence, while the specificities of geography, culture and institutions will also be significant. Our interviews with regulators and ministries highlighted that territorial elements such as the relative rurality of countries, the distribution of the population within countries (widespread or concentrated), and administrative/governance organisation (for example, size and number of local administrative units) are important for the promotion of balanced telecommunications supply and uptake in each country. For example, high rurality and widespread populations are likely to complicate the development of broadband access and uptake (from a technical and market perspective), whilst, in the latter case, multiple levels or units of government with differing, but overlapping, responsibilities can make it difficult to develop coherent territorial ICT strategies for areas requiring some form of public sector intervention. The potential for conflict is illustrated by a French respondent who suggested that, “maybe the *régions* can be seen as the major telecommunications actor, but the division of administrative tasks between them and the *départements* means that as soon as the development of any policies touches on a domain of the *départements*, for example, schools and colleges (and therefore, getting broadband into education establishments), it becomes a task for the *départements*” (Guillaume Gibert, ART, personal interview, June 2003). Institutions need to work together across levels, but with a clear leading authority to drive strategies and policies along.

These regulatory, geographical and cultural factors can explain, to a large extent, territorial differences in telecommunications supply and demand at a sub-national level, which, if we then consider each national context as a whole, can begin to suggest reasons for differences between countries. In this way, the macro, meso and micro level trends in telecommunications territoriality across Europe are inherently bound up with parallel and overlapping macro, meso and micro level contexts and factors. In this overarching ‘multiscalar’ perspective, then, just as regional differences within countries can be partly explained by macro level factors, so national differences at the European scale can be partly explained by micro level factors.

5.2 Typologies of telecommunications territoriality trends

The aim of this section is to introduce a series of typologies of EU27+2 countries and NUTS 2 regions, which positions or groups the territories of Europe according to their differing levels of advancement in access to and uptake of telecommunications networks and services. These typologies offer, then, a further perspective on and empirical validation of the findings of this study, as well as acting as a bridge to the policy recommendations of the following chapter.

One of the desired outcomes of ESPON is the creation of a 'Common Platform' upon which future researchers can build. An important element of this is the development of a set of typologies to summarise regional disparities for each of the specific themes, in this case of the provision of and access to telecommunications networks and services. Given the data availability problems this study has encountered since its inception, the typologies we present here take on an even greater significance as they represent a means of comparing all EU27+2 NUTS 2 regions, based on an amalgamation of the evidence we do have. Nevertheless, we must add an important caveat that the following typologies are evidently indicative of the relative positions of European regions at the time of the data on which they are based. Within the fast-moving landscape of the telecommunications sector, regions are likely to become more or less advanced, relative to other regions, more quickly than in other sectors or fields. These typologies do, however, give a very important 'snapshot' of comparative regional positions in telecommunications development that few, if any, other studies have offered.

A) National typologies

Table 5.2: Categorisation of EU27+2 countries according to their levels of mobile telephony and Internet penetration

	High Internet penetration	**Low Internet penetration**
High mobile penetration	• Sweden, Norway, Finland, Denmark • Netherlands, UK, Switzerland, Luxembourg • Austria, Belgium • Italy • Slovenia, Malta	• Ireland • Portugal, Spain, Greece • Czech Republic
Low mobile penetration	• Germany, France • Estonia, Latvia	• Cyprus • Poland, Lithuania, Slovakia, Hungary • Romania, Bulgaria

Source: CURDS

One way of summarising the territoriality of telecommunications at a macro European level is to produce a typology of countries according to their level of penetration of two of the most important communications services, mobile telephony and the Internet. As table 5.2 shows, a typology of European countries according to whether they are 'high' or 'low' on mobile and Internet penetration reveals a clear pattern of variation.

The 'high-high' category includes all of the Nordic countries, along with the Netherlands, the UK, Switzerland, Luxembourg, Austria and Belgium. At a slightly lower level, but still making this grade, are Italy, plus two new Member States, Slovenia and Malta.

The next category is 'high' in terms of mobile penetration, but 'low' in terms of the Internet. Ireland is in this category, as are the southern European states, Portugal, Spain and Greece, plus, of the new Member States, the Czech Republic.

Of the countries which are 'high' in terms of Internet penetration, but 'low' in terms of mobile, Germany and France obviously stand out. Two of the Baltic states, Estonia and Latvia are also present in this category.

Of the countries which can be considered as lagging for both mobile and Internet penetration, none are EU15, but there are the new Member States of Cyprus, Poland, Lithuania, Slovakia and Hungary. The two Accession Countries, Romania and Bulgaria, are clearly the least advanced of EU27+2 for mobile and Internet penetration.

Extent of 'spread' of regional differences in telecommunications uptake in EU15 countries

The following tables (5.3 – 5.17) summarise the territorial variations present between and within countries for the five technologies we have chosen to highlight in this report, based on data from the INRA household survey. First, they illustrate whether countries lead or lag in respect of individual technologies, and of all five technologies generally. Second, they illustrate the degree of regional variation within countries in respect of these technologies. Visually, their 'shapes' provide an illustration of the degree of overall advancement of countries in telecoms, with a left emphasis indicating advanced and a right emphasis indicating lagging. Thus, we have a quick way of comparing where countries stand overall, with, for example, Sweden being much more advanced than Finland, the Netherlands being more advanced than Belgium, and France showing a lagging tendency, behind even Spain.

In more detail, Sweden and the Netherlands tend to be quite advanced for all technologies, although they have higher regional variations for broadband than other technologies. In contrast, Portugal and France tend to be less advanced for most technologies (although Portugal has moderate mobile uptake), with relatively limited regional variation compared to other countries. Greece has high fixed and mobile uptake, but is low for PCs, Internet and broadband, while Belgium and Finland are low for fixed uptake, but moderate-high on broadband. Of all countries, Germany shows the most territorial variation, with regional uptake levels for all technologies (except mobile) spanning four categories. Regional differences in broadband uptake in Spain are also notably high.

Table 5.3: BELGIUM: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
Fixed line				■	■	■
Mobile			■	■		
PC			■	■	■	
Internet			■	■	■	
Broadband	■	■				

Source: CURDS; based on data drawn from INRA (2004)

Table 5.4: DENMARK: Extent of 'spread' of regional differences in telecommunications uptake*

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
Fixed line		■				
Mobile				■		
PC	■					
Internet		■				
Broadband	■					

*Denmark is national level at NUTS 2
Source: CURDS; based on data drawn from INRA (2004)

Table 5.5: GERMANY: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	Category 2	Category 3	Category 4	Category 5	Category 6 (low)
Fixed line	■	■	■	■		
Mobile				■	■	■
PC	■	■	■	■	■	
Internet	■	■	■	■	■	
Broadband			■	■	■	■

Source: CURDS; based on data drawn from INRA (2004)

Table 5.6: GREECE: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	Category 2	Category 3	Category 4	Category 5	Category 6 (low)
Fixed line	■	■	■	■		
Mobile	■	■	■	■		
PC					■	■
Internet					■	■
Broadband						■

Source: CURDS; based on data drawn from INRA (2004)

Table 5.7: SPAIN: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	Category 2	Category 3	Category 4	Category 5	Category 6 (low)
Fixed line		■	■	■		
Mobile		■	■	■	■	
PC			■	■	■	■
Internet				■	■	■
Broadband		■	■	■	■	■

Source: CURDS; based on data drawn from INRA (2004)

Table 5.8: FRANCE: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	Category 2	Category 3	Category 4	Category 5	Category 6 (low)
Fixed line				■	■	
Mobile			■	■	■	■
PC				■	■	■
Internet				■	■	■
Broadband			■	■	■	

Source: CURDS; based on data drawn from INRA (2004)

Table 5.9: IRELAND: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	Category 2	Category 3	Category 4	Category 5	Category 6 (low)
Fixed line			■	■		
Mobile		■	■			
PC			■	■	■	
Internet			■	■		
Broadband					■	■

Source: CURDS; based on data drawn from INRA (2004)

Table 5.10: ITALY: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	Category 2	Category 3	Category 4	Category 5	Category 6 (low)
Fixed line			■	■	■	
Mobile	■	■	■	■		
PC		■	■	■	■	
Internet		■	■	■		
Broadband			■	■	■	■

Source: CURDS; based on data drawn from INRA (2004)

Table 5.11: LUXEMBOURG: Extent of 'spread' of regional differences in telecommunications uptake*

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
Fixed line	■					
Mobile		■				
PC		■				
Internet		■				
Broadband					■	

*Luxembourg is national level at NUTS 2
Source: CURDS; based on data drawn from INRA (2004)

Table 5.12: NETHERLANDS: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
Fixed line	■	■				
Mobile		■	■			
PC	■	■				
Internet		■	■			
Broadband	■	■	■	■		

Source: CURDS; based on data drawn from INRA (2004)

Table 5.13: AUSTRIA: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
Fixed line				■	■	
Mobile			■	■		
PC			■	■		
Internet			■	■		
Broadband			■	■		

Source: CURDS; based on data drawn from INRA (2004)

Table 5.14: PORTUGAL: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	Category 2	Category 3	Category 4	Category 5	Category 6 (low)
Fixed line					■	■
Mobile			■	■		
PC					■	■
Internet					■	■
Broadband				■	■	■

Source: CURDS; based on data drawn from INRA (2004)

Table 5.15: FINLAND: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	Category 2	Category 3	Category 4	Category 5	Category 6 (low)
Fixed line					■	■
Mobile		■	■			
PC		■	■	■		
Internet			■	■		
Broadband		■	■	■	■	

Source: CURDS; based on data drawn from INRA (2004)

Table 5.16: SWEDEN: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	Category 2	Category 3	Category 4	Category 5	Category 6 (low)
Fixed line	■	■	■			
Mobile	■	■	■			
PC	■					
Internet	■					
Broadband	■	■	■	■		

Source: CURDS; based on data drawn from INRA (2004)

Table 5.17: UK: Extent of 'spread' of regional differences in telecommunications uptake

	Category 1 (high)	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6 (low)**
Fixed line	■	■	■			
Mobile		■	■			
PC		■	■	■		
Internet		■	■			
Broadband			■	■	■	

Source: CURDS; based on data drawn from INRA (2004)

B) Regional typologies

In this section, we provide typologies of NUTS 2 regions, including the regions of the N12 countries, as a method of producing comparisons of the degree of overall telecoms advancement of all regions across EU27+2. These typologies are based on composite indicators that we have constructed from a mix of data, some of which (related to enterprise Internet use) were estimated values. We present four such regional typologies:

- A typology of levels of household telecommunications uptake
- A typology of estimated levels of business telecommunications access and uptake
- A typology comparing levels of household and business telecommunications uptake
- An overall typology of combined household and business telecommunications development into a single index

1. A typology of levels of household telecommunications uptake

In this typology, we add the following weights to our chosen technologies to constitute the typology:

- Fixed 1

- Mobile 2
- PC 2
- Internet access 3
- Broadband Internet access 4

Thus, the index is clearly weighted more towards Internet-related technology penetration (7/12 of the index or 9/12 if we include PCs) than telephony. Broadband is thus recognised as the most pertinent illustration of the relative advancement of a region in household telecommunications uptake. In order to be able to include the regions of N12 countries plus Norway and Switzerland in this EU27+2 typology, the lack of sub-national data obliged us to use national level uptake data from ITU. Whilst this prevents any sub-national regional variations from being identifiable, we do obtain an important indication of the approximate positions of the regions of the N12 countries plus Norway and Switzerland for household uptake vis-à-vis EU15 regions (see annex 11 for full typology methodology).

The resulting typology is presented in map 5.1 and summarised in tables 5.18 and 5.19.

KEY MESSAGES

- The advanced status of Nordic and Dutch regions (and to a lesser extent, EU15 urban regions).
- The lagging status of many eastern and southern European regions.

Map 5.1: A typology of levels of household telecommunications uptake

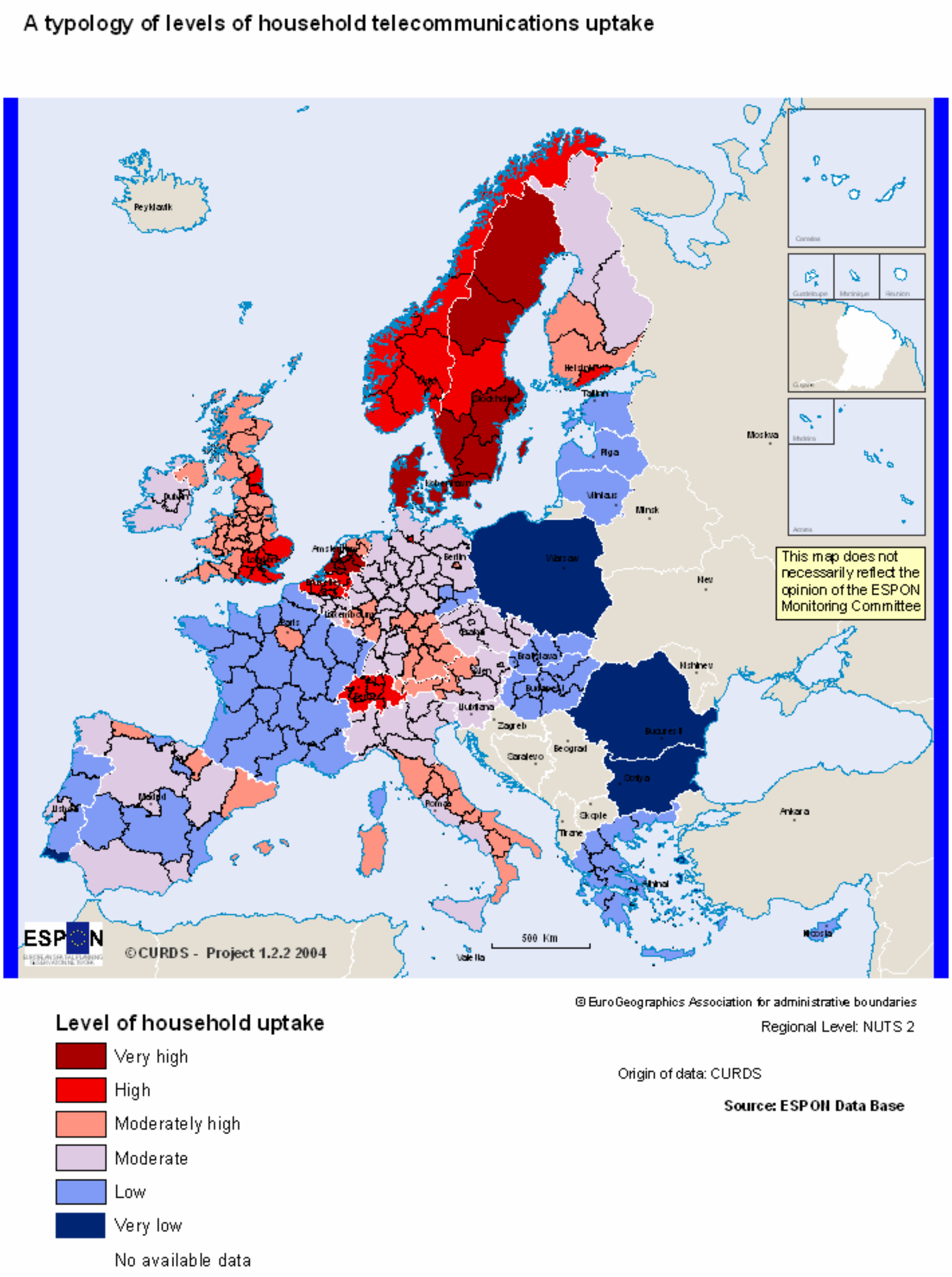


Table 5.18: A typology of levels of household telecommunications uptake (see annex 12 for full typology table)

Level of household uptake	Regions in category
Very high	Majority of Swedish and Dutch regions Danmark
High	Majority of Belgian regions Leading UK regions Hamburg Uusimaa Noord-Brabant and Limburg (NL) Norra Mellansverige Swiss and Norwegian regions
Moderately high	Leading Austrian, Spanish and Italian regions Some German and Finnish regions Remaining (and majority of) UK regions Remaining Dutch regions Ile-de-France Luxembourg
Moderate	Majority of (west) German regions Remaining Austrian, Belgian, Finnish and Italian regions Some Spanish regions Irish regions Czech regions Lisboa e Vale do Tejo Malta Slovenija
Low	Majority of Greek regions Remaining (east) German and Spanish regions Remaining (and majority of) French regions Some Portuguese regions Hungarian and Slovak regions Baltic States Kypros
Very low	Bulgarian, Polish and Romanian regions Voreio Aigaio Algarve

Source: CURDS

*Table 5.19: Regional variation within each country for household uptake***

	Very high	High	Moderately high	Moderate	Low	Very low
BE		■	■	■		
DK*	■					
DE		■	■	■	■	
GR					■	■
ES			■	■	■	
FR			■	■	■	
IE				■		
IT			■	■		
LU*			■			
NL	■	■	■			
AT			■	■		
PT				■	■	■
FI		■	■	■		
SE	■	■				
UK		■	■			
BG						■
CY*					■	
CZ				■		
EE*					■	
HU					■	
LT*					■	
LV*					■	
MT*				■		
PL						■
RO						■
SI*				■		
SK					■	
NO		■				
CH		■				

* National level at NUTS 2
** Household uptake categorisation for N12+2 regions shows no regional variation due to use of national level ITU data.
Source: CURDS

2. A typology of estimated levels of business telecommunications access and uptake

To complement the household uptake typology, we have also developed a regional typology of estimated levels of business access to and uptake of telecommunications. The data on which this is based is somewhat more tenuous, as there is currently no equivalent for business uptake to the regional level INRA household survey. We have therefore relied on the results of our regression analysis to estimate data at the regional level for two key indicators, firms with Internet access and firms with their own website. A measure of access to bandwidth-intensive fibre backbones from the KMI map is also included. As in the household typology, we have added weightings to these three measures in order to attribute most importance to the indicator of firms with their own websites, which is a good measure of the proportion of firms in a region actually looking to conduct business (e-commerce) using the Internet:

- Access to fibre backbones 1
- Firms with Internet access 2
- Firms with their own websites 3

(see annex 11 for full typology methodology).

The resulting typology is presented in map 5.2 and summarised in table 5.20 and 5.21.

KEY MESSAGES

- The advanced status of Nordic and German regions (and to a lesser extent, most EU15 urban regions).
- The lagging status of many eastern and southern European regions.
- The high placing for regions such as Praha, Bratislavský, Malta, Mazowieckie, Wielkopolskie and Slovenija (ahead of most French, Italian and Spanish regions) is encouraging for promotion of uptake in the new Member States.

Map 5.2: A typology of estimated levels of business telecommunications access and uptake

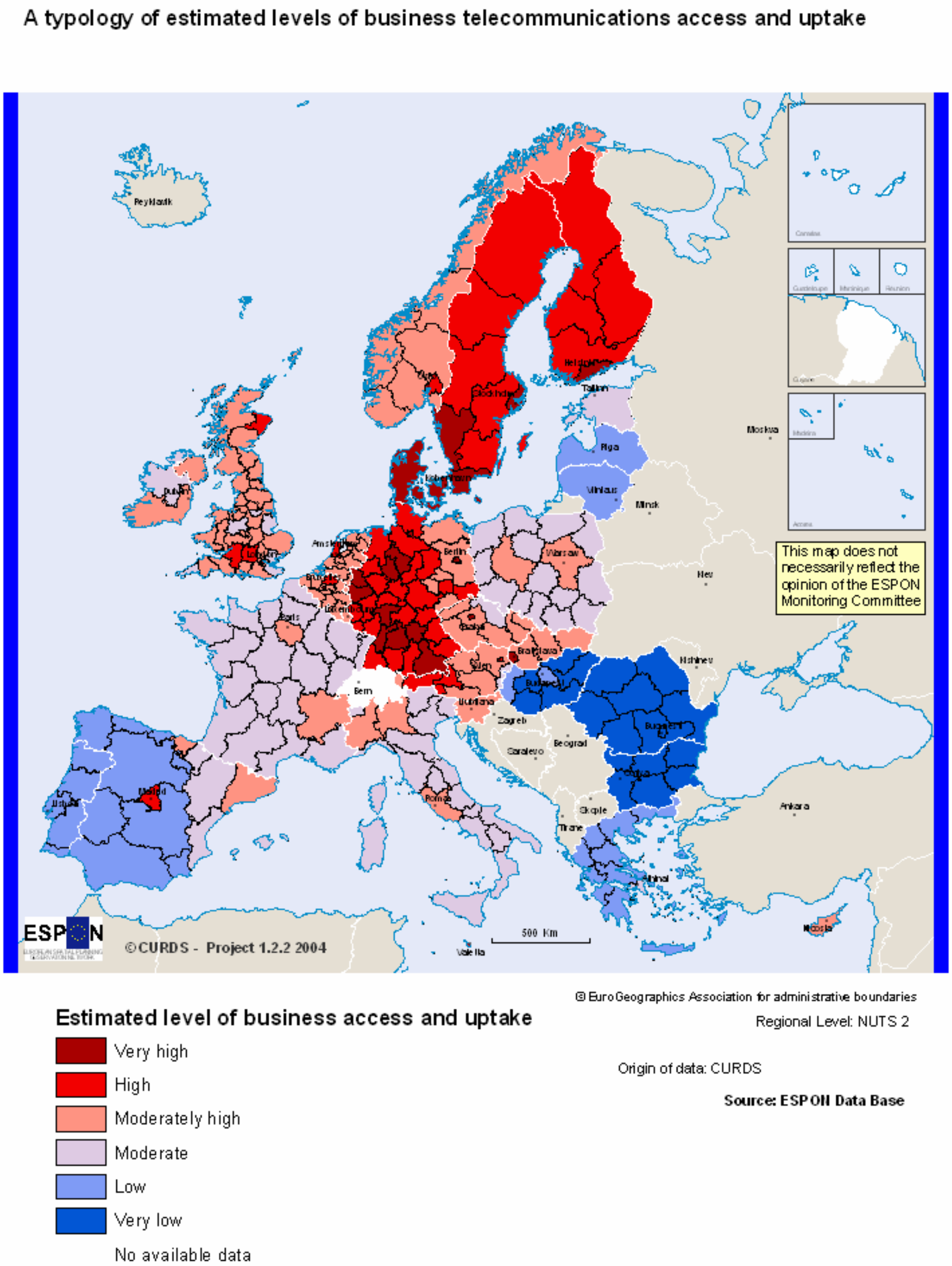
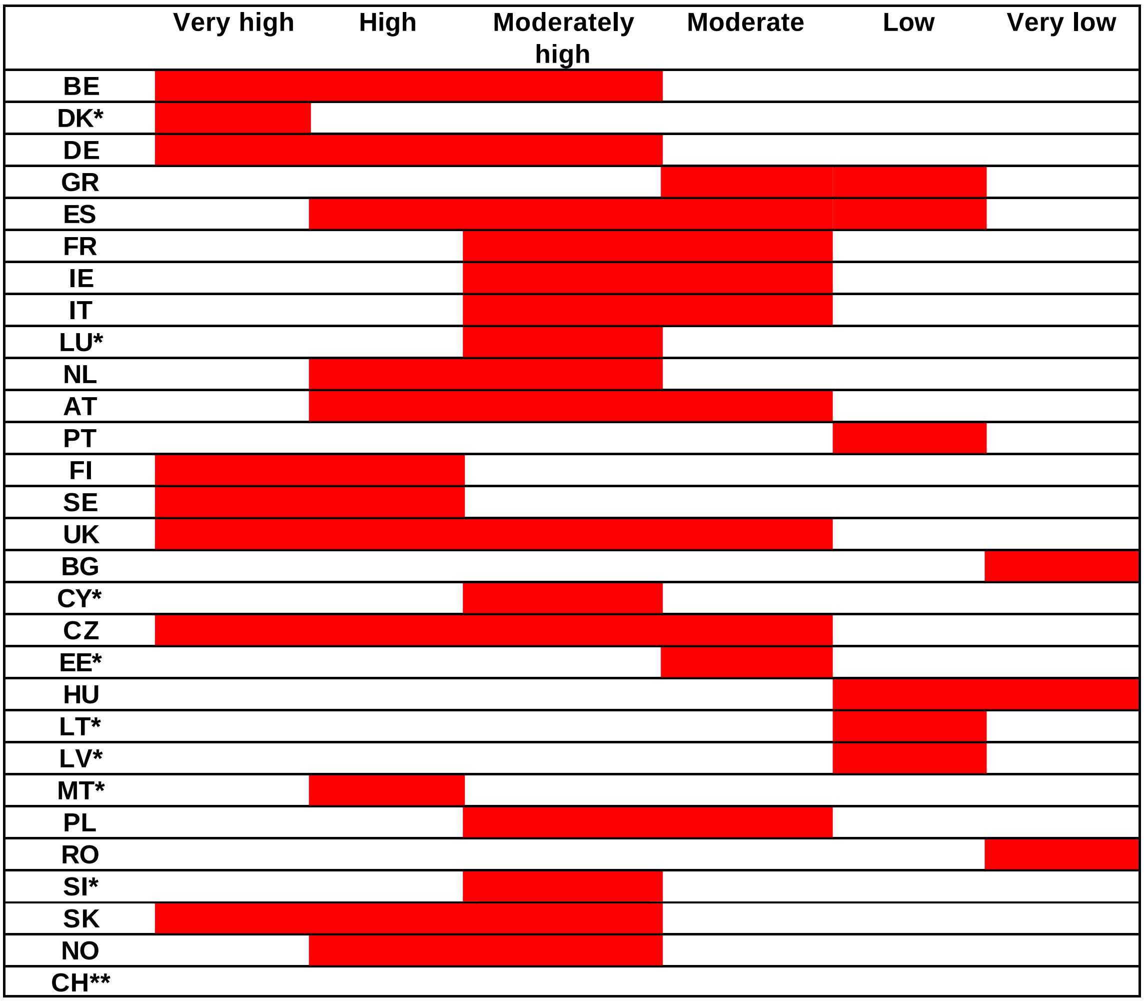


Table 5.20: A typology of estimated levels of business telecommunications access and uptake (see annex 12 for full typology table)

Level of business access and uptake	Regions in category
Very high	Leading German (urban) and Swedish regions Danmark Uusimaa Bruxelles Inner London Praha Bratislavský
High	Majority of (west) German regions Remaining Swedish and Finnish regions Other major EU15 urban regions (Wien, Salzburg, Antwerpen, Comunidad de Madrid, Noord-Holland) 3 UK regions Oslo Og Akershus Malta
Moderately high	Remaining Belgian, (east) German, Dutch, Norwegian and Slovak regions Majority of UK regions Other Austrian and Czech regions Pais Vasco and Cataluña Ile-de-France and Rhône-Alpes Piemonte, Lombardia and Lazio Southern and Eastern Ireland Mazowieckie and Wielkopolskie Luxembourg Slovenija Kypros
Moderate	Remaining French, Italian, Polish and UK regions Other Spanish regions Border, Midlands and Western Ireland Attiki Eesti
Low	All Portuguese regions Remaining Spanish and Greek regions Lietuva Latvija Közép-Magyarország and Nyugat-Dunántúl
Very low	Remaining Hungarian regions All Bulgarian and Romanian regions

Source: CURDS

Table 5.21: Regional variation within each country for business access and uptake



* National level at NUTS 2
** No data
Source: CURDS

3. A typology comparing levels of household and business telecommunications uptake

Map 5.3 and tables 5.22 and 5.23 below provide a 3x3 typology of NUTS 2 regions according to their relative household and business telecommunications uptake levels. Clearly, as before, household uptake for regions in the N12 countries plus Norway and Switzerland is based on national level uptake data from ITU (see annex 11 for full typology methodology).

KEY MESSAGES

- Although the high-high and high-medium categories mostly contain the usual suspects, at the low-low and low-medium end of the table, there is some evidence of a narrowing of the gap between EU15 and N12, with French, Spanish, Greek and Portuguese regions intermingling with eastern European regions. For example, Slovenija is present in the same medium-medium category as the leading French region, Ile de France; Bratislavský is high for business telecoms uptake.
- German and Polish regions are both higher for business than household uptake.
- French regions are generally low for households, but also lower than expected for business uptake.

Map 5.3: A typology comparing levels of household and business telecommunications uptake

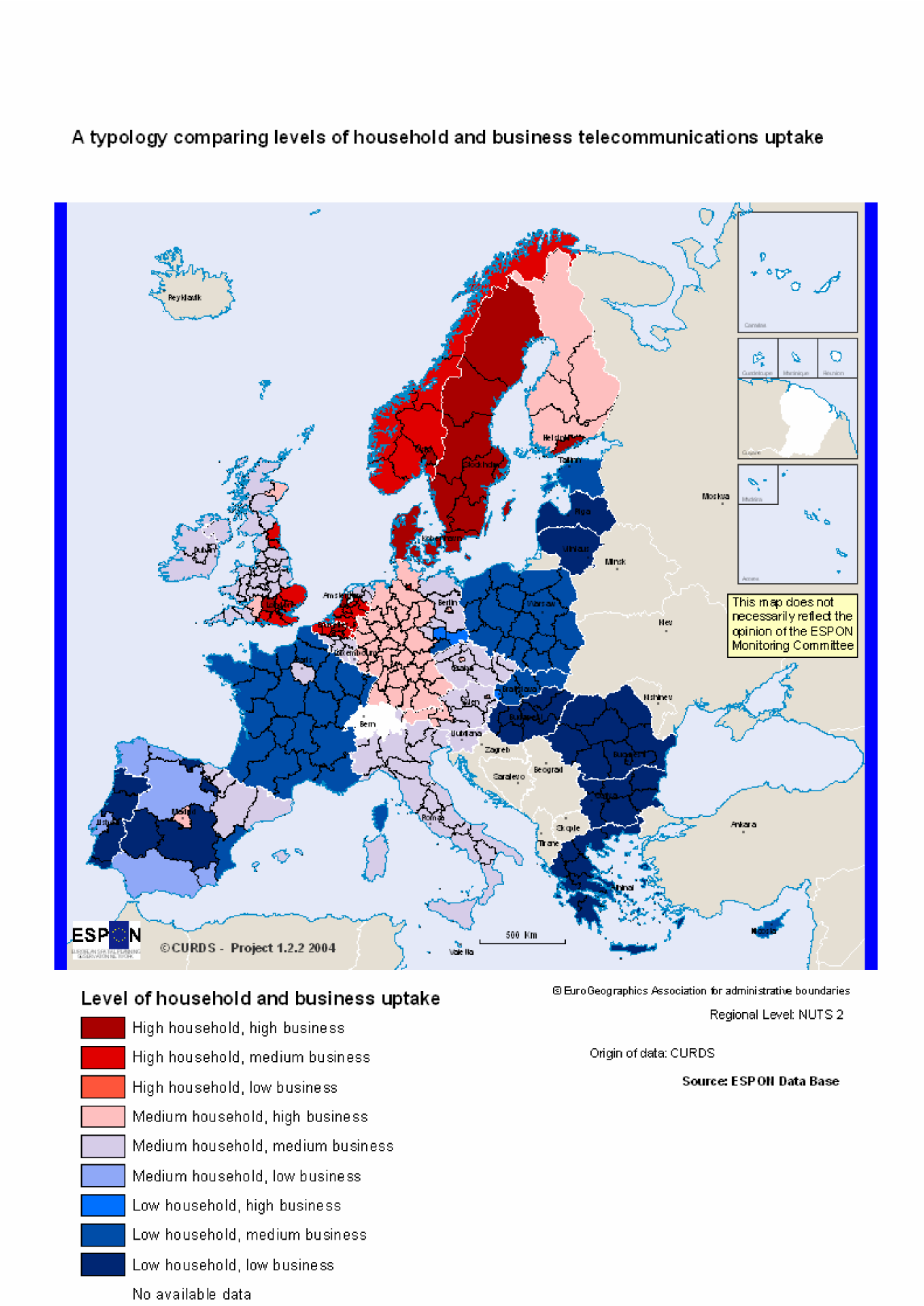
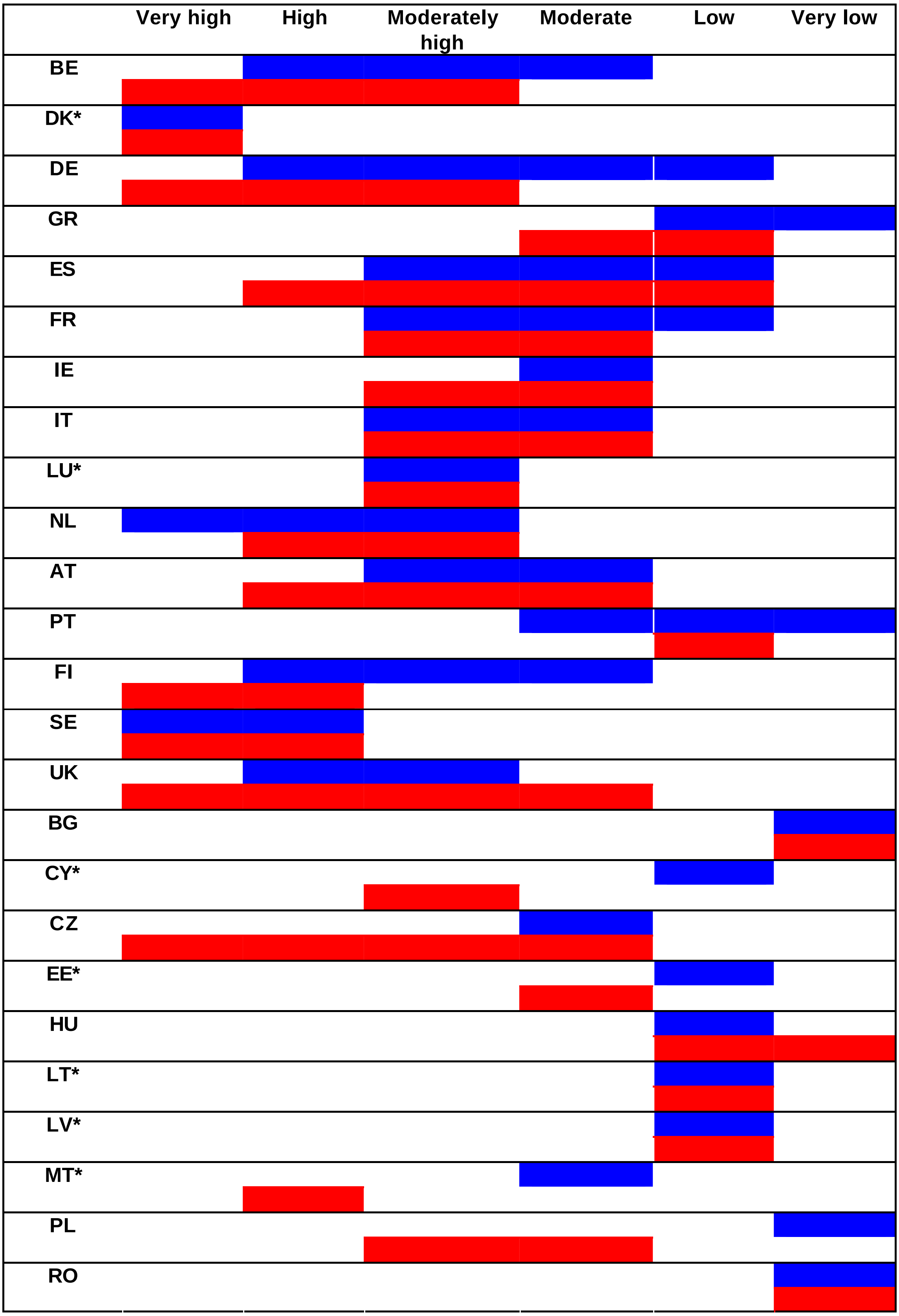


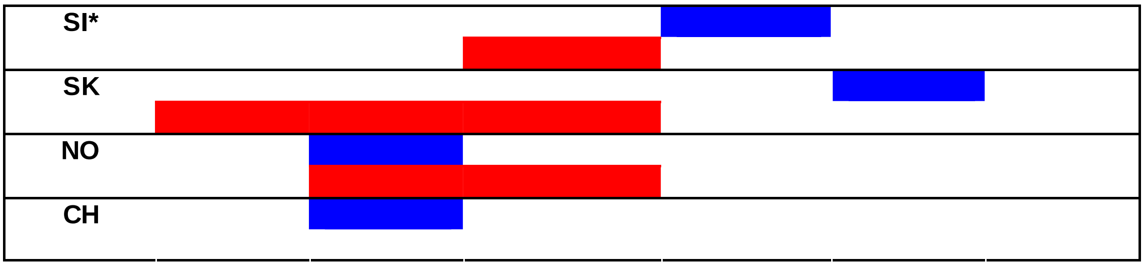
Table 5.22: A typology comparing levels of household and business telecommunications uptake (see annex 12 for full typology table)

	High business telecoms uptake	**Medium business telecoms uptake**	**Low business telecoms uptake**
High household telecoms uptake	All Swedish regions Danmark Major Pentagon and Nordic urban regions (London, Bruxelles, Antwerpen, Hamburg, Noord-Holland, Oslo Og Akershus, Uusimaa) Berkshire, Bucks and Oxfordshire	Many UK and Dutch regions Most Norwegian regions 4 Belgian regions	None
Medium household telecoms uptake	Majority of German regions (west, plus Berlin) 4 Finnish regions Leading Spanish and Austrian urban regions (Comunidad de Madrid, Wien, Salzburg) Gloucestershire, Wiltshire & North Somerset and North Eastern Scotland Praha Malta	Majority of Italian regions Some German and Spanish regions Remaining UK, Austrian, Belgian, Dutch and Czech regions Irish regions Ile de France Luxembourg Slovenija	6 Spanish regions Lisboa e Vale do Tejo
Low household telecoms uptake	2 East German regions (Leipzig and Dresden) Bratislavský	Remaining (and majority of) French and Slovak regions All Polish regions Kypros Eesti Chemnitz Comunidad Valenciana Attiki	Remaining Spanish regions Remaining (and majority of) Greek and Portuguese regions All Bulgarian, Hungarian and Romanian regions Lietuva Latvija
Not included (not sufficient data)	Swiss regions French DOMs Åland Canarias (ES) Açores and Madeira		

Source: CURDS

Table 5.23: Regional variation within each country for household and business uptake (blue=household uptake; red=business access and uptake)





* National level at NUTS 2
Household uptake categorisation for N12+2 regions shows no regional variation due to use of national level ITU data.
Source: CURDS

4. An overall typology of combined household and business telecommunications development into a single index

In this typology, as in the household uptake one, we add the following weightings to the six main indicators used to constitute the typology:

- Fixed 1
- Mobile 2
- Internet access 3
- Broadband Internet access 4
- Fibre backbone access 1
- Proportion of firms with their own websites 1

We include, therefore, a measure of enterprise uptake (proportion of firms with their own websites) and level of access to fibre backbones. Household broadband penetration continues to be recognised, however, as the most pertinent indicator of the relative advancement of a region in telecommunications development, and household uptake is given more weighting than business access and uptake (largely because the household data from the INRA survey is actual, rather than estimated, data, unlike the business data). For regions in the N12 countries plus Norway and Switzerland, for which no sub-national household uptake data was available, estimated data for the indicator 'households with Internet access' from our regression analysis was used and given a weighting of 3. As this meant that EU15 regions had values for 6 indicators and N12+2 for only 3 indicators, the total scores were divided by the number of indicators used in each case to obtain a comparable score. (see annex 11 for full typology methodology).

The resulting typology is presented in map 5.4 and summarised in table 5.24.

Map 5.4: An overall typology of combined household and business telecommunications development

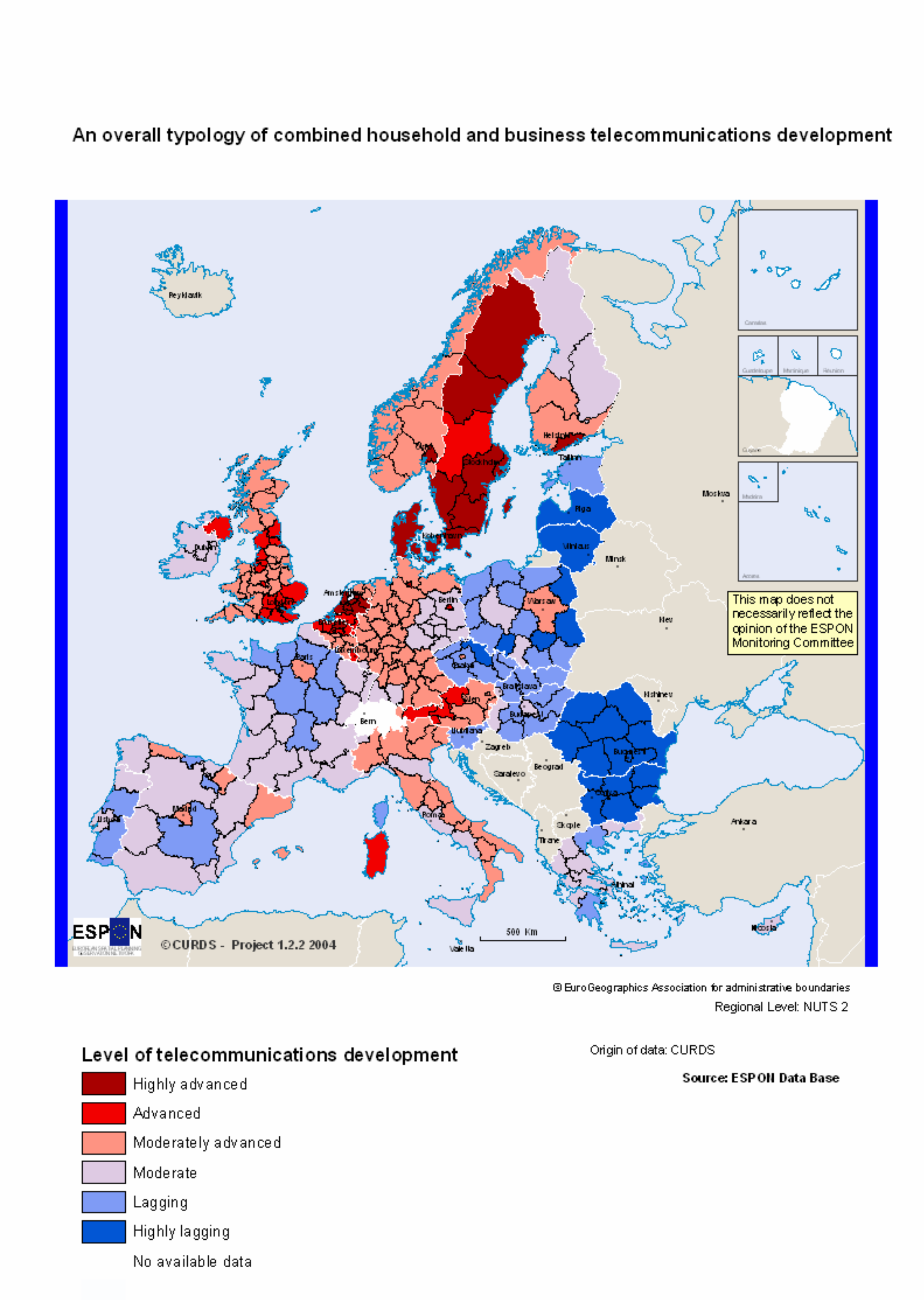


Table 5.24: An overall typology of combined household and business telecommunications development (see annex 12 for full typology table)

Typology category*	Regions in category
Highly advanced telecoms regions	Dutch and Nordic (particularly Swedish) regions, plus core city regions (Bruxelles, Antwerpen, Hamburg, Inner and Outer London).
Advanced telecoms regions	Numerous UK regions (northern and southern), other Benelux regions, three Austrian regions, the remaining Swedish region (Norra Mellansverige), plus Berlin and Sardegna.
Moderately advanced telecoms regions	The majority of German (west) and Italian regions, leading Spanish regions, remaining UK, Dutch, Belgian, Austrian and Nordic regions, plus Ile de France, Praha and Mazowieckie.
Moderate telecoms regions	The majority of French regions, other German (east), Spanish and Italian regions, some Greek regions, the two Irish regions, two remaining Finnish regions, two Portuguese, two Polish and two Hungarian regions, Kypros, Malta and Bratislavský.
Lagging telecoms regions	The majority of Czech regions, remaining French, Spanish, Greek, Hungarian and Slovak regions, other Portuguese and Polish regions, Eesti and Slovenija.
Highly lagging telecoms regions	All Bulgarian and Romanian regions, remaining Czech and Polish regions, Lietuva and Latvija, and Açores.

* It should be noted that these categorisations of regions depict the situation as of the time of the data we have used to construct them (for example, the INRA household survey was conducted in 2002). In such a fast-moving environment as telecommunications, therefore, some regions may have moved up or down this categorisation. It should thus be read with some level of caution.

Source: CURDS

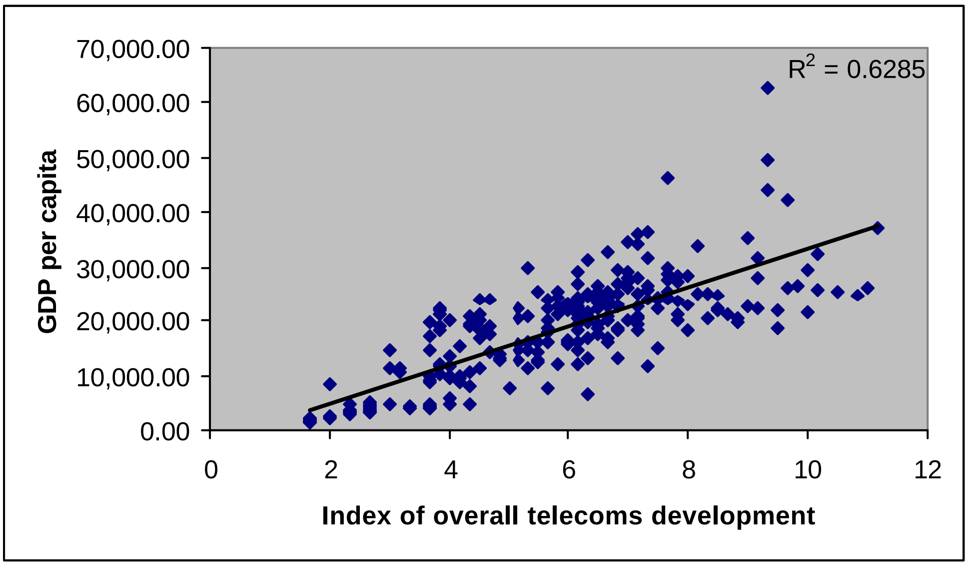
KEY MESSAGES

- Although the top category is dominated by 'rich' core regions, five Objective 1 regions are present in the top two categories: two Swedish Objective 1 regions are present among the most advanced telecoms uptake regions – Mellersta Norrland and Övre Norrland. Three other Objective 1 regions are classed in category 2 for overall telecoms uptake – Sardegna, Norra Mellansverige and Merseyside.
- The bottom category is dominated by N12 regions, with only the Açores providing an exception.

Figure 5.1 below illustrates that there is a relatively high correlation between the regional index on which the typology is produced and GDP levels (the R^2 value is 0.6285)[59]. Most regions from the highest GDP category are among the most advanced regions for telecoms uptake. The Dutch regions of Overijssel and Flevoland have high telecoms uptake overall, in spite of only moderate GDP levels. Luxembourg (category 2), Ile de France and Oberbayern (both category 3) are the only regions from the highest GDP category not among the most advanced regions for telecoms uptake. Without exception, the regions with lowest telecoms uptake also have lower levels of GDP (eastern European regions plus a few poorer EU15 regions), although the French regions of Champagne-Ardenne and Haute-Normandie are classed as lagging telecoms regions, whilst having moderately high GDP levels.

[59] This higher R^2 value and correlation, compared to those for household Internet uptake in chapter 3 and household broadband uptake in chapter 4, can be explained to a large extent by the inclusion of regions of N12 countries in this typology index (unlike in the INRA survey analyses), many of which have relatively low levels of both 'telecoms development' and GDP per capita.

Figure 5.1: The correlation between the typology index and GDP per capita



Source: CURDS

Most of the advanced telecoms regions of Europe are also (very) densely populated regions with large centres. The exceptions are six of the seven Swedish regions in the top telecoms category, which are all less densely populated regions, frequently without large centres.

In the bottom telecoms uptake category, most regions are less densely populated sometimes without centres, yet there is one very densely populated region with large centre, Bucuresti.

Only around half of the most advanced telecoms uptake regions are located within the Pentagon, with Nordic regions, and especially the seven advanced Swedish regions, located outside the Pentagon.

The least advanced telecoms uptake regions are all outside the Pentagon, although there are numerous German and French Pentagon regions only in categories 4 and 5.

A majority of the most advanced telecoms regions have quite significant top 1500 company HQ presence. Noord-Holland, Inner London and Outer London are three regions which are also in the top category for company HQ locations. Nevertheless, Ile de France ranks second overall for top company HQs, but is only in the third telecoms category, and there are also five advanced telecoms regions (3 Dutch and 2 Swedish regions) without any company HQs. At the same time, Oberbayern and Düsseldorf are both categorised among the leading European regions for company HQs, but are present in only category 3 for telecoms uptake. Lazio is also among the leading company HQ regions, but is only a moderate telecoms region. Almost all the least advanced telecoms regions have no HQ presence, with the only exception being Bucuresti with 1 HQ.

Table 5.25 below gives a meso national perspective on the above regional typology of telecommunications development by illustrating the relative spreads across the typology categories of regions within each country. Thus, ignoring those countries which are NUTS 2 at national level, we can see, for example, that Germany and Finland have a broad spread of regions from those which are highly advanced to those which are only moderate, whereas Sweden, whilst admittedly having fewer NUTS 2 regions than Germany, has regions spread only across the highly advanced and advanced categories. At the other end of the scale, Bulgaria and Romania are homogeneously highly lagging at regional level.

Table 5.25: Extent of 'spread' of regional differences in telecommunications development at the meso national level according to our typology

	Highly advanced	Advanced	Moderately advanced	Moderate	Lagging	Highly lagging
BE	■	■	■			
DK*	■					
DE	■	■	■	■		
GR				■	■	
ES			■	■	■	
FR			■	■	■	
IE				■		
IT		■	■	■		
LU*		■				
NL	■	■	■			
AT		■	■			
PT				■	■	■
FI	■	■	■	■		
SE	■	■				
UK	■	■	■			
BG						■
CY*				■		
CZ			■	■	■	■
EE*					■	
HU				■	■	
LT*						■
LV*						■
MT*				■		
PL			■	■	■	■
RO						■
SI*					■	
SK				■	■	
NO	■	■	■			
CH						

* Countries which are NUTS 2 at national level

Source: CURDS

5.3 National summaries of telecommunications territorialities

In this section, we provide a set of national summaries of telecommunications trends encompassing 20 of the 29 countries in the ESPON territory[60], but in different levels of detail. We present full summaries for 5 countries, including a table summarising the relative positions of their regions in the overall typology of telecoms advancement, a table breaking down the metro-urban-rural geography of telecoms uptake in the country according to the INRA household survey, and a commentary on this, highlighting the main analytical points and major territorial trends. These 5 countries are France and Germany from the 'core' of Europe, Spain from the Mediterranean periphery, Sweden from the Nordic periphery, and Hungary from eastern Europe. In addition, in annex 13, there are scatter plots for the first four countries, illustrating the respective relationships for national data between household Internet and broadband Internet access and our socio-economic-geographic variables. In the case of the other 15 countries, for EU15 member states, we present both the summary typology table of the positions of regions and the metro-urban-rural table of household uptake, while for the N12 countries, we present only the typology table as these countries were not included in the INRA survey.

1. Territorial trends of telecommunications networks in France

With the exception of the powerful capital region of Ile-de-France, France is a relatively balanced country in terms of overall telecommunications development. This is illustrated most clearly by our European regional typology (table 5.26), which places the majority of French regions in categories 4 and 5 of moderate-lagging levels of supply and uptake. This is partly reflected as well by regional GDP levels, which show Ile-de-France to be by far the richest French region (and with the vast majority of top company HQs located in France) and the rest of the country to be quite even in terms of average wealth.

[60] 8 countries (Denmark, Luxembourg, Cyprus, Estonia, Lithuania, Latvia, Malta and Slovenia) are NUTS 2 at national level, meaning that their relative typology positions and (in the case of the first two) household uptake data from the EU15 INRA survey do not reveal any sub-national territorial patterns on which this section focuses. There has not been sufficient data for Switzerland to include this country either, as it was not present in the overall typology.

Table 5.26: The level of telecoms advancement of French regions

Level of telecoms advancement	**Regions**
Highly advanced	
Advanced	
Moderately advanced	Ile-de-France
Moderate	Nord - Pas-de-Calais Lorraine Alsace Franche-Comté Pays de la Loire Bretagne Poitou-Charentes Aquitaine Midi-Pyrénées Limousin Rhône-Alpes Languedoc-Roussillon Provence-Alpes-Côte d'Azur
Lagging	Champagne-Ardenne Picardie Haute-Normandie Centre Basse-Normandie Bourgogne Auvergne Corse
Highly lagging	

Source: CURDS

The dominance of Ile-de-France on a meso national level is evident and largely unsurprising. According to the INRA data, the capital region has, by far, the highest uptake of mobile telephony, household Internet access, and household broadband access in France, even if, on a European level, it is not among the leading regions for any of these technologies.[61] The advance over other French regions is clearest for broadband access levels, where Ile-de-France has uptake of nearly twice that of the south west region of Aquitaine, Midi-Pyrenées and Limousin, and over three times that of all other regions.

Ile-de-France is also the only region to stand out in the regional e-commerce indicator data generated by our regression analysis. All other French regions are closely clustered together for firms with Internet access and firms with their own websites.

[61] Although the low French figures for broadband from INRA mask the very substantial recent acceleration of broadband penetration in this country.

On this same data, however, we can highlight more micro level intra-regional differences in e-commerce uptake. It is notable, for example, that within Ile-de-France, the départements of Paris and Hauts-de-Seine (which includes the La Défense business zone), the two richest and most economically dynamic départements of the capital region, have a major advance on their neighbouring départements in the proportions of firms with Internet access and with their own websites. Indeed, at this NUTS 3 level, the intra-regional differences between Paris and Seine-et-Marne are as great as, if not greater than, the NUTS 2 inter-regional differences between Ile-de-France and the least advanced French e-commerce region of Corse. These intra-regional disparities are not as strong within other French regions, leading to the important conclusion that, although Ile-de-France is, on a meso level, by far the most advanced French region for e-commerce (and telecoms uptake as a whole), on a micro level, this advance masks crucial territorial disparities within Ile-de-France. Paris and Hauts-de-Seine drive Ile-de-France along, while the firms and populations of Seine-et-Marne and Val d'Oise experience uptake levels similar to, or lower than, other provincial French départements.

Rhône-Alpes is usually held to be the second most powerful French region behind Ile-de-France, yet its state of advance in telecommunications terms is masked in the INRA data by it being part of a larger NUTS 1 region including the much less advanced rural region of Auvergne. That said, the estimated e-commerce data at NUTS 3 level does not show the départements of Rhône-Alpes to be ahead of others in terms of proportion of firms with Internet access, and only slightly ahead of other départements for the proportion of firms with their own website.

Table 5.27: The metro-urban-rural geography of telecommunications uptake in France (figures in brackets express the data as an index of the national figure)

	France	**Metro**	**Urban**	**Rural**
Fixed line	82 (*100*)	82 (*100*)	78 (*95*)	86 (*105*)
Mobile	66 (*100*)	69 (*105*)	69 (*105*)	57 (*86*)
PC	33 (*100*)	37 (*112*)	32 (*97*)	27 (*82*)
Internet access	20 (*100*)	25 (*125*)	17 (*85*)	15 (*75*)
Broadband Internet	3 (*100*)	5 (*167*)	1 (*33*)	0.1 (*3*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

As in other countries, rural areas of France register higher fixed line penetration than metro and urban areas, suggesting that many people in cities have forsaken their fixed telephone lines in favour of mobile, whereas poorer mobile network coverage in rural France means people there still rely largely on a fixed line.

France (along with Germany) has the lowest national mobile penetration rate in EU15, with a significant urban-rural divide, although no difference between metro and urban areas.

There is quite a significant divide between metro areas and urban areas in terms of both Internet access and broadband Internet access, yet much less of a divide between urban areas and rural areas. This suggests that it is really the firms and populations of Paris and other large metropoles which have been driving overall Internet and broadband Internet uptake in France (eg DSL deployment started in Paris, then Lyon and Marseille, before gradually diffusing down the urban hierarchy).

Summary

There appears to be a good level of territorial cohesion in telecommunications in France with relatively limited differences between provincial regions, whether north-south or east-west. Most French regions have urban and rural areas, so regional differences do not have much of an urban-rural dimension to them either. On the other hand, there is limited evidence of meso level polycentricity in telecommunications, with no real counter-weight region(s) to Ile-de-France. We do not have enough evidence to measure the extent to which the Lyon metropolitan area or other large urban areas such as Marseille, Bordeaux, Lille or Strasbourg are emerging as alternative advanced metropoles which would create a more polycentric territoriality of telecommunications in France.

Table 5.28: The level of telecoms advancement of German regions

Level of telecoms advancement	Regions
Highly advanced	Hamburg
Advanced	Berlin
Moderately advanced	Stuttgart Karlsruhe Oberbayern Niederbayern Oberpfalz Oberfranken Mittelfranken Unterfranken Schwaben Bremen Darmstadt Gießen Kassel Mecklenburg-Vorpommern Braunschweig Hannover Lüneburg Weser-Ems Düsseldorf Köln Münster Detmold Arnsberg Koblenz Trier Rheinhessen-Pfalz Schleswig-Holstein
Moderate	Freiburg Tübingen Brandenburg Saarland Chemnitz Dresden Leipzig Dessau Halle Magdeburg Thüringen
Lagging	
Highly lagging	

Source: CURDS

Table 5.29: The metro-urban-rural geography of telecommunications uptake in Germany (figures in brackets express the data as an index of the national figure)

	Germany	**Metro**	**Urban**	**Rural**
Fixed line	94 (*100*)	96 (*102*)	92 (*98*)	95 (*101*)
Mobile	66 (*100*)	65 (*98*)	66 (*100*)	66 (*100*)
PC	50 (*100*)	52 (*104*)	49 (*98*)	52 (*104*)
Internet access	33 (*100*)	39 (*118*)	33 (*100*)	32 (*97*)
Broadband Internet	3 (*100*)	4 (*133*)	3 (*100*)	2 (*67*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

It is notable that rural areas of Germany register slightly higher fixed line penetration than urban areas, although Germany as a whole still has one of the highest rates of fixed line telephony uptake in EU15. In contrast, Germany (along with France) has the lowest level of mobile telephony penetration in EU15, with little or no territorial variation between metro, urban and rural areas. Clearly, households in all areas of Germany remain attached to fixed line telephones, and are somewhat more reluctant to embrace mobile telephony.

There is quite a significant divide between metro areas and urban areas in terms of Internet access, yet much less of a divide between urban areas and rural areas. This suggests that it is really the firms and populations of the largest cities which have been driving Internet uptake in Germany. Although broadband uptake conforms to a metro-urban-rural hierarchy, the overall figure of 3% uptake demonstrates that, for the largest country and strongest economy in EU15, broadband development has been very slow.

Table 5.30: The level of telecoms advancement of Spanish regions

Level of telecoms advancement	Regions
Highly advanced	
Advanced	
Moderately advanced	Principado de Asturias Comunidad Foral de Navarra Comunidad de Madrid Cataluña Islas Baleares
Moderate	Galicia Pais Vasco Aragón Castilla y León Extremadura Comunidad Valenciana Andalucia Région de Murcia Ceuta y Melilla (ES)
Lagging	Cantabria La Rioja Castilla-la Mancha Canarias (ES)
Highly lagging	

Source: CURDS

Table 5.31: The metro-urban-rural geography of telecommunications uptake in Spain (figures in brackets express the data as an index of the national figure)

	Spain	**Metro**	**Urban**	**Rural**
Fixed line	84 (*100*)	89 (*106*)	84 (*100*)	83 (*99*)
Mobile	79 (*100*)	82 (*104*)	82 (*104*)	77 (*97*)
PC	44 (*100*)	48 (*109*)	46 (*105*)	42 (*95*)
Internet access	23 (*100*)	28 (*122*)	25 (*109*)	20 (*87*)
Broadband Internet	4 (*100*)	4 (*100*)	6 (*150*)	3 (*75*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

Fixed line telephony continues to be dominated by metro areas in Spain, but it is notable that rural areas do not lag much behind urban areas on this indicator. Although not quite at the levels of Italy and Greece, Spain does register relatively high mobile telephony penetration, which in turn has developed an urban-rural differentiation with rural areas having slightly lower uptake than Spanish cities. Nevertheless, the figures for fixed line and mobile telephony suggest that more than three quarters of households in Spanish rural areas have access to both forms.

Internet uptake in Spain has been slow to take off, and has developed a clear metro-urban-rural hierarchy. This is curiously not mirrored by the variations in broadband Internet access, where urban areas are ahead of Spanish metro areas. In both cases, however, it could not be said that rural areas lag too significantly behind Spanish cities.

4. Territorial trends of telecommunications networks in Sweden

Table 5.32: The level of telecoms advancement of Swedish regions

Level of telecoms advancement	**Regions**
Highly advanced	Stockholm Östra Mellansverige Sydsverige Mellersta Norrland Övre Norrland Småland med öarna Västsverige
Advanced	Norra Mellansverige
Moderately advanced	
Moderate	
Lagging	
Highly lagging	

Source: CURDS

Table 5.33: The metro-urban-rural geography of telecommunications uptake in Sweden (figures in brackets express the data as an index of the national figure)

	Sweden	**Metro**	**Urban**	**Rural**
Fixed line	95 (*100*)	94 (*99*)	95 (*100*)	95 (*100*)
Mobile	84 (*100*)	83 (*99*)	84 (*100*)	85 (*101*)
PC	73 (*100*)	73 (*100*)	72 (*99*)	73 (*100*)
Internet access	64 (*100*)	64 (*100*)	64 (*100*)	64 (*100*)
Broadband Internet	13 (*100*)	17 (*131*)	16 (*123*)	7 (*54*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

On four of the five indicators above, there is very little territorial variation in uptake between metro, urban and rural areas in Sweden. For fixed line and mobile telephony, rural areas even have marginally higher uptake rates than metro areas. In overall terms, Sweden is among the leading EU15 countries on all these indicators, and has the highest uptake rate for PC and Internet access. Only on broadband can we distinguish any kind of territorial divide in access to telecoms services, with rural areas lagging behind metro and urban areas (but at 7% penetration still having a higher rate than the national average for many other EU15 countries). Despite this, Sweden is evidently one of the most balanced and cohesive European countries for territorial telecommunications development, perhaps reflecting both a successful combination and cohabitation of competitive and dynamic market-led rollout and punctual public intervention when and where necessary, and the cultural enthusiasm of the Swedish people to embrace new communications technologies whenever possible?

Table 5.34: The level of telecoms advancement of Hungarian regions

Level of telecoms advancement	Regions
Highly advanced	
Advanced	
Moderately advanced	
Moderate	Közép-Magyarország Nyugat-Dunántúl
Lagging	Közép-Dunántúl Dél-Dunántúl Észak-Magyarország Észak-Alföld Dél-Alföld
Highly lagging	

Source: CURDS

With regard to telecommunications development, we would expect the region containing the capital Budapest (Közép-Magyarország) to be much more advanced than the rest of the country. In our overall typology (table 5.35), however, it is joined in the 'moderate' category by Nyugat-Dunántúl. Eastern and southern regions of Hungary are categorised as 'lagging' behind. This spatial pattern is very much following territorial disparities in general economic development (measured by indicators such as GDP per capita, unemployment, FDI, and number of SMEs, etc.).

Besides the gap between the Budapest region and the rest of the country, highlighted in section 3.4.3, and the traditional West-East 'slope', telecommunications trends show another pattern of variation along the settlement hierarchy, which is partly due to the fact that the general roll-out strategies of telecommunications companies are largely based on population concentrations and location of corporate clients (see table 5.36 below).[62] Villages and towns with populations of less than 10,000 tend to be more neglected by the market (Ministry of Informatics and Communications, 2004)[63].

[62] Evidence of this was provided by interviews with telecommunications companies and the ministry and regulator in Hungary carried out in spring 2003.

[63] Ministry of Informatics and Communications (2004): Broadband Electronic Communications in Hungary, p. 24 www.ihm.hu/strategia/broadband_eng.pdf. See also IHM "The Hungarian Information Society on the Eve of Accession to the European Union: snapshot and strategic objectives".

Table 5.35: Metropolitan-urban-rural disparities in ADSL roll-out and Internet uptake in Hungary

%	Budapest	Big towns	Towns	Villages
Estimated ADSL coverage of population	53	82	56	1
Internet users	40	32	23	15

Source: Ministry of Informatics and Communications (2003)

Table 5.36: Regional Internet use levels in Hungary

	Hungary	Közép-Magyarország	Nyugat-Dunántúl	Közép-Dunántúl	Dél-Dunántúl	Észak-Magyarország	Észak-Alföld	Dél-Alföld
% Internet usage	25	37	25	30	20	18	17	20

Source: Ministry of Informatics and Communications (2003)

6. Territorial trends of telecommunications networks in Belgium

Table 5.37: The level of telecoms advancement of Belgian regions

Level of telecoms advancement	**Regions**
Highly advanced	Région Bruxelles-capitale/Brussels hoofdstad gewest Antwerpen
Advanced	Limburg (B) Oost-Vlaanderen Vlaams Brabant West-Vlaanderen
Moderately advanced	Brabant Wallon Hainaut Liège Luxembourg (B) Namur
Moderate	
Lagging	
Highly lagging	

Source: CURDS

Table 5.38: The metro-urban-rural geography of telecommunications uptake in Belgium (figures in brackets express the data as an index of the national figure)

	Belgium	**Metro**	**Urban**	**Rural**
Fixed line	76 (*100*)	72 (*95*)	79 (*104*)	76 (*100*)
Mobile	71 (*100*)	76 (*107*)	67 (*94*)	71 (*100*)
PC	42 (*100*)	44 (*105*)	42 (*100*)	41 (*98*)
Internet access	32 (*100*)	33 (*103*)	32 (*100*)	31 (*97*)
Broadband Internet	15 (*100*)	17 (*113*)	14 (*93*)	15 (*100*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

The key trend is a relatively balanced uptake, even for broadband.

7. Territorial trends of telecommunications networks in Greece

Table 5.39: The level of telecoms advancement of Greek regions

Level of telecoms advancement	**Regions**
Highly advanced	
Advanced	
Moderately advanced	
Moderate	Anatoliki Makedonia, Thraki Dytiki Makedonia Thessalia Ipeiros Ionia Nisia Dytiki Ellada Sterea Ellada Attiki Notio Aigaio Kriti
Lagging	Kentriki Makedonia Peloponnisos Voreio Aigaio
Highly lagging	

Source: CURDS

Table 5.40: The metro-urban-rural geography of telecommunications uptake in Greece (figures in brackets express the data as an index of the national figure)

	Greece	**Metro**	**Urban**	**Rural**
Fixed line	91 (*100*)	89 (*98*)	91 (*100*)	94 (*103*)
Mobile	87 (*100*)	90 (*103*)	88 (*101*)	83 (*95*)
PC	27 (*100*)	32 (*119*)	29 (*107*)	20 (*74*)
Internet access	14 (*100*)	18 (*129*)	15 (*107*)	9 (*64*)
Broadband Internet	0 (*100*)	0 (*100*)	0 (*100*)	0 (*100*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

The key trend is that rural areas lag on mobile, PCs and Internet.

8. Territorial trends of telecommunications networks in Ireland

Table 5.41: The level of telecoms advancement of Irish regions

Level of telecoms advancement	**Regions**
Highly advanced	
Advanced	
Moderately advanced	
Moderate	Border, Midlands and Western Southern and Eastern
Lagging	
Highly lagging	

Source: CURDS

Table 5.42: The metro-urban-rural geography of telecommunications uptake in Ireland (figures in brackets express the data as an index of the national figure)

	Ireland	**Metro**	**Urban**	**Rural**
Fixed line	86 (*100*)	88 (*102*)	84 (*98*)	86 (*100*)
Mobile	82 (*100*)	87 (*106*)	80 (*98*)	81 (*99*)
PC	45 (*100*)	49 (*109*)	45 (*100*)	43 (*96*)
Internet access	33 (*100*)	36 (*109*)	32 (*97*)	32 (*97*)
Broadband Internet	0.1 (*100*)	0 (*0*)	0.4 (*400*)	0 (*0*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

The key trend is some metro dominance, but little variation between other urban and rural areas.

Table 5.43: The level of telecoms advancement of Italian regions

Level of telecoms advancement	Regions
Highly advanced	
Advanced	Sardegna
Moderately advanced	Piemonte Lombardia Trentino-Alto Adige Veneto Friuli-Venezia Giulia Toscana Umbria Marche Abruzzo Molise Puglia Basilicata Calabria
Moderate	Valle d'Aosta Liguria Emilia-Romagna Lazio Campania Sicilia
Lagging	
Highly lagging	

Source: CURDS

Table 5.44: The metro-urban-rural geography of telecommunications uptake in Italy (figures in brackets express the data as an index of the national figure)

	Italy	**Metro**	**Urban**	**Rural**
Fixed line	84 (*100*)	86 (*102*)	83 (*99*)	84 (*100*)
Mobile	83 (*100*)	80 (*96*)	87 (*105*)	81 (*98*)
PC	44 (*100*)	45 (*102*)	45 (*102*)	43 (*98*)
Internet access	34 (*100*)	37 (*109*)	34 (*100*)	34 (*100*)
Broadband Internet	1 (*100*)	2 (*200*)	2 (*200*)	1 (*100*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

The key trend is a relatively balanced uptake for all technologies.

Table 5.45: The level of telecoms advancement of Dutch regions

Level of telecoms advancement	Regions
Highly advanced	Overijssel Gelderland Flevoland Utrecht Noord-Holland Zuid-Holland Zeeland
Advanced	Noord-Brabant Limburg (NL)
Moderately advanced	Groningen Friesland Drenthe
Moderate	
Lagging	
Highly lagging	

Source: CURDS

Table 5.46: The metro-urban-rural geography of telecommunications uptake in the Netherlands (figures in brackets express the data as an index of the national figure)

	Netherlands	**Metro**	**Urban**	**Rural**
Fixed line	93 (*100*)	88 (*95*)	94 (*101*)	95 (*102*)
Mobile	85 (*100*)	89 (*105*)	82 (*96*)	85 (*100*)
PC	68 (*100*)	72 (*106*)	65 (*96*)	71 (*104*)
Internet access	48 (*100*)	53 (*110*)	45 (*94*)	50 (*104*)
Broadband Internet	12 (*100*)	19 (*158*)	12 (*100*)	5 (*42*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

The key trend is that only for broadband do rural areas not reach the national average. There is a high metro dominance, especially for broadband.

Table 5.47: The level of telecoms advancement of Austrian regions

Level of telecoms advancement	**Regions**
Highly advanced	
Advanced	Oberösterreich Salzburg Tirol
Moderately advanced	Burgenland Niederösterreich Wien Kärnten Steiermark Vorarlberg
Moderate	
Lagging	
Highly lagging	

Source: CURDS

Table 5.48: The metro-urban-rural geography of telecommunications uptake in Austria (figures in brackets express the data as an index of the national figure)

	Austria	**Metro**	**Urban**	**Rural**
Fixed line	71 (*100*)	61 (*86*)	68 (*96*)	77 (*108*)
Mobile	72 (*100*)	73 (*101*)	74 (*103*)	71 (*99*)
PC	46 (*100*)	44 (*96*)	47 (*102*)	47 (*102*)
Internet access	33 (*100*)	34 (*103*)	34 (*103*)	32 (*97*)
Broadband Internet	8 (*100*)	14 (*175*)	9 (*113*)	4 (*50*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

The key trend is a metro-urban dominance in broadband.

Table 5.49: The level of telecoms advancement of Portuguese regions

Level of telecoms advancement	**Regions**
Highly advanced	
Advanced	
Moderately advanced	
Moderate	Norte Lisboa e Vale do Tejo
Lagging	Centro (PT) Alentejo Algarve Madeira (PT)
Highly lagging	Açores (PT)

Source: CURDS

Table 5.50: The metro-urban-rural geography of telecommunications uptake in Portugal (figures in brackets express the data as an index of the national figure)

	Portugal	**Metro**	**Urban**	**Rural**
Fixed line	62 (*100*)	62 (*100*)	62 (*100*)	62 (*100*)
Mobile	76 (*100*)	80 (*105*)	79 (*104*)	74 (*97*)
PC	32 (*100*)	29 (*91*)	37 (*116*)	31 (*97*)
Internet access	15 (*100*)	15 (*100*)	17 (*113*)	15 (*100*)
Broadband Internet	3 (*100*)	7 (*233*)	3 (*100*)	2 (*67*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

The key trend is that urban areas perform better than metro areas for PCs and Internet. Metro areas drive broadband growth.

13. Territorial trends of telecommunications networks in Finland

Table 5.51: The level of telecoms advancement of Finnish regions

Level of telecoms advancement	Regions
Highly advanced	Uusimaa (suuralue)
Advanced	
Moderately advanced	Väli-Suomi Etelä-Suomi
Moderate	Itä-Suomi Pohjois-Suomi
Lagging	
Highly lagging	

Source: CURDS

Table 5.52: The metro-urban-rural geography of telecommunications uptake in Finland (figures in brackets express the data as an index of the national figure)

	Finland	Metro	Urban	Rural
Fixed line	69 (*100*)	76 (*110*)	65 (*94*)	71 (*103*)
Mobile	86 (*100*)	91 (*106*)	87 (*101*)	84 (*98*)
PC	52 (*100*)	66 (*127*)	51 (*98*)	47 (*90*)
Internet access	36 (*100*)	53 (*147*)	33 (*92*)	32 (*89*)
Broadband Internet	6 (*100*)	14 (*233*)	5 (*83*)	2 (*33*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

The key trend is a substantial metro dominance in all technologies, particularly in computing-related ones. The Helsinki region alone would appear to drive the advanced telecommunications status of Finland?

Table 5.53: The level of telecoms advancement of UK regions

Level of telecoms advancement	Regions
Highly advanced	Inner London Outer London
Advanced	Tees Valley and Durham Northumberland, Tyne and Wear Cumbria Cheshire Greater Manchester Lancashire Merseyside West Midlands East Anglia Bedfordshire, Hertfordshire Essex Berkshire, Bucks and Oxfordshire Surrey, East and West Sussex Hampshire and Isle of Wight Kent Northern Ireland
Moderately advanced	East Riding and North Lincolnshire North Yorkshire South Yorkshire West Yorkshire Derbyshire and Nottinghamshire Leicestershire, Rutland and Northants Lincolnshire Herefordshire, Worcestershire and Warks Shropshire and Staffordshire Gloucestershire, Wiltshire and North Somerset Dorset and Somerset Cornwall and Isles of Scilly Devon West Wales and The Valleys East Wales North Eastern Scotland Eastern Scotland South Western Scotland Highlands and Islands
Moderate	
Lagging	
Highly lagging	

Source: CURDS

Table 5.54: The metro-urban-rural geography of telecommunications uptake in the UK (figures in brackets express the data as an index of the national figure)

	UK	**Metro**	**Urban**	**Rural**
Fixed line	93 (*100*)	92 (*99*)	93 (*100*)	93 (*100*)
Mobile	81 (*100*)	78 (*96*)	82 (*101*)	81 (*100*)
PC	56 (*100*)	53 (*95*)	56 (*100*)	57 (*102*)
Internet access	45 (*100*)	44 (*98*)	45 (*100*)	47 (*104*)
Broadband Internet	4 (*100*)	7 (*175*)	4 (*100*)	2 (*50*)

Source: CURDS; elaborated from INRA (2004) (see annex 6 for definition of metropolitan-urban-rural adopted by INRA)

The key trend is a relatively balanced uptake except for broadband. Rural areas lead the way for PCs and Internet, while urban areas also score higher than metro areas for these 2 indicators.

15. Territorial trends of telecommunications networks in Bulgaria

Table 5.55: The level of telecoms advancement of Bulgarian regions

Level of telecoms advancement	**Regions**
Highly advanced	
Advanced	
Moderately advanced	
Moderate	
Lagging	
Highly lagging	Severozapaden Severen Tsentralen Severoiztochen Yugozapaden Yuzhen Tsentralen Yugoiztochen

Source: CURDS

16. Territorial trends of telecommunications networks in the Czech Republic

Table 5.56: The level of telecoms advancement of Czech regions

Level of telecoms advancement	Regions
Highly advanced	
Advanced	
Moderately advanced	Praha
Moderate	
Lagging	Strední Cechy Jihozápad Severozápad Jihovýchod Strední Morava Moravskoslezko
Highly lagging	Severovýchod

Source: CURDS

17. Territorial trends of telecommunications networks in Poland

Table 5.57: The level of telecoms advancement of Polish regions

Level of telecoms advancement	Regions
Highly advanced	
Advanced	
Moderately advanced	Mazowieckie
Moderate	Slaskie Wielkopolskie
Lagging	Dolnoslaskie Kujawsko-Pomorskie Lubuskie Lódzkie Malopolskie Podkarpackie Pomorskie Warminsko-Mazurskie Zachodniopomorskie
Highly lagging	Lubelskie Opolskie Podlaskie Swietokrzyskie

Source: CURDS

18. Territorial trends of telecommunications networks in Romania

Table 5.58: The level of telecoms advancement of Romanian regions

Level of telecoms advancement	Regions
Highly advanced	
Advanced	
Moderately advanced	
Moderate	
Lagging	
Highly lagging	Nord-Est Sud-Est Sud Sud-Vest Vest Nord-Vest Centru Bucuresti

Source: CURDS

19. Territorial trends of telecommunications networks in Slovakia

Table 5.59: The level of telecoms advancement of Slovakian regions

– Level of telecoms advancement	Regions
Highly advanced	
Advanced	
Moderately advanced	
Moderate	Bratislavský
Lagging	Západné Slovensko Stredné Slovensko Východné Slovensko
Highly lagging	

Source: CURDS

Table 5.60: The level of telecoms advancement of Norwegian regions

Level of telecoms advancement	**Regions**
Highly advanced	Oslo Og Akershus
Advanced	
Moderately advanced	Hedmark Og Oppland Sør-Østlandet Agder Og Rogaland Vestlandet Trøndelag Nord-Norge
Moderate	
Lagging	
Highly lagging	

Source: CURDS

Chapter 6 – Policy issues

6.1 Introduction

It is now widely recognised that a range of policy approaches will be required if all citizens across the whole European territory are to participate fully in the information society and knowledge economy. These policies range from stimulating the creation of suitable content provision (the elusive ‘killer application’) to the development of human and institutional capacity. The focus of our study is the *infrastructure* of the information society and we restrict our policy discussion to this topic, whilst recognising the need for a broader package of accompanying measures. The evidence presented in this Final Report and in our three interim reports clearly demonstrates that there are disparities in the supply and demand of telecommunications networks and services across the European territories. These divisions are complex, but can be seen at the macro, meso and micro levels. The nature and extent of disparities vary according to technologies and also vary between countries. To take one illustrative example, if we look at household adoption of the Internet (Chapter 3 of this report), we see that in Finland there are significant disparities between metro, urban and rural localities with cities having far higher penetration rates than rural areas. By contrast, in the UK rural areas have higher penetration rates than either metropolitan or urban areas. The factors behind these disparities are complex and, in some cases, may be deeply rooted in the specific economic, cultural and institutional histories of individual countries or regions.

In this chapter we address the question of what forms of intervention might be adopted to address these disparities. It is clear from the complexity of the patterns described in this report that a one-size-fits-all approach is not appropriate and we put forward, therefore, a menu of policy options. We are not, of course, considering policy options in a vacuum, but in the context of an already relatively well articulated set of strategies developed at European Union level and by many individual Member States. A broad policy consensus has developed in Europe over the past ten years or so which consists of two main strands. The first strand places an emphasis on the liberalisation of telecommunications and related markets, with movement towards ‘light touch’ regulation, through which it is hoped to stimulate competition and thus both supply and demand. The second strand emphasises the stimulation of demand for ICTs through a range of means, including training and education (for example, developing digital literacy), increasing awareness, encouraging e-commerce, e-government and e-healthcare, as well as stimulating content creation in the search for the 'killer application' (see, for example, the eEurope Action Plan 2005).

More recently, a third strand, the stimulation of the *supply* of infrastructure, to those areas regarded as being underserved by the market, and where it appears that the liberalisation strand will not provide sufficient stimulus, has come more to the fore. The key factor behind this has been the emergence of broadband technology. So, although the liberalisation and demand creation strands remain dominant, there has been a significant change in attitudes towards government intervention which seeks to directly stimulate demand for infrastructure and, indeed, to supply infrastructure. It is this policy strand which we mainly focus on in this policy chapter. We concentrate on broadband technologies as the universal provision of these technologies is the key policy goal at present.

Several developments are noteworthy. In the late 1990s state aids towards telecommunications infrastructure investment were strongly discouraged by the Commission. Recently, the Commission has acknowledged "the need for public intervention to accelerate coverage of under-served areas" and that Structural Funds and funding from the European Investment Bank can be used for this purpose (CEC, 2004a), though any use of Structural Funds should be in line with the Commission's recent Guidelines.[64]

The Commission also announced (at the end of 2003) support for 'Digital Divide Quick-Start' projects in order to "accelerate provision of broadband deployment in under-served areas" through a technology-neutral approach. The Connecting Europe paper recommends that:

[64] "Guidelines on criteria and modalities of use of Structural Funds for electronic communications" (2003a)

"Member States, in coordination with regions, should encourage digital-divide broadband quick-start projects in the context of the mid-term review of structural funds and on the basis of their national broadband strategies, with the emphasis on remote and rural areas, including the outermost regions." (CEC, 2004a: p12)

At the same time a number of EU15 countries have undertaken investment to stimulate telecommunications infrastructure in particular regions and others are considering doing so, with or without Structural Funds, as can be seen from Table 6.1. These initiatives vary from the provision of fibre backbone networks, through the creation of metropolitan area networks (MANs), to the enabling of local exchanges and piloting new broadband technologies.

Table 6.1: Outline of national government supply-side strategies to increase coverage of broadband in under-served areas through infrastructure investment in EU15

Country	***Specific supply-side strategy? Yes (✓) No (X)***	***Nature of supply-side intervention strategy for under-served areas***	***Examples of funding and implementation mechanisms***
Belgium	X	Has no plans to use public funds to bring broadband to under-served areas. A number of demand side mechanisms have been adopted	
Denmark	X	No plans to use public funds to bring broadband to under-served areas, but local authorities can drive wholesale networks	
Germany	X	Does not envisage public funding for broadband	
Greece	✓	Connect all cities with > 10k inhabitants to fibre-optic networks by end 2006. MANs in 50 larger cities by end 2005	€200 m through Public Private Partnerships to build LANs in under-served areas (60% public funding of which 70% SF).
Spain	✓	Promoting broadband particularly in rural and less favoured areas where (a) broadband is unlikely to be available in coming years (b) where incumbent only presently has infrastructure	Funding from Budget Law, Public Administration funds and Structural Funds. Around €188m 2003-2006. Reimbursable loans to operators through competitive tender, subject to geographical price averaging and open access rules.

France	✓	Increased coverage of under-served areas to reach citizens in all geographical and social situations	Fund to support broadband. Allocation of part of SF to broadband and measures to stimulate regions to use SF for broadband. €60m in preferential loans from Caisse des Depots et Consignation to stimulate €700m of total investment in under-served areas
Ireland	✓	Broadband (5mbs to home) to be available throughout the country. Multiple-level interventions.	€200m for broadband infrastructure projects. Part funded by SF. National fibre-optic backbone and MAN to 19 towns and cities. Open access broadband infrastructures to all cities and towns with >1,500 population. Facilitating pooling of broadband demand for smaller communities. Developing infrastructure in areas characterised by declining population.
Italy	✓	Actions to overcome digital divide including investment in underserved areas including monitoring coverage	5 year strategy for broadband in Southern Italy co-ordinated by 'Sviluppo Italia'. 60 per cent covered through public money.
Luxembourg	✓	Government is looking at ways of extending connectivity to 6-8% of households which do not have possibility of connecting to broadband	Exploring satellite and UMTS. Use of SF possible
Netherlands	X		
Austria	✓	Initiatives to cover under-served areas. A mapping exercise is underway to identify those areas.	Subsidised extension of broadband infrastructure to under-served areas (e.g. Niederösterreich). Mainly Public Private Partnerships and competitive tendering. Considering use of SF.
Portugal	✓	Overcoming the digital divide including providing broadband access in 15 underprivileged municipalities by the end of 2004.	Building new infrastructure, sharing infrastructure with private operators and taking advantage of existing public infrastructures and aggregating public demand. SF will be used to bring broadband to under-served areas.
Finland	✓	Mapping of availability has taken place and guidelines and a strategy to estimate future demand and market conditions in each municipality has been formulated	Municipalities can intervene but within the context of national guidelines. Municipal wholesale networks already exist.

Sweden	✓	National strategy for development of IT infrastructure access throughout Sweden in recognition that rural, sparsely populated areas and towns with fewer than 3000 inhabitants are unlikely to be connected without assistance from the state.	SEK 5,250m for 2000-2005. Mainly subsidies to private sector, but also to municipalities where no market interest. Covers connection to national backbone, regional network construction, local networks. Regional grants and SF may also be used for infrastructure development.
UK	✓	Key strategy is demand aggregation. Supply-side intervention mainly confined to trialling alternative technologies.	£30m Broadband Fund to fund innovative pilot projects including pioneering new technologies. Additional funds in Scotland and Wales. SF being used in rural areas. Limited areas of ADSL upgrades supported by SF, e.g., Cornwall

Source: CURDS; elaborated from CEC (2004b)

As can be seen from table 6.1, not all Member States have developed policy to intervene on the supply side and there is still a significant level of disagreement as to the efficacy of intervention in this area. The OECD, for example, argue for a measured and evidence-based approach to intervention (OECD, 2001a) and question why and how governments arrive at goals, objectives and targets such as ‘broadband access for all by the year 2005’ (OECD, 2004). In line with other commentators, they also ask what is so special about the ‘digital divide’ when compared to other long accepted social disparities (OECD, 2001b; 2003; 2004). These are interesting (and important) questions, but cannot be considered in detail here. It is not the role of ESPON, and therefore not of the role of this report, to challenge fundamental policy objectives of the Union.

In the following sections we consider some of the measures which could be taken by policymakers at various levels – European, national, regional and local – to stimulate the development of infrastructure and services in those areas which appear to be lagging. At the meso or regional level, these policies would clearly be most appropriate for the regions which we have identified as lagging and which appear in categories 5 and 6 in table 5.2 and annex 12 of this report. At the micro level there may also be smaller areas within regions which are more advanced overall than these lagging regions, where the policies will also be appropriate.

We look at four policy areas. First, in section 6.2, we look at selected polices which fall under the first policy strand referred to above – that of liberalisation and regulation – and explore if and how the competitive and regulatory environment might be adjusted to be more sympathetic to territorial development goals. We then turn to look at ways in which the public sector might intervene more directly to stimulate the supply of infrastructure. In sections 6.3 we consider how the public sector can aggregate demand for broadband in order to stimulate rollout in a region; in section 6.4 we explore ways in which regional and local authorities can create (or be partners in creating) models of broadband rollout, providing a number of examples of intervention. Here we extend the technological focus beyond the two currently dominant broadband technologies, DSL and cable, to look at examples of how regions are adopting less commercially developed broadband technologies such as satellite and wireless. In section 6.5, we stress the need for increased knowledge or 'institutional capacity' amongst public authorities in relation to telecommunications networks and services. We close the chapter with a plea for an improved system of data gathering and dissemination in respect of telecommunications networks and services. We argue that it is only through such an approach that a truly evidenced-based policy can be developed.

6.2 Regulation as a tool for regional balanced territorial development of infrastructure?

European regulation covering telecommunications and other 'electronic networks' has recently been updated and brought together under a New Regulatory Framework (NRF), the key directive being the Framework Directive (CEC, 2002a)[65]. The NRF reflects the fact that the telecommunications, media and information technologies sectors are converging. The overall intention of the NRF is to move away from specific sectoral regulation towards the application of market competition law (DotEcon, 2003;

[65] For details of the Directives which comprise the NRF see paragraph 5 of the recital to Directive 2002/21/EC of the European Parliament and the Council of 7th March 2002 on a common regulatory framework for electronic communications networks and services (Framework Directive). OJEC, L108/33.

Cave, 2003). This approach is based on the view that ICT markets are becoming more competitive. Notwithstanding this long-term goal, it is recognised that national regulatory authorities (NRA) will need to continue to regulate in the short to medium-term. The New Regulatory Framework, in line with other telecommunications regulation, is largely 'spatially blind' and tends to treat territories as being homogenous. The partial exception to this is the Universal Service Directive. In this section we look briefly at how the regulatory environment might be adjusted to take account of territorial development issues rather than merely focusing on competition and pricing. We look at three policy areas: regulation aimed at stimulating competition and how relevant the measures adopted are to the problems of under-served areas; the Universal Service Directive (USD); and adjusting the role of the regulatory authority to enable/require it to take into account questions of territorial development.

6.2.1 Regulation aimed at stimulating competition

There can be little doubt that the opening up of European telecommunications markets to competition, together with technological advances in the 1980s and 1990s, have led to rapid growth in the availability of telecommunications networks and services. Competition has clearly had a pronounced impact on some parts of the telecommunications market: for example, competition in the corporate market is intense. Similarly, intense competition has developed in certain territories, notably capital cities and other major cities, as new entrants have invested in fixed telephony and cable operators have provided further competition. Competition in the SME and domestic markets, however, is still not fully developed in several countries and the power of the incumbent remains entrenched. Competition in localities where markets are perceived to be small, notably remote and rural areas, but also, in some cases, peri-urban locations is also muted.

Regulators have undertaken a number of measures to try to stimulate competition. The key question from a regional perspective is how competition can be developed where there is little appetite amongst the telecommunications providers to address those markets. Measures adopted by national regulators to date seem to be 'spatially blind' in that they treat the country in question as a single entity and take no account of territorial differences when considering whether a measure designed to increase competitiveness is likely to be successful in inducing competition in peripheral regions. This point can be illustrated by looking at three examples of regulation.

The first example concerns the general question of licenses which (in the case of most networks) telecommunications companies require in order to provide services to businesses and customers. These licenses may allow firms to cover a whole country or a certain territory within a country. These licences generally contain the provision that a certain proportion of consumers must be capable of accessing the service within a certain period of time. The proportion of customers to be covered in any given territory is usually drawn so that the least populous parts of the territory are not served, the provider's target figure being met through serving the more urbanised areas of the territory. One policy option is to issue license conditions which impose more even territorial coverage. Such a strategy may make sense when the market for licenses is buoyant, but would be less productive in other circumstances. Furthermore, conditions would have to be enforced.

The second example is local loop unbundling (LLU). Under a European Directive, adopted in January 2001, national regulators were required to introduce rules on local loop unbundling (LLU) to overcome the incumbent's monopoly of the 'last mile'[66]. This initiative has been judged, by some, to have only had a limited effect due to the power of the incumbent[67] and the failure of regulators to enforce the regulations (see, for example, OECD 2001a; Richardson, 2002). In October 2002 there were just over 1 million unbundled lines in the EU out of a total of 187 million subscriber lines (OECD, 2003). Even if the initiative does become a success in terms of increasing LLU overall, however, it is likely that local loop unbundling will take place in those areas which were adjudged by new entrants to be profitable, that is to say those with dense consumer and business populations. It was clear from the interview and survey work carried out during

[66] LLU in N12 countries only became compulsory in 2003 (CEC, 2002b) and the process of effectively implementing the regulations is likely to be slow as it has been in most EU15 countries as a result of the incumbents' control over the key technology assets.

[67] Ironically, these incumbents are often new entrants in other countries where they, themselves, accuse the incumbent of denying them access to the 'last mile'.

our study that density of population was seen as a key factor in the investment strategies of new entrants. It is thus unlikely that LLU will benefit areas currently deprived of investment, particularly at a time when operators are finding it difficult to justify capital investment. One potential solution to this would be some form of 'matched pairing' or 'batching' of exchanges so that new entrants wishing to access a particular local loop would be obliged also to offer services at other exchanges. Such a process, however, is likely to be inordinately complex and might further slow the overall unbundling process.

The third example is the recent regulation, adopted by several countries, which requires that incumbents offer wholesale products at reasonable prices to other providers (i.e., in line with the actual price it offers to its own subsidiaries) such as resellers and ISPs. Some commentators judge that this approach offers a better opportunity for new players to enter a market than does LLU, as firms do not have to make the same level of capital investment. If properly enforced these new regulations may provide opportunities for competition in less densely populated areas; for example, local ISPs may be able to find a market niche, or larger companies may seek to specialise (or create divisions which specialise) in providing services to less densely populated or less favoured regions, perhaps in partnership with local authorities. The problem of the market power of incumbents, of course, remains considerable. The regulator will have the power to ensure that the incumbent does not charge external customers more for its wholesale products than it does its own subsidiary. Incumbents have, however, found a number of strategies to retain market power, including, some allege, predatory pricing, thus making it more difficult for smaller companies to make a profit.

6.2.2 The Universal Service Directive

From a territorial perspective the most important directive within the NRF is the updated Universal Service Directive (USD) (CEC, 2002b). Universal service obligations (USO) exist in most developed economies. In essence, USOs "constitute a requirement that telecommunications operators provide a basic voice telephone service to all who request it at a uniform affordable price even though there may be significant differences in the costs of supply" (OECD, 2001b, p24). The USD is the Union's attempt to bring a degree of harmonisation to USOs in Europe. It recognises that in a liberalised market some individuals, groups and communities may miss out on the potential benefits which the market offers. The USD defines a minimum set of services and directs that Member States should ensure that these services:

> "..are made available with the quality specified to all end-users in their territory *irrespective of their geographical location*, and, in the light of specific national conditions, at an affordable price." (CEC, 2002b, para 7 of Recital, italics added).

It further states that:

> "Member States in the context of universal service obligations and in the light of national conditions, may take specific measures for consumers in rural or geographically isolated areas to ensure their access to.. [those minimum]..services, and the affordability of those services.." (CEC, 2002b, para 7 of Recital).

The services covered by the USD[68] include access to directory enquiry services and directories, public pay telephones, and emergency numbers. There are also a number of provisions relating to quality and features of services provided. There is also provision for special measures for disabled users. From the perspective of the current report the key provision is that users, irrespective of geographical location, should, on request, be provided with a connection to the public telephone network at a fixed location, at an affordable price. Here the current USD recognises that it is no longer sufficient for citizens merely to have access to voice services. Rather:

> "Connections to the…network at a fixed location should be capable of supporting speech and data communications at rates sufficient for access to online services such as those provided via the public Internet…Member States should be able to require the connection to be brought up to the level enjoyed by the majority of

[68] See Chapter II of USD (CEC, 2002b).

subscribers so that it supports data rates sufficient for access to the Internet". (CEC, 2002b: Article 4)

The USD also recognises that such services might be delivered by a variety of technologies, such as wireless, and not just fixed networks.

Although the USD notes the increasing importance of data and of access to the Internet, it limits the mandated service through which designated operators are obliged to offer connections to 'data rates that are sufficient to permit functional internet access'. Here it is assumed that a single narrowband network connection is sufficient. The 2002 USD does not define this by speed or bandwidth. This lack of specificity can be seen as recognition that speeds in excess of 14.4kbt/s are difficult to achieve over some kinds of network without significant upgrade (OECD, 2003).

The USD then only refers to 'narrowband' technologies and does not encompass 'higher bandwidth' services, such as ISDN, which is specifically excluded from mandated minimum services, let alone 'current generation broadband', such as ADSL. It does, however, recognise that technology is continually advancing and that, consequently, the concept of universal service should evolve to reflect advances in technology, market developments and changes in user demand. With this in mind the 2002 USD made provision for a review within two years (from 2003). The review should take account of social, economic and technological developments. The first such review will be carried out by July 2005 and will consider whether it should be extended to include new services, as well as whether existing provisions should be adapted or removed[69].

The USD also sets out guidelines as to how 'undertakings' (telecommunications companies) should be designated as providers of universal services. Member States may designate one or more operators, and this designation can be on a regional or a national basis, "so long as no undertaking is *a priori* excluded from being designated".

[69] Personal communication with the Petri Koistinen. DG Information Society. The Commission do not propose any new or additional studies of the USD, but will utilise a 2004 update of the 2002 INRA study which is due to published later in the year.

The 2002 Directive also amends rules on funding with the intention of making the process more transparent and establishes criteria for funding mechanisms for financing USOs in Member States. The 'net costs' of designated operators providing USO services can be met either by public funds or through a fund, known as Universal Service Fund (USF), to which other telecommunications companies contribute. To date, individual countries have taken different stances on funding the USO. Although a national framework for setting up a funding scheme for the USO has been established in the majority of Member States, by the end of 2002 only France and Italy had activated the fund to require payments from other operators to the universal service provider (CEC, 2002c, Annex II). In both cases legal challenges were mounted (CEC, 2002c)[70]. The majority of N12 countries also have adopted a USO cost recovery scheme, but by 2003 only the Czech Republic was applying the scheme in practice, with all operators (fixed, mobile, cable) financing the net loss of the incumbent, though Latvia and Romania also had intentions to do so (IBM, 2003). Several national regulators have taken the view that, to date, the designated provider had not incurred additional net costs sufficient to justify funding contributions.

The type of network access described above is mainly relevant to consumers and to small firms. For larger firms leased lines remain important. The USD acknowledges this and mandates a minimum set of least lines which should be available in Member States. National regulators can impose obligations on undertakings identified as having significant market power where markets for the minimum set of leased lines are adjudged not to be competitive. It recognises that the degree of competition is likely to vary between different markets of leased lines in the minimum set, and in different parts of the territory. It states that national regulatory authorities should make separate assessments for each market of leased lines in the minimum set, taking into account their geographic dimension. Leased line services constitute mandatory services to be provided without recourse to any compensation mechanisms.

[70] A later report - Report on the Implementation of the EU Electronic Communications Regulatory Package, COM(2003) 715 final – updates the situation but (because the new framework was in the process of being transposed) is rather vague and gives nowhere near the detail of the 8th Implementation Report.

The USD sets out a minimum set of services which Member States must include in their USOs. Any Member State has the right to go beyond the minimum services set out in the USD, to mandate additional services in its own territory, though no compensation mechanism involving specific undertakings may be imposed (CEC, 2002b, Article 32). The only example which we were able to find of a Member State doing so is Denmark. Denmark has mandated that the designated universal service provider, in addition to providing a basic voice line capable of transmitting at speeds which ensure fax and 2400 bit/s data communication, should provide, on request, an ISDN2[71] service or equivalent at an affordable price[72]. Such a service should allow transmission of data at 64 kbt/s. The reasons for inclusion of ISDN within the Danish USO appear to be historical. ISDN infrastructure was fully rolled-out by the incumbent prior to liberalisation and was included in the 1996 USO as a basic service. There has been no evaluation of the impact of the inclusion of ISDN in the USO from a territorial perspective[73].

There are also examples of ISDN equivalent services being provided within a universal service famework outside Europe. In Australia, for example, a Digital Data Service Obligation (DDSO) was introduced to complement the USO. It mandates the provision of data services with a 64 kbt/s digital data capacity. The DDSO splits down into two service types. The General Digital Data Service (GDDS) covers ninety-six per cent of the population and provides for that population to have ISDN access (on request) to suitably enabled telephone exchanges. The incumbent, Telstra, provides these services. The remaining four per cent of the population are covered by the Special Digital Data Service (SDDS) provision. SDDS services are provided by satellite (with dial up internet backhaul) by Telstra and a second satellite provider Hotkey Internet Services. These satellite services are mainly supplied to Australia's islands (e.g., Christmas Islands and Cocos Islands)[74]. Again we can find no impact assessment studies of this initiative.

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[71] Integrated Services Digital Network is a service using digital techniques throughout the network for transmitting voice, data and video over the same infrastructure. A customer who has access to ISDN should therefore be able to transmit data while talking over the phone, using a single line. ISDN2 is the basic rate ISDN service.

[72] Other regulators have required that ISDN be available across a territory on demand, but at prices left to the market (OECD, 2003).

[73] Personal communication with Kasper Nyrup Madsen of the Danish National IT and Telecom Agency.

[74] See Australian Communications Authority Consumer Fact Sheet 'What is the digital data service obligation?'. http//www.aca.gov.au/consumer_info/fct_sheets/consumer_fact_sheets/fsc62.htm

A major issue relating to the digital divide is whether provision of *broadband* service into regional, rural and remote areas should be mandated, and if so, whether they should be offered at a subsidised price as part of a universal offering, to ensure affordability for all (OECD, 2001b, p24)

It is argued by some that USOs could be extended to other telecommunications services such as broadband. We were unable, however, to find examples of more advanced services such as ADSL to consumers or businesses being included in USOs. Under the 1996 Telecommunications Act, the United States expanded its universal service policy to cover more advanced services to include support for schools, libraries, and rural health care. It has introduced a discounted rate for Internet services to schools and libraries, known as the 'E-rate' (short for the "education rate")[75]. Schools may apply for all "commercially available telecommunications services". A Universal Service Fund, to which all telecommunications companies contribute a set portion of their revenues, pays for these discounts. The applicable discount is based on a school's economic need (as measured by number of students eligible for subsidized school meals) and whether it is located in an urban or rural area. The carrier providing the service is paid at the commercial rate. A study carried out by Hudson (2004) of early progress in the 'E-rate' initiative in schools suggested that there were major disparities among states in E-rate funds received per capita or per eligible student, not all of which could be explained in terms of economic indicators, demographics or rurality. Hudson suggests that success in bidding for funds will, to an important degree, be determined by the institutional capacity of schools (and supporting organisations) to construct bids in line with Federal regulations. It may, of course, be that the poorest schools or localities are least likely to have such capacity.

In the European context, the creation of an E-rate, through the USO and USF, would not seem to be appropriate. Based on the reviewed above it appears overly cumbersome and potentially creates as many losers as winners. The 'universal' intention appears not to be met. It may be sensible to impose financial obligations on

[75] See Hudson (2004) for a detailed review of the implementation of the 'E-rate'.

telecommunications providers, given the profits to be made from schools and other institutions in the longer run. It may, however, be more sensible to obtain these by central or regional governments negotiating discounts, based on economies of scale, through aggregation, and through ‘universal’ (e.g., all schools must be covered) contract clauses, under open and transparent competitive tendering regimes.

Beyond this example of the e-rate our literature searches and interviews did not uncover any examples of the USOs being extended to encompass broadband, indicating that the OECD’s assertion that, “In practice, no OECD countries have yet taken steps to included broadband access as part of universal service” (OECD, 2003, p15) is accurate[76]. A number of reviews of regulation have been undertaken in recent years in Europe. The key concern of these reviews is whether the existing Directive has been fully transposed by Member States rather than whether any Member State has used its USO innovatively to extend geographical coverage of more advanced telecommunications[77].

As mentioned above it is widely recognised that the telecommunications environment is rapidly changing and therefore there is a need to review policy on a regular basis to take this into account. There are strong arguments that the USD should be reviewed accordingly. The 1999 Communications Review concluded that the scope of the USD should be kept under review. It noted that any such review should combine an analysis of the demand for and availability of the service, with an assessment of its social and economic desirability, arguing that, otherwise there was a risk of distortion of competition and an unfair cross-subsidy by the majority of consumers to higher

[76] Organisations contacted include: OECD who have undertaken a number of studies on broadband including exploring Broadband and the USO; consultants Analysys, who have carried out a number of studies on regulation for the Commission and others; the European Regulators Group which had not carried out any studies to ascertain whether and how any of its members have gone beyond the minimum services set out in the USD, but were unaware of any such action; DG Information Society who are currently preparing to review the USD; OFCOM, the UK regulator which has undertaken one of the most detailed reviews of the telecoms regulatory environment; Danish National IT and Telecom Agency.

[77] See, for example: Eighth Report From the Commission on the Implementation of the Telecommunications Regulatory Package: European telecoms regulation and the markets 2002, COM(2002) 695 final; European Electronic Communications Regulation and Markets 2003: Report on the Implementation of the EU Electronic Communications Regulatory Package, COM(2003) 715 final.

bandwidth users (generally businesses and "early adopters")[78]. As noted above the 2002 USD did not extend the scope of the USD to more advanced technologies, but it did set out a process for reviewing the scope of the USD (CEC, 2002b, Annex V), stating that a review should take into account:

- Social and market developments in terms of services used by consumers
- Social and market developments in terms of the availability and choice of services to consumers
- Technological developments in terms of the way services are provided to consumers

When considering whether the scope of universal service obligations is to be changed or redefined, the review process should also consider:

- Whether specific services are available to and used by a majority of consumers and whether the lack of availability or non-use by a minority of consumers results in social exclusion; and

- Whether the availability and use of specific services convey a general net benefit to all consumers such that public intervention is warranted in circumstances where the specific services are not provided to the public under normal commercial circumstances.

A review will be published by July 2005, but our interviews indicate that there is little appetite for an extension to the scope of the USD.

A number of arguments have been made against broadening the scope of the USO to address geographical differences. In line with its general stance on state supply-side intervention, the OECD puts forward a number of arguments as to why the scope of the USO should not, at present, be extended to cover broadband. The majority of these arguments could be applied to any form of intervention in the field of broadband. Others

[78] Guide to the 1999 Communications Review: http://europa.eu.int/information_society/topics/telecoms/regulatory/userinfo/00comrev/index_en.htm

relate more specifically to the USO as a mechanism for intervening. The OECD suggests what it terms "a systematic procedure for considering USO status for broadband" (see Box 6.1).

Box 6.1: The OECD's systematic procedure for considering USO status for broadband

A systematic process for considering the need to re-define USO to encompass broadband, should include:

1. Consideration of whether broadband is an essential service of significant 'social importance'
2. Estimation of the degree of expected market penetration of broadband service
3. Assessment of the nature and extent to which broadband will not be made available by the market and why
4. Identification and specification of objectives and desired outcomes clearly and specifically
5. Assessment of the extent to which market demand and delivery can/will meet the specified objectives
6. Consideration of the social and economic disadvantages incurred by those without access to broadband if there is no government intervention in this expected market situation.
7. Estimation of the costs of intervention to widen broadband deployment through the use of the USO mechanism
8. Estimation of the costs of intervention through the use of the USO mechanism compared against the use of other approaches to establish that the USO mechanism is superior.
9. Establishment that the benefits of intervention through the USO exceed the costs of doing so, taking into account the incidence of such benefits and costs (especially those on unsubsidised telecommunications/Internet/broadband Internet customers); and of effects on other communications and broader policy objectives. (Intervention should only occur where overall benefits persuasively outweigh overall costs and where a substantial increase in the level of USO expenditure would not result).

Source: OECD, 2003

Putting this into the context of European telecommunications policy, these criteria can be placed in three categories:

First, whether, and the extent to which, broadband will benefit individuals and how those who are not served by the market will be denied those benefits (1, 6 and to some extent 4). Whilst it is true that claims for the benefits of broadband often lack rigorous evidence, we assume that a settled view has been reached by the Union and by Member States, as expressed in policies such as 'Broadband for All', that broadband will bring both social and economic benefits to individuals and communities. In a sense, from a European perspective, the 'whether' questions have been answered in the affirmative, even if the evidence of the scale of benefits is lacking.

Second, whether the market will make broadband available, how widely it will be made available, what will be the time frame for roll-out and how this will differ between places – will there be a digital divide or merely a digital delay? (2, 3 and 5). The evidence presented by our study suggests that broadband is being rolled out quickly relative to other rounds of technology, but has reached only a small proportion of the population in most (new and old) Member States. It also suggests that when left to the market alone there is, at least, a digital delay in roll-out. Other studies suggest that if left to the market alone some European territories will not be covered in the foreseeable future. This suggests that some form of intervention will be required if a digital divide is to be avoided[79]. It leaves open the question of whether such intervention should be on the demand or supply side. However, in order to meet the targets set by the Union and by various Member States, intervention on both sides of the equation is likely to be required. A question for the longer term, posed by OECD and others, is whether intervening through the USO (or indeed other supply side interventions) undermine longer term competitiveness or technology development by supporting certain firms or certain technologies.

A key question here is whether the USD and USOs can be used to overcome these divides. One set of significant disparities are between states within EU27+2. There can be little doubt, for example, that the gap between Sweden and Bulgaria represents a 'digital divide' rather than merely a 'delay'. If the basic level of provision under the USD were to be raised to include 'functional broadband access' as opposed to 'functional internet access'[80] then lagging countries could, in theory, use their USOs to stimulate broadband investment across their territories, as could more advanced countries. The levels of investment required in the former, however, might be prohibitive. They may also entrench the position of the incumbent operator as they would usually be in the best position to provide universal service across a whole country.

[79] Here we use the term digital divide in its very narrow sense of access to technologies.
[80] There is also an issue of how 'functional broadband access' would be defined. For a fuller discussion on this see OECD (2002) Universal Service Obligations and Broadband.

The final set of criteria (7,8,9) are aimed at establishing whether (assuming there will be intervention on the supply side) the USO is the best means of intervening in terms of costs and of impact on other policies and on wider objectives. This is a crucial question, but although we were able to find cost models for the USO[81], we know of no study which compares and contrasts the cost or impact of intervention through the USO with other forms of intervention. Such a study should be undertaken by the Commission, if not in time for the coming (July 2005) review, then in time for any *subsequent* review.

In addition to the question of comparative costs of different forms of supply side intervention, there is the further question of who should pay for this intervention. Currently, in Europe, at least, it is often the USO-designated provider that bears the cost of providing universal services. This is generally, though not exclusively, the incumbent. This situation reflects the fact that the net costs of delivering universal voice and basic data telephony are relatively small, given that investment is often historical and that additional profits may be made as a result of a firm's position as USO provider. There are a small number of cases where the universal fund has been activated to ensure that other telecommunications companies make a contribution to the costs of service delivery. Again, the costs are likely to be limited. It is argued, however, that were the USO to be extended to more advanced technologies, notably broadband, the costs incurred would be much higher and that it would be unfair to impose this burden on commercial companies. It is argued by some (see, for example, OECD, 2003), that, if a universal fund were to be established in order to share cost, this could deter new market entrants. A further question is which types of providers should contribute to a USF – should, for example, internet service providers (ISPs) be included as more traffic flows across internet networks, or TV cable operators included as telephone traffic becomes part of their 'offer' (Jayakar and Sawhney, 2004)?

Ultimately, of course, it would be telephone consumers who would bear the costs through higher charges, effectively creating a cross-subsidy. This is, of course, a well established principle of universal service. However, such cross-subsidisation has

[81] There is no universally agreed way of costing.

historically been founded on the basic principle that the majority of consumers who use a telephone service can afford to cross-subsidise the limited, basic needs of a small minority that might otherwise miss out. Oftel (now OFCOM), the UK regulator, suggests that “this principle does not translate easily to the provision of expensive new technology at affordable prices, at least in the early stages of market development” (Oftel, 2001, cited in OECD, 2003). From a territorial perspective, extending the principle could lead to the perverse situation where urban consumers who do not want or cannot afford access to broadband, notwithstanding that it may be available, would subsidise perhaps more affluent consumers or businesses in rural areas who choose to adopt broadband. An alternative approach would be to fund the USO through public funds. This approach would take responsibility from commercial companies and the consumer and place it on the taxpayer, but would potentially still lead to the same outcome of poorer urban citizens paying for what might still be regarded as a luxury. These arguments could, of course, be deployed in respect of all forms of distributive intervention in respect of broadband.

In spite of these arguments against extending the USO a number of possible approaches to developing the USO to make it suitable for an environment characterised by competition and multiple technologies have been suggested. Jayakar and Sawhney (2004) summarise the work of several authors. The suggestions put forward include[82]:

- Introducing an auction whereby the regulator asks operators to make sealed bids setting out the subsidy support required per subscriber for providing universal service to a defined geographical territory. This seems to be in line with the system employed in Australia in respect of ISDN (see above). Proponents of the auction system argue that they transfer the burden of determining the costs of providing service from the regulator to the firm providing the service. Each obligation would have a targeted objective to provide a specific service (a milestone), within a specific deadline (a commitment). Some commentators argue that the obligations should be tradable between operators.

[82] Unless otherwise stated, the following suggestions draw on the work of Jayakar and Sawhney (2004).

- The provision of ‘virtual vouchers’ to consumers in high-cost areas, thereby transferring subsidies to the consumer rather than the provider. The customer would then identify the service provider from whom he/she wants to obtain service, and the voucher payment is made directly to that carrier. This approach, it is argued, overcomes issues of competition distortion. In reality, of course, a company may not be prepared to enter a high cost market if it was not sure that it would obtain a decent return. Having to compete for subsidized (voucher holding) customers in an expensive to serve area may not be attractive.

- Introducing a variable universal service obligation (to some extent this seems to be a contradiction in terms). One suggestion is that in a more dynamic and evolving environment a decentralised bottom-up approach is required “where innovations that occur at the local level are later harmonised into an integrated policy framework with local variations in each jurisdiction” (Jayakar and Sawhney, 2004, p9). Hart (1998, cited in Jayakar and Sawhney, 2004) suggested (in the context of a pre-expansion EU) that three levels of universal service classes: a basic high-quality service class, a state-of-the-art service class and a broadband-for-all class, with performance criteria specified for each. Countries and regions would be placed in classes whose performance criteria they meet, and obligated to achieve the targets for the next higher level. This approach may be even more appropriate in the context of an expanded Europe where, as is illustrated in this report, there are considerable disparities between Member States. The proposal also seems to imply, however, that a mechanism for monitoring Member States and regions would need to be in place and that a central body (presumably the Commission) would have to set targets, decide if they have been met, and when the targets should be raised. This would radically change the nature of the USD which, as it stands, merely sets a minimum service level for Member States and leaves it to individual states to elaborate the Directive through their USOs.

6.2.3 Requiring the regulator to take greater account of territorial development issues

In addition to a review of the USD and of individual USOs there may also be a need to consider whether and how the policies of the regulator relate (or fail to relate) to the regional development policies of Member States. Indeed, this may be a more cost-effective approach and also one which is in line with the current vogue for 'joined-up government'. Generally speaking, the main concern of telecommunications regulators in Europe appears to be competition and price control, with the territorial focus being the nation state. Given the importance of telecommunications to other policy areas it would seem appropriate for governments to widen their regulators' brief or to ensure mechanisms for cooperation/coordination between them and ministries or regional authorities concerned with territorial development issues. One example of this approach recently emerged in Ireland. Under the 2002 Communications Act, the relevant ministry[83] can issue Ministerial Directions on government policy to the Commission to which it must have regard. It has been argued that regional development is one such area which should be taken into account (ComReg, 2003).

Another adjustment of the role of regulators could see them mandated to gather information on territorial disparities in provision. Regulators collect and publish huge amounts of valuable information, but in most cases pay little attention to territorial differences within their countries – for example, which exchanges are ADSL enabled. There are, of course, questions of commercial sensitivity, but these also apply in areas where regulators routinely intervene. Regulators should be mandated with collecting data to show the differential provision of telecommunications networks and services across territories. This would form a basis on which reasoned public intervention could be undertaken.

6.3 Examples of forms of intervention by regional and local authorities to directly stimulate the supply of broadband networks and services

The regulatory options discussed above are mainly a matter for national governments and regional and local authorities will have little or no control over these. In this section

[83] Ministry for Communications, Marine and Natural Resources.

we turn to discuss a number of potential policy options which regional and local authorities might consider adopting. Of course, for many regions national government approval and even guidance and help will be required. In some cases European clearance may be required.

6.3.1 Aggregation of telecommunications procurement by public (regional) bodies

One approach to stimulating or 'pulling through' broadband technologies into a region or locality is creating a critical mass of users to provide the incentive to telecommunications companies to provide networks. Regional and local authorities can act as key players in this process.

In most European regions the public sector is a major economic and social actor and will therefore have a significant role to play in the stimulation of the information or 'e' society. This will be true in all regions of Europe where public authorities (local, regional and central governments) will be the main players in designing and delivering eGovernment, eHealth and eLearning which are at the heart of eEurope 2005. In non-core regions of Europe, where the private sector tends to be less strong, the public sector, through its role as employer, will also have a crucial role in reorienting the workforce towards the e-economy. This is particularly the case in jobs associated with the knowledge or information economy, broadly defined, as the public sector is likely to be the largest employer of 'white collar' workers in peripheral areas.

There are examples, both in Europe and elsewhere of regional and local authorities banding together to jointly procure ICTs, including broadband network capacity. In Italy the central government has established a system to allow public administrations to come together to procure broadband, the purpose of which is to "encourage infrastructure rollout to under-served regions" (Battisti, 2002). It is envisaged that the initiative will reduce costs and improve the technology available to administrations. In turn improved technologies should allow customers to access services more easily. This process, of course, need not result in enhanced capacity in a region or locality more generally if the aim behind the aggregation is simply cost reduction and improved capacity for the public sector organisations involved. The UK government is introducing a system which potentially addresses this issue (Box 6.2)

Box 6.2: UK Broadband aggregation project

In the UK, the government has recently established a number of Regional Aggregation Bodies (RAB) to join up individual public sector requirements and present them as one bigger package to the market. The RABs will effectively act as resellers of telecommunications providers' services and will not own or operate infrastructure. They will initially be publicly funded but the aim is that they become self-funding through the retention of funds derived from reselling. The focus of RABs is on value for money and maximising broadband for public bodies. The RABs are also allowed to expand into the provision of services for the private sector providing that this is consistent with state aid rules. Decisions on whether or not to offer services to the private sector will be taken at the regional level, through consultation with the relevant Regional Development Agency. It is likely, therefore, that services to the private sector will only be provided in those Regions (or parts of regions) where there is perceived to be gap in provision.

Source: Interview with UK Broadband Taskforce representative and information at http://www.broadband.gov.uk/

Ideally, the broadband aggregation would be complemented by initiatives to organise the private sector purchasing (particularly by SMEs) on the same basis in these regions. Gillet, Lehr and Osorio (2004) report an example of such a development in the US, where the Ohio Department of Development administers the Ohio Broadband Link, a programme that negotiates volume discounts with telecommunications providers based on the combined purchasing power of businesses within the state. The state covers the administrative costs of running a buying cooperative (eVantage), and passes the discounts through from providers to participating members. "The state thus functions as a kind of reseller for commercial providers, reducing the sales and marketing costs required to serve a large number of smaller customers" (Gillet et al, 2004, p544) These authors also cite other similar initiatives where geographic cost averaging is an integral element in a buying cooperative, requiring providers to offer services at similar prices regardless of the customer's location.

If the public sector aggregation is combined with the cooperative purchasing initiatives local or regional government can effectively act as an 'anchor tenant'. In other words the winner of an aggregated broadband for government institutions may be obliged also to supply buying cooperatives. In order to aggregate sufficient demand such actions would probably take place at the regional level. There is no reason why inter-regional cooperation between contiguous regions (or indeed parts of regions), including cross-border cooperation could not take place. One pilot example of cross-border cooperation is the ‘Bothnia Digital Bridge’. This Interreg project has the aim to explore how a boundary-crossing IT network dealing with technology, trade and business, and administration could link the regions of Västerbotten and Västernorrland in Sweden, Österbotten in Finland and Helgeland in Norway. Such cross border cooperation will, of course, generally be developed between territorially contiguous countries or regions. In the case of satellite technology there may, however, be room for ‘aggregation’ between distant places. Given the extensive footprint of satellite there appears to no reason that partnerships might not be formed by countries or regions at opposite end of the Union (or even beyond). Joint contracts to buy satellite capacity could result in economies of scale for participating regions. Such partnerships might also form the basis of longer term cooperation and knowledge-exchange between regions. The Commission could have a role in brokering such partnerships and ‘twinning’ arrangements.

The process of aggregation has a number of difficulties, even within the public sector. For example, individual organisations already have contracts with providers which may run for some time. In countries with weak regional structures key organisations within a region may well not negotiate contracts locally, but on a national basis. They may, therefore, see little advantage (in commercial terms or ‘best value’ terms) in joining the purchasing consortium. There are also questions relating to the balance of political power within regions with complex territorial structures. For example, in a region dominated by urban areas will the urban authorities be sensitive to the differential requirements of rural areas? Aggregation initiatives could also run the risk of stifling competition given that it is likely to be larger players which can operate at such a scale. Despite these reservations, the aggregation of telecommunications at a regional level, with the participation of national players located in the region, and with the political will from national or regional governments to ensure the success of the process, could lead to significant cost savings through economies of scale. These savings could, in turn, be redirected to stimulate supply and demand in parts of the region where the market has failed to deliver in respect of telecommunications.

Another area in which the public sector, or indeed community groups, can aggregate demand is through coordinating or articulating responses to exchange activation registration schemes. Several European telecommunications providers now set targets for the number of potential customers which are required in order for them to invest in upgrading exchanges to ADSL standard. Individuals or businesses who wish to obtain ADSL services register with the company and once the number of people registered hits the company's target the exchange is enabled. Local authorities and community groups could play a role in awareness raising and encouraging individuals and businesses to register.

Finally, regional authorities and particularly local authorities in territories which are sparsely populated may wish to aggregate demand at certain access points in order to justify investment in infrastructure. These 'hot-spots' can include schools (our research suggests that 'wiring' schools is a priority in most countries), business centres and community centres. There are already numerous examples of these activities across Europe, many of which have been part-funded by Structural Funds. In the N12 countries telecentres and public internet access points (PIAPs) are becoming increasingly important. In Poland, for example, the 'Ikonka' project has been launched in order to create free PIAPS in libraries and community centres, particularly in communities which currently do not have Internet access (Szewko, 2004). The private sector also seems to be playing a role in this process in some N12 countries at least. In Hungary, for example, as a result of co-operation between the civil, private sectors and the Hungarian State, as well as significant foreign donation, since the success of a local grass-roots initiative in 1994, telecentres (or "telecottages") have been mushrooming throughout Hungary (see Box 6.3).

Box 6.3: Telecentres in Rural Hungary

Over the last few years a large number of telecentres have been created in Hungary with the aim of supporting rural, disadvantaged localities, through the provision of ICTs, linked to services and training. The majority of telecentres have sprung up in small villages clearly need such institutions. The most dense coverage of telecentres is in western and south-western parts of the country (Southern Transdanubia) which are the most rural parts of the country and whose settlement patterns are characterised by "micro-sized" villages and are thus expensive places in which to invest in telecommunications infrastructure. To some extent, the telecottage movement seems to have been successful in compensating for the lack of interest in the region on the part of major ICT suppliers, yet the lack of advanced technologies in their locations is a drawback to the telecentres as well.

The key issue is how these sites – whether they be telecentres, electronic business centres, or public internet access points – can be utilised by the wider community and not just certain segments. For example, the conditions attached to funding streams for ICTs in schools can mean that the local community is not able to use them. Similarly, ICT hot-spots created primarily for business users will often not be made accessible to community groups because of concerns over security of data. There is a need to have a more 'joined-up' approach to these developments so that communities can gain maximum access to the scarce technological resources. Further research is required in this area.

6.3.2 Direct public subsidies to telecommunications providers

Direct subsidy to individual telecommunications providers remains an option to policymakers. A well established example of this in a rural region was in the Highlands and Islands of Scotland. More recently, Cornwall in the UK has had several exchanges upgraded as a result of subsidy to the incumbent provider BT, which involved European Structural Funds. In France in the realm of mobile network coverage, the government has decided to offer support for operator investment in the construction of base stations, with the aim of ensuring complete national coverage of all permanently and semi-permanently inhabited zones and transport routes within three years. One of the problems with intervening in this way is that it is clearly high-risk in terms of value-for-money for public investment, given the asymmetry of information about telecoms networks costs between operators and public agencies, a point we return to in section 6.4 (below).

6.3.3 Public-private partnerships

Another way of stimulating investment in infrastructure is through public-private partnerships. This may involve partnerships between public authorities and telcos and/or partnerships between public authorities and locally-based enterprises (endogenous or exogenous).

It has been suggested that infrastructure providers should enter into longer term partnerships with local authorities (Luger et al, 2002). It is argued that public officials and users cannot be expected to have the knowledge of telecommunications required to integrate ICTs into their planning process and that ICT providers should contribute to this process. A recent study of the relationship between ICT and spatial planning in Europe also suggested that there was a lack of knowledge, and indeed interest, in the planning community (ASPECT, 2001), beyond a limited group of leading planning authorities. The notion that the spatial development community should draw on the expertise of infrastructure providers is, therefore, a sound one. In practice, however, this approach is not without problems. There are questions as to which providers should be involved and what role they should have. There is a danger that an advisory body becomes a lobbying tool for the common interest of telecoms providers. If only a few telcos (or only one in a particular region) take part there is the danger that some technologies are promoted over others, thus undermining the notion of technological neutrality. Further, it has been suggested that larger telecoms companies tend to attempt to sell one-size-fits-all systems and technologies which do not necessarily meet the requirements of particular organisations or regions. Planning authorities need, therefore, to retain the flexibility to utilise smaller alternative providers when necessary. So whilst we agree that a cooperative approach between regional (and indeed local and national) authorities and telecoms providers should be welcomed, we believe that the public authorities themselves need to become more knowledgeable about TN&S as a basis of entering into such partnerships. The crucial point for authorities forming relationships with infrastructure providers is that, in addition to delivering technology, the relationship should provide the authority with an opportunity to garner expertise in respect of ICT networks and services. We return to this question in section 6.6.

In addition to telecommunications companies, public-private partnerships can also involve private companies based in a particular region, which has the advantage of creating a guaranteed market for the technology. Boxes 6.4 and 6.5 provide examples of such partnerships from the northern and southern rural peripheries of Europe.

Box 6.4: Castres Mazamet: broadband via a public-private partnership

The rural agglomeration of Castres Mazamet in the south western French region of Midi-Pyrenées inaugurated a fibre optic broadband network in 1998 to be accessible to businesses, the public and local authorities. A public-private partnership was created between the various local communes, the Caisse des Dépôts, one of the major enterprises located there, and a dozen or so SMEs. The subsequent 70 kilometre 'metropolitan' dark fibre network and teleport interconnection to link to backbone networks are open to operators and service providers. The investment for this infrastructure was partly provided by the Region, the state and the European Union. Since this initiative, it is held that competition in the local broadband telecommunications market has increased, and that 'the image and the attractiveness of the territory have been boosted' with 112 ICT sector jobs created in just over a year.

Source: Observatoire des Télécommunications dans la Ville – http://www.telecomville.org

Box 6.5 New wireless infrastructure for extending broadband connections beyond municipalities in northern Sweden

In Västerbotten county in northern Sweden (Övre Norrland region), Skellefteå has become the first municipality of Sweden to install wireless broadband throughout its entire area, enabling villages and other settlements outside the town to have broadband connection to the Internet. Developed by a public-private partnership including processor manufacturers Intel, Luleå University of Technology and Skellefteå's own project, Mobile City, WiMAX technology is being installed to extend existing urban hot spot Internet access well beyond the usual limits of wi-fi networks (a few hundred metres), and without requiring users to be within direct line of sight of a base station. Indeed, a WiMAX base station can beam high-speed Internet connections to a radius of almost 50 kilometres, thus providing broadband wireless access to remoter villages of Västerbotten where cable deployment has been seen as too expensive. Skellefteå municipality considers that the investment for WiMAX will be paid for by subscription charges paid by Skellefteå´s 71,000 inhabitants, an increasing proportion of which work from home.
Source: http://www.welcometovasterbotten.se/default.asp?NewsPages=2004&P=1485&LID=1

The private sector has also been involved in developments in Lithuania. Here the impetus actually came from the private sector, albeit in the context of a national information or knowledge society strategy having been articulated by central government (see Box 6.6).

Box 6.6: Private driven public-private initiative – PIAPs in Lithuania

The 'Window to the future' initiative was launched in 2002 by the country's biggest telecommunications providers, together with two banks and two IT companies. These companies have entered into partnerships with a number of municipalities and communes to stimulate Internet uptake. It was acknowledged that Lithuania had made great strides in rolling out networks (it is claimed that 80% of fixed network subscribers can access ADSL), but that Internet penetration rates were low. So, the technology was largely in place, there were barriers to its usage in respect of the Internet. These were identified as: (lack of) affordability, awareness and motivation in the less well educated and lower income groups in Lithuania. A three phase plan was developed: to establish Public Internet Access Points (PIAPs), train new Internet users, and, develop new relevant e-content. The PIAPs are reported to be very popular and are oversubscribed. Some communes have plans to extend existing PIAPs or to create others. The project aims to open 1000 PIAPs by 2005, using private, state and EU funds.

Source:www.helsinkikef.org/.../a87216857c6755b685256ce0006c95e6/
$FILE/lithuania%20case%2010.doc

6.3.4 Public construction and/or ownership of networks

There is increasing evidence that national governments in Europe are prepared to intervene or permit intervention by regional or local authorities in the construction and/or ownership of networks in order to overcome a perceived failure to invest by the private sector. In France, for example, the previously restrictive conditions under which local authorities could intervene in the telecommunications sector have been eased to allow the public construction of broadband infrastructure networks where necessary (see box 6.7 below for an example). The government fixed 2005 as the date by which access to broadband networks for all at a reasonable cost should be achieved. The state bank, the Caisse des Dépôts et Consignations, was given the task of assisting territorial authorities in their projects of infrastructure deployment, with a budget of 1.5 billion francs over 5 years. In addition, the national electricity grid network of RTE has been opened to the deployment of fibre optic infrastructures in order to serve peripheral zones, which also has the advantage of reducing engineering costs as the fibres are laid along the electricity lines in the air rather than in ducts under the ground.

Box 6.7 Ariège – the first French departmental council to become an operator?

The Conseil Général of the department of Ariège in the south west of France partly in the Pyrenees looks like becoming the first French local authority to take on the status of a telecommunications operator when the new 'digital economy' law comes into effect. The department is peripheral, rural and mountainous, and has a population density of only 27 inhabitants per square kilometre. The authority has realised that competitive broadband offers are highly unlikely to develop on its territory: "Instead of waiting for an offer, we're creating the need, by starting from the five ADSL plaques of France Télécom, beginning with schools (which is also a political choice) and then towards economic activity zones" (Jean-Louis Vigneau, quoted in La Gazette des Communes, 6 January 2003). Investing around 25 million euros, and having sought the advice of the French regulator and the Caisse des Dépôts, the authority plans to deploy its own network as soon as there are sufficient numbers of users: "it will aim for maximum territorial coverage over 8 years, making use of technologies adapted to the geography of the department: fibre optics, wi-fi from local loops, or satellite" (La Gazette des Communes, 6 January 2003).

The construction of municipal networks is well established in another member state, Sweden. Here municipal authorities build a dark fibre network as a public utility with the intention of leasing it to potential users and network builders. Private companies light the fibre. The best known example of this is the Stokab fibre-optic network in Stockholm (see box 6.8). The Stokab example is the most advanced in Sweden but the approach has become common in Sweden with 173 out of total of 289 communities having such a network[84] and the Swedish Urban Network Association has been established in order to facilitate cooperation. One example of this approach in a more rural area is Project Norrsken which covers seven counties and strives to offer smaller regions the same communication capacities as in the big cities and ultimately links to Stokab[85].

[84] http://gigaman.gigaport.nl/en_stokab.html
[85] http://english.gavleregionen.com/focus/broadband.regnet.aspx

Box 6.8: A publicly owned network – Stokab 'dark fibre' network.

Construction of the Stokab fibre-optic network commenced in 1994. The network is owned and managed by a company wholly owned by Stockholm City Council. Stokab provides 'dark fibre', thus providing an open infrastructure to private sector telecommunications operators to light the fibre and provide data services to companies and to end consumers. Clients (private sector, public sector and voluntary sector) are connected by Stokab, but must find their own provider of data services (though Stokab will provide a list of companies providing such services). It is argued that this approach allows firms to enter the market without the heavy investment required in laying fibre optic cables and a number of major telcos including Cable and Wireless, Vodafone, BT Ignite, as well as Swedish incumbent Telia use the network. Stokab provides data transfer only on its own behalf and for a network of several municipal organisations. The network mainly utilises existing ducts and other networks, such as railways. Around 80 per cent of customers are in the private sector. The network has grown since 1994, to around 4000 kilometres in 2002, to cover most of the Greater Stockholm, including the larger islands in the Stockholm archipelago. It is now being extended beyond Sweden to the Baltic port of Ventspils in Latvia.

Source: information from Stokab; http://gigaman.gigaport.nl/en_stokab.html; http://english.gavleregionen.com/focus/broadband.regnet.aspx.

The Swedish model has been particularly influential. The broadband 'status report' of Austria's telecoms regulator RTR, for example, identifies the Swedish broadband strategy as a role model. It has also been influential in Ireland. The case of Ireland is interesting in that Structural Funds have been used to build a broadband network. The National Development Plan for 2000-2006 allowed €200 million to spend on broadband infrastructure, including €90 million of ERDF money. As part of this, €60 million was committed to support the construction of a Metropolitan Area Network (MAN) in selected provincial cities and towns across Ireland. As a result of difficulties being experienced by telecommunications companies, the public sector became more heavily involved. Local and regional authorities were grant aided to put in place broadband networks. It is envisaged that the infrastructure will be owned by the local authorities on behalf of the state, while marketing, management and maintenance of these infrastructures will be undertaken by a Managed Services Entity (MSE), which will administer access to the networks on a carrier-neutral and open access basis. An innovative project being undertaken within this strategy is the creation of 'Southwest Broadband' which explores the use of satellite technologies to deliver broadband to rural areas in order to 'bridge the digital divide' (see box 6.9).

Box 6.9: Southwest Broadband – Satellite and Wireless in the rural periphery

The south west of Ireland is a peripheral European region with a high growth economy, large territory and dispersed population, but growth was being limited by lack of broadband infrastructure access. The size of the region and widespread population mean fibre deployment would be too costly and commercial operators did not see a business case for serving small towns of around 1,000 inhabitants or less. This Regional Authority (and a consortium including the county councils and a range of industrial partners) decided to adopt a 'self help approach' based on satellite and wireless technology. A project, assisted by the European Space Agency and the Artes 4 programme, was established to research and demonstrate satellite technology as a means of delivering broadband to rural and peripheral areas and to evaluate its usability, cost-effectiveness and reliability. A number of applications involving a range of organisations in the areas of SME development, eGovernment, health delivery, distance education and wireless Local Area Networks were developed. The Regional Authority concluded that a combination of satellite and WLANS provided a cost effective way of introducing broadband to areas which would otherwise not be able to access it.
Source: Cowley, 2004

The Southwest Broadband Initiative not only illustrates how a regional authority can intervene through 'construction' of a broadband network, but also how 'alternative' broadband technologies, which may be more suitable for some remote and rural areas, can be deployed. Another initiative which combines satellite and wireless technologies is being undertaken at the eastern border of the Union, in rural Poland where few ADSL connections are available and where the incumbent operator still holds a 'de facto monopoly'. A pilot is being undertaken in the Czyze community of Podlaskie voivodship in eastern Poland. This has combined satellite broadband access (provided by Eutelsat) and the deployment of wi-fi networks to end users (Szewko, 2004).

Another initiative involving regional or local construction of broadband networks in a region, even more peripheral than those mentioned above, is occurring in the French territory of Réunion in the Indian Ocean. Here, the 'Gazelle' broadband project, initiated in 2003 for an estimated total cost of 20 million euros, is deploying a fibre infrastructure to link all 24 communes and operator points of presence (POPs) on the island. The particularity of this project is that the cable is being deployed along the electricity network of EDF (wrapping the fibre around high tension lines). The network will be ready by the end of 2005, and will be managed under a public service delegation[86].

[86] See http://www.telecomville.org

6.3.5 *Creating an attractive environment for commercial providers*

Gillet et al (2004) point out that one of the key roles of local government is as a 'rule-maker'[87]. Local policies can therefore be adapted to encourage telecommunications providers, particularly those using alternative broadband technologies, to invest in a region or locality. One approach which involves a lighter touch and perhaps less public expenditure is to create a more permissive planning regime – for example, in respect of mast and antenna siting – to enable companies to pilot particular technologies. This approach, of course, potentially raises environmental questions and the opportunities and costs would have to be explained to the community in question. An example of this approach is the Ayuntamiento de Zamora in Spain, which formed a test bed for a Wireless Local Area Network (WLAN) (see box 6.9).

Box 6.9: Permissive Planning Regime – Zamora Wireless City

In June 2002 a small Spanish private sector network operator called Wireless and Satellite Networks (WSN) set up a pilot project in Zamora, a town of around 70,000 people, in Castilla y Leon in Spain, to deliver WiFi broadband services to consumers. Until now WiFi has been generally used in offices and, more recently, at service 'hot spots' in densely populated areas or at transport hubs, such as airports. This project aims to 'wire' an entire town. The service, known as Afitel, provides Internet access in a similar way to a traditional ISP, but WSN also provides the means of accessing the network through its access points. These act as a substitute for the dial-up phone lines, modems and other telecoms infrastructure which would normally be used. Two hundred access points were created using Intel technology. The service was aimed at those who did not have Internet access or had only slow dial-up access. Local government has provided strong support and encouragement. Importantly, it has granted permission for WSN to site more than 250 white antennas which relay wireless signals from the backbone connection.
Source: eris@ (2003): Wall Street Journal Online
(http://www.afitel.com/espanol/prensa/wallsj.htm);
Intel: http://www.intel.com/ebusiness/pdf/notebook/W_CS_Zamora.pdf)

6.4 Establishing greater symmetry of knowledge between public authorities and telecommunications providers

A clear message which emerges from our recent research is the need for greater symmetry of knowledge between the public and private sector in the area of

[87] Of course, the strength of local 'rule making' powers varies between Member States and in some countries local room for interpretation of essentially national guidelines is heavily constrained.

telecommunications. This is true at European, national, regional and local level. It is also true regardless of the particular policies adopted from the policy menu, unless a decision is made to leave everything to the market. Each state of EU27+2 will have its own government structures, including regional and local governance systems. The relationship between the telecommunications providers and government agencies will also differ between countries. In these circumstances it is perhaps unwise to be prescriptive about how expertise is to be garnered or utilised. One approach would be to create a multi-layered system, acting in a coordinated manner, with varying degrees of expertise resting in different layers. At the regional level a regional telecommunications plan, with a "regional telecommunications directorate" to act as a policy and implementation unit, might be established. Such a unit could call upon expertise at the national or even European level, thus avoiding the replication of expertise on all aspects of telecommunications in all regions. Regardless of particular structures, however, a number of requirements can be identified. These include the following:

- A better system of collecting and disseminating information and data about the territorial aspects of telecommunications. This requires a common approach so that decisions on public interventions can be transparent. This should be *coordinated* at the European level, though the onus would be on national statistical agencies *and/or* regulators to collect the regional and sub-regional data. This would allow informed judgement in forming regional policy. One current set of institutions on which this process could build are the regional observatories seen in examples such as ORTEL in France, the Osservatorio Banda Larga in Italy and OVSI Foundation (Valencian Office for the Information Society) in Spain.

- Knowledge of the technical aspects of telecommunications. The examples provided in the preceding sections and also in Chapter 3 of the report illustrate that there are a number of technologies which can be used to deliver broadband networks and services. The environment, in terms of technological change, is evolving rapidly, even if the commercial development of services cannot always keep pace. This diversity is recognised and the benefits of fostering diversity is recognised in the eEurope 2005 Action Plan and also in the recent Communication 'Electronic Communications: the Road to the Knowledge Economy'. Planning and development authorities need to be aware of the range of technologies available and to be able to decide which of these are appropriate for particular circumstances. A regional fibre ring might best be complemented by ADSL in some parts of a territory while a wireless solution will be more appropriate in others. An ability to plan appropriate technological solutions (in a flexible way) for all parts of a territory, either in-house or through an outside systems-integrator, is essential. Another benefit of being aware of the various technologies available and their potential is that an informed decision can be made whether to invite or encourage providers to use a territory for experimental or pilot projects.

- Knowledge of the regulatory aspects of telecommunications. At the very least, regional authorities must be aware of the universal service provisions and the Commission guidelines and criteria and modalities for implementing structural funds. It would also be valuable, however, if they were aware of (or could easily access) the wider NRF and how it is interpreted by their national regulators.

- Intelligence of the situation within a region regarding deployment of technologies and pilots to stimulate supply and demand. This would involve establishing a database of initiatives and pilots. Often these are publicly–funded but no record is kept and there is no check on outcomes. A new approach is required to avoid duplication and to exchange best practice. Intelligence could also be exchanged between regions.

6.5 Development of common indicators and improved and standardised collection of data with a regional focus

Finally, it has become clear from our study that there is a paucity of data on ICTs from a regional perspective. Projects have been completed or are near completion within FP5, including BISER and NEsis[88], which are attempting to establish common indicators for data collection at the regional level. Attempts to establish regional ICT indicators are also being developed by networks of regions, such as eris@. There is a need to ensure that these processes are integrated, that outcomes are agreed and that standards are implemented. There is a need to mainstream these regional ICT indicators and data collection procedures within the European and national statistical collection processes, as is currently being done in respect of national indicators[89]. At present the amount of data collected by national statistical offices, the indicators used, and the territorial levels for which data is collected or can be disaggregated varies considerably. Most collect only at the national level or at the level immediately below the national level, providing a very poor basis for informed policy-making with respect to regional telecommunications.

It is encouraging that DG Information Society are updating the 1999 EOS-Gallup Report (analysed extensively in our SIR) and the 2002 INRA Report (analysed extensively in the present report). From an ESPON perspective, it would be useful if the household regional study could be extended into EU27 (plus Norway and Switzerland if at all possible), and the enterprise survey regionalised and extended to EU27+2. It is also encouraging that a new regulation (Regulation (EC) NO 808/2004 of the European Parliament and Council) is seeking to establish harmonised statistics on ICT usage by enterprises and by individuals and in households. The new statistics are to be collected at the regional level.

Unless such exercises go beyond the first sub-national level of data collection (which varies between NUTS 1 and NUTS 3 depending on the country) to provide information at the more localised level, the information base on which policymakers rely will continue to be insufficiently detailed for a truly evidence-based policy. In this report we have drawn on a range of information sources to identify the disparities within the Union. We have been able to clearly identify which countries are leading and which are lagging. We have also been able to do this at the regional level and in the typologies in chapter 5 and in Annex 12 we provide a list of regions which are lagging and in which it

[88] BISER is an acronym for Benchmarking the Information Society: e-Europe Indicators for European Regions. NEsis is an acronym for New Economy Statistical Information Society.
[89] For example the E-Commerce in Europe pilot surveys carried out in 2001 by national statistical institutes co-ordinated by Eurostat using a common methodology.

might therefore be appropriate to apply Structural Funds. The paucity of data upon which we were able to draw, particularly for the N12 countries, however, means that these lists can only be seen as *indicative*.

Cost factors are likely to continue to militate against the collection of data at the NUTS 3, 4 and 5 levels, though we would urge that surveys to be undertaken by the Commission, Eurostat and Member States are sufficiently large and properly weighted to allow finer spatial analysis. Beyond this it will be necessary to rely on modelling techniques to uncover the picture at the more localised level. This has been one focus of our work during this project and we believe that the regression models described in annex 10 make an important contribution to this process. The complexity of the territorialities of telecommunications networks and services, which is demonstrated throughout this report, including the continuing importance of national effects and so forth, lead us to recommend that further work is commissioned in this area.

Summary

In this policy section we have looked at two particular areas where policy is designed to simulate the provision of telecommunications networks and services. The first set of policies relate to regulation, that is to say, policies which attempt to create conditions in which the roll out of telecommunications networks will flourish. The second set relate to intervention on the supply side which recognise that regulation and other measures aimed at ensuring that the market serves all appear to have territorial limitations. Such policies are increasingly common, and there has been a significant change in attitude towards government intervention to stimulate investment in areas where development appears to be slow, with the Commission acknowledging the "need for public intervention to accelerate coverage of under-served areas", through, for example, Digital Quick Start Projects. In this closing section we summarise and recap the key points of our discussion of these policies.

(1) Regulation:

- Most regulation is 'spatially blind'. The use of regulation to stimulate competition – e.g., local loop unbundling – can exacerbate territorial disparities, as new entrants target the most lucrative localities.

- One of the few types of regulation which is actually designed (in part) to address territorial disparities are those relating to universal service provision. To date both the (European) Universal Service Directive and national universal services orders have confined themselves to narrowband services. We found no examples USOs being extended to encompass broadband to consumers, apart from the 'E-rate' scheme in USA which provides discounted rate for Internet services to schools and libraries, but is rather cumbersome in operation. There is little evidence to suggest that the European USD is likely to be extended to broadband in the next review due to take place in 2005.

- We would suggest that regulators should be required to take into account broader regional or territorial development goals – Ireland provides an interesting example of such 'joining up' of policy. Further, regulators should be mandated to collect information on territorial disparities in provision.

(2) Aggregation of demand: we found some interesting examples found of regional agencies aggregating public sector demand in order to reduce the costs of broadband procurement. We also found instances in which the networks so procured can then be made available to SMEs.

(3) Public access points: we found many examples across Europe of public intervention to stimulate public internet access points (PIAPs), for example in rural areas.

(4) Direct subsidy to private operators; examples of this approach is evident, but it is clearly high-risk in terms of value-for-money for public investment, given the asymmetry of information about telecoms networks costs between operators and public agencies.

(5) Public-private partnerships: a number of successful examples evident of public-private partnerships.

(6) Public construction and /or ownership of networks: a growing range of examples evident. Municipal networks particularly well established in Sweden (173 out of a total of 289 communities have built their own broadband networks). Such networks can also be used to experiment with alternative technologies, including wireless and satellite.

Clearly, various combinations of these approaches will be relevant in different regional contexts. One clear message which emerges is that if the public sector does wish to intervene in order to achieve more balanced broadband coverage, there needs to be greater symmetry of knowledge between public authorities and telecommunications providers. We advocate the establishment of 'regional telecommunications units' in order to address the existing pronounced asymmetries in knowledge.

Finally, we draw attention to the paucity of regional telecoms/ICT data, and argue that this provides a very poor basis for informed policy-making with respect to regional telecommunications. We advocate, in consequence, the need for investing in the harmonised collection of household and enterprise data across Europe's regions (disaggregated to NUTS 3 level), through regular surveys.

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Source: CURDS; based on data drawn from INRA (2004)

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Source: Data supplied by ITU through personal correspondence, charted by CURDS

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Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

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Source: CURDS; based on data drawn from KMI Research map

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Source: CURDS

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Source: ESPON 1.2.2 FIR. Data abstracted from ITU (2001); mapped by CURDS

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Source: Mapped by Karelian Institute

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Source: Mapped by Karelian Institute

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Source: © PriMetrica, Inc., 2003 – http://www.telegeography.com

Figure A4.6: European terrestrial networks in 2002: 'core' area detail

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Figure A4.7: Pan-European networks in South East Europe

Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

Figure A4.8: Pan-European networks in Southern Italy and Greece

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Figure A4.9: Pan-European networks in Germany

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Figure A4.10: Pan-European networks in Sweden

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Figure A4.11: Copenhagen as a pan-European infrastructure 'gateway'

Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

Figure A4.12: The 'local' national loop of Energis in Poland

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Source: CURDS; based on data drawn from INRA (2004)

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Source: CURDS; based on data drawn from INRA (2004)

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Source: CURDS; based on data drawn from INRA (2004)

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Source: CURDS; based on data drawn from INRA (2004)

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Source: CURDS; based on data drawn from INRA (2004)

Figure A5.10: The relationship between household cable modem connections and GDP category in EU15 regions (mean = 2.3)
Source: CURDS; based on data drawn from INRA (2004)

Figure A5.11: The relationship between household cable modem connections and population density/urban status in EU15 regions (mean = 2.3)
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Source: Adapted from Office of the e-Envoy (2001)

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Source: One North East (2003)

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Source: CURDS; based on data drawn from INRA (2004)

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Source: CURDS; based on data drawn from INRA (2004)

Figure A13.3: The relationship between household Internet access and Pentagon location in French regions
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Source: CURDS; based on data drawn from INRA (2004)

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Source: CURDS; based on data drawn from INRA (2004)

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Source: CURDS; based on data drawn from INRA (2004)

Figure A13.7: The relationship between household Internet access and Objective 1 status in German regions
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.8: The relationship between household Internet access and GDP level in German regions
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.9: The relationship between household Internet access and population density/urban status in German regions
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.10: The relationship between household Internet access and Pentagon location in German regions
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.11: The relationship between broadband Internet access at home and Objective 1 status in German regions
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.12: The relationship between broadband Internet access at home and GDP level in German regions

Source: CURDS; based on data drawn from INRA (2004)

Figure A13.13: The relationship between broadband Internet access at home and population density/urban status in German regions
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Figure A13.14: The relationship between broadband Internet access at home and Pentagon location in German regions
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.15: The relationship between household Internet access and Objective 1 status in Spanish regions
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.16: The relationship between household Internet access and GDP level in Spanish regions
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Figure A13.21: The relationship between household Internet access and Objective 1 status in Swedish regions
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.22: The relationship between household Internet access and GDP level in Swedish regions
Source: CURDS; based on data drawn from INRA (2004)

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Source: CURDS; based on data drawn from INRA (2004)

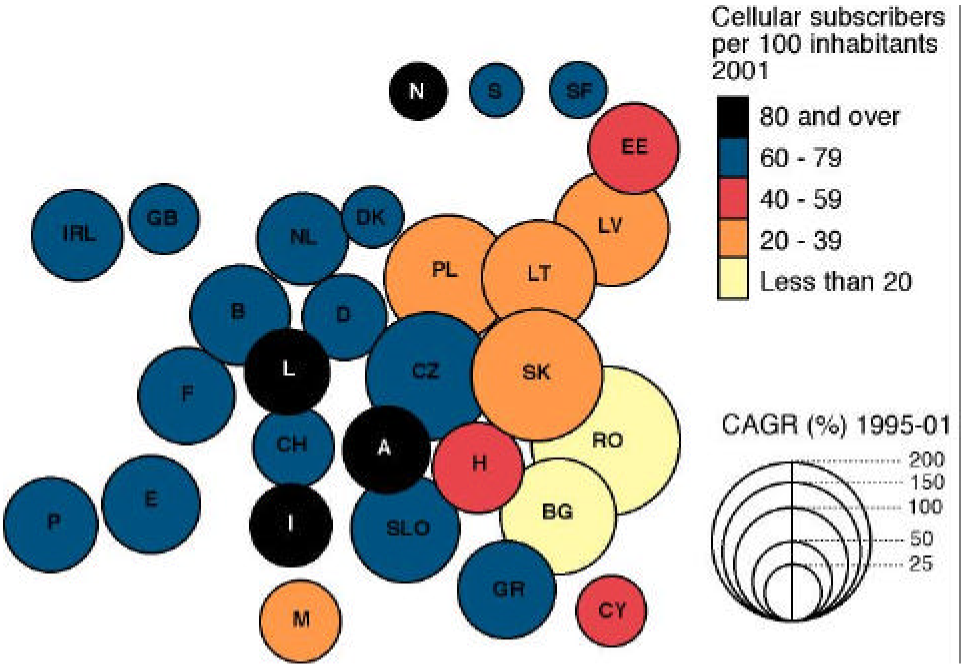
Figure A13.24: The relationship between broadband Internet access at home and Objective 1 status in Swedish regions
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.25: The relationship between broadband Internet access at home and GDP level in Swedish regions
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.26: The relationship between broadband Internet access at home and population density/urban status in Swedish regions
Source: CURDS; based on data drawn from INRA (2004)

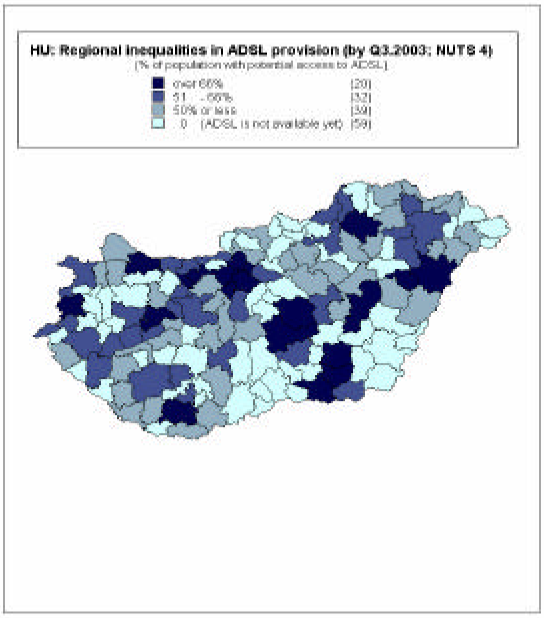
Annex 4 Additional maps and figures not included in the main part of the report

Figure A4.1: Cellular subscribers per 100 inhabitants 2001 (and compound annual growth rate (CAGR) 1995-2001)



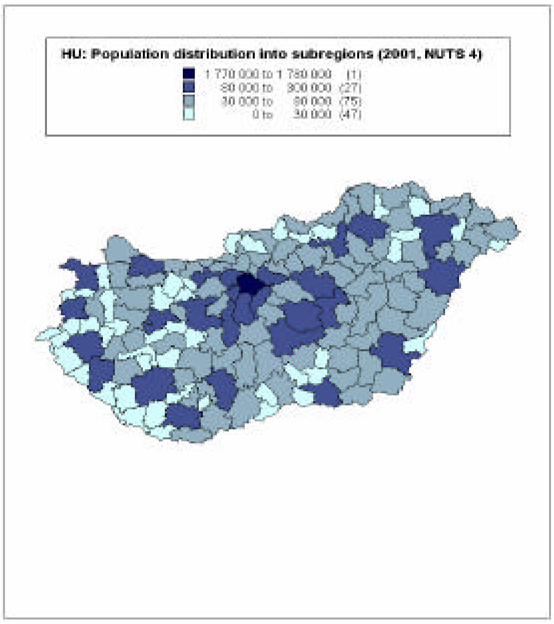
Source: ESPON 1.2.2 FIR. Data abstracted from ITU (2001); mapped by CURDS

Figure A4.2: ADSL coverage in Hungary



Source: Mapped by Karelian Institute

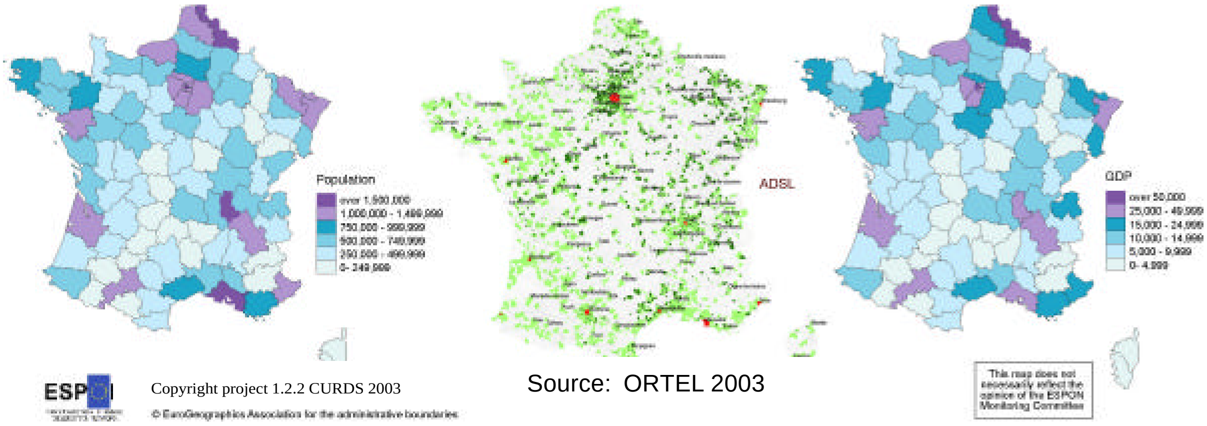
Figure A4.3: Population distribution in Hungary



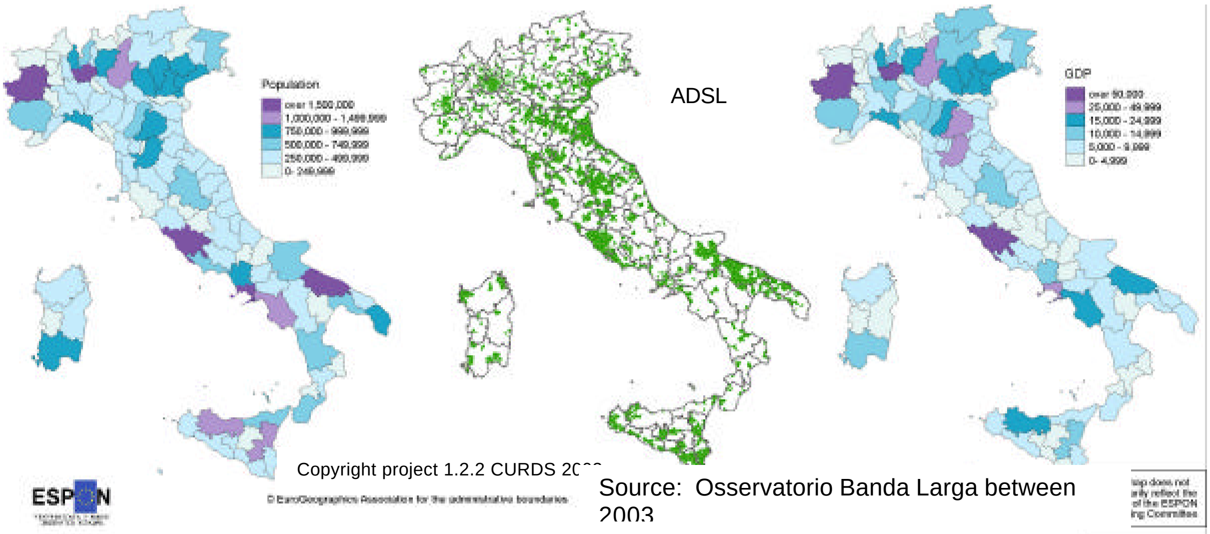
Source: Mapped by Karelian Institute

Figure A4.4: ADSL coverage, population density and GDP per capita in France, Italy and the UK

France



Italy



UK

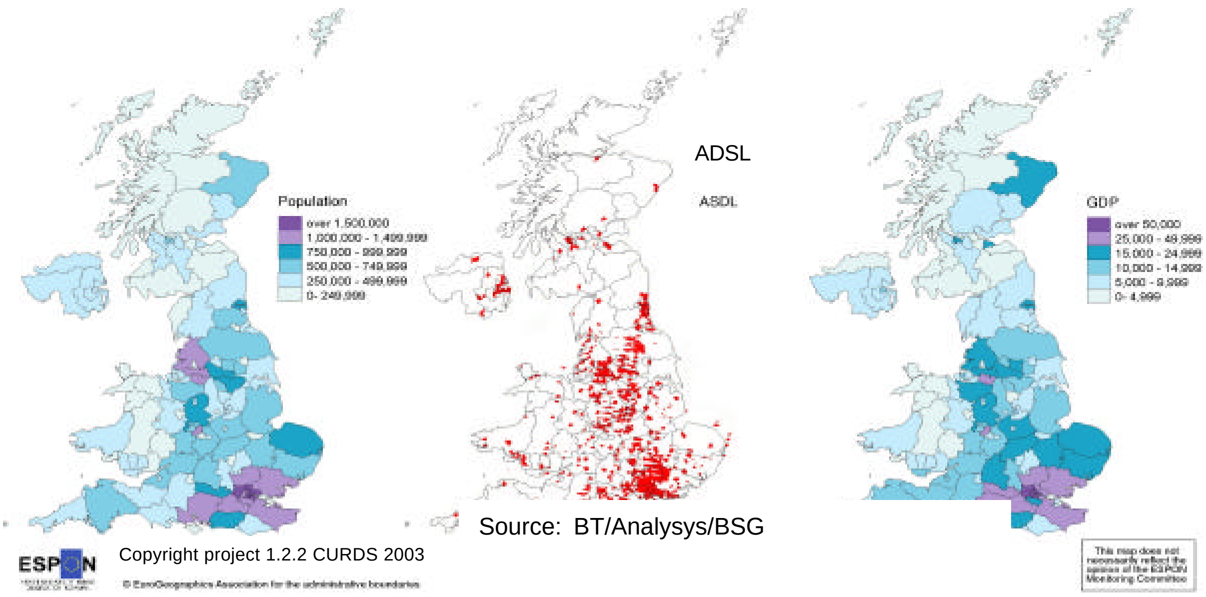
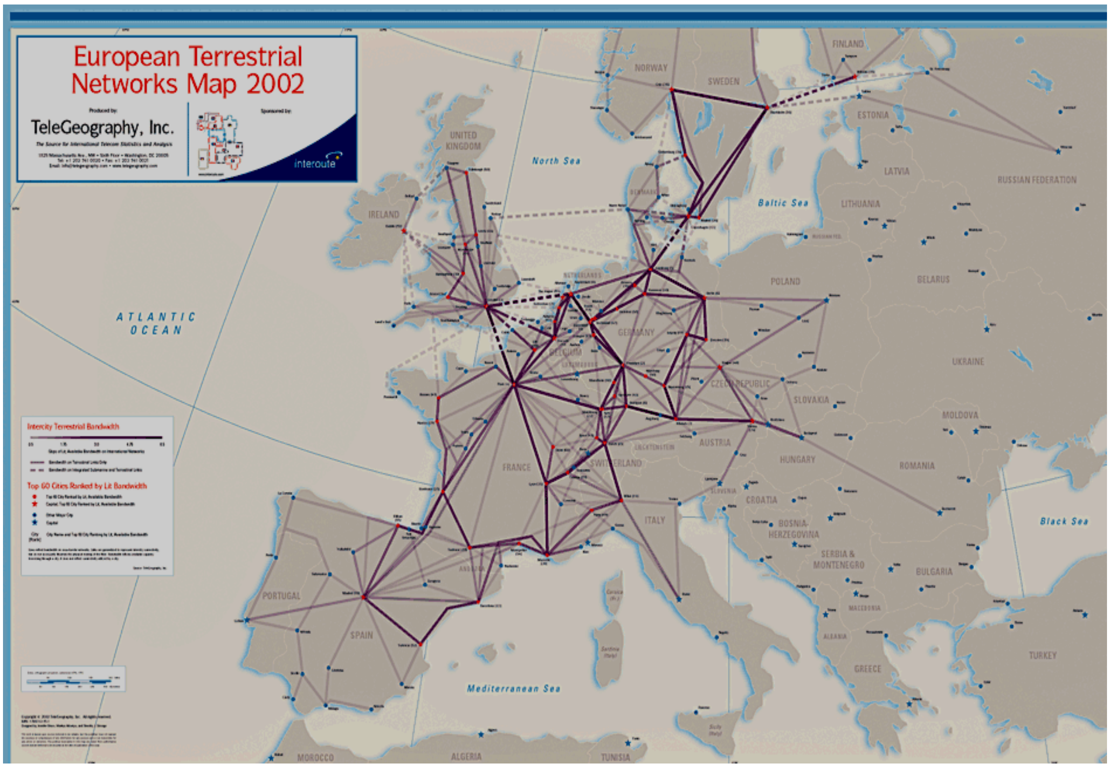
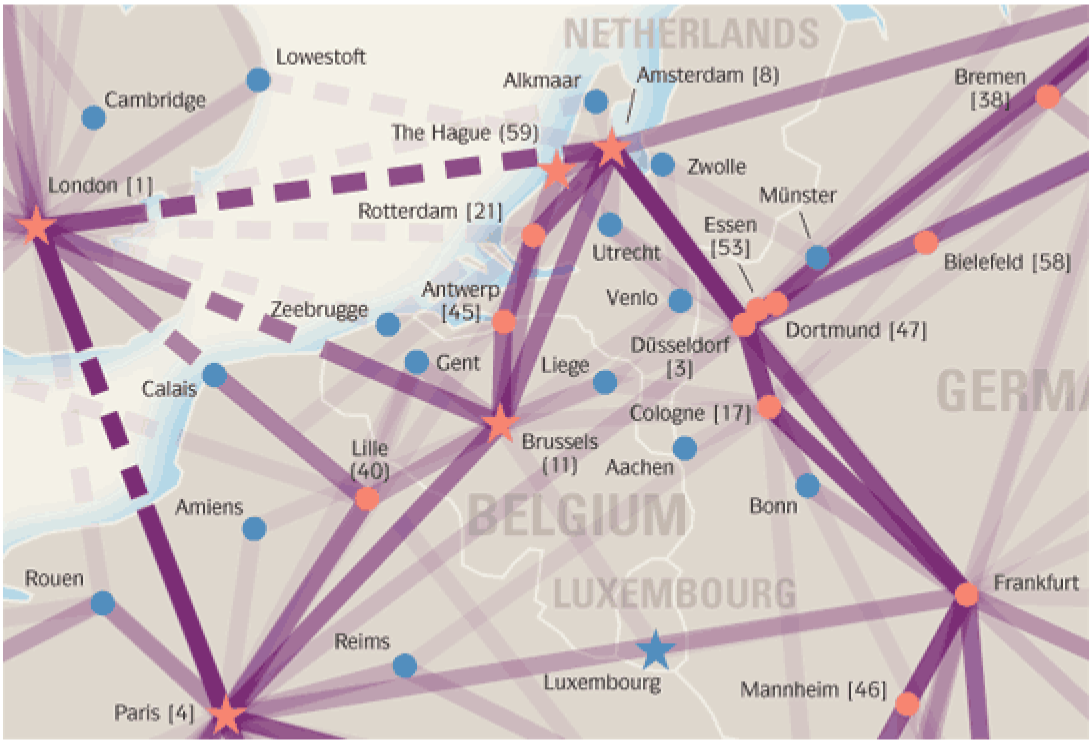


Figure A4.5: European terrestrial networks in 2002



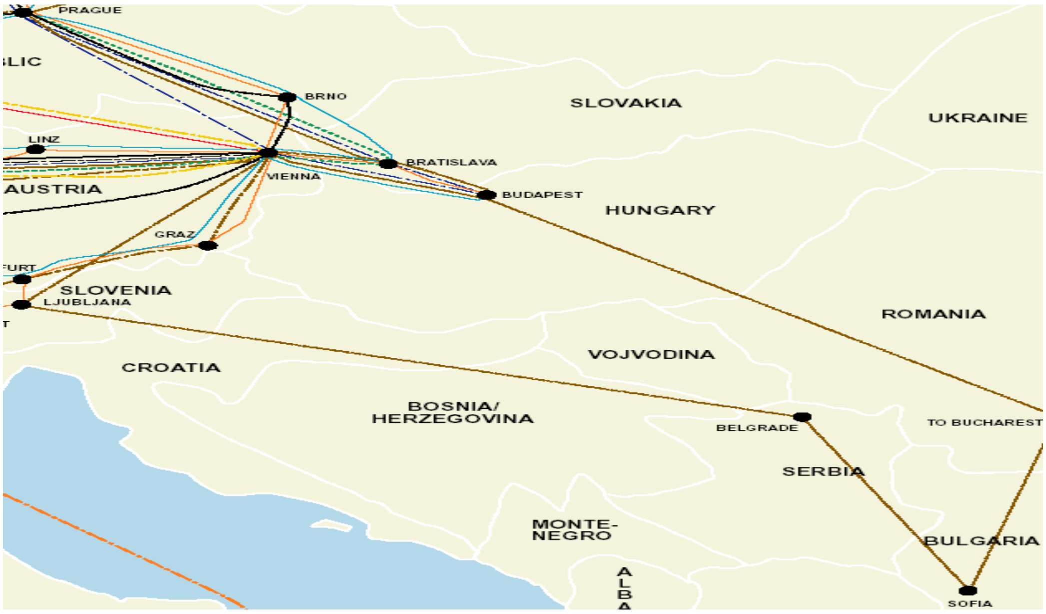
Source: © PriMetrica, Inc., 2003 – http://www.telegeography.com

Figure A4.6: European terrestrial networks in 2002: 'core' area detail



Source: © PriMetrica, Inc., 2003 – http://www.telegeography.com

Figure A4.7: Pan-European networks in South East Europe

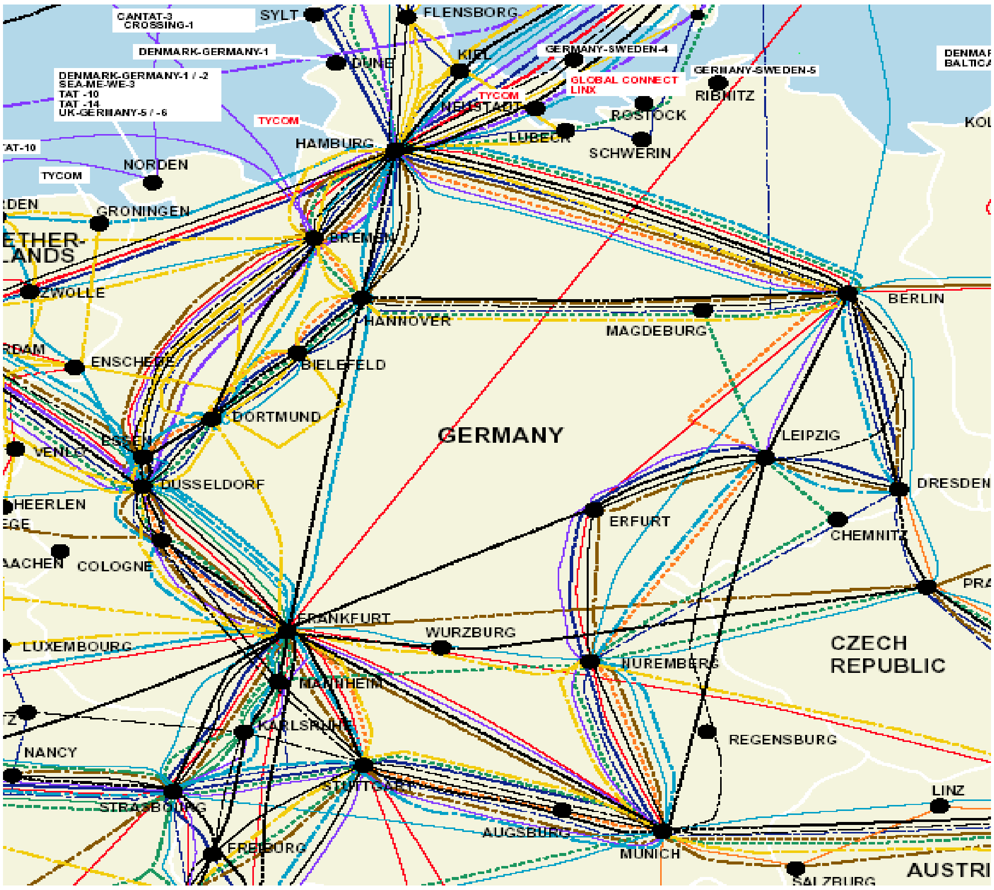


Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

Figure A4.8: Pan-European networks in Southern Italy and Greece

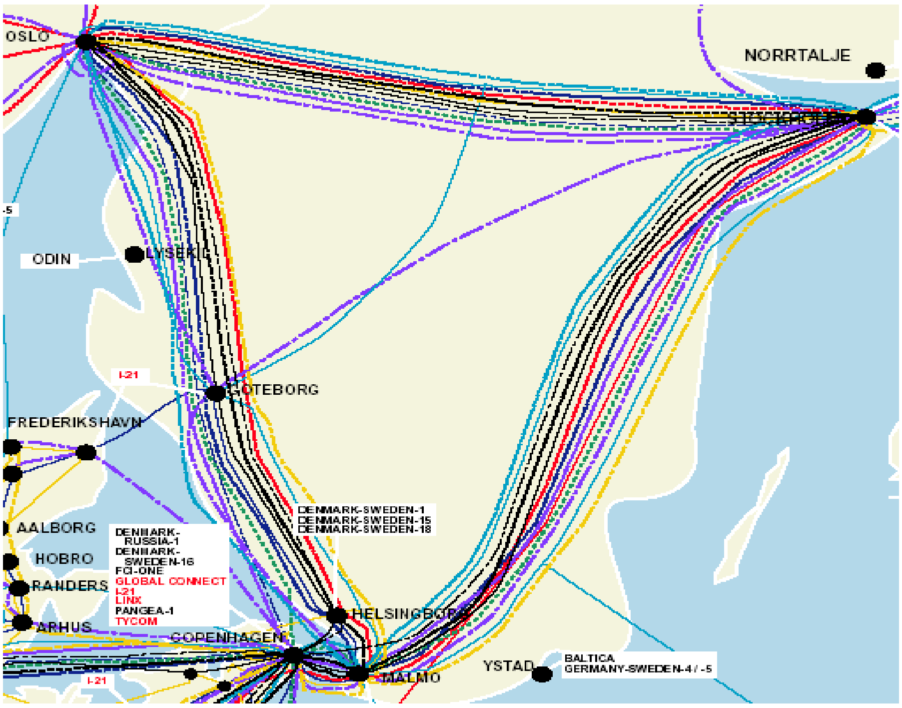
Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

Figure A4.9: Pan-European networks in Germany



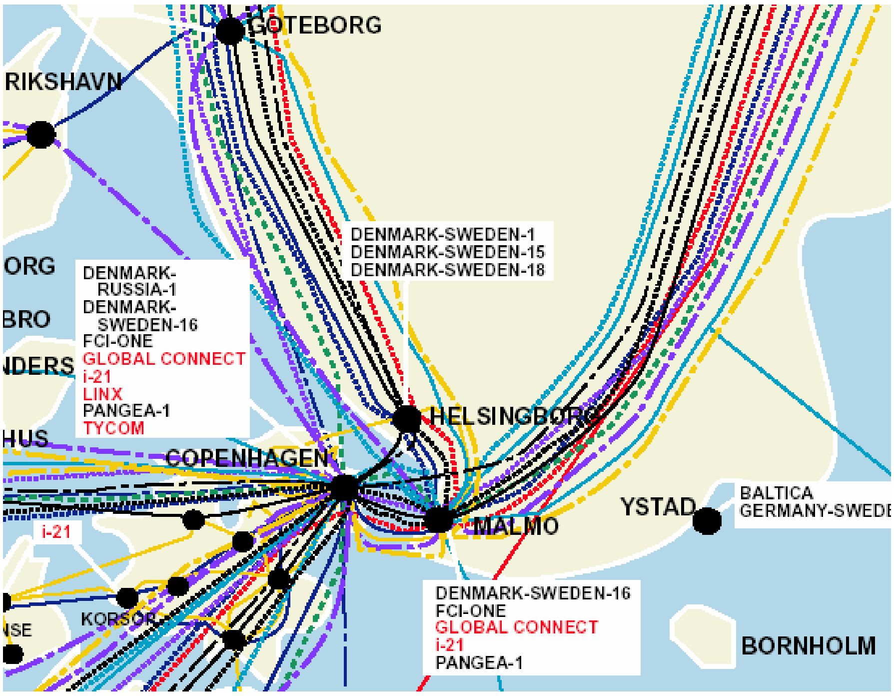
Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

Figure A4.10: Pan-European networks in Sweden



Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

Figure A4.11: Copenhagen as a pan-European infrastructure 'gateway'



Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

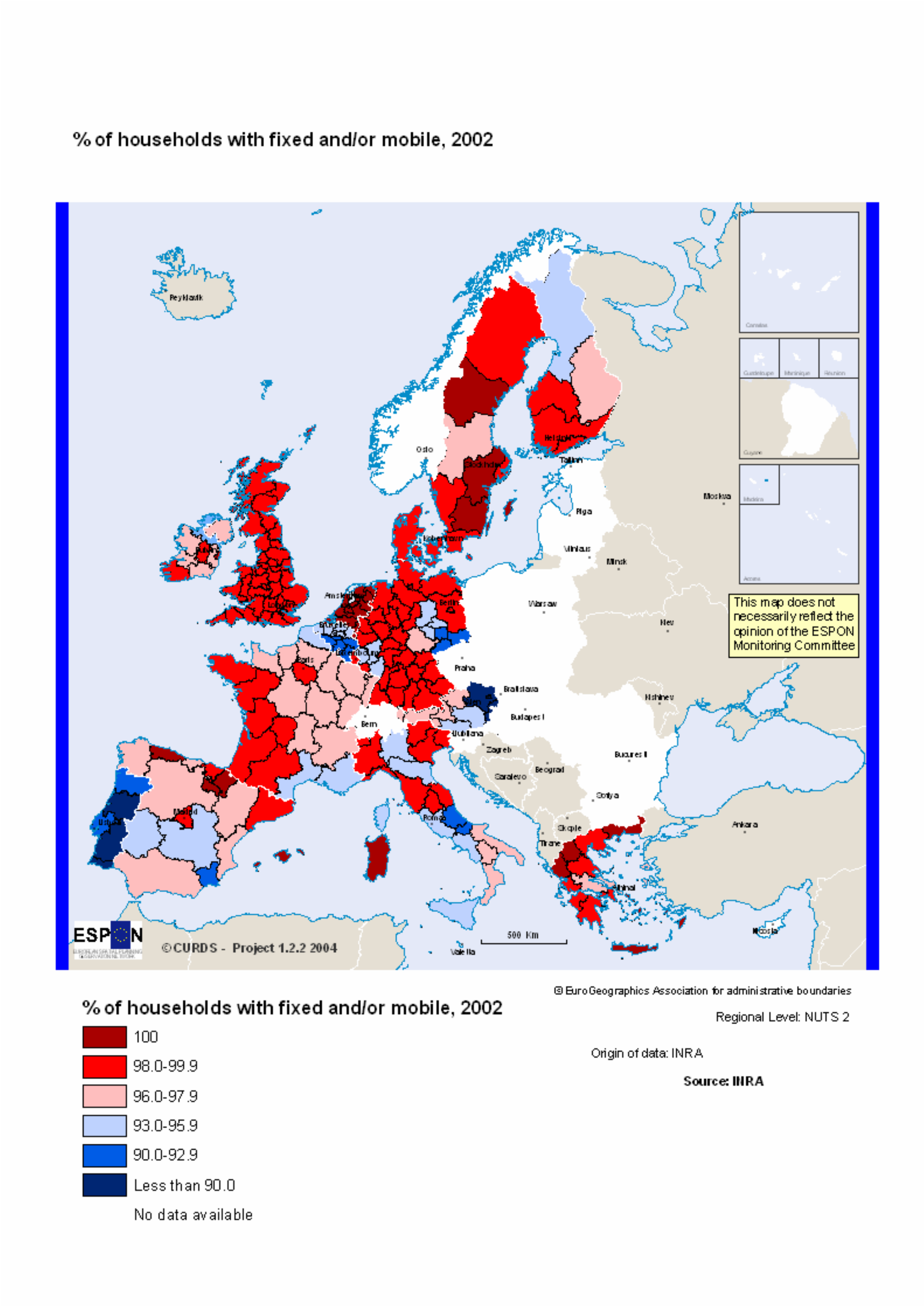
Figure A4.12: The 'local' national loop of Energis in Poland

Source: www.kmiresearch.com (based on publicly available information or information shared with KMI as of Q3 2001). Copyright of map is with KMI, used by permission.

Annex 5 – Further analysis of the regional level INRA household survey

1. Households with fixed and/or mobile telephony

Map A5.1: % of households with fixed and/or mobile 2002



Key points

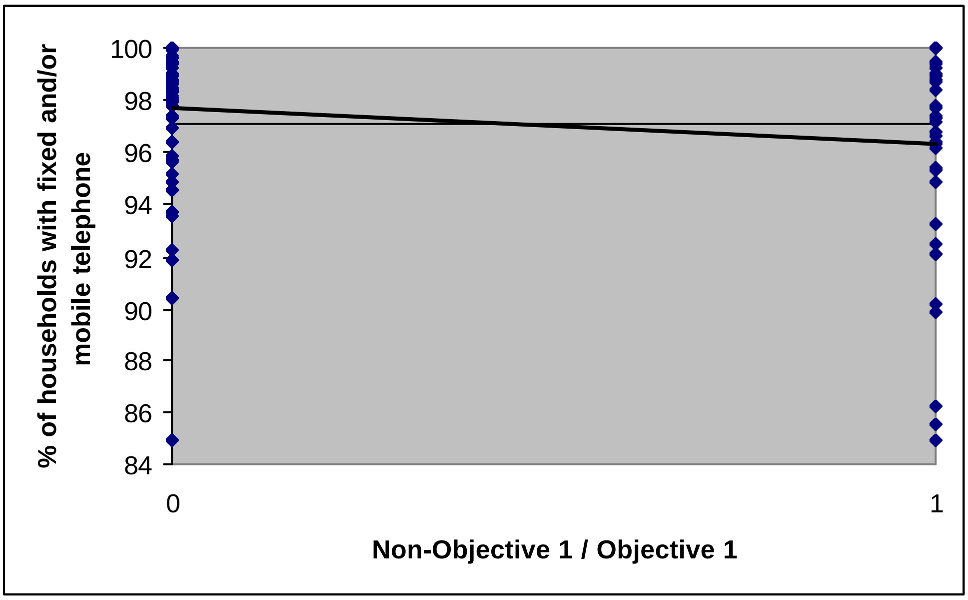
There exists little or no relationship between fixed and/or mobile penetration levels in EU15 and the four socio-economic variables of Objective 1 status, GDP per capita, settlement structure and Pentagon location.

Although advanced Dutch and Swedish regions have 100% household penetration of fixed and/or mobile telephony, this is also the case for five Greek and four Spanish regions, plus Sardegna.

It is difficult to explain why the three Austrian regions (particularly Wien) have the lowest levels (below 85%), and why Belgian regions (including Bruxelles) are also well below the EU15 regional average on this indicator.
The INRA data for other indicators such as households with a fixed line and households with mobile only suggests that it is these Austrian and Belgian regions (along with Finnish and Portuguese regions) which are among the best illustrations of the current trend of fixed telephony being replaced by mobile telephony in some cases, but this does not explain their low levels for fixed *and/or* mobile.

Nearly three quarters of EU15 regions are above the overall average (97.1%) for fixed and/or mobile penetration, demonstrating that there is a much larger spread in the levels of those regions which are below average, and/or that below average regions have much larger populations.

Figure A5.1: The relationship between fixed and/or mobile uptake and Objective 1 status in EU15 regions (mean = 97.1)



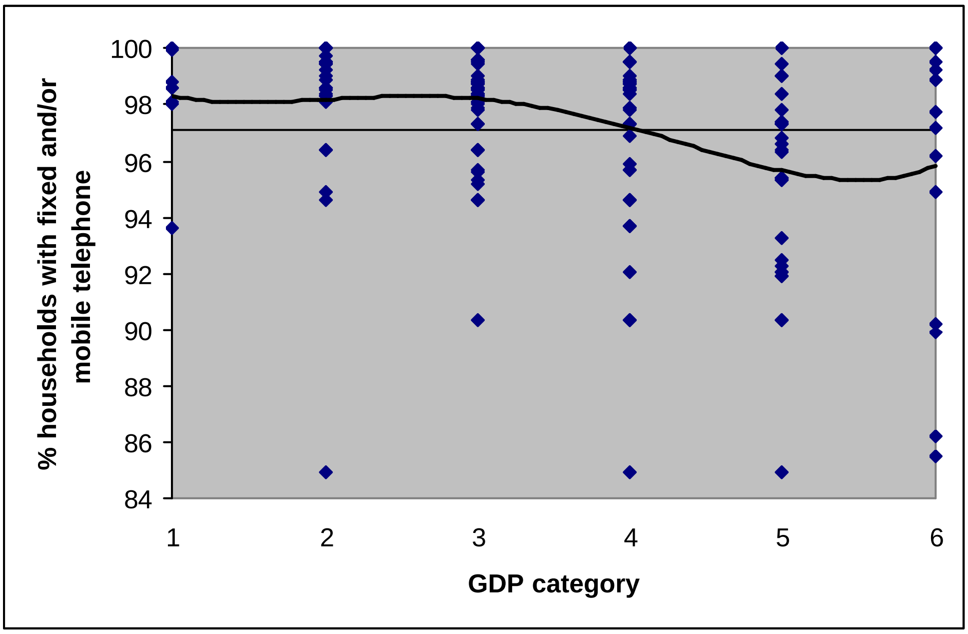
Source: CURDS; based on data drawn from INRA (2004)

Fixed and/or mobile – Obj1

There are a number of Objective 1 regions with above average fixed and/or mobile uptake: 5 Greek regions, Principado de Asturias, Sardegna and Mellersta Norrland all have 100% fixed and/or mobile penetration levels.

There are a number of non-Objective 1 regions with below average fixed and/or mobile uptake: less than 85% of households in Burgenland, Niederosterreich and Wien in Austria have a fixed and/or mobile telephone line, with Portuguese and Belgian regions only slightly higher.

Figure A5.2: The relationship between fixed and/or mobile uptake and GDP category in EU15 regions (mean = 97.1)



Source: CURDS; based on data drawn from INRA (2004)

<u>Fixed and/or mobile – GDP</u>

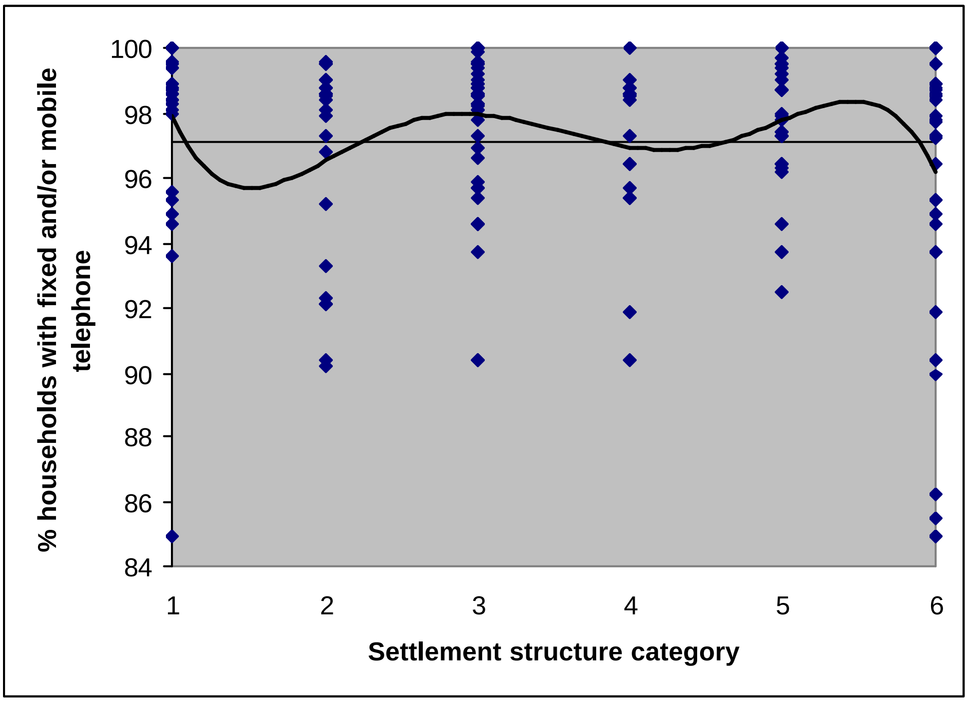
Some German, Dutch, and, to a lesser extent, Swedish regions have 100% fixed and/or mobile uptake in keeping with their relatively high levels of GDP.

A number of Greek regions also have 100% fixed and/or mobile uptake, but despite their relatively low GDPs.

Wien stands out as a region with high GDP, but low fixed and/or mobile uptake.

4 Portuguese regions conform to expectation with low GDP levels and relatively low fixed and/or mobile penetration.

Figure A5.3: The relationship between fixed and/or mobile uptake and population density/urban status in EU15 regions (mean = 97.1)



Source: CURDS; based on data drawn from INRA (2004)

Fixed and/or mobile – population density/urban status

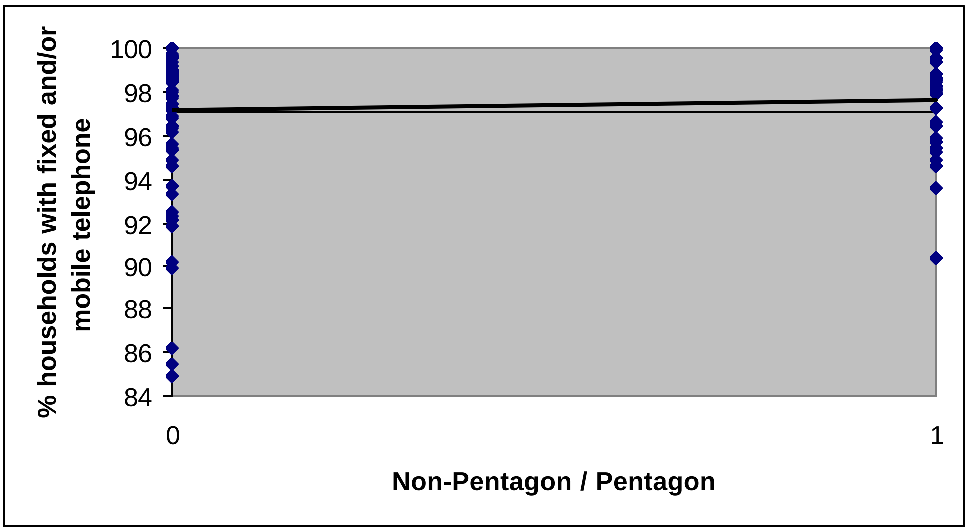
Bremen, Hamburg, and numerous Dutch regions have 100% fixed and/or mobile uptake in keeping with their positions in the European settlement structure (densely populated with large centres).

There are Greek and Swedish regions also with 100% fixed and/or mobile uptake, but which are less densely populated without centres.

Wien, Norte and Liege are densely populated regions with large centres, but which have relatively low levels of fixed and/or mobile uptake.

Other Austrian and Portuguese regions conform more to expectation as being less densely populated without centres and having relatively low fixed and/or mobile penetration.

Figure A5.4: The relationship between fixed and/or mobile uptake and Pentagon location in EU15 regions (mean = 97.1)



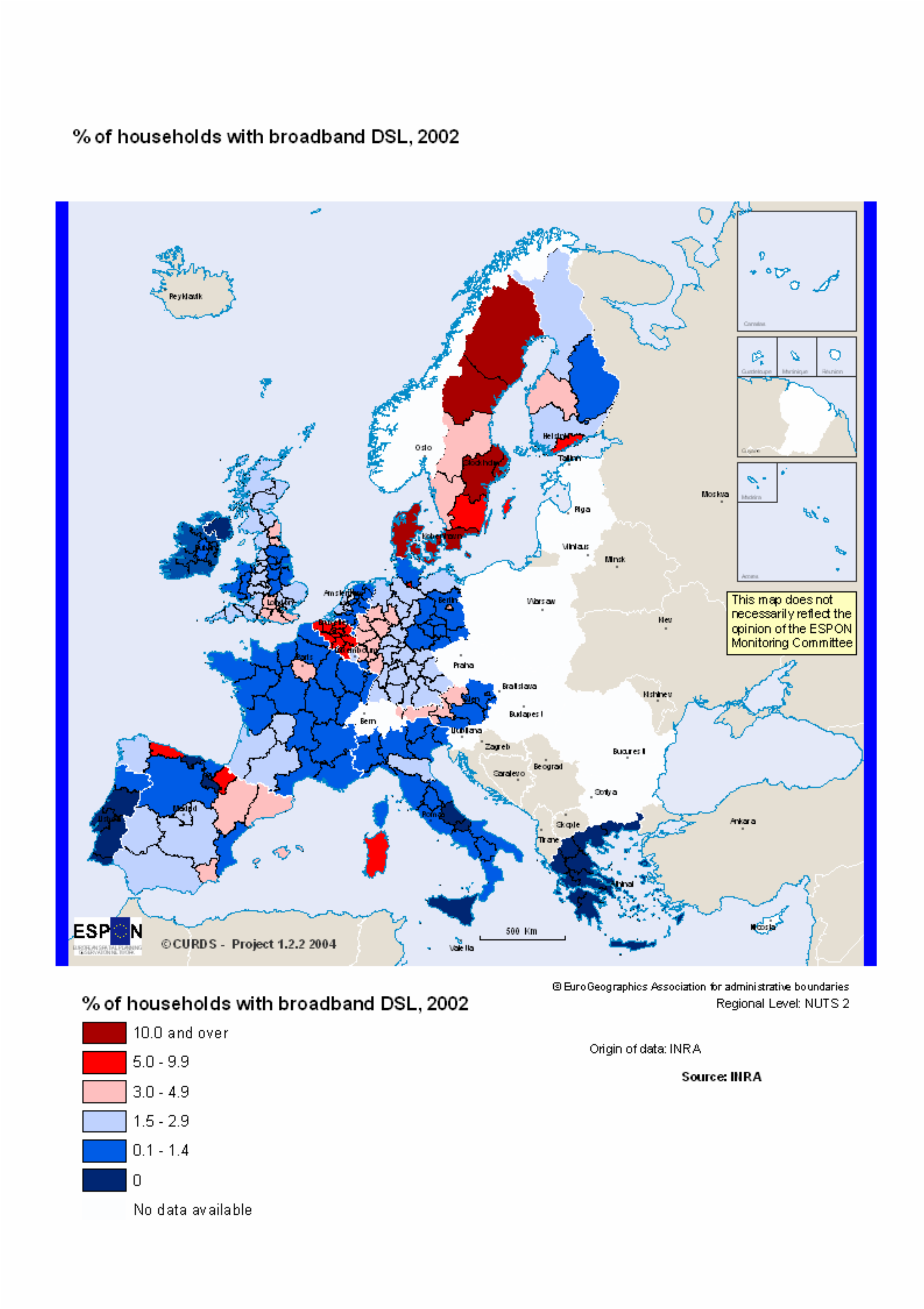
Source: CURDS; based on data drawn from INRA (2004)

Fixed and/or mobile – Pentagon

There are as many non-Pentagon regions (Spanish, Greek and Swedish) with 100% fixed and/or mobile uptake as Pentagon regions (German and Dutch). Non-Pentagon Austrian and Portuguese regions have the lowest fixed and/or mobile uptake levels in EU15, but Belgian regions in the Pentagon have only slightly higher uptake levels.

2. Households with broadband DSL connections

Map A5.2: % of households with broadband DSL 2002

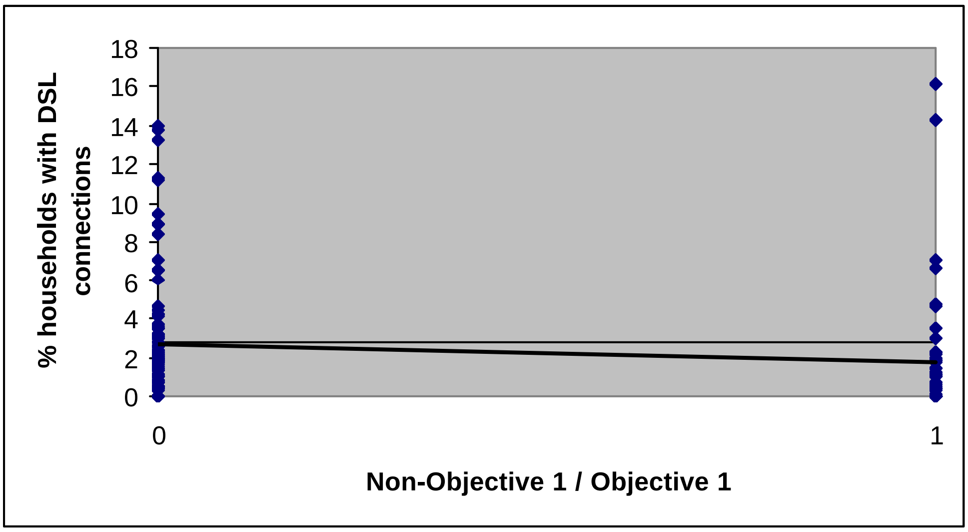


Key points

As for overall broadband, the relationship between DSL take-up and our four socio-economic variables appears to be quite strong, but with a few notable exceptions in each case.

Swedish and Belgian regions dominate the classification of DSL take-up. In the former case, a national policy context of widespread exchange upgrading has clearly borne fruit, while in the latter case, it is suggested that technology competition (notably from cable) forced Belgacom to offer widespread DSL services across the country.

Figure A5.5: The relationship between household DSL connections and Objective 1 status in EU15 regions (mean = 2.8)



Source: CURDS; based on data drawn from INRA (2004)

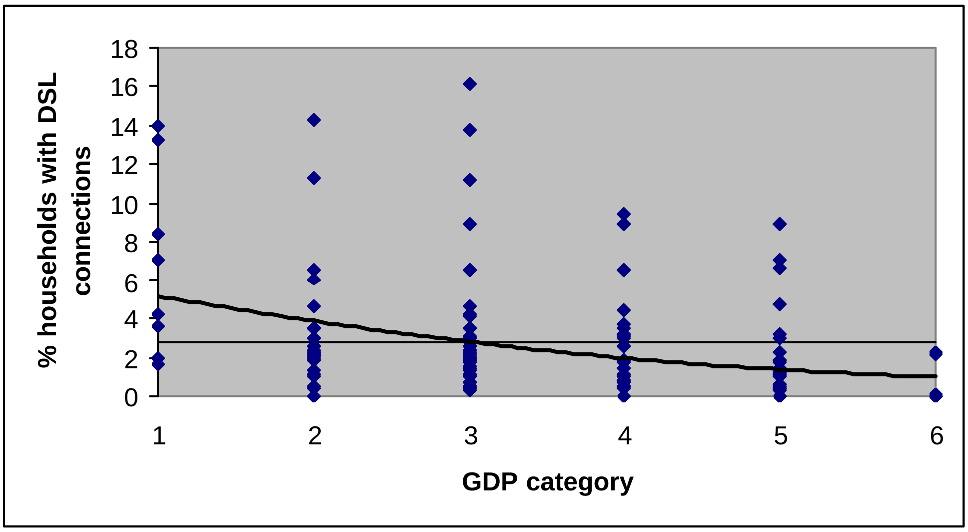
DSL connections – Obj1

The leading EU15 regions for DSL uptake are mostly non-Objective 1 regions (Benelux and Nordic regions), although the two regions with highest DSL rates, Ovre Norrland and Mellersta Norrland are both Swedish Objective 1 regions. Principado de Asturias and Sardegna, and to a slightly lesser extent, Ceuta y Melilla and Norra Mellansverige, are also Objective 1 regions with quite high DSL uptake.

Regions with 0% DSL penetration include the Objective 1 regions of Greece, Sicilia, Centro, Alentejo and Algarve, but also several non-Objective 1 regions

(Bremen, Cantabria, La Rioja, Abruzzo, Molise, Lisboa e Vale do Tejo, Northern Ireland).

Figure A5.6: The relationship between household DSL connections and GDP category in EU15 regions (mean = 2.8)



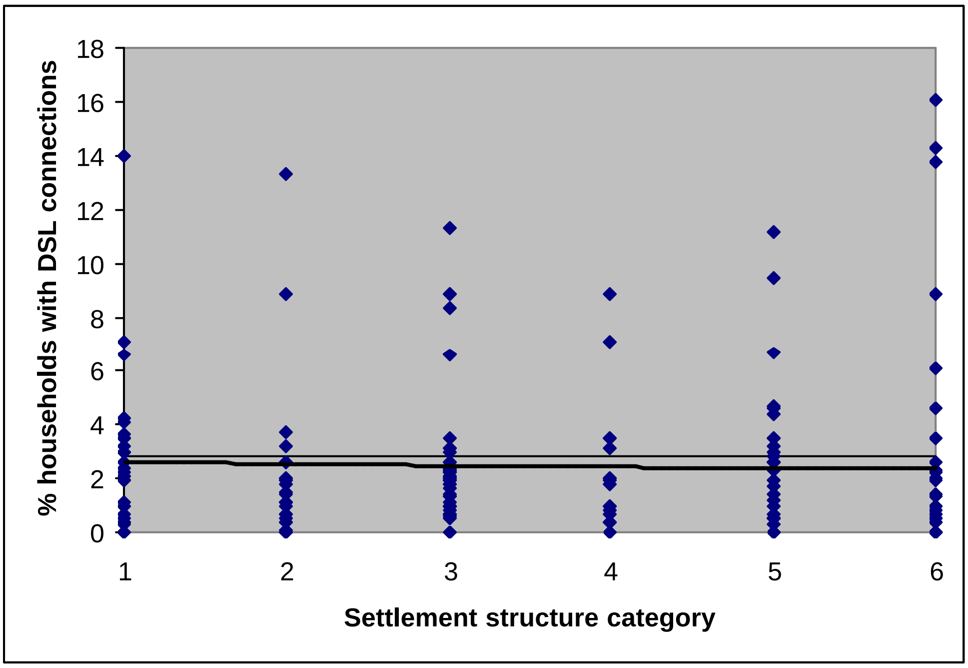
Source: CURDS; based on data drawn from INRA (2004)

<u>DSL connections – GDP</u>

Generally speaking, regions with highest DSL uptake also have at least relatively high GDP levels. Bruxelles, Stockholm, Uusimaa and Hamburg are all in both the top 20 DSL regions and the top GDP category. Nevertheless, Namur, Hainaut, Principado de Asturias and Sardegna, from only the fifth GDP category, all have relatively high DSL penetration rates.

Regions with the lowest DSL uptake tend to be among the poorest EU15 regions (Greek and Portuguese regions). Bremen again stands out as an exception, with Leicestershire, Rutland and Northants and Wien also being in the second GDP category, whilst having DSL uptake of 0.5% or below.

Figure A5.7: The relationship between household DSL connections and population density/urban status in EU15 regions (mean = 2.8)



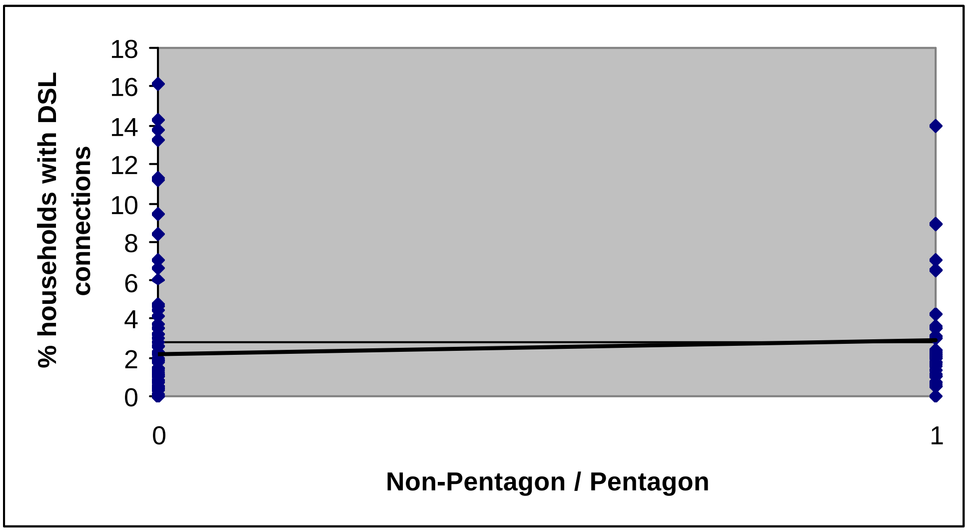
Source: CURDS; based on data drawn from INRA (2004)

DSL connections – population density/urban status

The regions with the highest DSL uptake range from very densely populated regions with large centres (Bruxelles, Hamburg, Antwerpen) to less densely populated regions without centres (Swedish regions, plus the Belgian region of Luxembourg). There are also densely populated Benelux regions, but equally less densely populated regions such as Comunidad Foral de Navarra, Sardegna and Ceuta y Melilla.

Most of the regions with lowest DSL uptake are less densely populated regions in southern Europe, although the presence in this group of the very densely populated regions of Bremen, Attiki, Lazio, Campania, Derbyshire and Nottinghamshire and Leicestershire, Rutland and Northants is quite surprising.

Figure A5.8: The relationship between household DSL connections and Pentagon location in EU15 regions (mean = 2.8)



Source: CURDS; based on data drawn from INRA (2004)

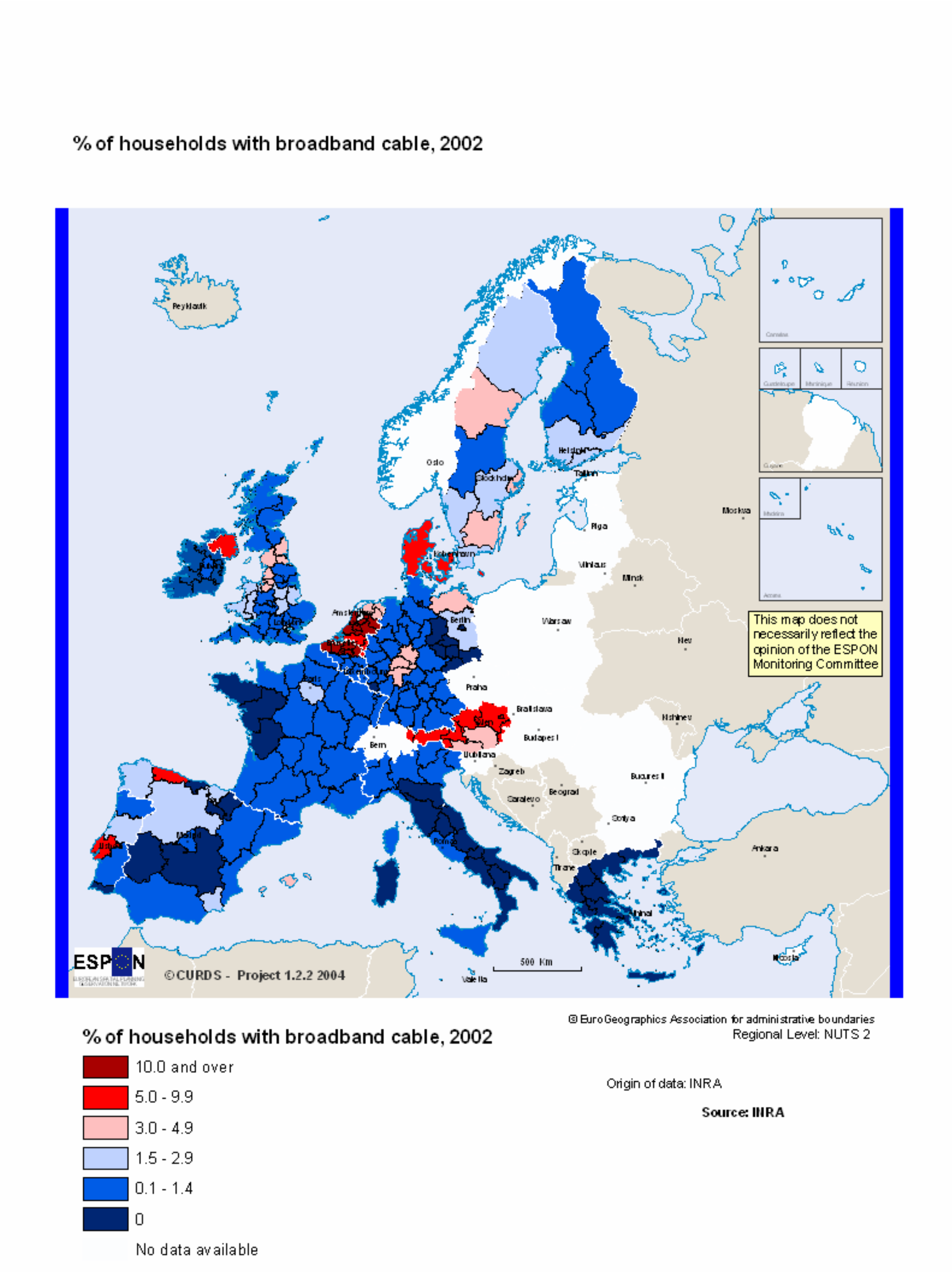
DSL connections – Pentagon

Although there are Belgian regions, plus Hamburg, among those with highest DSL uptake, and thus several Pentagon regions, there are also a number of non-Pentagon regions with high DSL penetration – Swedish regions, Danmark, Comunidad Foral de Navarra, Uusimaa, Principado de Asturias and Sardegna.

By contrast, given the southern European dominance of regions with low DSL uptake, only Bremen and the French regions of Champagne-Ardenne, Picardie, Haute-Normandie, Bourgogne, Alsace, Lorraine and Franche-Comté represent Pentagon regions with DSL penetration of 0.5% and below.

3. Households with broadband cable (Internet) connections

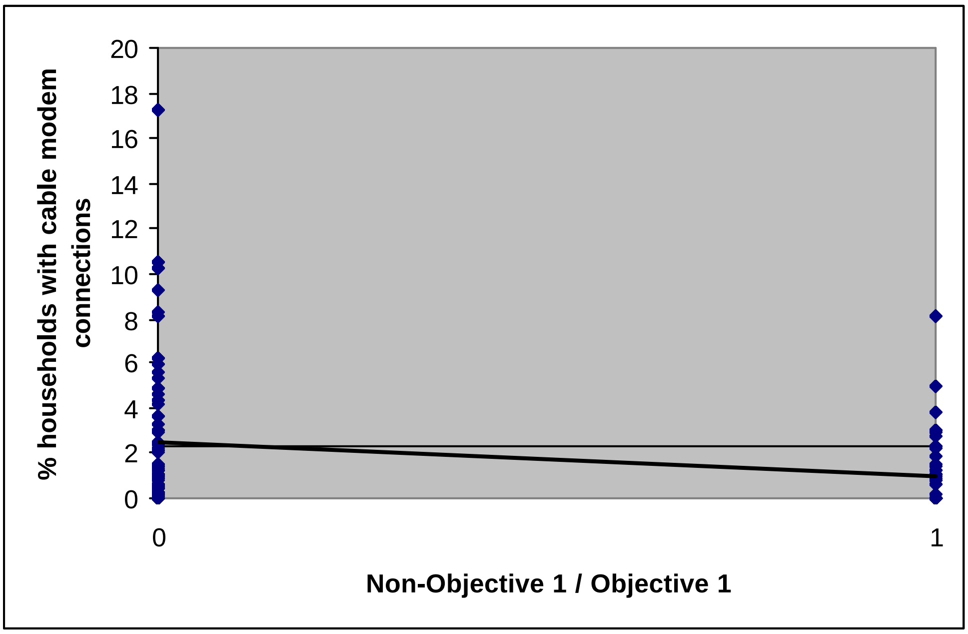
Map A5.3: % of households with broadband cable 2002



Key points

Benelux (particularly Dutch) and Austrian regions dominate the broadband cable classification, so while there may be some level of relationship between this indicator and our socio-economic variables, the lack of a cable culture in, for example, German, French and UK regions (despite their relatively high GDP levels, urban and/or core Pentagon status) is the key reason behind their low figures for cable take-up.

Figure A5.9: The relationship between household cable modem connections and Objective 1 status in EU15 regions (mean = 2.3)



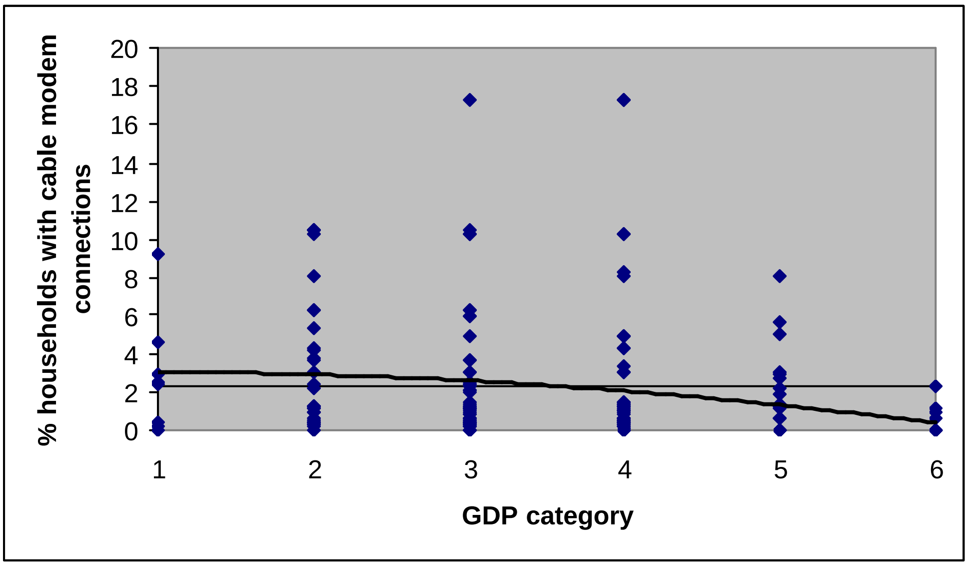
Source: CURDS; based on data drawn from INRA (2004)

Cable – Obj1

The vast majority of the regions with the highest cable Internet penetration in EU15 are non-Objective 1 regions, dominated by Benelux and Austrian regions. The Objective 1 exceptions with relatively high cable Internet include Burgenland (15th) and Principado de Asturias (26th).

There are over 40 Objective 1 and non-Objective 1 regions with 0% cable Internet penetration. The former are dominated by Greek, Italian and eastern German regions. The latter include German city regions like Berlin, Bremen and Hamburg, Spanish, French and Italian regions.

Figure A5.10: The relationship between household cable modem connections and GDP category in EU15 regions (mean = 2.3)



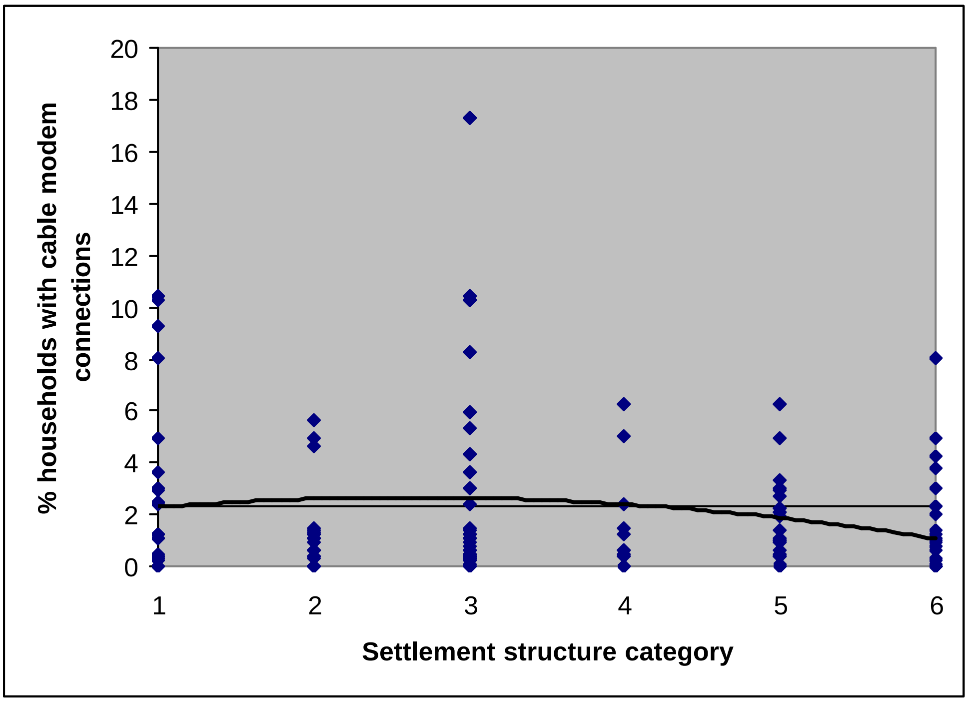
Source: CURDS; based on data drawn from INRA (2004)

Cable – GDP

Regions with the highest cable Internet uptake tend to have moderate rather than high GDP levels. In neither the Netherlands nor Belgium is it the richest capital city region which has the highest uptake, and it is curious that it is one of the relatively poorer regions of the UK, Northern Ireland, which has the highest national cable Internet uptake. Burgenland, Lisboa e Vale do Tejo and Principado de Asturias stand out as regions with relatively lower GDP but relatively high cable Internet penetration above 5%.

Regions with 0% cable Internet uptake are dominated by poorer regions of southern Europe, but we should note the presence here of Hamburg (GDP category 1), Bremen (category 2) and Emilia-Romagna, Toscana, Saarland and Berlin (category 3). The rich regions of Luxembourg and Oberbayern also have minimal cable Internet penetration.

Figure A5.11: The relationship between household cable modem connections and population density/urban status in EU15 regions (mean = 2.3)



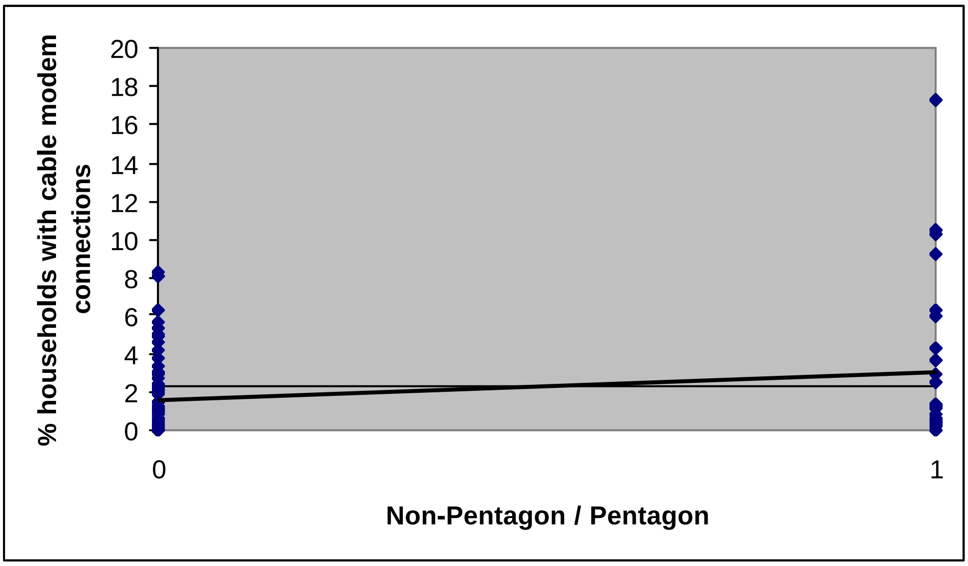
Source: CURDS; based on data drawn from INRA (2004)

Cable – population density/urban status

The densely populated regions of the Netherlands and Belgium lead the way for cable Internet uptake in EU15, although, as previously noted, in neither case is it the densely populated capital region which has the highest uptake. In the Netherlands, it is the 'merely' densely populated Overijssel, Gelderland and Flevoland regions which have the highest cable penetration at over 17%, while the very densely populated regions of Noord-Holland and Zuid-Holland remain at just over 10%. The high cable Internet uptake in Austrian regions is remarkable too, given the relatively less densely populated nature of many of these regions, especially Burgenland and Niederosterreich.

Beyond the less densely populated regions with 0% cable Internet, there are some very densely populated regions with large centres that one might have expected to have significantly higher than 0% penetration – Berlin, Bremen, Hamburg, Attiki and Campania. At only 0.2% uptake, the Spanish and Italian capital regions, Comunidad de Madrid and Lazio, also have very low cable Internet uptake levels.

Figure A5.12: The relationship between household cable modem connections and Pentagon location in EU15 regions (mean = 2.3)



Source: CURDS; based on data drawn from INRA (2004)

Cable – Pentagon

The Pentagon regions of the Netherlands and Belgium have the highest cable Internet uptake, yet there are a number of non-Pentagon regions with cable penetration above 5% - Northern Ireland, Burgenland, Niederosterreich, Wien, Oberosterreich, Salzburg, Lisboa e Vale do Tejo, Danmark and Principado de Asturias.

Non-Pentagon regions of southern Europe make up the largest proportion of the regions with 0% cable Internet uptake, but there are Pentagon regions in this group as well – Bremen, Hamburg, Saarland, Halle, Magdeburg and Emilia-Romagna.

Annex 6 – The metropolitan-urban-rural definitions used in the INRA report

Inhabitants	Metropolitan	Urban	Rural
Belgium	Antwerpen, Bruxelles, Charleroi, Gent, Liege	43 urban cities	Other localities
Danmark	The Copenhagen area	Over 10 000	Less than 10 000
Deutschland	More than 499 999	20 000 – 499 999	Less than 20 000
Ellada	Athens, Salonica	Over 10 000	Less than 10 000
Espana	More than 500 000	100 000 – 500 000	Less than 100 000
France	More than 100 000 and agglomeration of Paris	2 000 – 100 000	Less than 2 000
Ireland	Dublin County Borough North, Dublin County Borough South, Munster CB 1, 2 and 3 (id est Cork, Limerick, Waterford) and Connaught CB (ie. Galway)	Rest of Dublin (ie. Belgard, Fingal and Dunlaoire Rathdown) and urban towns over 1500 people	Less than 1500
Italia	More than 500 000	50 000 – 500 000	Less than 50 000
Luxembourg	Luxembourg-ville	5 000 – 30 000	Less than 5 000
Nederland	More than 99 999	20 000 – 99 999	Less than 20 000
Osterreich	Vienna and environs	Main cities and environs	Less than 7500
Portugal	More than 149 999	10 000 – 149 999	Less than 10 000
Finland	Greater Helsinki: Helsinki, Espoo, Vantaa, Kauniainen	Over 15 000	Less than 15 000
Sverige	More than 199 999	20 000 – 199 999	Less than 20 000
United Kingdom	Tyne & Wear, Merseyside, Greater Manchester, West and South Yorkshire, West Midlands, Greater London	Other areas with more than 2.84 persons per hectare	Other areas with less than 2.84 persons per hectare

Annex 7 – Tables of results of analysis of variance tests

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
FIXED * OBJ1	Between Groups	(Combined)	586.841	1	586.841	6.995	.009
	Within Groups		17366.772	207	83.897		
	Total		17953.613	208			
MOBILE * OBJ1	Between Groups	(Combined)	447.117	1	447.117	5.672	.018
	Within Groups		16316.560	207	78.824		
	Total		16763.677	208			
PCS * OBJ1	Between Groups	(Combined)	3959.697	1	3959.697	27.564	.000
	Within Groups		29736.020	207	143.652		
	Total		33695.717	208			
INTERNET * OBJ1	Between Groups	(Combined)	4424.695	1	4424.695	28.431	.000
	Within Groups		32214.731	207	155.627		
	Total		36639.426	208			
Broadband * OBJ1	Between Groups	(Combined)	238.614	1	238.614	11.054	.001
	Within Groups		4468.149	207	21.585		
	Total		4706.762	208			

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
FIXED * GDP	Between Groups	(Combined)	1874.322	5	374.864	4.733	.000
	Within Groups		16079.291	203	79.208		
	Total		17953.613	208			
MOBILE * GDP	Between Groups	(Combined)	945.551	5	189.110	2.427	.037
	Within Groups		15818.125	203	77.922		
	Total		16763.677	208			
PCS * GDP	Between Groups	(Combined)	12708.690	5	2541.738	24.585	.000
	Within Groups		20987.027	203	103.384		
	Total		33695.717	208			
INTERNET * GDP	Between Groups	(Combined)	14834.269	5	2966.854	27.621	.000
	Within		21805.156	203	107.415		

	Groups						
	Total		36639.426	208			
Broadband * GDP	Between Groups	(Combined)	571.146	5	114.229	5.607	.000
	Within Groups		4135.617	203	20.372		
	Total		4706.762	208			

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
FIXED * SETTLM	Between Groups	(Combined)	1785.409	5	357.082	4.483	.001
	Within Groups		16168.204	203	79.646		
	Total		17953.613	208			
MOBILE * SETTLM	Between Groups	(Combined)	856.591	5	171.318	2.186	.057
	Within Groups		15907.086	203	78.360		
	Total		16763.677	208			
PCS * SETTLM	Between Groups	(Combined)	4399.589	5	879.918	6.097	.000
	Within Groups		29296.128	203	144.316		
	Total		33695.717	208			
INTERNET * SETTLM	Between Groups	(Combined)	4518.598	5	903.720	5.711	.000
	Within Groups		32120.827	203	158.231		
	Total		36639.426	208			
Broadband * SETTLM	Between Groups	(Combined)	288.494	5	57.699	2.651	.024
	Within Groups		4418.268	203	21.765		
	Total		4706.762	208			

ANOVA Table

			Sum of Squares	df	Mean Square	F	Sig.
FIXED * PENT27P2	Between Groups	(Combined)	939.518	1	939.518	11.431	.001
	Within Groups		17014.095	207	82.194		
	Total		17953.613	208			
MOBILE * PENT27P2	Between Groups	(Combined)	1803.539	1	1803.539	24.955	.000
	Within Groups		14960.138	207	72.271		
	Total		16763.677	208			
PCS * PENT27P2	Between Groups	(Combined)	1996.596	1	1996.596	13.038	.000
	Within Groups		31699.120	207	153.136		
	Total		33695.717	208			
INTERNET *	Between Groups	(Combined)	910.525	1	910.525	5.275	.023

PENT27P2	Within Groups		35728.901	207	172.603		
	Total		36639.426	208			
Broadband * PENT27P2	Between Groups	(Combined)	263.578	1	263.578	12.280	.001
	Within Groups		4443.185	207	21.465		
	Total		4706.762	208			

Annex 8 – Defining broadband

The current focus of governments in respect of ICT infrastructure, then, is broadband. There is, however, no single definition of broadband. The term broadband is generally used to refer to the ability of certain technologies to transmit data and pictures, which are 'bandwidth hungry', at high speed. Increasingly the term is used as a shorthand for high-speed 'always on' Internet access (OECD, 2002).

Broadband, or very high bandwidth networks, have been available to large companies and to large public sector organisations for a number of years. Such organisations have been able to lease lines from telecommunications providers to create their own 'private networks', for example, to link together multiple sites nationally or internationally. Latterly, large firms have leased capacity within the network of telecoms providers, rather than leasing dedicated lines, to create what are known as 'virtual private networks'. These types of products allow data transmission at speeds of between 2mbt/s and 155mbt/s and have generally been designed (and priced) with large organisations, with significant data transmission demands, in mind. Leased lines are also used by value added service providers such as Internet Service Providers (ISPs). Large firms are likely to continue to use leased lines for some time to come, as the newer technologies described below do not meet their capacity requirements or their security concerns (see OECD, 2002 – Broadband Access for SMEs). Leased lines are covered by the Universal Service Directive (USD), but only for a minimum set of services. National regulatory authorities are required to make separate assessments for each market of leased lines in the minimum set (established by Commission Directive), *taking into account their geographic dimension* (OJC, 2002; 108/51).

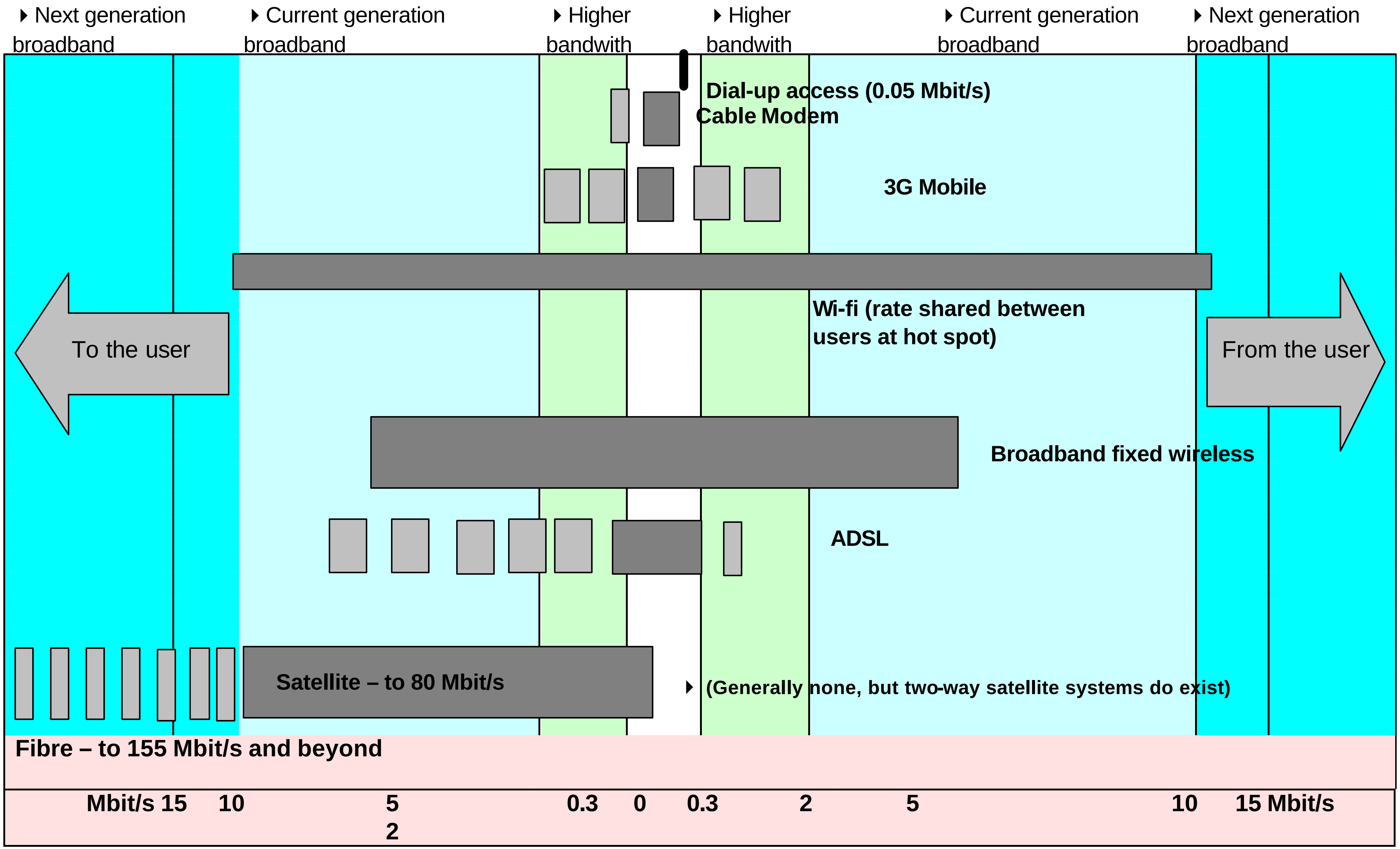
Leased lines are likely to remain beyond the financial reach of most small firms and domestic consumers, and they do not anyway satisfy their communications requirements which are for switched services. Recently, however, a number of 'broadband' products – notably ADSL and Cable Modem (see below) – have been designed with the aim of providing access to multi-media services and, in particular, improved access to the Internet for SMEs and consumers.

Amongst the technical community there is a debate about what the minimum speed requirements are above which a technology can be described as broadband. A distinction is made between higher bandwidth, current generation broadband and next generation broadband. Some of the technologies discussed in this section, for example ADSL, would be regarded by some as being 'higher bandwidth' (than traditional transmission technologies) rather than true broadband. Figure A8.1 illustrates the capability of existing technologies and the expectations for future technologies.[1]

Several European governments have set targets for broadband coverage, but, in the main, it is the lower rate technologies which they seek to push. The telecommunications providers also tend to use the term to encompass relatively low bandwidth technologies and it is these technologies which they are marketing. Indeed, there is an argument that telecommunications companies and governments, by not developing or supporting higher rate broadband, are going for 'easy wins'.

[1] For a fuller discussion of broadband see, for example, OECD (2001a) 'The development of broadband access in OECD countries"

Figure A8.1: Data rates for main broadband technologies



Source: Adapted from office of the e-Envoy (2001) 'UK online: the broadband future'

In this section we concentrate on the two forms of broadband technology which, to date, are the most commercially developed – Digital Subscriber Lines (DSL) and cable modem. The roll-out of these technologies is proceeding at a pace, though they still represent a relatively small share of total telecommunications infrastructure and services.

Digital Subscriber Lines (DSL) technology represents a way of delivering broadband services down a single twisted-pair copper telephone line that has been split down into two channels – one for voice use and one for data. The currently most popular form of DSL, and the one being pushed by incumbent telecoms operators in most European countries, is Asynchronous DSL (ADSL). ADSL provides maximum data transfer rates of approximately 250 kbt/s *upstream* (i.e., from the customers' premises) and approximately 500 kbt/s, 1 mbt/s or 2mbt/s *downstream* (the higher values tending to be restricted to business customers). ADSL is a 'contended' system: that is to say actual transmission rates are conditioned by the number of users at any one time, meaning that capacity can be 'overbooked'. This means that ADSL is not suitable for businesses which need to be sure that they can use the service as and when required or which need to transmit, as well as receive, significant amounts of data. These technical limitations mean that only a limited number of operations can be carried out by the consumer and ADSL should be seen as an entry level version of broadband. Some new entrants and incumbents are now starting to introduce Symmetrical DSL, which provides firms with the capacity to transmit data at high speed.

ADSL makes use of existing copper telephone wires. The upgrading of these wires to broadband capacity requires the installation of ADSL equipment in local telephone exchanges. There are number of technical, economic, and competition issues which constitute barriers to ADSL roll-out into certain territorial areas.

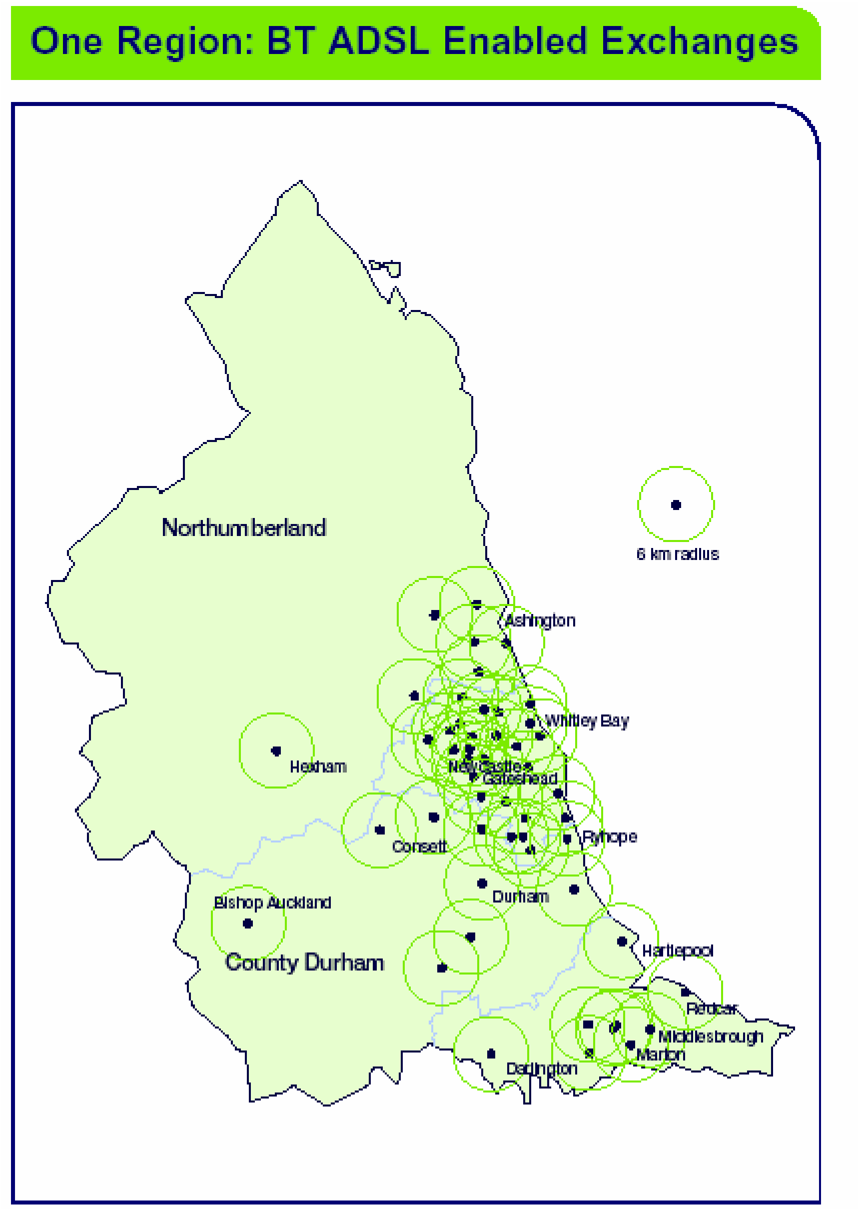
- One technical problem is that the system does not work over some non-copper wires so places with such networks will not easily be upgraded;

- Another technical problem is that the farther from an ADSL enabled exchange a consumer is the more degraded the service will be. In most countries an ADSL-enabled exchange covers a radius of 6 km.

- ADSL availability depends on individual exchanges being upgraded. The costs of upgrading are significant and telecoms companies have been unwilling to do so unless they perceive there to be sufficient demand from customers in the exchange area. This, in turn, will depend on the volume of potential domestic and business consumers, as evidenced by population density and socio-economic profiles: providers must decide whether there are enough sufficiently prosperous customers to make it pay. Thus, on a simple cost model, major cities are most likely to be upgraded first with rural areas bringing up the rear. It is possible that it will never be commercially viable to upgrade some exchanges. Work by the UK Broadband Stakeholder Group, for example, suggests that there will be some places where it will never be commercially viable for broadband investment, particularly for the technologies considered here (see 4.12, later in this chapter). A similar point has been made by the Swedish government. In this view it is not merely a question of a time lag, but of broadband failing to penetrate these areas at all.

- These points are illustrated graphically in figure A8.2. The figure shows a map of ADSL enabled exchanges in one European region – the north-east of England. The nodes represent enabled exchanges. These exchanges are mainly located in the urban cores of the region and in business development corridors along the main road trunk route. The circle around the nodes represents the area within which the ADSL service can be received. Beyond that distance the service is likely to be either non-existent or degraded. Interviews with BT, the incumbent fixed telecoms provider in the region reveal that it has no plans to rollout beyond selected exchanges unless requisite levels of demand can be shown to exist, at least without some form of subsidy.

Figure A8.2: ADSL roll-out in North East England



Source: One North East (2003)

- Another factor which might have an impact on the willingness of a telecoms provider to upgrade a particular exchange is whether or not competition is present in that exchange area. Where cable operators are present the incumbent fixed telephony provider is likely to be concerned about losing both existing voice customers and potential new Internet customers and might, therefore, upgrade the exchange. Although the geography of cable varies between countries, cable tends to be a technology used in urban areas (see 1.2.2 SIR figure 4.17). Therefore, competition is most likely to be present in urban areas, stimulating incumbents to respond to the threat. Competition may be enhanced by opening up the local loop through local loop unbundling and through forcing incumbents to offer wholesale ADSL products to competitors at affordable rates. Regulation is in place to support these moves, but many incumbents have been criticised for dragging their feet. And, of course, competitors are most likely to target the most profitable (i.e., urban) exchanges.

Cable modem. Cable technology is now a relatively mature way of delivering television services, but there is huge variation in rates of penetration between European countries (see figure 16 in ESPON 1.2.2 FIR). Modern cable technology also offers the capacity to deliver telephone services and cable operators now tend to offer a package of services which include both television services (an alternative to satellite and traditional terrestrial delivery mechanisms) and telephone services. They are increasingly offering broadband access to the Internet as part of that package. Cable broadband services utilise the cable television co-axial cable to provide 'always on' connection to the Internet. The customer's computer is connected via a network interface card or USB to a 'cable modem' which is connected to the co-axial cable and thus to the nearest fibre optic network point.

Cable broadband internet services operate at maximum speeds of 512 kbt/s into the subscribers premises and 128 kbt/s out of the subscribers premises. Thus, like ADSL they are asymmetric. Also like ADSL, services are contended and actual speeds of service depend on numbers of local subscribers using the service at any one time. Thus, cable modem broadband suffers from similar bandwidth limitations to ADSL. The experience in several countries suggests that cable providers tend to target urban areas in order to reach a large number of customers in a short time and at minimum cost.

A key policy issue which emerges from the above description is that the key broadband technologies which are currently being rolled-out by the most powerful commercial providers are most likely to be available in high density areas and potentially ignore rural and remote areas. In the next section, after considering differences between take up between European countries, we explore whether the empirical evidence supports this hypothesis.

Annex 9 – Tables of broadband roll-out and strategy focus

Table A9.1 – The territorialities of DSL network deployment across Europe

Country	**Incumbent DSL roll-out**	**Competitor DSL roll-out**	**Comments**
Austria (AT)	State capitals, followed by rest of country – now at 75% of households covered	Focus on main cities only – Wien, Graz, Linz, Klagenfurt	Cable modem networks have driven broadband penetration
Belgium (BE)	Main urban areas, followed by rest of country – now at 98% of households covered		Cable modem networks have offered competition to DSL offers
Bulgaria (BG)			DSL not yet available
Switzerland (CH)	Zurich and Geneva, then other cities, followed by rest of country – now at 85% of households covered		LLU only initiated in April 2003. Cable modems far more used than DSL connections
Cyprus (CY)	Incipient DSL roll-out by incumbent which still held monopoly at end of 2002		
Czech Republic (CZ)	Prague, Brno and Ostrava, with limited access in ten other cities – 12% of Central Offices covered	Incipient	DSL only introduced by incumbent in 2003
Germany (DE)	Ruhr cities, other major cities and business users, before residential users and rest of country – 90% of households, with the rest to be covered by satellite	Unbundled offers target the business market. HanseNet only in Hamburg. QSC in 46 cities to cover over 1 million businesses	Relatively limited broadband competition, but low DSL prices
Denmark (DK)	Odense, Alborg, Arhus and Copenhagen, then rest of country – 95% of households		Very high DSL competition penetration
Estonia (EE)	Tallinn first, then rest of country, for business and residential users – all cities covered		
Spain (ES)	Barcelona and Madrid, then other cities (not always the largest first), and rest of country – 83% of lines enabled	Jazztel in Madrid first, then 42 Central Offices, aimed at SMEs Colt network between Madrid, Barcelona and Valencia	LLU restricted, so competitive DSL offers via incumbent wholesale services

Finland (FI)	Major cities and regions with business and residential users at same time, but different coverages – southern and western regions and Aland virtually fully covered	Focus on major cities, with Helsinki first and others after	Importance of historical structure of telecoms sector (local municipal operators as well as Sonera)
France (FR)	Trials in medium-sized cities and peripheral Paris, before Paris first, and other large city regions (particularly in north) – 74% of population covered	Paris region and business users targeted first	Relatively uncompetitive market dominated by incumbent
Greece (GR)	Pilot in Athens and Salonika		Slow development
Hungary (HU)	Budapest, then 10 other cities over a year later		
Ireland (IE)	Trials in Ennis and Dublin, followed by roll-out in Dublin, Cork, Kerry, Limerick, Galway and NW – 70 exchanges enabled now	Esat BT with unbundled access to Limerick exchange	One of last European countries to have broadband access
Italy (IT)	Relatively well distributed urban area roll-out – over 30 cities initially, then rest of country – 80% of population covered	Metropolitan areas	Limited cable network and strong incumbent. LLU trials in Rome, Milan and Turin
Lithuania (LT)	Vilnius first, then 4 next major cities, and 34 additional regional centres		
Luxembourg (LU)	10 centres for residential and teleworking users		
Latvia (LV)	SMEs in Riga first, then other cities and residential users – 26 regions and 80% of telephone lines covered		
Malta (MT)	Deployed by incumbent in a number of areas since 2000		
Netherlands (NL)	Main west coast metropolitan areas, followed by other cities – 85% of population covered	'Certain regions are expected to be omitted for economic reasons'	Cable ahead of DSL. Possible 'technical limitations and competitive disadvantages' for DSL

Norway (NO)	Trial of business users in central Oslo, before Oslo, Tromso and Baerum covered, and all main municipalities – now 65% of population covered	SME users in municipalities (Catch) – Oslo, Bodo and Tronso, then expanding gradually to more than 80 places NextGenTel – Bergen before other cities	
Poland (PL)	Warsaw covered first, then 6 other major cities		DSL only recently launched
Portugal (PT)	Lisbon and Porto, and parts of other cities, then other municipalities – now 50% of country covered		Dominant incumbent (also cable provider). DSL only recently promoted
Romania (RO)	Incipient DSL roll-out by incumbent, with unbundling yet to start		
Sweden (SE)	Trial in Stockholm and Gothenburg, then other cities, and rest of country – now 80% of population covered		90% of population live within 3 km of digital switch, so few technical DSL problems. Fibre LAN as well as cable competes with DSL.
Slovenia (SI)	First rolled out in Llubjana, Maribor, followed by major cities	Medinet – business access in Llubjana and Maribor	Slovenia has one of highest broadband take up rates in EUCC. Incumbent offers 'reasonable price' ADSL and there is competition from cable (see ITU figs)
Slovakia (SK)	Centre of Bratislava, Kosice (the second city) and Banska Bystrica (one of the third tier cities). The next stage of planned roll-out is other regional capitals		ADSL only introduced 1st June 2003
United Kingdom (UK)	London exchanges, then other large cities, medium-sized English cities, then Wales, N Ireland and Scotland, and rest of country – now 63% of households covered	Easynet – trial in Leeds and Edinburgh, then other major cities for business users Freeserve – Manchester and London Kingston – Hull	Slow uptake in residential broadband

Source: CURDS; drawn from Point Topic (2003), and supplemented by national studies by 1.2.2 partners

Table A9.2 – A summary of national broadband territorialities and strategies

AUSTRIA (AT)
DSL availability figures end 2003 (OECD) – 80% lines
Households passed by cable modem networks 2003 (OECD) – 38%
Degree of competition in providers and in technologies – Incumbent-led broadband roll-out.
Territorial issues / observations – Incumbent continuing to upgrade exchanges in Lower Austria, but prohibitive costs for sparsely populated areas ? incumbent wireless LAN broadband offer.
National policy issues / observations / response – Temporary fiscal subsidy initiated in June 2003 for residential broadband connections until end of 2004. National broadband strategy emphasises need to stimulate demand. Niederosterreich tendering for subsidised extension of broadband infrastructure.

BELGIUM (BE)
DSL availability figures end 2003 (OECD) – 98% lines
Households passed by cable modem networks 2003 (OECD) – 80%
Degree of competition in providers and in technologies – Strong competition between DSL and cable platforms ? high availability.
Territorial issues / observations – Few under-served areas, as municipalities have introduced cable networks if no private network was available.
National policy issues / observations / response – Competition between platforms and between providers as main thrust to government's broadband strategy. National strategy complemented by strategy for Flanders, Wallonia and Bruxelles?

BULGARIA (BG)
DSL availability figures end 2003 (OECD) – Unavailable
Households passed by cable modem networks 2003 (OECD) –
Degree of competition in providers and in technologies – Incipient
Territorial issues / observations – No DSL offers yet
National policy issues / observations / response –

SWITZERLAND (CH)
DSL availability figures end 2003 (OECD) – 95% lines
Households passed by cable modem networks 2003 (OECD) – 76%
Degree of competition in providers and in technologies –
Territorial issues / observations – Incumbent DSL roll-out started in largest cities, but expanded rapidly to almost whole country.
National policy issues / observations / response –

CYPRUS (CY)
DSL availability figures end 2003 (OECD) –
Households passed by cable modem networks 2003 (OECD) –
Degree of competition in providers and in technologies – Still fixed and mobile market monopoly.
Territorial issues / observations –
National policy issues / observations / response – Relatively low Internet take-up, but incumbent DSL offer becoming popular?

CZECH REPUBLIC (CZ)

DSL availability figures end 2003 (OECD) – 44%

Households passed by cable modem networks 2003 (OECD) – 9%

Degree of competition in providers and in technologies – Developing competition between both providers and technologies.

Territorial issues / observations – Incumbent wi-fi hotspots only in urban areas.
Residential satellite broadband offer from alternative operator since April 2003 for areas beyond DSL coverage.
Multiple FWA providers, particularly for SME market in urban areas.

National policy issues / observations / response –

GERMANY (DE)

DSL availability figures end 2003 (OECD) – 85% lines

Households passed by cable modem networks 2003 (OECD) – 10%

Degree of competition in providers and in technologies – Very concentrated broadband market still highly dominated by incumbent.

Territorial issues / observations – Incumbent has satellite broadband offer for urban and rural areas not covered by its DSL offer.
Alternative wireless operators focus on particular urban areas.

National policy issues / observations / response – Broadband as part of the D21 initiative – the largest national PPP, aiming at fostering the information society.

DENMARK (DK)

DSL availability figures end 2003 (OECD) – 95% lines

Households passed by cable modem networks 2003 (OECD) – 47%

Degree of competition in providers and in technologies –

Territorial issues / observations – "The only country where fixed wireless broadband has a wider availability than DSL" ? high incumbent DSL coverage.
Alternative operator FWA services largely aimed at business market in urban areas.

National policy issues / observations / response – Leading EU broadband country – 12.7% penetration (CEC) in Jan 2004.
2001 government strategy – market-based infrastructure, demand-driven deployment, public sector as an 'IT locomotive'.

ESTONIA (EE)

DSL availability figures end 2003 (OECD) –

Households passed by cable modem networks 2003 (OECD) –

Degree of competition in providers and in technologies –

Territorial issues / observations –

National policy issues / observations / response – High proportion of DSL lines per inhabitant among EUCCs (almost 7% of fixed lines have DSL connections).
The only EUCC where LLU was fully implemented by June 2003.

SPAIN (ES)

DSL availability figures end 2003 (OECD) – 92% lines

Households passed by cable modem networks 2003 (OECD) – 40%

Degree of competition in providers and in technologies – Wireless technologies being deployed in rural areas.

Territorial issues / observations – Poor rural broadband access ? wireless broadband trials for communities in rural areas.
Wi-fi networks providing broadband access to smaller regional cities.

National policy issues / observations / response – No universal access to dial-up Internet in rural areas ? low capacity TRAC wireless service. Government policy trying to promote universal dial-up access by end of 2004.
Broadband Strategy focuses on coverage of rural and less favoured areas, with aim of overall 10% penetration by end 2005.
Public long-term loans offered to operators for infrastructure deployment in certain areas.

FINLAND (FI)
DSL availability figures end 2003 (OECD) – 85% lines
Households passed by cable modem networks 2003 (OECD) – 25%
Degree of competition in providers and in technologies – Good level of competition between providers.
Territorial issues / observations – Broadband available to at least the centres of all municipalities. Increasing substitution of cellular services for PSTN ? driving local exchange carriers to upgrade smaller exchanges. Energy companies expanding into wireless telecoms services in regional cities.
National policy issues / observations / response – Broadband access to be available for all citizens by 2005 using technologically neutral means. One of key features of national broadband market is the "shared access model" where owners of apartment buildings purchase broadband connections and then share them among users in that building via a LAN. This model, originally introduced by small ISPs for DSL provision, is now followed also by incumbents ? high competition and low prices. Regional councils and municipalities to develop and implement their own broadband strategies.

FRANCE (FR)
DSL availability figures end 2003 (OECD) – 79% pop
Households passed by cable modem networks 2003 (OECD) – 25%
Degree of competition in providers and in technologies – Incumbent-led broadband roll-out. Emerging uses of alternative technologies in rural areas.
Territorial issues / observations – Threshold level of 100 for incumbent to upgrade exchanges in local areas. Incumbent has also launched satellite and wi-fi services in rural areas. Recent policy changes ? forced incumbent to roll-out broadband services in rural areas more than it would otherwise have done?
National policy issues / observations / response – Local and regional authorities to help evaluate (and aggregate?) broadband demand. Government encouraging private sector lead on infrastructure provision in rural areas, but also making loans to municipalities for broadband development and encouraging use of electricity networks for fibre roll-out. Amended law now allows local authorities to be operators provided there is no private alternative. Tax breaks offered for companies purchasing satellite receivers, and free wi-fi licenses to be offered up to 2006.

GREECE (GR)
DSL availability figures end 2003 (OECD) – Launched Jul 2003
Households passed by cable modem networks 2003 (OECD) – 0%
Degree of competition in providers and in technologies – New entrants beginning though to dominate DSL market.
Territorial issues / observations – Incumbent DSL services launched initially in Athens and Thessalonica. Will be extended to focus on other larger cities and business users.
National policy issues / observations / response – Broadband task force established. €200 million will be invested through PPPs (60% public money) to build LANs in under-served areas. 75% of public funding will come from Structural Funds. All cities of over 10,000 inhabitants to be connected to fibre-optic network by end 2006, with MANs in 50 larger cities by end 2005. SMEs can also receive funding for initial installation and service costs of wireless hotspots via DSL and satellite.

HUNGARY (HU)
DSL availability figures end 2003 (OECD) – 45% lines
Households passed by cable modem networks 2003 (OECD) – Launched Nov 2000
Degree of competition in providers and in technologies –
Territorial issues / observations – Incumbent DSL strategy to serve areas of high population first and then less populated areas. This has aim to protect its fixed line business in areas where competitors are present. Alternative wireless services offered in urban areas without DSL.
National policy issues / observations / response –

IRELAND (IE)
DSL availability figures end 2003 (OECD) – 62% lines
Households passed by cable modem networks 2003 (OECD) – 4%
Degree of competition in providers and in technologies – Competition from wireless infrastructures in urban areas. Technology competition stronger than provider competition?
Territorial issues / observations – Incumbent introduced small town trigger of between 200-700 for DSL upgrade. Wireless services make up significant proportion of broadband connections in Dublin and Cork due to slow DSL expansion (was above number of DSL customers according to CEC). South West Regional Authority have innovative rural broadband project involving European Space Agency, with local wireless access and satellite backhaul. Aimed at both residents and SMEs with lower costs than standard DSL in urban areas?
National policy issues / observations / response – Major national broadband strategy with construction of nationwide infrastructure covering 88 towns, largely funded by government but also co-funded by ERDF money (€200 million in total). Controversial national tax on major telecoms firms ? funding school, library and community centre broadband connections.

ITALY (IT)
DSL availability figures end 2003 (OECD) – 80% lines
Households passed by cable modem networks 2003 (OECD) – 9%
Degree of competition in providers and in technologies –
Territorial issues / observations – Advantage of high proportion of short distance local copper loops ? distance from exchanges less of a barrier. Wireless services have developed in urban, rural and mountain areas.
National policy issues / observations / response – Government Task Force identified backhaul access problem for rural and remote areas ? demand aggregation and public procurement. 5 year strategy for broadband development in Southern Italy co-ordinated by National Agency for Enterprise Development and Investments, with 60% of cost covered by public sector.

LITHUANIA (LT)
DSL availability figures end 2003 (OECD) –
Households passed by cable modem networks 2003 (OECD) –
Degree of competition in providers and in technologies –
Territorial issues / observations –
National policy issues / observations / response – Broadband penetration growing, but high Internet access costs.

LUXEMBOURG (LU)
DSL availability figures end 2003 (OECD) – 90% pop
Households passed by cable modem networks 2003 (OECD) – 38%
Degree of competition in providers and in technologies –
Territorial issues / observations – All exchanges upgraded. Satellite and UMTS to extend connectivity to 6-8% of households without broadband access, including use of structural funds?
National policy issues / observations / response – Affordable broadband to 95% of population by 2005.

LATVIA (LV)
DSL availability figures end 2003 (OECD) – 1.4% lines
Households passed by cable modem networks 2003 (OECD) –
Degree of competition in providers and in technologies –
Territorial issues / observations –
National policy issues / observations / response – Broadband relatively developed for EUCCs, but high Internet access costs.

MALTA (MT)
DSL availability figures end 2003 (OECD) –
Households passed by cable modem networks 2003 (OECD) –
Degree of competition in providers and in technologies – Incumbent-led broadband roll-out.
Territorial issues / observations – DSL introduced by incumbent in 2000 and has been widely deployed (5% household penetration).
National policy issues / observations / response –

NETHERLANDS (NL)
DSL availability figures end 2003 (OECD) – 85% lines
Households passed by cable modem networks 2003 (OECD) – 79%
Degree of competition in providers and in technologies – Fierce competition between cable and DSL (and therefore between alternative providers and incumbent?).
Territorial issues / observations – Fierce competition between cable and DSL ? lower prices and higher speeds. Wireless services being rolled out in eastern and northern areas where DSL and cable are not readily available.
National policy issues / observations / response – Cable modem had twice as many subscribers as DSL, but the latter is catching up. Demand aggregation in under-served areas, with government encouraging cross-sector regional aggregation ? private operators have begun investing in rural areas.

NORWAY (NO)
DSL availability figures end 2003 (OECD) – 65% lines
Households passed by cable modem networks 2003 (OECD) – 28%
Degree of competition in providers and in technologies –
Territorial issues / observations – Majority of municipalities with very low or no broadband take-up. Evidence of enthusiastic take-up of residential and SME wireless services in rural areas when introduced. Broadband offered over power lines in western Norway.
National policy issues / observations / response – Some municipalities have become ISPs and have offered broadband services to all residents.

POLAND (PL)
DSL availability figures end 2003 (OECD) – 69% lines
Households passed by cable modem networks 2003 (OECD) – 11%
Degree of competition in providers and in technologies –
Territorial issues / observations – DSL coverage expanded from a small number of urban areas to more widespread territorial coverage. Wireless services so far largely restricted to largest cities.
National policy issues / observations / response – Objectives of National Broadband Strategy: building access infrastructure, extending coverage to rural areas and small towns, developing content and services, and ensuring the active role of Public Administration. PPPs seen as main source of funding for extending coverage in under-served areas.

PORTUGAL (PT)
DSL availability figures end 2003 (OECD) – 60.7% pop (2002)
Households passed by cable modem networks 2003 (OECD) – 60%
Degree of competition in providers and in technologies –
Territorial issues / observations –
National policy issues / observations / response – Government introduced National Broadband Initiative aiming for 50% residential and business take-up by 2005. Within this, deployment of Broadband Community Networks (new infrastructure, sharing investment with private sector, and using existing utility networks for broadband delivery) promotes access in rural and remote areas. Structural Funds also to be used for under-served areas – level of social cohesion and public demand aggregation will determine regional eligibility.

ROMANIA (RO)
DSL availability figures end 2003 (OECD) –
Households passed by cable modem networks 2003 (OECD) –
Degree of competition in providers and in technologies – Incipient
Territorial issues / observations – Incipient incumbent and competitive DSL services.
National policy issues / observations / response –

SWEDEN (SE)
DSL availability figures end 2003 (OECD) – 78% lines
Households passed by cable modem networks 2003 (OECD) – 23%
Degree of competition in providers and in technologies – Strong competition between operators (over dark fibre networks). Extensive network roll-out ? less need for wireless technologies?
Territorial issues / observations – 91% of households and 95% of companies located in areas connected by backbone network of incumbent subsidiary.
National policy issues / observations / response – Government IS policy, including promotion of residential and business broadband access, outlined and passed in 2000. Market-led approach, with public dark fibre networks open to all operators using national electricity infrastructure. Funding also for regional and local networks (private or public) in rural areas. Municipalities can apply for funding for national backbone links, as well as regional, local and access network construction / expansion.

SLOVENIA (SI)
DSL availability figures end 2003 (OECD) –
Households passed by cable modem networks 2003 (OECD) –
Degree of competition in providers and in technologies –
Territorial issues / observations – High Internet use among EUCCs. DSL developing quite rapidly, with comparatively cheap access.
National policy issues / observations / response –

SLOVAKIA (SK)
DSL availability figures end 2003 (OECD) – Launched in 2003
Households passed by cable modem networks 2003 (OECD) – Launched in 2003
Degree of competition in providers and in technologies – Incipient
Territorial issues / observations – Incipient DSL services
National policy issues / observations / response –

UNITED KINGDOM (UK)
DSL availability figures end 2003 (OECD) – 85% lines
Households passed by cable modem networks 2003 (OECD) – 45%
Degree of competition in providers and in technologies – Incumbent-led broadband roll-out, although increasing competition in providers and in technologies.
Territorial issues / observations – Technical limitations mean that 3% of households within exchange areas will not have DSL access. Incumbent 'trigger mechanism' for DSL coverage to be replaced by planned roll-out for remaining areas. Incumbent also using wireless infrastructure to reach other areas. Almost half of all wi-fi hotspots in Europe allegedly located in UK.
National policy issues / observations / response – 2001 government policy aimed to create most extensive and competitive broadband market in G7 by 2005, including access in rural and remote areas ? creation of Broadband Task Force and Rural Broadband Unit ? Broadband Aggregation Project and Regional Aggregation Bodies / DTI Broadband Fund ? RABBIT wireless and satellite pilots project.

Source: CURDS; drawn from OECD (2004); CEC (2004b); IBM (2003)

Annex 10 – Estimation Process of Telecommunication Indicators: Definition of the Models and Mapping

Introduction

The problems arising from the paucity of European-wide regional telecommunications data were partly resolved by estimating the missing data of some indicators. The methods used were:

a) Regression analysis relating the use and availability of telecommunications (Internet) to socio-economic data at Nuts 2 and 3 levels for the following indicators:
   - Proportion of households with Internet access;
   - Internet users per 1000 inhabitants;
   - Proportion of firms with access to Internet;
   - Proportion of firms with own website.

b) Principal Components Analysis of the four Internet indicators referred to above, allowing to estimate a new variable reflecting the use of Internet.

c) Analysis of intermediate consumption of telecommunications by sector and final consumption by families at Nuts 2 level using data from national input/output tables.

These methods were partly described in the Third Interim Report. Some initial results were presented. This final report summarises all the modelling work undertaken by the consortium and the positive results achieved.

In the following points a summary description of each method referred to above and the results achieved are presented.

Regression Analysis

The regression analysis is used to estimate quantitative functional relationships between dependent variables and independent explanatory variables. It is assumed that the observed values of dependent variables are generated by random distributions which are a function of other causal variables.

Due to the lack of regional telecommunications data this method was used to estimate the use and availability of telecommunications as a function of socio-economic data.

The regression analysis was undertaken at Nuts 2 and Nuts 3 levels for indicators reflecting the use of Internet. The indicators chosen were those for which data was available for the maximum number of regions at Nuts 0, 1 and 2 levels:

a) Proportion of households with Internet access;
b) Internet users per 1000 inhabitants;
c) Proportion of firms with access to Internet;
d) Proportion of firms with own website.

In the estimation process, the initial purpose was to use several socio-economic indicators as independent variables in order to get the most accurate possible results. However, the lack of socio-economic data for many of the countries under study at Nuts 2 and 3 levels reduced the number of possible socio-economic indicators to use as independent variables. Amongst the indicators available, GDP per capita alone was the best predictor whilst the other variables could not add significant information.

Multiple regression equation generally takes the following form:

$$y = b_1x_1 + b_2x_2 + ... + b_nx_n + c + e$$

Where:

y is the dependent variable

b's are the regression coefficients, reflecting how much does the dependent variable *y* changes when the independent changes 1 unit;

c is the intercept of the regression line with the y-axis, representing the value of the dependent *y* will be when all the independent variables are 0;

e is the error term reflected in the residuals.

Following the general form of the equation for the regression analysis, and taking into consideration the fact that GDP per capita was the best and only independent variable used, the equation can thus be expressed as follows:

$$y = bGDP/cap + c + e$$

However, the analysis of the data revealed that the form of regression equation which better fitted the data was the logarithmic transformation, which produced the most reliable estimations and in some cases higher percentages of explanation of the variance of the dependent variables. In addition, in order to increase the stability and significance of the coefficients, *dummy variables* were used. Dummy variables are independent variables which take the value of either 0 or 1.

The Dummy variables were used, on the one hand, to characterise the countries in which data at Nuts 2 level was available (Austria, Spain, Czech Rep and Hungary) and, on the other hand, to join the southern European countries in a particular group.

Hence, the equation is:

$$y = a + b \ln GDP/cap + cD_i + dD_s$$

Where:

y is the dependent variable (an indicator of telecommunications)

a is the constant

b is the regression coefficient of ln GDP/cap

D_i is a dummy variable reflecting the countries which have telecoms values at Nuts 2 level

c is the regression coefficient of D_i

D_S is a dummy variable reflecting the southern countries

d is the regression coefficient of D_s

Using this regression equation it is thus possible to estimate the values which the four telecommunications dependent variables take for almost all European Nuts 2 and Nuts 3 levels.

Proportion of households with Internet access

The regression equation is the following:

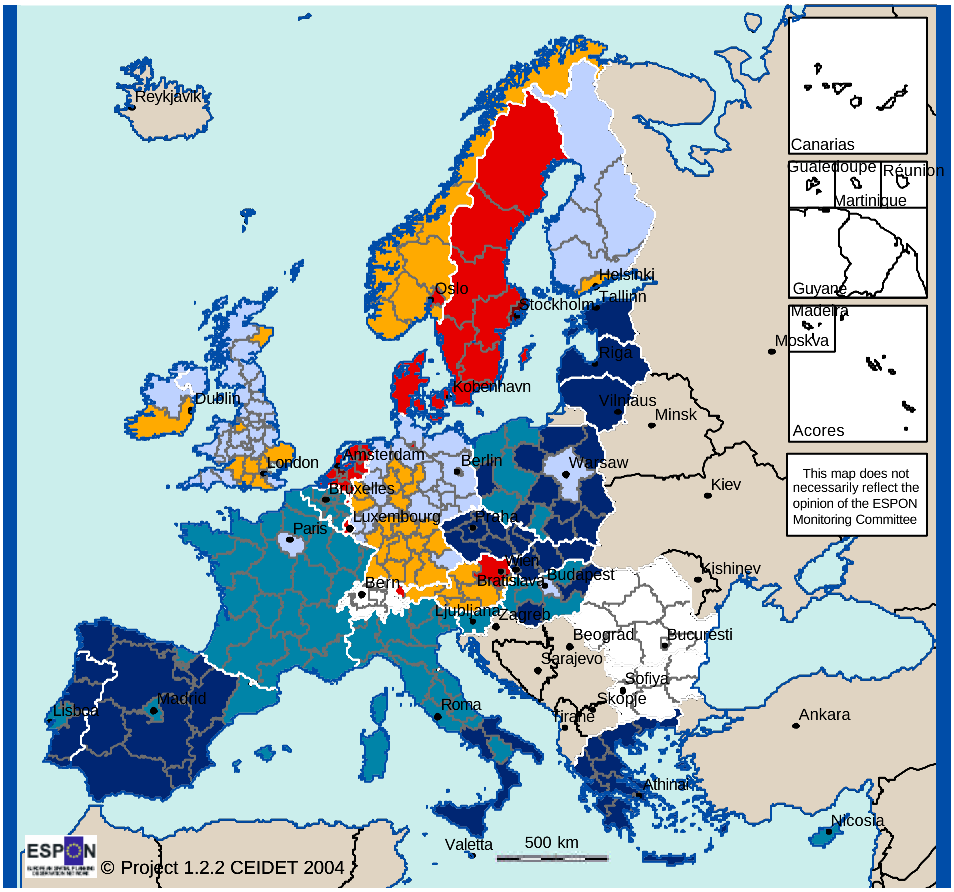
$$y = -151 + 19 \ln GDP/cap + 15D_{Aust} - 16D_{Sp} - 0.3D_{CR} + 16D_{Hun} - 8D_S$$

The equation explains 83% of the variance of the dependent variable (for all regressions it was used the *Adjusted R Square* which counts for sample size and number of independent variables) and shows a positive relationship between Proportion of households with Internet access and GDP/cap.

The next figure maps the estimated proportion of households with Internet access for most of the EU27+2 at Nuts 2 level.

It is worth mentioning that i) whenever there was data at Nuts 2 level, these were the values considered in the map rather than the estimated values and; ii) whenever there was information available at Nuts 0 or Nuts 1 levels the values estimated at Nuts 2 level were corrected in order to fit the condition that the sum of values of all Nuts 2 regions (U_r) should be equal to the value of the variable at Nuts 0 or Nuts 1 levels (U_N): ? $U_r = U_N$.

Proportion of households with Internet access at Nuts 2 level



Proportion of households with Internet access at Nuts 2 level 2003 (%)

- **More than 70**
- **55 to 69.99**
- **45 to 54.99**
- **35 to 44.99**
- **20 to 34.99**
- **Less than 20**
- **Data not available**

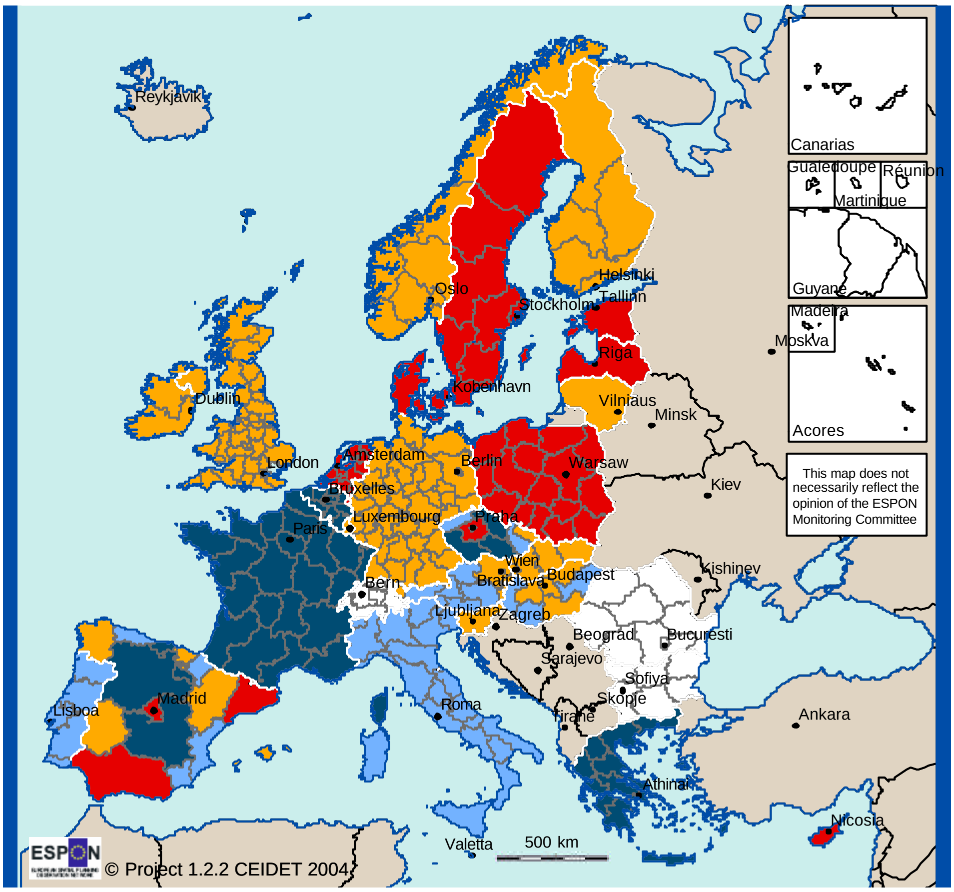
Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

In addition, it was also possible to determine for the cases in which data was available at Nuts 0, 1 or 2 levels the difference between the data presented in the previous map and the estimated one (i.e. without the real value or the correction procedure).

The following figure presents the ratio *estimated data / real data*, which represents the more or less access to Internet than it would be expected from its GDP/capita and location.

Proportion of households with Internet access at Nuts 2 level – Ratio Estimated data / real data



Proportion of households with Internet access at Nuts 2 level – Ratio Estimated data / real data 2003 (%)

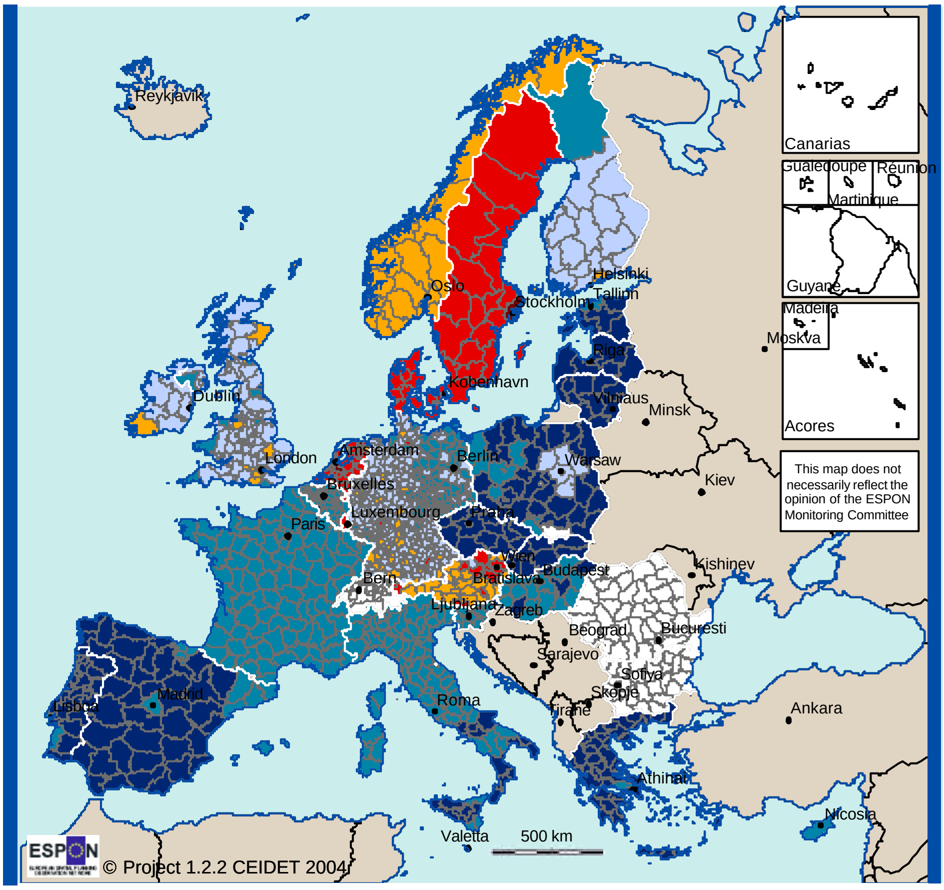
Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

- Data not available
- Uses more than estimated
- Uses a little more than estimated
- Uses a little less than estimated
- Uses less than estimated

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

The following step was to perform the same exercise for Nuts 3. The next figure shows the regional differences for most of the EU27+2 countries.

Proportion of households with Internet access at Nuts 3 level



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Proportion of households with Internet access at Nuts 3 level 2003 (%)

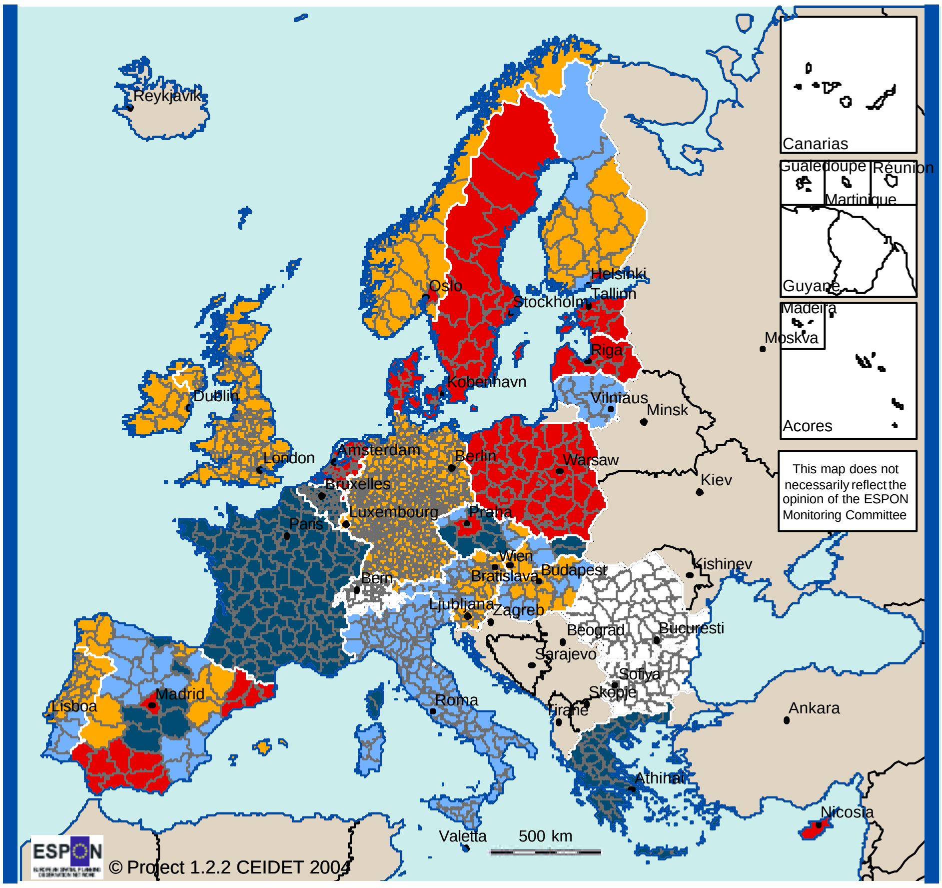
- **More than 70**
- **55 to 69.99**
- **45 to 54.99**
- **35 to 44.99**
- **20 to 34.99**
- **Less than 20**
- **Data not available**

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Once more the ratio estimated data / real data was determined, this time for Nuts 3 as illustrated in the next figure.

Proportion of households with Internet access at Nuts 3 level – Ratio Estimated data / real data



Proportion of households with Internet access at Nuts 3 level – Ratio Estimated data / real data 2003 (%)

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

- Data not available
- Uses more than estimated
- Uses a little more than estimated
- Uses a little less than estimated
- Uses less than estimated

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

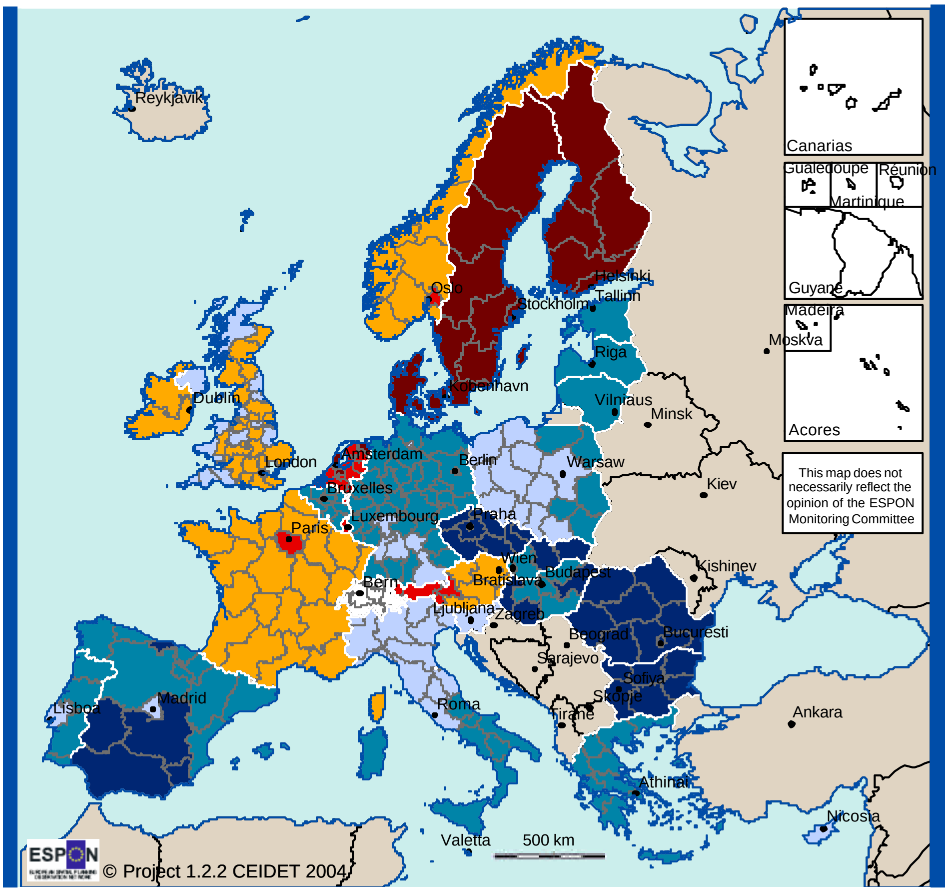
Internet users per 100 inhabitants

The regression equation, which explains 70% of the variance of the dependent variable, is the following:

$$y = -83 + 12 \ln GDP/cap + 1.3 D_{Aust} - 19 D_{Sp} - 12 D_{CR} - 5 D_{Hun} - 8 D_{S}$$

The sequence of the next four figures follows the same logic presented for the previous indicator: i) the first figure maps the estimated Internet users per 100 inhabitants for most of the EU27+2 at Nuts 2 level; ii) the second figure maps the ratio *estimated data / real data* for Nuts 2; iii) The following figure maps the estimated Internet users per 100 inhabitants for Nuts 2 and; iv) finally, the last figure maps the ratio *estimated data / real data* for Nuts 3.

Internet users per 100 inhabitants at Nuts 2 level



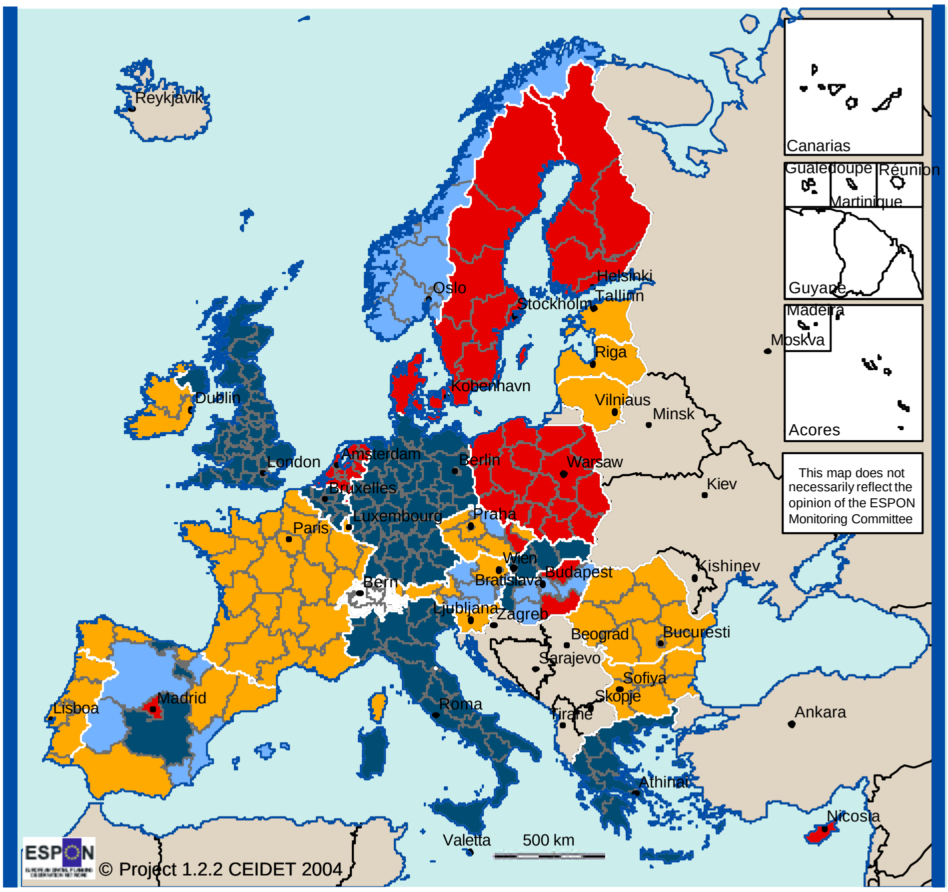
Internet users per 1000 inhabitants at Nuts 2 level 2003 (%)

- More than 60
- 45 to 59.99
- 35 to 44.99
- 25 to 34.99
- 15 to 24.99
- Less than 15
- Data not available

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Internet users per 100 inhabitants at Nuts 2 level – Ratio Estimated data / real data



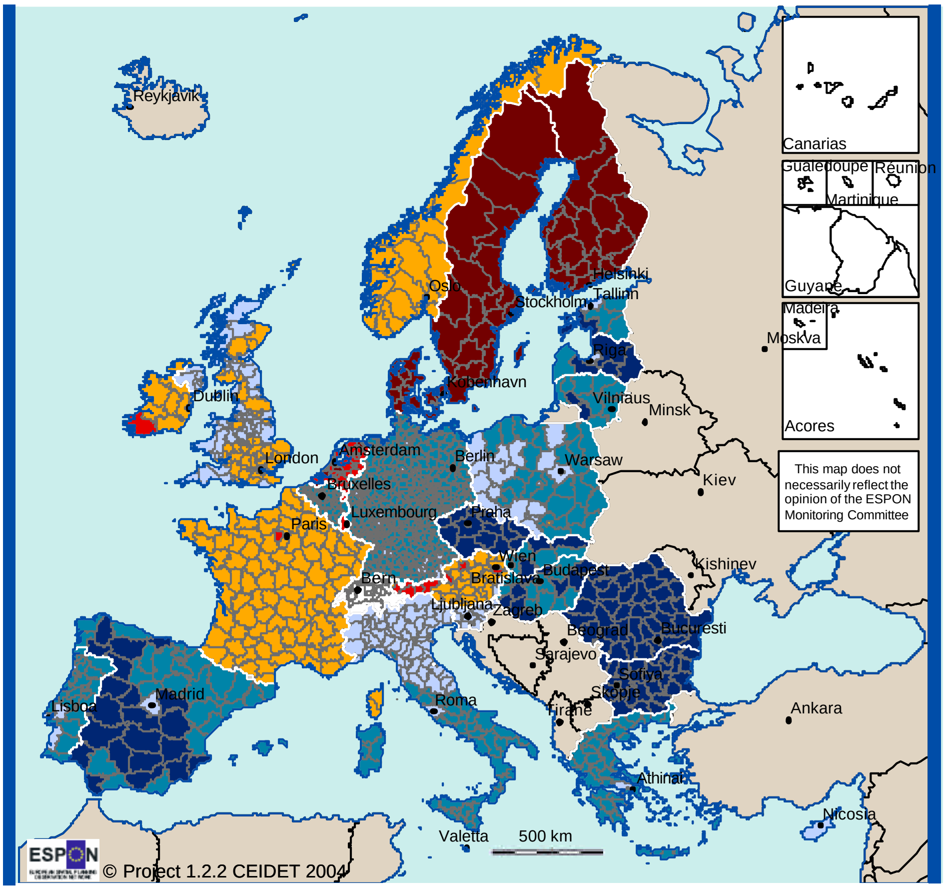
Internet users per 1000 inhabitants at Nuts 2 level – Ratio Estimated data / real data 2003 (%)

- **Data not available**
- **Uses more than estimated**
- **Uses a little more than estimated**
- **Uses a little less than estimated**
- **Uses less than estimated**

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Internet users per 100 inhabitants at Nuts 3 level



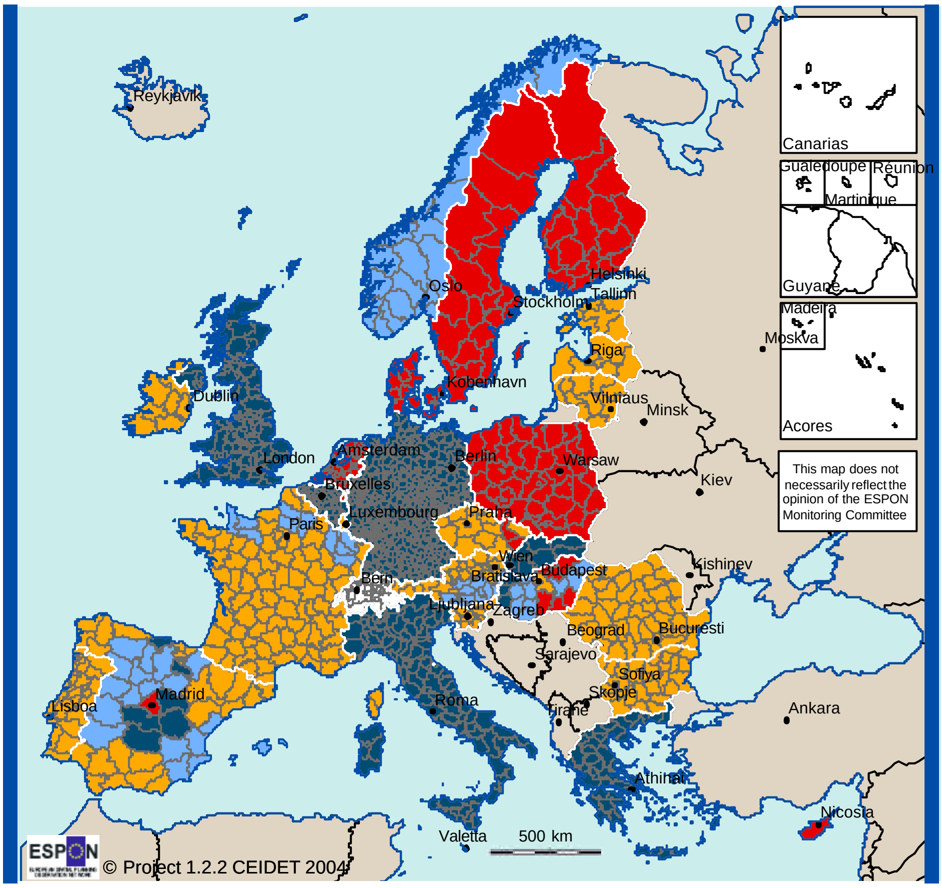
Internet users per 1000 inhabitants at Nuts 3 level 2003 (%)

- **More than 60**
- **45 to 59.99**
- **35 to 44.99**
- **25 to 34.99**
- **15 to 24.99**
- **Less than 15**
- **Data not available**

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Internet users per 100 inhabitants at Nuts 3 level – Ratio Estimated data / real data



Internet users per 1000 inhabitants at Nuts 3 level – Ratio Estimated data / real data 2003 (%)

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Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

- Data not available
- Uses more than estimated
- Uses a little more than estimated
- Uses a little less than estimated
- Uses less than estimated

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

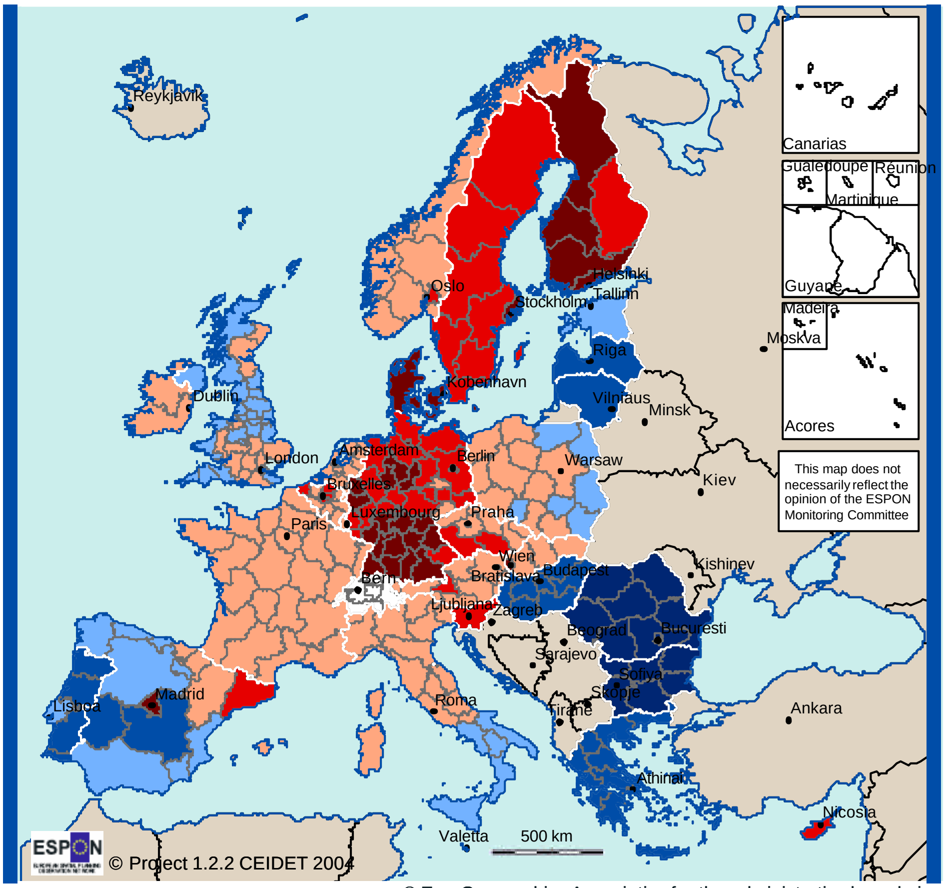
Proportion of firms with access to Internet

The regression equation, which explains 61% of the variance of the dependent variable, is the following:

$$y = -24 + 11 \ln GDP/cap + 0.2 D_{Aust} + 0.6 D_{Sp} + 16 D_{CR} - 13 D_{Hun} + 2 D_S$$

Again, the sequence of the next four figures follows the same logic presented for the first two indicators: i) the first figure maps the estimated proportion of firms with access to Internet for most of the EU27+2 at Nuts 2 level; ii) the second figure maps the ratio *estimated data / real data* for Nuts 2; iii) The following figure maps the estimated proportion of firms with access to Internet for Nuts 2 and; iv) finally, the last figure maps the ratio *estimated data / real data* for Nuts 3.

Proportion of firms with access to Internet at Nuts 2 level



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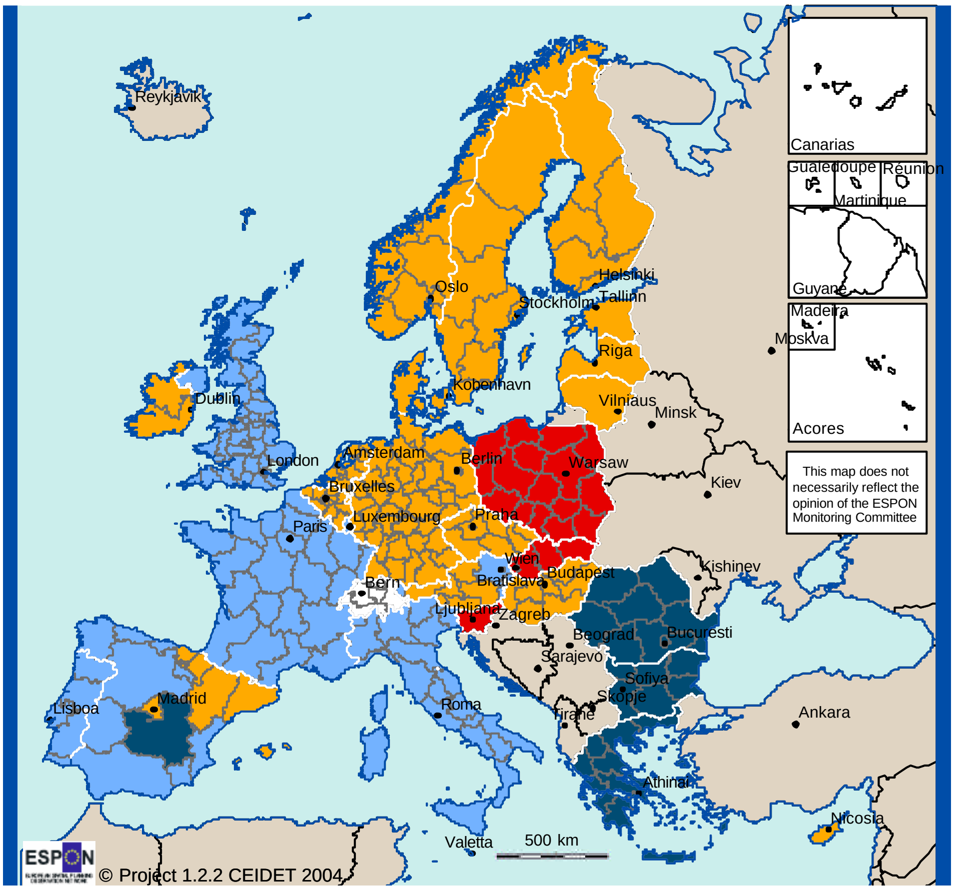
Proportion of firms with access to Internet at Nuts 2 level 2003 (%)

- More than 95
- 90 to 94.99
- 80 to 89.99
- 70 to 79.99
- 50 to 69.99
- Less than 50
- Data not available

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Proportion of firms with access to Internet at Nuts 2 level – Ratio Estimated data / real data



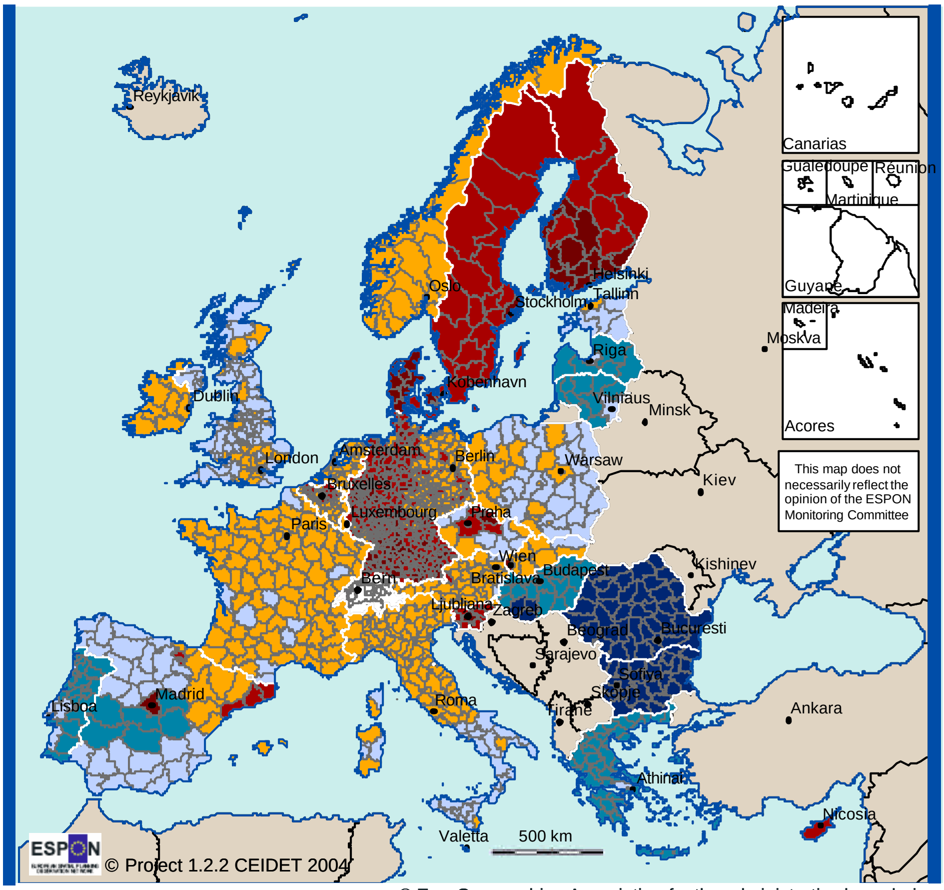
Proportion of firms with access to Internet at Nuts 2 level – Ratio Estimated data / real data 2003 (%)

- Data not available
- Uses more than estimated
- Uses a little more than estimated
- Uses a little less than estimated
- Uses less than estimated

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Proportion of firms with access to Internet at Nuts 3 level



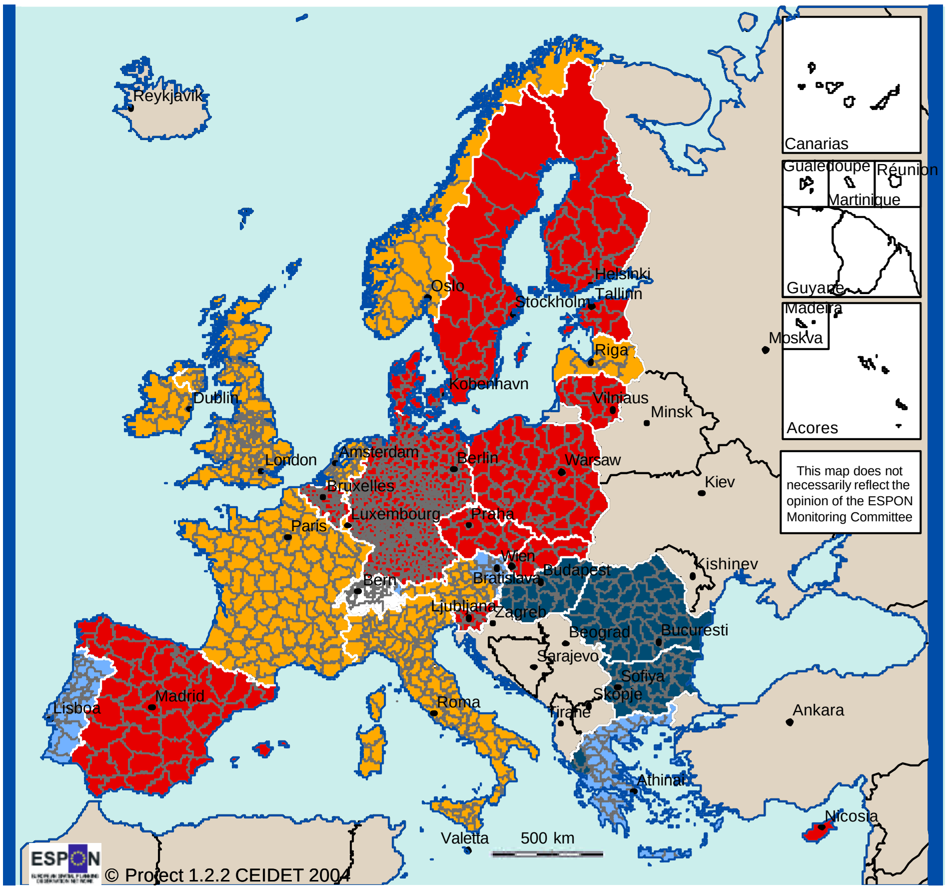
Proportion of firms with access to Internet at Nuts 3 level 2003 (%)

- More than 95
- 90 to 94.99
- 80 to 89.99
- 70 to 79.99
- 50 to 69.99
- Less than 50
- Data not available

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Proportion of firms with access to Internet at Nuts 3 level – Ratio Estimated data / real data



Proportion of firms with access to Internet at Nuts 3 level – Ratio Estimated data / real data 2003 (%)

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Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

- **Data not available**
- **Uses more than estimated**
- **Uses a little more than estimated**
- **Uses a little less than estimated**
- **Uses less than estimated**

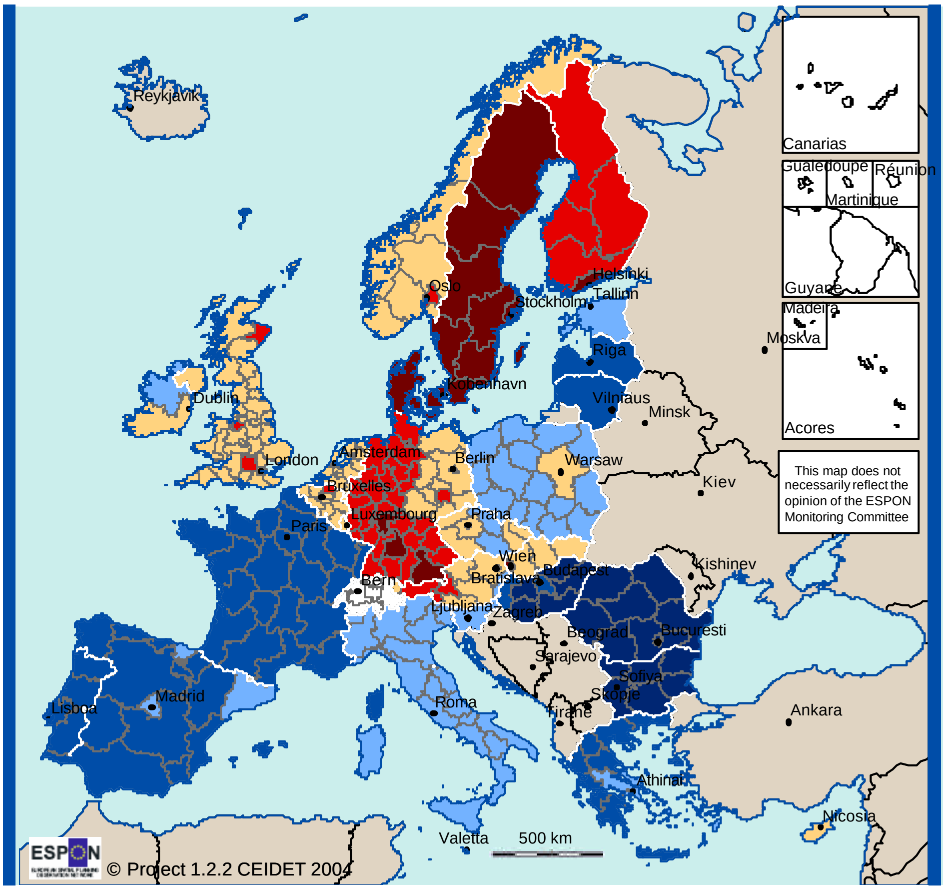
Proportion of firms with own website

The regression equation, which explains 73% of the variance of the dependent variable, is the following:

$$y = -87 + 15 \ln GDP/cap + D_{Aust} - 23 D_{Sp} + 20 D_{CR} - 18 D_{Hun} - 5 D_{S}$$

Again, the sequence of the next four figures follows the same logic presented for the previous indicators: i) the first figure maps the estimated proportion of firms with own website for most of the EU27+2 at Nuts 2 level; ii) the second figure maps the ratio *estimated data / real data* for Nuts 2; iii) The following figure maps the estimated proportion of firms with own website for Nuts 2 and; iv) finally, the last figure maps the ratio *estimated data / real data* for Nuts 3.

Proportion of firms with own website at Nuts 2 level



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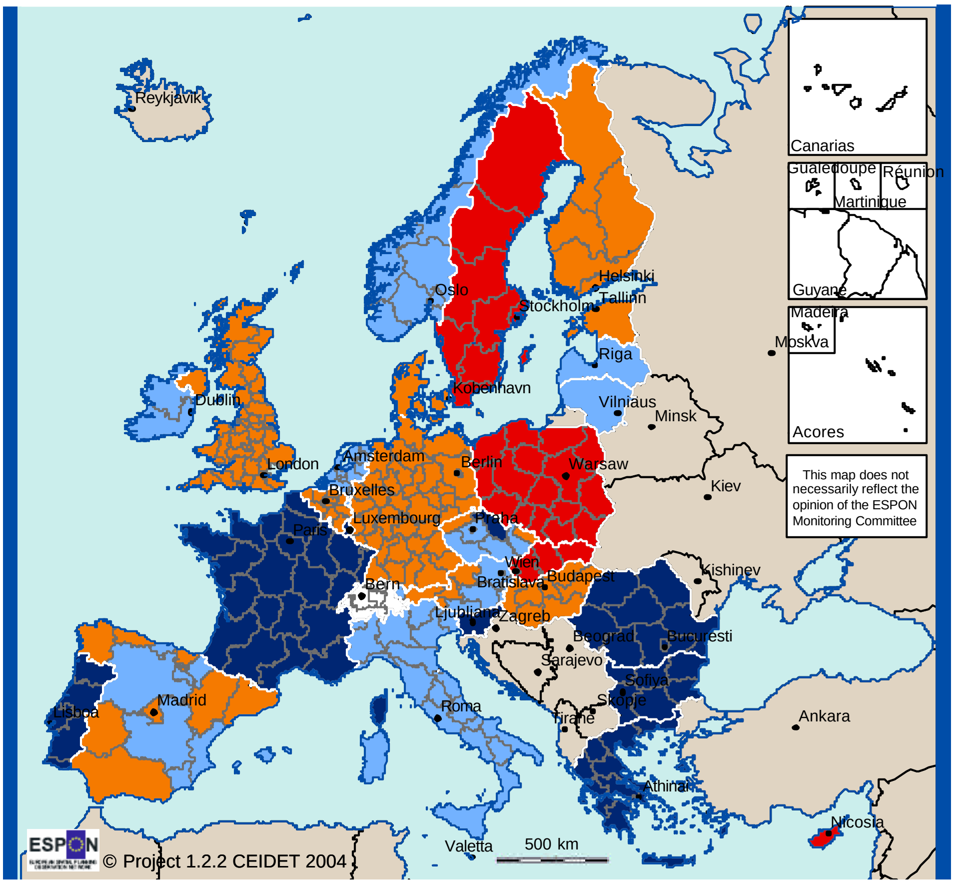
Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Proportion of firms with own website at Nuts 2 level 2003 (%)

- **More than 75**
- **65 to 77.99**
- **55 to 64.99**
- **35 to 54.99**
- **20 to 34.99**
- **Less than 20**
- **Data not available**

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Proportion of firms with own website at Nuts 2 level – Ratio Estimated data / real data



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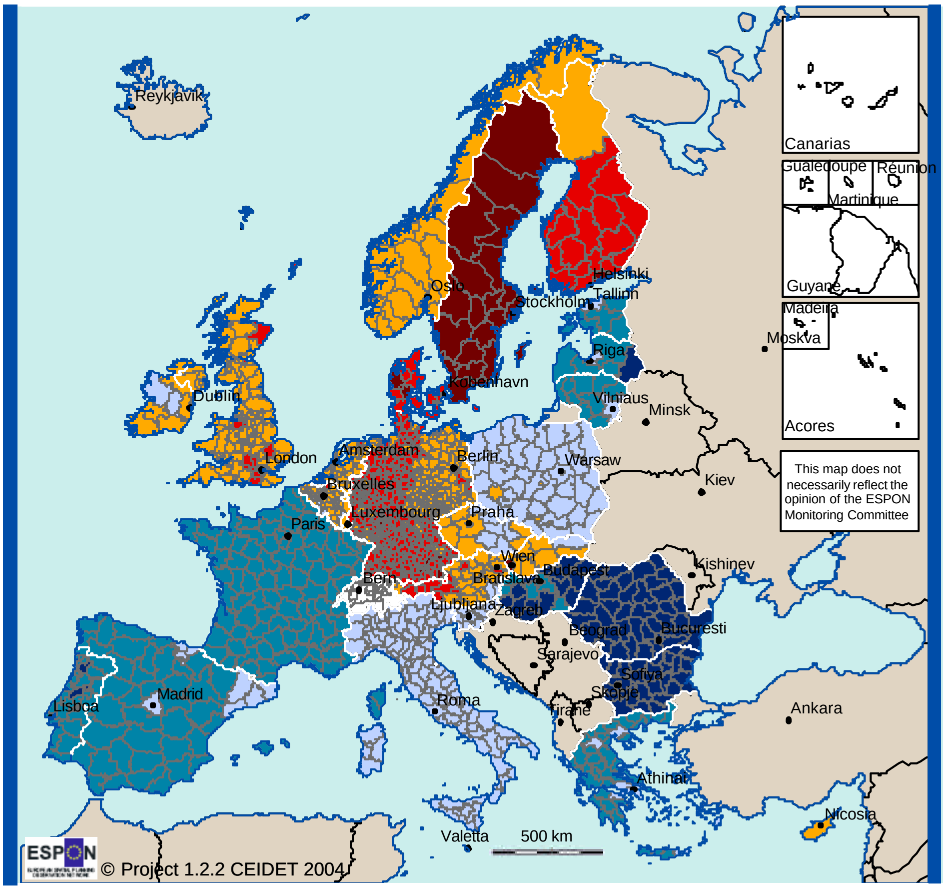
Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Proportion of firms with own website at Nuts 2 level – Ratio Estimated data / real data 2003 (%)

- **Data not available**
- **Uses more than estimated**
- **Uses a little more than estimated**
- **Uses a little less than estimated**
- **Uses less than estimated**

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Proportion of firms with own website at Nuts 3 level



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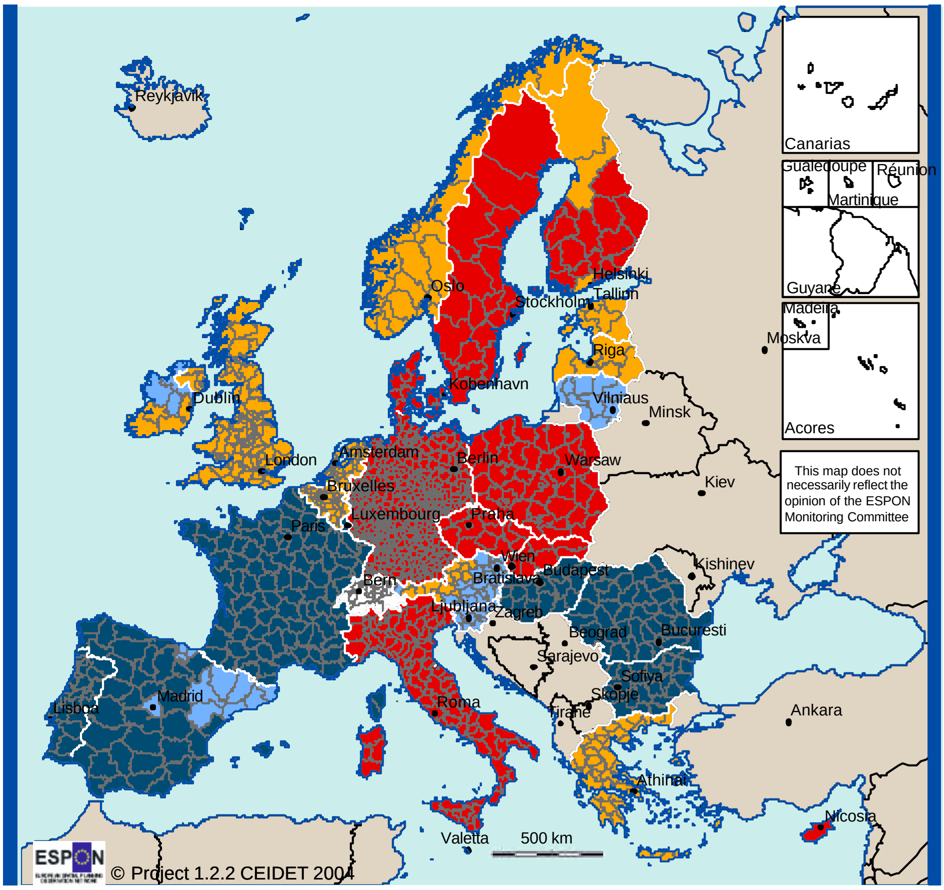
Proportion of firms with own website at Nuts 3 level 2003 (%)

- More than 75
- 65 to 74.99
- 55 to 64.99
- 35 to 54.99
- 20 to 34.99
- Less than 20
- Data not available

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Proportion of firms with own website at Nuts 3 level – Ratio Estimated data / real data



Proportion of firms with own website at Nuts 3 level – Ratio Estimated data / real data 2003 (%)

- Data not available
- Uses more than estimated
- Uses a little more than estimated
- Uses a little less than estimated
- Uses less than estimated

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

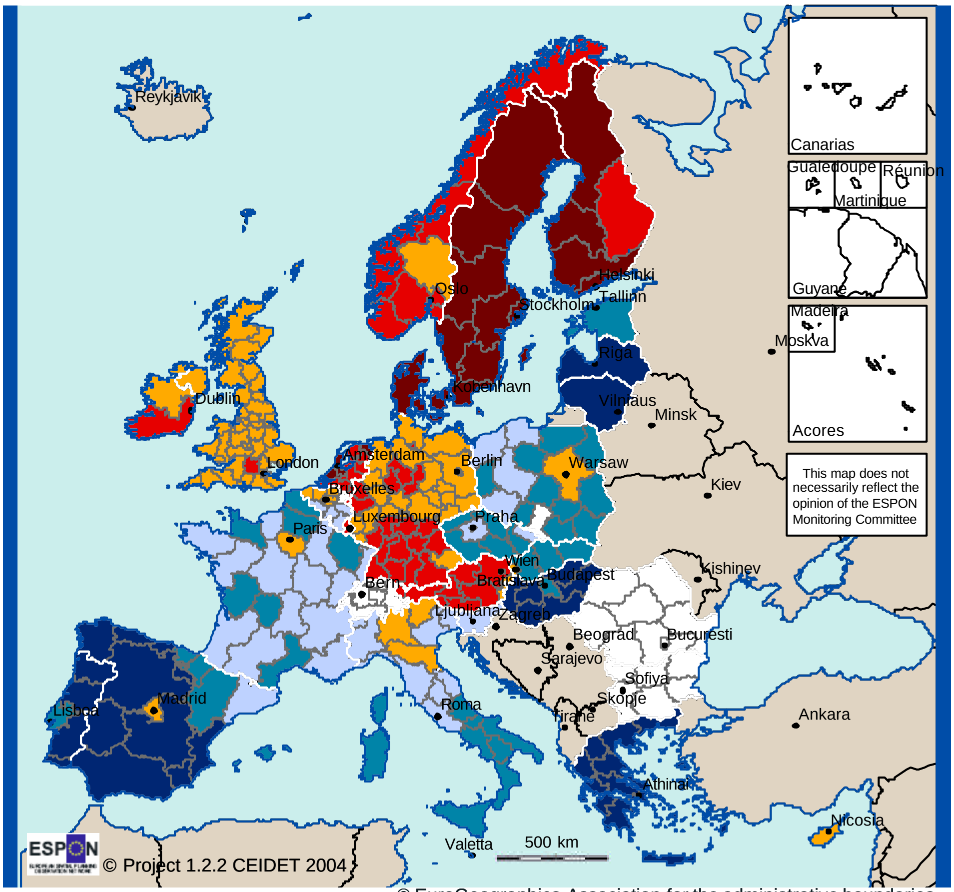
Source: Estimation based on da from Eurostat, eEurope+ and ESPON Data Base

Principal Components Analysis: definition of a new variable reflecting the use of Internet

In addition to the regression analysis, a new variable reflecting the *use of Internet* was estimated. This new variable is the outcome of a Principal Components Analysis of the four variables of telecommunications previously mentioned both at Nuts 2 and 3 levels, with a cumulative total variance explained of approximately 67% and 68%, respectively.

The next two figures map the estimations of this variable for Nuts 2 and 3 levels, in which it is possible to notice which are the regions reflecting a higher or lower use of Internet ("0" is the medium value).

Variable reflecting the Use of Internet at Nuts 2 level



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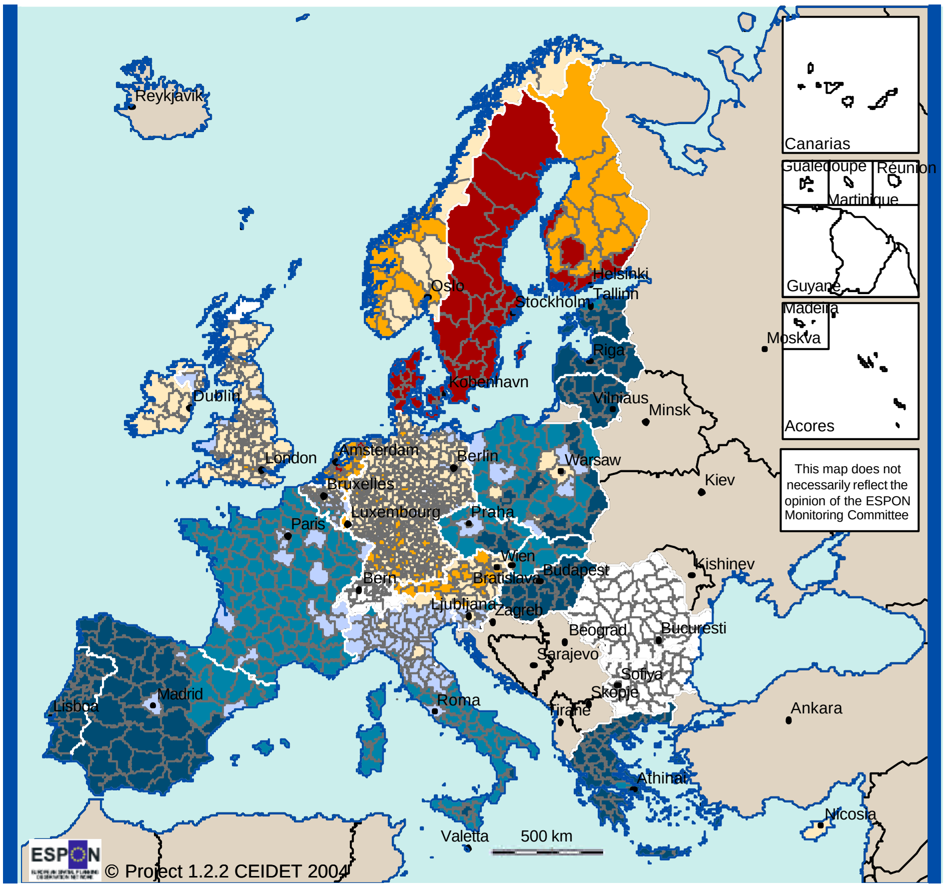
Variable reflecting the Use of Internet at Nuts 2 level 2003 (%)

- More than 4
- 2 to 3.99
- 0 to 1.99
- -1 to -0,01
- -2.5 to -0.99
- Less than -2.49
- Data not available

Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Variable reflecting the Use of Internet at Nuts 3 level



Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Variable reflecting the Use of Internet at Nuts 3 level 2003

- More than 4
- 2 to 3.99
- 0 to 1.99
- -1 to -0,01
- -2.5 to -0.99
- Less than -2.49
- Data not available

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Additional analysis using data from Input/Output tables

Data concerning the use of telecommunications provide key indicators to describe the telecommunications sector. The limitations arising from the paucity of data could be partly overcome by using the models previously mentioned. One additional indicator, which is perhaps one of the best indicators reflecting the willingness to pay for telecommunications services, is the consumption of telecommunications. This indicator is given by national Input/Output tables and provides information regarding intermediate consumption of telecommunications by sector and final consumption by families.

As data is available only at national level, it was assumed that:

i) The sectoral consumption patterns (consumption of telecommunications per unit of output) are the same in all regions and equal to the national average;

ii) The percentage of household consumption is the same in all regions and equal to the national average.

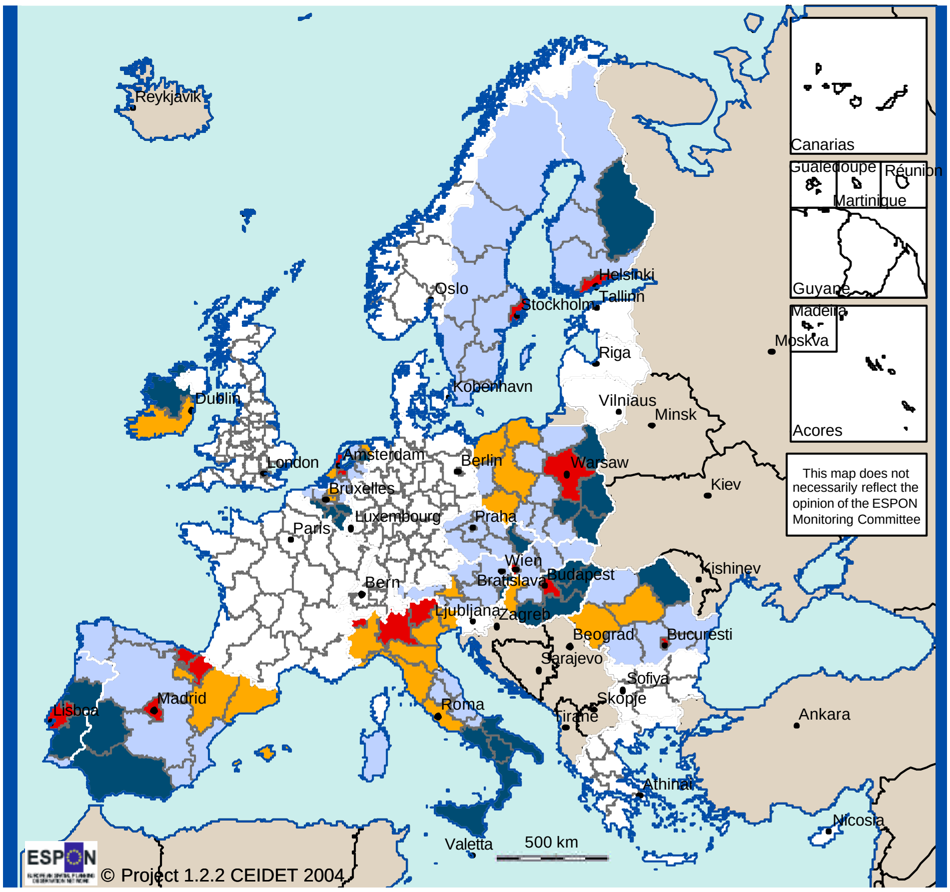
With these assumptions, the analysis showed that:

i) Differences in intermediate consumption reflect differences in sectoral composition of economies in different regions;

ii) Differences in household consumption depend on the level of regional income.

The next two figures map country by country the index numbers of total consumption of telecoms per capita and of intermediate consumption of telecoms per unit of value added. The results are presented at Nuts 2 level for the countries we could have access to Input/Output tables.

Index numbers of intermediate consumption of telecoms per unit of value added at Nuts 2 level



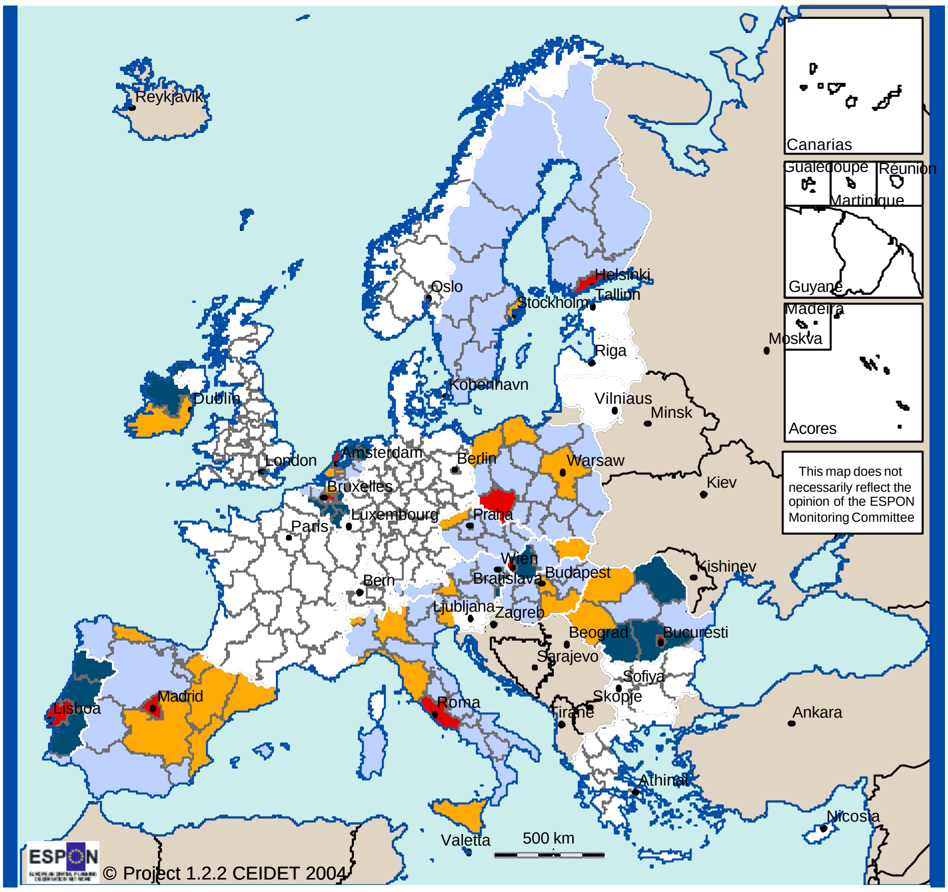
Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Index numbers of intermediate consumption of telecoms per unit of value added at Nuts 2 level 2003

- **More than 125**
- **100 to 124.99**
- **75 to 99,99**
- **Less than 74.99**
- **Data not available**

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Index numbers of total consumption of telecoms per capita at Nuts 2 level



Origin of data: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Index numbers of total consumption of telecoms per capita at Nuts 2 level2003

- **More than 110**
- **100 to 109.99**
- **90 to 99,99**
- **Less than 89.99**
- **Data not available**

Source: Estimation based on data from Eurostat, eEurope+ and ESPON Data Base

Full estimated values for e-commerce indicators from the modelling exercise

Country	Region	Proportion of firms with Internet access	Proportion of firms with their own website
BELGIUM	Admin. Arr. Brussel hoofdstad	99.00	73.40
BELGIUM	Antwerpen	93.38	65.05
BELGIUM	Limburg (B)	89.55	60.14
BELGIUM	Oost-Vlaanderen	89.90	60.59
BELGIUM	Vlaams Brabant	92.10	63.42
BELGIUM	West-Vlaanderen	90.48	61.33
BELGIUM	Brabant Wallon	91.06	62.08
BELGIUM	Hainaut	86.76	56.56
BELGIUM	Liège	88.39	58.65
BELGIUM	Luxembourg (B)	87.69	57.75
BELGIUM	Namur	87.46	57.46
DENMARK	Denmark	97.00	75.00
GERMANY	Stuttgart	98.20	75.49
GERMANY	Karlsruhe	97.36	74.31
GERMANY	Freiburg	95.31	71.44
GERMANY	Tubingen	95.79	72.11
GERMANY	Oberbayern	99.00	78.03
GERMANY	Niederbayern	94.35	70.08
GERMANY	Oberpfalz	95.55	71.77
GERMANY	Oberfranken	95.07	71.10
GERMANY	Mittelfranken	97.48	74.48
GERMANY	Unterfranken	95.07	71.10
GERMANY	Schwaben	95.55	71.77
GERMANY	Berlin	93.99	69.58
GERMANY	Brandenburg	90.25	64.34
GERMANY	Bremen	98.81	76.34
GERMANY	Hamburg	99.00	80.56
GERMANY	Darmstadt	99.00	77.18
GERMANY	Gießen	93.99	69.58
GERMANY	Kassel	94.71	70.59
GERMANY	Mecklenburg-Vorpommern	90.13	64.17
GERMANY	Braunschweig	95.31	71.44
GERMANY	Hannover	95.55	71.77
GERMANY	Lüneburg	91.82	66.54
GERMANY	Weser-Ems	93.38	68.73
GERMANY	Düsseldorf	96.88	73.63
GERMANY	Köln	96.40	72.96
GERMANY	Münster	93.02	68.23
GERMANY	Detmold	95.31	71.44
GERMANY	Amsberg	94.59	70.42
GERMANY	Koblenz	93.26	68.56
GERMANY	Trier	92.66	67.72

GERMANY	Rheinhessen-Pfalz	95.19	71.27
GERMANY	Saarland	94.23	69.92
GERMANY	Chemnitz	89.53	63.32
GERMANY	Dresden	90.61	64.85
GERMANY	Leipzig	91.09	65.52
GERMANY	Dessau	89.04	62.65
GERMANY	Halle	90.13	64.17
GERMANY	Magdeburg	90.01	64.00
GERMANY	Schleswig-Holstein	94.23	69.92
GERMANY	Thüringen	90.13	64.17
GREECE	Anatoliki Makedonia, Thraki	62.20	31.77
GREECE	Kentriki Makedonia	64.04	34.05
GREECE	Dytiki Makedonia	64.13	34.16
GREECE	Thessalia	63.25	33.07
GREECE	Ipeiros	60.89	30.13
GREECE	Ionia Nisia	62.73	32.42
GREECE	Dytiki Ellada	61.59	31.00
GREECE	Sterea Ellada	65.35	35.68
GREECE	Peloponnisos	62.73	32.42
GREECE	Attiki	65.09	35.35
GREECE	Voreio Aigaio	63.78	33.72
GREECE	Notio Aigaio	65.53	35.90
GREECE	Kriti	63.86	33.83
SPAIN	Galicia	75.30	29.71
SPAIN	Principado de Asturias	77.07	30.58
SPAIN	Cantabria	72.68	28.43
SPAIN	Pais Vasco	88.86	36.37
SPAIN	Comunidad Foral de Navarra	83.48	33.72
SPAIN	La Rioja	77.47	30.77
SPAIN	Aragón	85.08	34.51
SPAIN	Comunidad de Madrid	97.25	40.49
SPAIN	Castilla y León	75.39	29.75
SPAIN	Castilla-la Mancha	67.83	26.04
SPAIN	Extremadura	68.15	26.20
SPAIN	Cataluña	90.69	37.26
SPAIN	Comunidad Valenciana	78.00	31.04
SPAIN	Illes Balears	84.95	34.45
SPAIN	Andalucia	75.04	29.58
SPAIN	Región de Murcia	73.60	28.88
SPAIN	Ceuta y Melilla (ES)	77.99	28.81
SPAIN	Canarias (ES)	82.88	33.43
FRANCE	Île de France	87.95	28.92
FRANCE	Champagne-Ardenne	82.44	25.67
FRANCE	Picardie	80.96	24.79
FRANCE	Haute-Normandie	82.55	25.73
FRANCE	Centre	82.02	25.42
FRANCE	Basse-Normandie	81.28	24.98
FRANCE	Bourgogne	82.23	25.54

FRANCE	Nord - Pas-de-Calais	80.75	24.67
FRANCE	Lorraine	81.06	24.86
FRANCE	Alsace	83.50	26.29
FRANCE	Franche-Comté	81.59	25.17
FRANCE	Pays de la Loire	81.91	25.36
FRANCE	Bretagne	81.49	25.11
FRANCE	Poitou-Charentes	80.96	24.79
FRANCE	Aquitaine	82.02	25.42
FRANCE	Midi-Pyrénées	81.81	25.29
FRANCE	Limousin	80.96	24.79
FRANCE	Rhône-Alpes	83.39	26.23
FRANCE	Auvergne	81.49	25.11
FRANCE	Languedoc-Roussillon	80.53	24.54
FRANCE	Provence-Alpes-Côte d'Azur	82.12	25.48
FRANCE	Corse	80.43	24.48
IRELAND	Border, Midlands and Western	82.74	54.88
IRELAND	Southern and Eastern	87.14	60.48
ITALY	Piemonte	85.09	49.54
ITALY	Valle d'Aosta	85.30	49.80
ITALY	Liguria	83.93	48.13
ITALY	Lombardia	86.36	51.09
ITALY	Trentino-Alto Adige	86.47	51.22
ITALY	Veneto	85.09	49.54
ITALY	Friuli-Venezia Giulia	84.56	48.90
ITALY	Emilia-Romagna	85.94	50.58
ITALY	Toscana	84.56	48.90
ITALY	Umbria	83.29	47.35
ITALY	Marche	83.39	47.48
ITALY	Lazio	84.56	48.90
ITALY	Abruzzo	81.27	44.90
ITALY	Molise	80.64	44.13
ITALY	Campania	78.73	41.80
ITALY	Puglia	78.94	42.06
ITALY	Basilicata	79.89	43.22
ITALY	Calabria	77.99	40.90
ITALY	Sicilia	78.62	41.68
ITALY	Sardegna	80.11	43.48
LUXEMBOURG	Luxembourg	85.00	58.00
NETHERLANDS	Groningen	87.28	62.69
NETHERLANDS	Friesland	84.02	58.37
NETHERLANDS	Drenthe	83.58	57.80
NETHERLANDS	Overijssel	84.34	58.81
NETHERLANDS	Gelderland	84.56	59.09
NETHERLANDS	Flevoland	82.82	56.79
NETHERLANDS	Utrecht	88.69	64.56
NETHERLANDS	Noord-Holland	87.82	63.41
NETHERLANDS	Zuid-Holland	86.52	61.68
NETHERLANDS	Zeeland	84.67	59.24
NETHERLANDS	Noord-Brabant	85.97	60.96

NETHERLANDS	Limburg (NL)	84.67	59.24
AUSTRIA	Burgenland	80.00	53.30
AUSTRIA	Niederösterreich	81.20	60.50
AUSTRIA	Vienna	87.20	70.50
AUSTRIA	Kärnten	85.20	58.60
AUSTRIA	Steiermark	84.20	58.20
AUSTRIA	Oberösterreich	86.50	63.40
AUSTRIA	Salzburg	90.30	70.10
AUSTRIA	Tirol	87.10	72.20
AUSTRIA	Vorarlberg	81.90	62.20
PORTUGAL	Norte	68.46	23.71
PORTUGAL	Centro	67.89	23.22
PORTUGAL	Lisboa e Vale do Tejo	73.28	27.75
PORTUGAL	Alentejo	67.98	23.30
PORTUGAL	Algarve	69.43	24.52
PORTUGAL	Açores	67.21	22.66
PORTUGAL	Madeira	70.20	25.17
FINLAND	Itä-Suomi	94.54	66.63
FINLAND	Väli-Suomi	96.15	68.84
FINLAND	Pohjois-Suomi	97.15	70.21
FINLAND	Uusimaa (suuralue)	99.00	78.03
FINLAND	Etelä-Suomi	97.77	71.06
SWEDEN	Stockholm	98.55	85.51
SWEDEN	Östra Mellansverige	93.69	77.97
SWEDEN	Sydsverige	94.05	78.52
SWEDEN	Norra Mellansverige	93.81	78.15
SWEDEN	Mellersta Norrland	94.28	78.89
SWEDEN	Övre Norrland	93.69	77.97
SWEDEN	Småland med öarna	94.28	78.89
SWEDEN	Västsverige	94.52	79.26
UNITED KINGDOM	Tees Valley and Durham	77.56	59.41
UNITED KINGDOM	Northumberland, Tyne and Wear	77.96	60.01
UNITED KINGDOM	Cumbria	79.48	62.23
UNITED KINGDOM	Cheshire	81.70	65.49
UNITED KINGDOM	Greater Manchester	79.07	61.64
UNITED KINGDOM	Lancashire	78.27	60.45
UNITED KINGDOM	Merseyside	76.75	58.23
UNITED KINGDOM	East Riding and North Lincolnshire	79.78	62.68
UNITED KINGDOM	North Yorkshire	79.78	62.68
UNITED KINGDOM	South Yorkshire	77.46	59.27
UNITED KINGDOM	West Yorkshire	79.48	62.23
UNITED KINGDOM	Derbyshire and Nottinghamshire	79.28	61.93
UNITED	Leicestershire,	80.59	63.86

KINGDOM	Rutland and Northants		
UNITED KINGDOM	Lincolnshire	78.67	61.05
UNITED KINGDOM	Herefordshire, Worcestershire and Warks	80.08	63.12
UNITED KINGDOM	Shropshire and Staffordshire	78.87	61.34
UNITED KINGDOM	West Midlands	79.58	62.38
UNITED KINGDOM	East Anglia	81.19	64.75
UNITED KINGDOM	Bedfordshire, Hertfordshire	80.99	64.46
UNITED KINGDOM	Essex	79.68	62.53
UNITED KINGDOM	Inner London	89.26	76.61
UNITED KINGDOM	Outer London	78.97	61.49
UNITED KINGDOM	Berkshire, Bucks and Oxfordshire	83.01	67.42
UNITED KINGDOM	Surrey, East and West Sussex	80.89	64.31
UNITED KINGDOM	Hampshire and Isle of Wight	81.29	64.90
UNITED KINGDOM	Kent	79.68	62.53
UNITED KINGDOM	Gloucestershire, Wiltshire and North Somerset	80.89	64.31
UNITED KINGDOM	Dorset and Somerset	78.97	61.49
UNITED KINGDOM	Cornwall and Isles of Scilly	76.05	57.19
UNITED KINGDOM	Devon	77.96	60.01
UNITED KINGDOM	West Wales and The Valleys	76.85	58.38
UNITED KINGDOM	East Wales	80.18	63.27
UNITED KINGDOM	North Eastern Scotland	82.40	66.53
UNITED KINGDOM	Eastern Scotland	80.39	63.57
UNITED KINGDOM	South Western Scotland	79.48	62.23
UNITED KINGDOM	Highlands and Islands	77.46	59.27
UNITED KINGDOM	Northern Ireland	77.76	59.71
BULGARIA	Severozapaden	40.00	11.00
BULGARIA	Severen Tsentralen	39.92	10.92
BULGARIA	Severoiztochen	40.08	11.08
BULGARIA	Yugozapaden	43.46	14.46
BULGARIA	Yuzhen Tsentralen	39.76	10.76
BULGARIA	Yugoiztochen	41.42	12.42

CYPRUS	Cyprus	92.00	61.00
CZECH REPUBLIC	Praha	99.00	99.00
CZECH REPUBLIC	Strední Cechy	89.59	57.09
CZECH REPUBLIC	Jihozápad	90.74	57.09
CZECH REPUBLIC	Severozápad	89.01	58.72
CZECH REPUBLIC	Severovýchod	89.82	45.67
CZECH REPUBLIC	Jihovýchod	90.28	52.20
CZECH REPUBLIC	Strední Morava	89.13	55.46
CZECH REPUBLIC	Moravskoslezko	89.59	63.62
ESTONIA	Estonia	77.00	38.00
HUNGARY	Közép-Magyarország	60.14	27.00
HUNGARY	Közép-Dunántúl	54.95	19.93
HUNGARY	Nyugat-Dunántúl	57.11	22.87
HUNGARY	Dél-Dunántúl	53.00	17.28
HUNGARY	Észak-Magyarország	51.27	14.92
HUNGARY	Észak-Alföld	50.84	14.33
HUNGARY	Dél-Alföld	52.46	16.54
LITHUANIA	Lithuania	68.00	31.00
LATVIA	Latvia	64.00	31.00
MALTA	Malta	91.00	73.00
POLAND	Dolnoslaskie	82.65	53.03
POLAND	Kujawsko-Pomorskie	80.66	49.89
POLAND	Lubelskie	77.60	45.08
POLAND	Lubuskie	81.06	50.52
POLAND	Lódzkie	81.06	50.52
POLAND	Malopolskie	80.79	50.10
POLAND	Mazowieckie	87.57	60.76
POLAND	Opolskie	79.99	48.84
POLAND	Podkarpackie	78.13	45.92
POLAND	Podlaskie	78.13	45.92
POLAND	Pomorskie	82.39	52.61
POLAND	Slaskie	83.72	54.70
POLAND	Swietokrzyskie	79.06	47.38
POLAND	Warminsko-Mazurskie	78.93	47.17
POLAND	Wielkopolskie	82.92	53.44
POLAND	Zachodniopomorskie	82.25	52.40
ROMANIA	Nord-Est	37.11	12.60
ROMANIA	Sud-Est	39.19	15.24
ROMANIA	Sud	38.37	14.20
ROMANIA	Sud-Vest	38.67	14.58
ROMANIA	Vest	40.07	16.37
ROMANIA	Nord-Vest	38.52	14.39
ROMANIA	Centru	40.00	16.27
ROMANIA	Bucuresti	41.70	18.44
SLOVENIA	Slovenia	93.00	42.00

SLOVAKIA	Bratislavský	95.37	78.79
SLOVAKIA	Západné Slovensko	84.66	59.39
SLOVAKIA	Stredné Slovensko	83.53	57.35
SLOVAKIA	Východné Slovensko	82.69	55.81
NORWAY	Oslo og Akershus	92.38	68.75
NORWAY	Hedmark og Oppland	85.21	59.33
NORWAY	Sor-Ostlandet	86.29	60.76
NORWAY	Agder og Rogaland	87.82	62.76
NORWAY	Vestlandet	87.71	62.62
NORWAY	Trondelag	86.73	61.33
NORWAY	Nord-Norge	85.86	60.19
SWITZERLAND	Région Lémanique	n/a	n/a
SWITZERLAND	Espace Mitteland	n/a	n/a
SWITZERLAND	Nordwestschweiz	n/a	n/a
SWITZERLAND	Zurich	n/a	n/a
SWITZERLAND	Ostschweiz	n/a	n/a
SWITZERLAND	Zentralschweiz	n/a	n/a
SWITZERLAND	Ticino	n/a	n/a

Annex 11 – Typologies methodology

Developing the typologies presented in chapter 5 was a constantly iterative process, in which we started with a basic typology and worked to gradually improve it based on the data we had, and by adding weightings to different variables in order to obtain categorisations of regions which best reflected the telecoms status of each region.

The INRA household survey data

We have relied quite substantially, but not exclusively, on the regional level INRA household survey to construct the typologies of levels of household telecommunications uptake and of combined household and business telecommunications development into a single index. However, this EU15 INRA data does not, unfortunately, use one comparable NUTS level. The differences between countries are the following:

AT – 1
BE – 1
DE – 1
DK – 2
ES – 2
FI – 2
FR – 1
GR – 2
IE – 3
IT – 1
LU – 2
NL – 1
PT – 2
SE – 2
UK – 1

In order to obtain comparable NUTS 2 data then, NUTS 1 region data was simply transposed unchanged to each NUTS 2 region within the bigger NUTS

1 region. The only issue here is that we are thus unable to highlight any intra-regional telecoms differences within NUTS 1 regions.

This leaves the problem of Ireland, however, as we cannot simply transpose NUTS 3 data up to NUTS 2 level. Thus, a considered judgement had to be made (based on a broad amalgamation of the NUTS 3 categories into NUTS 2 categories) on which categories these regions should be classed under for the INRA indicators as part of the overall typologies.

The other issue with regard to the INRA data is its categorisation of regions into 9, rather than 6, categories for mapping purposes. As on some indicators, some of the 9 categories did not have any regions in them, when it came to the stage of developing overall typologies, it was felt that a re-categorisation of the regions into 6 categories would fit better with allowing comparison of regions' positions between the different typology elements and for the goal of developing an overall typology of the telecommunications development of EU27+2 NUTS 2 regions of 6 categories.

1. A typology of levels of household telecommunications uptake

This typology is mostly based on INRA data from the following five indicators: households with a fixed line, households with at least one mobile, households with a PC, households with Internet access and households with broadband Internet access.

In order to distinguish between these indicators and to attribute a greater importance to Internet-related technologies, and particularly broadband, as these are the focus of current policy attention and best reflect the relative advance of regions in terms of telecommunications uptake, weightings were added to each indicator as follows:

- Fixed 1
- Mobile 2
- PC 2
- Internet access 3
- Broadband Internet access 4

Thus, the index is clearly weighted more towards Internet-related technology penetration (7/12 of the index or 9/12 if we include PCs) than telephony. Broadband is thus recognised as the most pertinent illustration of the relative advancement of a region in household telecommunications uptake.

In order to be able to include the regions of the N12 plus Norway and Switzerland in this EU27+2 typology, the lack of sub-national data obliged us to use the latest national level uptake data from ITU. Each NUTS 2 region is therefore allotted the 'score' of its country. Whilst this prevents any sub-national regional variations from being identifiable, we do obtain an important indication of the approximate positions of the regions of the N12 plus Norway and Switzerland for household uptake vis-à-vis EU15 regions.

The 272 NUTS 2 regions for which we had data (the INRA household survey did not include Canarias (ES), Aland (FI), Guadaloupe (FR), Martinique (FR), Guyane (FR), Réunion (FR), Açores (PT) or Madeira (PT)) were placed in a spreadsheet and the categories within which they were present for each of the five indicators were included against them. These categories were then turned into a score of 1-6 for each indicator, with 6 for regions in the highest category down to 1 for regions in the lowest category. Scores were then doubled for mobile and PC, tripled for Internet and quadrupled for broadband, in accordance with the allotted weightings. The total score for each region was included in the final column, and the regions were sorted in descending order of score. Regions were then placed into six typology categories according to these scores, with the divisions between categories depending on either clear breaks in the scores or a set interval (e.g. 40-49 or 30-39). It was verified that neither too many or too few regions could be present in any one category, and attention was also paid to having slightly fewer regions in the top and bottom categories in order to clearly highlight those regions with very high and very low overall household telecommunications uptake respectively.
The full typology table can be found in annex 12.

2. A typology of estimated levels of business telecommunications access and uptake

To complement the household uptake typology, we have also developed a regional typology of estimated levels of business access to and uptake of telecommunications. The data on which this is based is somewhat more tenuous, as there is currently no equivalent for business uptake to the regional level INRA household survey. We have therefore relied on the results of our regression analysis to estimate data at the regional level for two key indicators, firms with Internet access and firms with their own website. A measure of access to bandwidth-intensive fibre backbones from the KMI map is also included. As in the household typology, we have added the following weightings to these three measures in order to attribute most importance to the indicator of firms with their own websites, which is a good measure of the proportion of firms in a region actually looking to conduct business (e-commerce) using the Internet:

- Access to fibre backbones 1
- Firms with Internet access 2
- Firms with their own websites 3

Due to unavailability of some data needed to conduct the regression exercise, Swiss regions were unable to be included in this typology (as again were Aland (FI), Guadaloupe (FR), Martinique (FR), Guyane (FR) and Réunion (FR)). As in the household uptake typology, the remaining 268 NUTS 2 regions were placed in a spreadsheet and the categories within which they were present for each of the three indicators were included against them. For the firms with Internet access and firms with their own website indicators, regions were categorised according to their uptake 'scores' for these indicators, using clear breaks or set intervals to decide upon category intervals. For the access to fibre backbones indicator, the categorisation process was the same with the number of pan-European networks 'noded' in each region according to the KMI Research map being the determining variable. These categories were then turned into a score of 1-6 for each indicator, with 6 for regions in the highest category down to 1 for regions in the lowest category. Scores were then doubled for firms with Internet access

and tripled for firms with their own website, in accordance with the allotted weightings. The total score for each region was included in the final column, and the regions were sorted in descending order of score. Regions were then placed into six typology categories according to these scores, with the divisions between categories depending on either clear breaks in the scores or a set interval (e.g. 40-49 or 30-39). It was verified that neither too many or too few regions could be present in any one category, and attention was also paid to having slightly fewer regions in the top and bottom categories in order to clearly highlight those regions with very high and very low overall estimated business telecommunications access and uptake respectively.
The full typology table can be found in annex 12.

3. A typology comparing levels of household and business telecommunications uptake

By combining the above two typologies into one overall one, we provide a 3x3 typology of NUTS 2 regions which directly compares their relative household and business telecommunications uptake levels. As mentioned for the household uptake typology, in order to be able to include the regions of the N12 plus Norway and Switzerland in this EU27+2 typology, the lack of sub-national household uptake data for these regions obliged us to use the latest national level uptake data from ITU. Each NUTS 2 region is therefore allotted the 'score' of its country. Whilst this prevents any sub-national regional variations from being identifiable, we do obtain an important indication of the approximate positions of the regions of the N12 plus Norway and Switzerland vis-à-vis EU15 regions.

The 265 NUTS 2 regions for which we had data from both the household uptake and estimated business access and uptake typologies (Swiss regions, plus Canarias (ES), Aland (FI), Guadaloupe (FR), Martinique (FR), Guyane (FR), Réunion (FR), Açores (PT) and Madeira (PT) were excluded because they were unable to be included in either or both of these typologies) were placed in a spreadsheet and the categories within which they had been placed in both typologies were included against them. The regions were then

sorted against these categories in ascending order, so that regions in category 1 for both typologies were first and regions in category 6 for both typologies were at the bottom. In order to obtain three classes for each typology to construct a 3x3 comparative table, for both typologies, regions in categories 1 and 2 were classed as ‘high’, regions in categories 3 and 4 were classed as ‘medium’, and regions in categories 5 and 6 were classed as ‘low’. Thus, those regions present in category 1 or 2 for household uptake and for business access and uptake were placed in the ‘high-high’ box of the table. Regions in category 1 or 2 for household uptake, but category 3 or 4 for business access and uptake were placed in the ‘high-medium’ box. This process was repeated until all nine boxes of the table were filled.
The full typology table can be found in annex 12.

4. An overall typology of combined household and business telecommunications development into a single index

Like the 3x3 comparative table, this typology also uses a combination of indicators of household uptake and business access and uptake. However, rather than providing a direct comparison of these, as in the previous typology, this time we produce a single index of overall combined household and business telecommunications development. This index allows us to see which regions are most and least advanced overall according to a composite of all the most relevant and available data we have.

We add again a number of weightings to the six main indicators used to constitute the typology:

- Fixed 1
- Mobile 2
- Internet access 3
- Broadband Internet access 4
- Fibre backbone access 1
- Proportion of firms with their own websites 1

We include, therefore, a measure of enterprise uptake (proportion of firms with their own websites) and level of access to fibre backbones. Household broadband penetration continues to be recognised, however, as the most pertinent indicator of the relative advancement of a region in telecommunications development. Household uptake is also given more weighting than business access and uptake (mainly because the household data from the INRA survey is actual, rather than estimated, data, unlike the business data).

The process of obtaining regional 'scores' for each indicator was the same as in the previous typologies, with 6 for regions in the highest category down to 1 for regions in the lowest category. For regions of the N12 plus Norway and Switzerland, for which no sub-national household uptake data was available, estimated data for the indicator 'households with Internet access' from our regression analysis was used and given a weighting of 3. Scores were then doubled for mobile, tripled for Internet access and quadrupled for broadband access, in accordance with the allotted weightings. The total score for each region was included in the final column, but, as this meant that EU15 regions had values for 6 indicators and regions of the N12 plus Norway and Switzerland for only 3 indicators, the total scores were divided by the number of indicators used in each case to obtain a comparable score. The regions were then sorted in descending order, and placed into six typology categories according to these scores, with the divisions between categories depending on either clear breaks in the scores or a set interval (e.g. 40-49 or 30-39). It was verified that neither too many or too few regions could be present in any one category, and attention was also paid to having slightly fewer regions in the top and bottom categories in order to clearly highlight those regions with highly advanced and highly lagging status for overall combined household and business telecommunications development respectively.
The full typology table can be found in annex 12.

Annex 12 – Full typology tables

Table A12.1: A typology of levels of household telecommunications uptake

NUTS 2	REGION	Fixed	Mobile	PC	Internet	Broadband	Total	
	Weighting	*1*	*2*	*2*	*3*	*4*		
SE07	Mellersta Norrland	5	6	6	6	6	71	1
SE02	Östra Mellansverige	6	5	6	6	6	70	1
SE08	Övre Norrland	5	5	6	6	6	69	1
SE01	Stockholm	5	4	6	6	6	67	1
SE09	Småland med öarna	6	5	6	6	5	66	1
NL21	Overijssel	5	4	6	5	6	64	1
NL22	Gelderland	5	4	6	5	6	64	1
NL23	Flevoland	5	4	6	5	6	64	1
SE04	Sydsverige	6	4	6	6	5	64	1
DK	Danmark	5	3	6	5	6	62	1
NL31	Utrecht	5	5	6	5	5	62	1
NL32	Noord-Holland	5	5	6	5	5	62	1
NL33	Zuid-Holland	5	5	6	5	5	62	1
NL34	Zeeland	5	5	6	5	5	62	1
SE0A	Västsverige	6	5	6	6	4	62	1
DE6	Hamburg	6	3	6	6	4	58	2
NL41	Noord-Brabant	6	4	6	5	4	57	2
NL42	Limburg (NL)	6	4	6	5	4	57	2
UKC1	Tees Valley and Durham	5	5	5	5	4	56	2
UKC2	Northumberland, Tyne and Wear	5	5	5	5	4	56	2
FI16	Uusimaa (suuralue)	2	5	5	4	5	54	2
SE06	Norra Mellansverige	4	4	6	6	3	54	2
UKI1	Inner London	5	4	5	5	4	54	2
UKI2	Outer London	5	4	5	5	4	54	2
BE1	Région Bruxelles-capitale/Brussels hoofdstad gewest	1	4	4	4	6	53	2
NO01	Oslo Og Akershus	5	6	4	5	3	52	2
NO02	Hedmark Og Oppland	5	6	4	5	3	52	2
NO03	Sør-Østlandet	5	6	4	5	3	52	2
NO04	Agder Og Rogaland	5	6	4	5	3	52	2
NO05	Vestlandet	5	6	4	5	3	52	2
NO06	Trøndelag	5	6	4	5	3	52	2
NO07	Nord-Norge	5	6	4	5	3	52	2
BE21	Antwerpen	3	3	3	4	6	51	2
BE22	Limburg (B)	3	3	3	4	6	51	2
BE23	Oost-Vlaanderen	3	3	3	4	6	51	2
BE24	Vlaams Brabant	3	3	3	4	6	51	2
BE25	West-Vlaanderen	3	3	3	4	6	51	2
UKH1	East Anglia	6	4	5	5	3	51	2

UKH2	Bedfordshire, Hertfordshire	6	4	5	5	3	51	2
UKH3	Essex	6	4	5	5	3	51	2
CH01	Région Lémanique	6	4	6	4	3	50	2
CH02	Espace Mittelland	6	4	6	4	3	50	2
CH03	Suisse Du Nord-Est	6	4	6	4	3	50	2
CH04	Zürich	6	4	6	4	3	50	2
CH05	Suisse Orientale	6	4	6	4	3	50	2
CH06	Suisse Centrale	6	4	6	4	3	50	2
CH07	Ticino	6	4	6	4	3	50	2
UKJ1	Berkshire, Bucks and Oxfordshire	5	4	5	5	3	50	2
UKJ2	Surrey, East and West Sussex	5	4	5	5	3	50	2
UKJ3	Hampshire and Isle of Wight	5	4	5	5	3	50	2
UKJ4	Kent	5	4	5	5	3	50	2
ITB	Sardegna	4	6	4	3	4	49	3
LU	Luxembourg	6	5	5	5	2	49	3
UKD1	Cumbria	5	4	4	5	3	48	3
UKD2	Cheshire	5	4	4	5	3	48	3
UKD3	Greater Manchester	5	4	4	5	3	48	3
UKD4	Lancashire	5	4	4	5	3	48	3
UKD5	Merseyside	5	4	4	5	3	48	3
UKG1	Herefordshire, Worcestershire and Warks	6	4	5	4	3	48	3
UKG2	Shropshire and Staffordshire	6	4	5	4	3	48	3
UKG3	West Midlands	6	4	5	4	3	48	3
AT31	Oberösterreich	3	4	4	4	4	47	3
AT32	Salzburg	3	4	4	4	4	47	3
AT33	Tirol	3	4	4	4	4	47	3
AT34	Vorarlberg	3	4	4	4	4	47	3
NL11	Groningen	5	4	5	4	3	47	3
NL12	Friesland	5	4	5	4	3	47	3
NL13	Drenthe	5	4	5	4	3	47	3
UKM1	North Eastern Scotland	5	4	5	4	3	47	3
UKM2	Eastern Scotland	5	4	5	4	3	47	3
UKM3	South Western Scotland	5	4	5	4	3	47	3
UKM4	Highlands and Islands	5	4	5	4	3	47	3
UKN	Northern Ireland	5	4	3	4	4	47	3
ES53	Islas Baleares	5	5	3	3	4	46	3
ES22	Comunidad Foral de Navarra	3	4	4	3	4	44	3
FI14	Väli-Suomi	2	5	4	4	3	44	3
IT51	Toscana	4	6	4	4	2	44	3
IT52	Umbria	4	6	4	4	2	44	3
IT53	Marche	4	6	4	4	2	44	3

UKK1	Gloucestershire, Wiltshire and North Somerset	5	4	5	4	2	43	3
UKK2	Dorset and Somerset	5	4	5	4	2	43	3
UKK3	Cornwall and Isles of Scilly	5	4	5	4	2	43	3
UKK4	Devon	5	4	5	4	2	43	3
DE3	Berlin	6	2	4	4	3	42	3
DEB1	Koblenz	5	3	5	3	3	42	3
DEB2	Trier	5	3	5	3	3	42	3
DEB3	Rheinhessen-Pfalz	5	3	5	3	3	42	3
ES12	Principado de Asturias	4	4	2	2	5	42	3
FR1	Île de France	3	4	3	3	4	42	3
IT71	Abruzzo	3	5	5	5	1	42	3
IT72	Molise	3	5	5	5	1	42	3
DE21	Oberbayern	5	3	5	4	2	41	3
DE22	Niederbayern	5	3	5	4	2	41	3
DE23	Oberpfalz	5	3	5	4	2	41	3
DE24	Oberfranken	5	3	5	4	2	41	3
DE25	Mittelfranken	5	3	5	4	2	41	3
DE26	Unterfranken	5	3	5	4	2	41	3
DE27	Schwaben	5	3	5	4	2	41	3
ES51	Cataluña	4	4	4	3	3	41	3
FI17	Etelä-Suomi	2	5	4	3	3	41	3
IT91	Puglia	3	5	4	4	2	41	3
IT92	Basilicata	3	5	4	4	2	41	3
IT93	Calabria	3	5	4	4	2	41	3
UKL1	West Wales and The Valleys	5	4	4	4	2	41	3
UKL2	East Wales	5	4	4	4	2	41	3
UKE1	East Riding and North Lincolnshire	4	4	4	4	2	40	3
UKE2	North Yorkshire	4	4	4	4	2	40	3
UKE3	South Yorkshire	4	4	4	4	2	40	3
UKE4	West Yorkshire	4	4	4	4	2	40	3
UKF1	Derbyshire and Nottinghamshire	4	4	4	4	2	40	3
UKF2	Leicestershire, Rutland and Northants	4	4	4	4	2	40	3
UKF3	Lincolnshire	4	4	4	4	2	40	3
AT11	Burgenland	2	3	3	3	4	39	4
AT12	Niederösterreich	2	3	3	3	4	39	4
AT13	Wien	2	3	3	3	4	39	4
AT21	Kärnten	2	4	4	3	3	39	4
AT22	Steiermark	2	4	4	3	3	39	4
DE91	Braunschweig	5	3	4	4	2	39	4
DE92	Hannover	5	3	4	4	2	39	4
DE93	Lüneburg	5	3	4	4	2	39	4
DE94	Weser-Ems	5	3	4	4	2	39	4
DEF	Schleswig-Holstein	5	3	4	4	2	39	4

BE31	Brabant Wallon	2	3	2	2	5	38	4
BE32	Hainaut	2	3	2	2	5	38	4
BE33	Liège	2	3	2	2	5	38	4
BE34	Luxembourg (B)	2	3	2	2	5	38	4
BE35	Namur	2	3	2	2	5	38	4
DE5	Bremen	6	3	5	4	1	38	4
ES3	Comunidad de Madrid	5	4	4	3	2	38	4
ES63	Ceuta y Melilla (ES)	3	4	3	3	3	38	4
IT31	Trentino-Alto Adige	4	4	3	4	2	38	4
IT32	Veneto	4	4	3	4	2	38	4
IT33	Friuli-Venezia Giulia	4	4	3	4	2	38	4
IT4	Emilia-Romagna	4	3	4	4	2	38	4
DEA1	Düsseldorf	6	2	3	3	3	37	4
DEA2	Köln	6	2	3	3	3	37	4
DEA3	Münster	6	2	3	3	3	37	4
DEA4	Detmold	6	2	3	3	3	37	4
DEA5	Arnsberg	6	2	3	3	3	37	4
IT2	Lombardia	3	4	3	4	2	37	4
DE71	Darmstadt	5	2	3	3	3	36	4
DE72	Gießen	5	2	3	3	3	36	4
DE73	Kassel	5	2	3	3	3	36	4
DE8	Mecklenburg-Vorpommern	5	2	3	3	3	36	4
ES24	Aragón	4	4	3	2	3	36	4
FI15	Pohjois-Suomi	1	5	4	3	2	36	4
IT11	Piemonte	3	5	3	3	2	36	4
IT12	Valle d'Aosta	3	5	3	3	2	36	4
IT13	Liguria	3	5	3	3	2	36	4
SI	Slovenija	2	5	2	4	2	36	4
DE11	Stuttgart	6	2	4	3	2	35	4
DE12	Karlsruhe	6	2	4	3	2	35	4
DE13	Freiburg	6	2	4	3	2	35	4
DE14	Tübingen	6	2	4	3	2	35	4
DEE1	Dessau	4	3	4	3	2	35	4
DEE2	Halle	4	3	4	3	2	35	4
DEE3	Magdeburg	4	3	4	3	2	35	4
ES11	Galicia	3	4	3	2	3	35	4
ES41	Castilla y León	3	4	3	2	3	35	4
ES61	Andalucia	3	4	3	2	3	35	4
IE01	Border, Midlands and Western	4	4	3	3	2	35	4
IT6	Lazio	4	4	3	3	2	35	4
IT8	Campania	3	4	3	3	2	34	4
DE4	Brandenburg	6	2	3	3	2	33	4
ES21	Pais Vasco	5	4	3	2	2	33	4
FI13	Itä-Suomi	2	4	3	3	2	33	4
MT	Malta	4	3	1	3	3	33	4
CZ01	Praha	1	6	1	3	2	32	4
CZ02	Stredni Cechy	1	6	1	3	2	32	4
CZ03	Jihozápad	1	6	1	3	2	32	4
CZ04	Severozápad	1	6	1	3	2	32	4

CZ05	Severovýchod	1	6	1	3	2	32	4
CZ06	Jihovýchod	1	6	1	3	2	32	4
CZ07	Strední Morava	1	6	1	3	2	32	4
CZ08	Moravskoslezko	1	6	1	3	2	32	4
DEG	Thüringen	5	2	3	3	2	32	4
DEC	Saarland	6	1	3	3	2	31	4
ITA	Sicilia	2	4	2	3	2	31	4
PT13	Lisboa e Vale do Tejo	1	4	2	2	3	31	4
ES62	Région de Murcia	3	4	2	1	3	30	4
IE02	Southern and Eastern	3	4	3	3	1	30	4
ES52	Comunidad Valenciana	3	4	2	2	2	29	5
FR61	Aquitaine	3	2	2	2	3	29	5
FR62	Midi-Pyrénées	3	2	2	2	3	29	5
FR63	Limousin	3	2	2	2	3	29	5
GR42	Notio Aigaio	6	6	2	1	1	29	5
EE	Eesti	1	2	1	3	3	28	5
GR3	Attiki	4	5	2	2	1	28	5
ES23	La Rioja	5	2	4	2	1	27	5
GR21	Ipeiros	6	5	2	1	1	27	5
CY	Kypros	5	1	1	3	2	26	5
GR11	Anatoliki Makedonia, Thraki	5	5	2	1	1	26	5
GR43	Kriti	5	6	1	1	1	26	5
FR3	Nord - Pas-de-Calais	3	2	2	2	2	25	5
FR41	Lorraine	3	2	2	2	2	25	5
FR42	Alsace	3	2	2	2	2	25	5
FR43	Franche-Comté	3	2	2	2	2	25	5
FR51	Pays de la Loire	3	2	2	2	2	25	5
FR52	Bretagne	3	2	2	2	2	25	5
FR53	Poitou-Charentes	3	2	2	2	2	25	5
GR14	Thessalia	6	5	1	1	1	25	5
LV	Latvija	1	1	1	4	2	25	5
ES42	Castilla-la Mancha	3	3	2	1	2	24	5
DED1	Chemnitz	3	1	2	2	2	23	5
DED2	Dresden	3	1	2	2	2	23	5
DED3	Leipzig	3	1	2	2	2	23	5
ES13	Cantabria	3	3	2	2	1	23	5
ES43	Extremadura	2	4	1	1	2	23	5
GR13	Dytiki Makedonia	6	4	1	1	1	23	5
GR22	Ionia Nisia	4	5	1	1	1	23	5
GR23	Dytiki Ellada	4	5	1	1	1	23	5
HU01	Közép-Magyarország	1	3	1	2	2	23	5
HU02	Közép-Dunántúl	1	3	1	2	2	23	5
HU03	Nyugat-Dunántúl	1	3	1	2	2	23	5
HU04	Dél-Dunántúl	1	3	1	2	2	23	5
HU05	Észak-Magyarország	1	3	1	2	2	23	5

HU06	Észak-Alföld	1	3	1	2	2	23	5
HU07	Dél-Alföld	1	3	1	2	2	23	5
PT14	Alentejo	2	3	2	1	2	23	5
FR21	Champagne-Ardenne	3	2	2	1	2	22	5
FR22	Picardie	3	2	2	1	2	22	5
FR23	Haute-Normandie	3	2	2	1	2	22	5
FR24	Centre	3	2	2	1	2	22	5
FR25	Basse-Normandie	3	2	2	1	2	22	5
FR26	Bourgogne	3	2	2	1	2	22	5
FR81	Languedoc-Roussillon	2	2	1	2	2	22	5
FR82	Provence-Alpes-Côte d'Azur	2	2	1	2	2	22	5
FR83	Corse	2	2	1	2	2	22	5
GR12	Kentriki Makedonia	5	4	1	1	1	22	5
GR24	Sterea Ellada	5	4	1	1	1	22	5
GR25	Peloponnisos	5	4	1	1	1	22	5
PT11	Norte	1	4	1	1	2	22	5
PT12	Centro (PT)	1	3	2	1	2	22	5
SK01	Bratislavský	1	3	1	3	1	22	5
SK02	Západné Slovensko	1	3	1	3	1	22	5
SK03	Stredné Slovensko	1	3	1	3	1	22	5
SK04	Východné Slovensko	1	3	1	3	1	22	5
FR71	Rhône-Alpes	3	1	1	2	2	21	5
FR72	Auvergne	3	1	1	2	2	21	5
LT	Lietuva	1	2	1	2	2	21	5
PL01	Dolnoslaskie	1	1	1	2	2	19	6
PL02	Kujawsko-Pomorskie	1	1	1	2	2	19	6
PL03	Lubelskie	1	1	1	2	2	19	6
PL04	Lubuskie	1	1	1	2	2	19	6
PL05	Lódzkie	1	1	1	2	2	19	6
PL06	Malopolskie	1	1	1	2	2	19	6
PL07	Mazowieckie	1	1	1	2	2	19	6
PL08	Opolskie	1	1	1	2	2	19	6
PL09	Podkarpackie	1	1	1	2	2	19	6
PL0A	Podlaskie	1	1	1	2	2	19	6
PL0B	Pomorskie	1	1	1	2	2	19	6
PL0C	Slaskie	1	1	1	2	2	19	6
PL0D	Swietokrzyskie	1	1	1	2	2	19	6
PL0E	Warminsko-Mazurskie	1	1	1	2	2	19	6
PL0F	Wielkopolskie	1	1	1	2	2	19	6
PL0G	Zachodniopomorskie	1	1	1	2	2	19	6
GR41	Voreio Aigaio	3	3	1	1	1	18	6
PT15	Algarve	1	4	1	1	1	18	6
RO01	Nord-Est	1	1	1	2	1	15	6
RO02	Sud-Est	1	1	1	2	1	15	6
RO03	Sud	1	1	1	2	1	15	6
RO04	Sud-Vest	1	1	1	2	1	15	6

RO05	Vest	1	1	1	2	1	15	6
RO06	Nord-Vest	1	1	1	2	1	15	6
RO07	Centru	1	1	1	2	1	15	6
RO08	Bucuresti	1	1	1	2	1	15	6
BG01	Severozapaden	1	1	1	1	1	12	6
BG02	Severen Tsentralen	1	1	1	1	1	12	6
BG03	Severoiztochen	1	1	1	1	1	12	6
BG04	Yugozapaden	1	1	1	1	1	12	6
BG05	Yuzhen Tsentralen	1	1	1	1	1	12	6
BG06	Yugoiztochen	1	1	1	1	1	12	6
ES7	Canarias (ES)							n/a
FI2	Åland							n/a
FR91	Guadeloupe (FR)							n/a
FR92	Martinique (FR)							n/a
FR93	Guyane (FR)							n/a
FR94	Réunion (FR)							n/a
PT2	Açores (PT)							n/a
PT3	Madeira (PT)							n/a

Source: CURDS

Table A12.2: A typology of estimated levels of business telecommunications access and uptake

NUTS 2	Region	Access to fibre backbones	Firms with Internet access	Firms with their own websites	Total	
DE21	Oberbayern	6	6	6	36	1
DE5	Bremen	6	6	6	36	1
DE6	Hamburg	6	6	6	36	1
DE71	Darmstadt	6	6	6	36	1
SE01	Stockholm	6	6	6	36	1
DE11	Stuttgart	5	6	6	35	1
DK	Danmark	5	6	6	35	1
CZ01	Praha	4	6	6	34	1
FI16	Uusimaa (suuralue)	4	6	6	34	1
BE1	Région Bruxelles-capitale/Brussels hoofdstad gewest	6	6	5	33	1
DEA1	Düsseldorf	6	6	5	33	1
SE04	Sydsverige	5	5	6	33	1
SK01	Bratislavský	3	6	6	33	1
DE12	Karlsruhe	5	6	5	32	1
DE25	Mittelfranken	5	6	5	32	1
DE92	Hannover	5	6	5	32	1
DEA2	Köln	5	6	5	32	1
UKI1	Inner London	6	4	6	32	1
DE3	Berlin	6	5	5	31	1
DEA4	Detmold	4	6	5	31	1
SE0A	Västsverige	3	5	6	31	1
BE21	Antwerpen	5	5	5	30	2
DE13	Freiburg	3	6	5	30	2
DE26	Unterfranken	3	6	5	30	2
DE27	Schwaben	3	6	5	30	2
DEA5	Arnsberg	5	5	5	30	2
NO01	Oslo Og Akershus	5	5	5	30	2
SE08	Övre Norrland	2	5	6	30	2
DE23	Oberpfalz	2	6	5	29	2
DED3	Leipzig	4	5	5	29	2
FI14	Väli-Suomi	2	6	5	29	2
FI17	Etelä-Suomi	2	6	5	29	2
SE02	Östra Mellansverige	1	5	6	29	2
SE06	Norra Mellansverige	1	5	6	29	2
SE07	Mellersta Norrland	1	5	6	29	2
SE09	Småland med öarna	1	5	6	29	2
AT13	Wien	5	4	5	28	2
DE14	Tübingen	1	6	5	28	2
DE24	Oberfranken	1	6	5	28	2
DE91	Braunschweig	1	6	5	28	2
DEB3	Rheinhessen-Pfalz	1	6	5	28	2
DEF	Schleswig-Holstein	3	5	5	28	2
FI15	Pohjois-Suomi	1	6	5	28	2
AT32	Salzburg	2	5	5	27	2

FI13	Itä-Suomi	2	5	5	27	2
UKJ1	Berkshire, Bucks and Oxfordshire	4	4	5	27	2
DE22	Niederbayern	1	5	5	26	2
DE72	Gießen	1	5	5	26	2
DE73	Kassel	1	5	5	26	2
DE93	Lüneburg	1	5	5	26	2
DE94	Weser-Ems	1	5	5	26	2
DEA3	Münster	1	5	5	26	2
DEB1	Koblenz	1	5	5	26	2
DEB2	Trier	1	5	5	26	2
DEC	Saarland	1	5	5	26	2
DED2	Dresden	4	5	4	26	2
DEG	Thüringen	4	5	4	26	2
ES3	Comunidad de Madrid	5	6	3	26	2
MT	Malta	1	5	5	26	2
NL32	Noord-Holland	6	4	4	26	2
AT33	Tirol	2	4	5	25	2
DEE3	Magdeburg	3	5	4	25	2
UKK1	Gloucestershire, Wiltshire and North Somerset	5	4	4	25	2
UKM1	North Eastern Scotland	2	4	5	25	2
BE25	West-Vlaanderen	2	5	4	24	3
DE8	Mecklenburg-Vorpommern	2	5	4	24	3
ES51	Cataluña	5	5	3	24	3
IE02	Southern and Eastern	4	4	4	24	3
NL21	Overijssel	4	4	4	24	3
NL33	Zuid-Holland	4	4	4	24	3
UKD2	Cheshire	1	4	5	24	3
UKI2	Outer London	6	3	4	24	3
AT21	Kärnten	3	4	4	23	3
BE23	Oost-Vlaanderen	3	4	4	23	3
BE24	Vlaams Brabant	1	5	4	23	3
BE31	Brabant Wallon	1	5	4	23	3
BE33	Liège	3	4	4	23	3
CY	Kypros	1	5	4	23	3
CZ03	Jihozápad	1	5	4	23	3
DE4	Brandenburg	1	5	4	23	3
DEE2	Halle	1	5	4	23	3
LU	Luxembourg	3	4	4	23	3
PL07	Mazowieckie	3	4	4	23	3
UKF2	Leicestershire, Rutland and Northants	3	4	4	23	3
UKH1	East Anglia	3	4	4	23	3
UKJ2	Surrey, East and West Sussex	3	4	4	23	3

UKJ3	Hampshire and Isle of Wight	3	4	4	23	3
UKM2	Eastern Scotland	3	4	4	23	3
AT22	Steiermark	2	4	4	22	3
AT31	Oberösterreich	2	4	4	22	3
BE32	Hainaut	2	4	4	22	3
BE35	Namur	2	4	4	22	3
CZ06	Jihovýchod	3	5	3	22	3
DED1	Chemnitz	2	4	4	22	3
IT2	Lombardia	5	4	3	22	3
NL11	Groningen	2	4	4	22	3
NL12	Friesland	2	4	4	22	3
NL41	Noord-Brabant	2	4	4	22	3
NL42	Limburg (NL)	2	4	4	22	3
NO04	Agder Og Rogaland	2	4	4	22	3
NO05	Vestlandet	2	4	4	22	3
NO06	Trøndelag	2	4	4	22	3
UKD3	Greater Manchester	4	3	4	22	3
UKD5	Merseyside	4	3	4	22	3
UKE4	West Yorkshire	4	3	4	22	3
UKG3	West Midlands	4	3	4	22	3
UKL2	East Wales	2	4	4	22	3
AT12	Niederösterreich	1	4	4	21	3
AT34	Vorarlberg	1	4	4	21	3
BE22	Limburg (B)	1	4	4	21	3
BE34	Luxembourg (B)	1	4	4	21	3
CZ02	Strední Cechy	1	4	4	21	3
CZ04	Severozápad	1	4	4	21	3
CZ07	Strední Morava	1	4	4	21	3
CZ08	Moravskoslezko	1	4	4	21	3
DEE1	Dessau	1	4	4	21	3
ES21	Pais Vasco	4	4	3	21	3
IT11	Piemonte	4	4	3	21	3
NL13	Drenthe	1	4	4	21	3
NL22	Gelderland	1	4	4	21	3
NL23	Flevoland	1	4	4	21	3
NL31	Utrecht	1	4	4	21	3
NL34	Zeeland	1	4	4	21	3
NO02	Hedmark Og Oppland	1	4	4	21	3
NO03	Sør-Østlandet	1	4	4	21	3
NO07	Nord-Norge	1	4	4	21	3
SI	Slovenija	2	5	3	21	3
SK02	Západné Slovensko	1	4	4	21	3
SK03	Stredné Slovensko	1	4	4	21	3
SK04	Východné Slovensko	1	4	4	21	3
UKC1	Tees Valley and Durham	3	3	4	21	3
UKC2	Northumberland, Tyne and Wear	3	3	4	21	3
UKD1	Cumbria	3	3	4	21	3

UKD4	Lancashire	3	3	4	21	3
UKE2	North Yorkshire	3	3	4	21	3
UKF1	Derbyshire and Nottinghamshire	3	3	4	21	3
UKG1	Herefordshire, Worcestershire and Warks	1	4	4	21	3
UKH2	Bedfordshire, Hertfordshire	1	4	4	21	3
UKK2	Dorset and Somerset	3	3	4	21	3
UKK4	Devon	3	3	4	21	3
UKM3	South Western Scotland	3	3	4	21	3
FR1	Île de France	6	4	2	20	3
FR71	Rhône-Alpes	6	4	2	20	3
IT6	Lazio	3	4	3	20	3
PL0F	Wielkopolskie	3	4	3	20	3
UKE1	East Riding and North Lincolnshire	2	3	4	20	3
UKL1	West Wales and The Valleys	2	3	4	20	3
UKM4	Highlands and Islands	2	3	4	20	3
UKN	Northern Ireland	2	3	4	20	3
FR42	Alsace	5	4	2	19	4
FR61	Aquitaine	5	4	2	19	4
FR81	Languedoc-Roussillon	5	4	2	19	4
FR82	Provence-Alpes-Côte d'Azur	5	4	2	19	4
IE01	Border, Midlands and Western	2	4	3	19	4
IT13	Liguria	2	4	3	19	4
IT31	Trentino-Alto Adige	2	4	3	19	4
IT32	Veneto	2	4	3	19	4
IT33	Friuli-Venezia Giulia	2	4	3	19	4
IT4	Emilia-Romagna	2	4	3	19	4
IT51	Toscana	2	4	3	19	4
PL01	Dolnoslaskie	2	4	3	19	4
PL02	Kujawsko-Pomorskie	2	4	3	19	4
PL06	Malopolskie	2	4	3	19	4
PL0B	Pomorskie	2	4	3	19	4
UKE3	South Yorkshire	1	3	4	19	4
UKF3	Lincolnshire	1	3	4	19	4
UKG2	Shropshire and Staffordshire	1	3	4	19	4
UKH3	Essex	1	3	4	19	4
UKJ4	Kent	1	3	4	19	4
UKK3	Cornwall and Isles of Scilly	1	3	4	19	4
AT11	Burgenland	1	4	3	18	4

CZ05	Severovýchod	1	4	3	18	4
FR3	Nord - Pas-de-Calais	4	4	2	18	4
FR52	Bretagne	4	4	2	18	4
FR62	Midi-Pyrénées	4	4	2	18	4
IT12	Valle d'Aosta	1	4	3	18	4
IT52	Umbria	1	4	3	18	4
IT53	Marche	1	4	3	18	4
IT71	Abruzzo	1	4	3	18	4
IT72	Molise	1	4	3	18	4
ITB	Sardegna	1	4	3	18	4
PL04	Lubuskie	1	4	3	18	4
PL05	Lódzkie	1	4	3	18	4
PL0C	Slaskie	1	4	3	18	4
PL0G	Zachodniopomorskie	1	4	3	18	4
EE	Eesti	2	3	3	17	4
FR21	Champagne-Ardenne	3	4	2	17	4
FR22	Picardie	3	4	2	17	4
FR23	Haute-Normandie	3	4	2	17	4
FR24	Centre	3	4	2	17	4
FR26	Bourgogne	3	4	2	17	4
FR41	Lorraine	3	4	2	17	4
FR51	Pays de la Loire	3	4	2	17	4
FR53	Poitou-Charentes	3	4	2	17	4
IT8	Campania	2	3	3	17	4
IT91	Puglia	2	3	3	17	4
PL09	Podkarpackie	2	3	3	17	4
PL0E	Warminsko-Mazurskie	2	3	3	17	4
ES52	Comunidad Valenciana	4	3	2	16	4
FR25	Basse-Normandie	2	4	2	16	4
IT92	Basilicata	1	3	3	16	4
IT93	Calabria	1	3	3	16	4
ITA	Sicilia	1	3	3	16	4
PL03	Lubelskie	1	3	3	16	4
PL08	Opolskie	1	3	3	16	4
PL0A	Podlaskie	1	3	3	16	4
PL0D	Swietokrzyskie	1	3	3	16	4
ES22	Comunidad Foral de Navarra	1	4	2	15	4
ES24	Aragón	1	4	2	15	4
ES53	Islas Baleares	1	4	2	15	4
ES7	Canarias (ES)	1	4	2	15	4
FR43	Franche-Comté	1	4	2	15	4
FR63	Limousin	1	4	2	15	4
FR72	Auvergne	1	4	2	15	4
FR83	Corse	1	4	2	15	4
GR3	Attiki	2	2	3	15	4
ES11	Galicia	2	3	2	14	5
ES41	Castilla y León	2	3	2	14	5

GR24	Sterea Ellada	1	2	3	14	5
GR42	Notio Aigaio	1	2	3	14	5
PT13	Lisboa e Vale do Tejo	2	3	2	14	5
ES12	Principado de Asturias	1	3	2	13	5
ES13	Cantabria	1	3	2	13	5
ES23	La Rioja	1	3	2	13	5
ES61	Andalucia	1	3	2	13	5
ES62	Région de Murcia	1	3	2	13	5
ES63	Ceuta y Melilla (ES)	1	3	2	13	5
HU01	Közép-Magyarország	3	2	2	13	5
PT3	Madeira (PT)	1	3	2	13	5
GR22	Ionia Nisia	2	2	2	12	5
GR23	Dytiki Ellada	2	2	2	12	5
LT	Lietuva	2	2	2	12	5
LV	Latvija	2	2	2	12	5
PT11	Norte	2	2	2	12	5
PT12	Centro (PT)	2	2	2	12	5
ES42	Castilla-la Mancha	1	2	2	11	5
ES43	Extremadura	1	2	2	11	5
GR11	Anatoliki Makedonia, Thraki	1	2	2	11	5
GR12	Kentriki Makedonia	1	2	2	11	5
GR13	Dytiki Makedonia	1	2	2	11	5
GR14	Thessalia	1	2	2	11	5
GR21	Ipeiros	1	2	2	11	5
GR25	Peloponnisos	1	2	2	11	5
GR41	Voreio Aigaio	1	2	2	11	5
GR43	Kriti	1	2	2	11	5
HU03	Nyugat-Dunántúl	1	2	2	11	5
PT14	Alentejo	1	2	2	11	5
PT15	Algarve	1	2	2	11	5
PT2	Açores (PT)	1	2	2	11	5
HU02	Közép-Dunántúl	1	2	1	8	6
HU04	Dél-Dunántúl	1	2	1	8	6
HU05	Észak-Magyarország	1	2	1	8	6
HU06	Észak-Alföld	1	2	1	8	6
HU07	Dél-Alföld	1	2	1	8	6
BG04	Yugozapaden	2	1	1	7	6
RO08	Bucuresti	2	1	1	7	6
BG01	Severozapaden	1	1	1	6	6
BG02	Severen Tsentralen	1	1	1	6	6
BG03	Severoiztochen	1	1	1	6	6
BG05	Yuzhen Tsentralen	1	1	1	6	6
BG06	Yugoiztochen	1	1	1	6	6
RO01	Nord-Est	1	1	1	6	6
RO02	Sud-Est	1	1	1	6	6
RO03	Sud	1	1	1	6	6
RO04	Sud-Vest	1	1	1	6	6

RO05	Vest	1	1	1	6	6
RO06	Nord-Vest	1	1	1	6	6
RO07	Centru	1	1	1	6	6
CH01	Région Lémanique	5				n/a
CH02	Espace Mittelland	4				n/a
CH03	Suisse Du Nord-Est	5				n/a
CH04	Zürich	5				n/a
CH05	Suisse Orientale	1				n/a
CH06	Suisse Centrale	1				n/a
CH07	Ticino	3				n/a
FI2	Åland	1				n/a
FR91	Guadeloupe (FR)	1				n/a
FR92	Martinique (FR)	1				n/a
FR93	Guyane (FR)	1				n/a
FR94	Réunion (FR)	1				n/a

Source: CURDS

Table A12.3: A typology comparing levels of household and business telecommunications uptake

	High business telecoms uptake	Medium business telecoms uptake	Low business telecoms uptake
High household telecoms uptake	BE1 Région Bruxelles-capitale/Brussels hoofdstad gewest BE21 Antwerpen DE6 Hamburg DK Danmark FI16 Uusimaa (suuralue) NL32 Noord-Holland NO01 Oslo Og Akershus SE01 Stockholm SE02 Östra Mellansverige SE04 Sydsverige SE06 Norra Mellansverige SE07 Mellersta Norrland SE08 Övre Norrland SE09 Småland med öarna SE0A Västsverige UKI1 Inner London UKI2 Outer London UKJ1 Berkshire, Bucks and Oxfordshire	BE22 Limburg (B) BE23 Oost-Vlaanderen BE24 Vlaams Brabant BE25 West-Vlaanderen NL21 Overijssel NL22 Gelderland NL23 Flevoland NL31 Utrecht NL33 Zuid-Holland NL34 Zeeland NL41 Noord-Brabant NL42 Limburg (NL) NO02 Hedmark Og Oppland NO03 Sør-Østlandet NO04 Agder Og Rogaland NO05 Vestlandet NO06 Trøndelag NO07 Nord-Norge UKC1 Tees Valley and Durham UKC2 Northumberland, Tyne and Wear UKH1 East Anglia UKH2 Bedfordshire, Hertfordshire UKH3 Essex UKJ2 Surrey, East and West Sussex UKJ3 Hampshire and Isle of Wight UKJ4 Kent	
Medium household telecoms uptake	AT13 Wien AT32 Salzburg AT33 Tirol CZ01 Praha DE11 Stuttgart DE12 Karlsruhe DE13 Freiburg DE14 Tübingen DE21 Oberbayern DE22 Niederbayern DE23 Oberpfalz DE24 Oberfranken DE25 Mittelfranken DE26 Unterfranken DE27 Schwaben DE3 Berlin DE5 Bremen DE71 Darmstadt DE72 Gießen DE73 Kassel	AT11 Burgenland AT12 Niederösterreich AT21 Kärnten AT22 Steiermark AT31 Oberösterreich AT34 Vorarlberg BE31 Brabant Wallon BE32 Hainaut BE33 Liège BE34 Luxembourg (B) BE35 Namur CZ02 Stredni Cechy CZ03 Jihozápad CZ04 Severozápad CZ05 Severovýchod CZ06 Jihovýchod CZ07 Strední Morava CZ08 Moravskoslezko DE4 Brandenburg DE8 Mecklenburg-	ES11 Galicia ES12 Principado de Asturias ES41 Castilla y León ES61 Andalucia ES62 Région de Murcia ES63 Ceuta y Melilla (ES) PT13 Lisboa e Vale do Tejo

	DE91 Braunschweig DE92 Hannover DE93 Lüneburg DE94 Weser-Ems DEA1 Düsseldorf DEA2 Köln DEA3 Münster DEA4 Detmold DEA5 Arnsberg DEB1 Koblenz DEB2 Trier DEB3 Rheinhessen-Pfalz DEC Saarland DEE3 Magdeburg DEF Schleswig-Holstein DEG Thüringen ES3 Comunidad de Madrid FI13 Itä-Suomi FI14 Väli-Suomi FI15 Pohjois-Suomi FI17 Etelä-Suomi MT Malta UKK1 Gloucestershire, Wiltshire and North Somerset UKM1 North Eastern Scotland	Vorpommern DEE1 Dessau DEE2 Halle ES21 Pais Vasco ES22 Comunidad Foral de Navarra ES24 Aragón ES51 Cataluña ES53 Islas Baleares FR1 Île de France IE01 Border, Midlands and Western IE02 Southern and Eastern IT11 Piemonte IT12 Valle d'Aosta IT13 Liguria IT2 Lombardia IT31 Trentino-Alto Adige IT32 Veneto IT33 Friuli-Venezia Giulia IT4 Emilia-Romagna IT51 Toscana IT52 Umbria IT53 Marche IT6 Lazio IT71 Abruzzo IT72 Molise IT8 Campania IT91 Puglia IT92 Basilicata IT93 Calabria ITA Sicilia ITB Sardegna LU Luxembourg NL11 Groningen NL12 Friesland NL13 Drenthe SI Slovenija UKD1 Cumbria UKD2 Cheshire UKD3 Greater Manchester UKD4 Lancashire UKD5 Merseyside UKE1 East Riding and North Lincolnshire UKE2 North Yorkshire UKE3 South Yorkshire UKE4 West Yorkshire UKF1 Derbyshire and Nottinghamshire UKF2 Leicestershire, Rutland and Northants UKF3 Lincolnshire UKG1 Herefordshire, Worcestershire and Warks UKG2 Shropshire and	

		Staffordshire UKG3 West Midlands UKK2 Dorset and Somerset UKK3 Cornwall and Isles of Scilly UKK4 Devon UKL1 West Wales and The Valleys UKL2 East Wales UKM2 Eastern Scotland UKM3 South Western Scotland UKM4 Highlands and Islands UKN Northern Ireland	
Low household telecoms uptake	DED2 Dresden DED3 Leipzig SK01 Bratislavský	CY Kypros DED1 Chemnitz EE Eesti ES52 Comunidad Valenciana FR21 Champagne-Ardenne FR22 Picardie FR23 Haute-Normandie FR24 Centre FR25 Basse-Normandie FR26 Bourgogne FR3 Nord - Pas-de-Calais FR41 Lorraine FR42 Alsace FR43 Franche-Comté FR51 Pays de la Loire FR52 Bretagne FR53 Poitou-Charentes FR61 Aquitaine FR62 Midi-Pyrénées FR63 Limousin FR71 Rhône-Alpes FR72 Auvergne FR81 Languedoc-Roussillon FR82 Provence-Alpes-Côte d'Azur FR83 Corse GR3 Attiki PL01 Dolnoslaskie PL02 Kujawsko-Pomorskie PL03 Lubelskie PL04 Lubuskie PL05 Lódzkie PL06 Malopolskie PL07 Mazowieckie PL08 Opolskie PL09 Podkarpackie PL0A Podlaskie PL0B Pomorskie PL0C Slaskie	BG01 Severozapaden BG02 Severen Tsentralen BG03 Severoiztochen BG04 Yugozapaden BG05 Yuzhen Tsentralen BG06 Yugoiztochen ES13 Cantabria ES23 La Rioja ES42 Castilla-la Mancha ES43 Extremadura GR11 Anatoliki Makedonia, Thraki GR12 Kentriki Makedonia GR13 Dytiki Makedonia GR14 Thessalia GR21 Ipeiros GR22 Ionia Nisia GR23 Dytiki Ellada GR24 Sterea Ellada GR25 Peloponnisos GR41 Voreio Aigaio GR42 Notio Aigaio GR43 Kriti HU01 Közép-Magyarország HU02 Közép-Dunántúl HU03 Nyugat-Dunántúl HU04 Dél-Dunántúl HU05 Észak-

		PL0D Swietokrzyskie PL0E Warminsko-Mazurskie PL0F Wielkopolskie PL0G Zachodniopomorskie SK02 Západné Slovensko SK03 Stredné Slovensko SK04 Východné Slovensko	Magyarország HU06 Észak-Alföld HU07 Dél-Alföld LT Lietuva LV Latvija PT11 Norte PT12 Centro (PT) PT14 Alentejo PT15 Algarve RO01 Nord-Est RO02 Sud-Est RO03 Sud RO04 Sud-Vest RO05 Vest RO06 Nord-Vest RO07 Centru RO08 Bucuresti
Not included (not sufficient data)	CH01 Région Lémanique CH02 Espace Mittelland CH03 Suisse Du Nord-Est CH04 Zürich CH05 Suisse Orientale CH06 Suisse Centrale CH07 Ticino ES7 Canarias (ES) FI2 Åland FR91 Guadeloupe (FR) FR92 Martinique (FR) FR93 Guyane (FR) FR94 Réunion (FR) PT2 Açores (PT) PT3 Madeira (PT)		

Source: CURDS

Table A12.4: An overall typology of combined household and business telecommunications development into a single index

Typology category*	NUTS 2	Region	Index score
Highly advanced telecoms regions	SE01	Stockholm	11.16667
	SE07	Mellersta Norrland	11
	SE02	Östra Mellansverige	10.83333
	SE08	Övre Norrland	10.83333
	SE04	Sydsverige	10.5
	DK	Danmark	10.16667
	SE09	Småland med öarna	10.16667
	NL21	Overijssel	10
	NL32	Noord-Holland	10
	SE0A	Västsverige	9.833333
	DE6	Hamburg	9.666667
	NL33	Zuid-Holland	9.666667
	NL22	Gelderland	9.5
	NL23	Flevoland	9.5
	BE1	Région Bruxelles-capitale/Brussels hoofdstad gewest	9.333333
	NO01	Oslo Og Akershus	9.333333
	UKI1	Inner London	9.333333
	BE21	Antwerpen	9.166667
	NL31	Utrecht	9.166667
	NL34	Zeeland	9.166667
	FI16	Uusimaa (suuralue)	9
	UKI2	Outer London	9
Advanced telecoms regions	UKC1	Tees Valley and Durham	8.833333
	UKC2	Northumberland, Tyne and Wear	8.833333
	BE23	Oost-Vlaanderen	8.666667
	BE25	West-Vlaanderen	8.5
	NL41	Noord-Brabant	8.5
	NL42	Limburg (NL)	8.5
	BE22	Limburg (B)	8.333333
	BE24	Vlaams Brabant	8.333333
	SE06	Norra Mellansverige	8.166667
	UKJ1	Berkshire, Bucks and Oxfordshire	8.166667
	UKD3	Greater Manchester	8
	UKD5	Merseyside	8
	UKH1	East Anglia	8
	UKD1	Cumbria	7.833333
	UKD4	Lancashire	7.833333
	UKJ2	Surrey, East and West Sussex	7.833333
	UKJ3	Hampshire and Isle of Wight	7.833333
	UKN	Northern Ireland	7.833333
	AT32	Salzburg	7.666667

	AT33	Tirol	7.666667
	LU	Luxembourg	7.666667
	UKD2	Cheshire	7.666667
	UKG3	West Midlands	7.666667
	UKH2	Bedfordshire, Hertfordshire	7.666667
	UKH3	Essex	7.666667
	AT31	Oberösterreich	7.5
	DE3	Berlin	7.5
	ITB	Sardegna	7.5
	UKJ4	Kent	7.5
Moderately advanced telecoms regions	AT34	Vorarlberg	7.333333
	CZ01	Praha	7.333333
	FR1	Île de France	7.333333
	UKM1	North Eastern Scotland	7.333333
	UKM2	Eastern Scotland	7.333333
	UKM3	South Western Scotland	7.333333
	AT13	Wien	7.166667
	DE21	Oberbayern	7.166667
	ES53	Islas Baleares	7.166667
	FI14	Väli-Suomi	7.166667
	NL11	Groningen	7.166667
	NL12	Friesland	7.166667
	UKG1	Herefordshire, Worcestershire and Warks	7.166667
	UKG2	Shropshire and Staffordshire	7.166667
	UKM4	Highlands and Islands	7.166667
	DE71	Darmstadt	7
	DEA1	Düsseldorf	7
	NL13	Drenthe	7
	NO04	Agder Og Rogaland	7
	NO05	Vestlandet	7
	NO06	Trøndelag	7
	UKK1	Gloucestershire, Wiltshire and North Somerset	7
	BE33	Liège	6.833333
	DE25	Mittelfranken	6.833333
	DE92	Hannover	6.833333
	DEA2	Köln	6.833333
	DEA5	Arnsberg	6.833333
	ES12	Principado de Asturias	6.833333
	ES51	Cataluña	6.833333
	IT51	Toscana	6.833333
	BE32	Hainaut	6.666667

	BE35	Namur	6.666667
	DE5	Bremen	6.666667
	DEA4	Detmold	6.666667
	FI17	Etelä-Suomi	6.666667
	IT52	Umbria	6.666667
	IT53	Marche	6.666667
	NO02	Hedmark Og Oppland	6.666667
	NO03	Sør-Østlandet	6.666667
	NO07	Nord-Norge	6.666667
	UKE4	West Yorkshire	6.666667
	UKK2	Dorset and Somerset	6.666667
	UKK4	Devon	6.666667
	BE31	Brabant Wallon	6.5
	BE34	Luxembourg (B)	6.5
	DE26	Unterfranken	6.5
	DE27	Schwaben	6.5
	DEF	Schleswig-Holstein	6.5
	ES22	Comunidad Foral de Navarra	6.5
	IT2	Lombardia	6.5
	UKE2	North Yorkshire	6.5
	UKF1	Derbyshire and Nottinghamshire	6.5
	UKF2	Leicestershire, Rutland and Northants	6.5
	UKL1	West Wales and The Valleys	6.5
	UKL2	East Wales	6.5
	AT12	Niederösterreich	6.333333
	AT21	Kärnten	6.333333
	DE11	Stuttgart	6.333333
	DE23	Oberpfalz	6.333333
	DEB1	Koblenz	6.333333
	DEB2	Trier	6.333333
	DEB3	Rheinhessen-Pfalz	6.333333
	ES3	Comunidad de Madrid	6.333333
	IT91	Puglia	6.333333
	PL07	Mazowieckie	6.333333
	UKE1	East Riding and North Lincolnshire	6.333333
	UKK3	Cornwall and Isles of Scilly	6.333333
	AT11	Burgenland	6.166667
	AT22	Steiermark	6.166667
	DE12	Karlsruhe	6.166667
	DE22	Niederbayern	6.166667
	DE24	Oberfranken	6.166667
	DE91	Braunschweig	6.166667
	DE93	Lüneburg	6.166667

	DE94	Weser-Ems	6.166667
	DEA3	Münster	6.166667
	IT11	Piemonte	6.166667
	IT31	Trentino-Alto Adige	6.166667
	IT32	Veneto	6.166667
	IT33	Friuli-Venezia Giulia	6.166667
	IT92	Basilicata	6.166667
	IT93	Calabria	6.166667
	UKE3	South Yorkshire	6.166667
	UKF3	Lincolnshire	6.166667
	DE72	Gießen	6
	DE73	Kassel	6
	DE8	Mecklenburg-Vorpommern	6
	IT71	Abruzzo	6
	IT72	Molise	6
Moderate telecoms regions	DE13	Freiburg	5.833333
	ES63	Ceuta y Melilla (ES)	5.833333
	IT13	Liguria	5.833333
	IT4	Emilia-Romagna	5.833333
	IT6	Lazio	5.833333
	DEE3	Magdeburg	5.666667
	DEG	Thüringen	5.666667
	ES21	Pais Vasco	5.666667
	FI13	Itä-Suomi	5.666667
	FI15	Pohjois-Suomi	5.666667
	HU01	Közép-Magyarország	5.666667
	IE01	Border, Midlands and Western	5.666667
	IT12	Valle d'Aosta	5.666667
	DE14	Tübingen	5.5
	ES11	Galicia	5.5
	ES24	Aragón	5.5
	ES41	Castilla y León	5.5
	IT8	Campania	5.5
	DE4	Brandenburg	5.333333
	DEE1	Dessau	5.333333
	DEE2	Halle	5.333333
	ES61	Andalucia	5.333333
	FR61	Aquitaine	5.333333
	IE02	Southern and Eastern	5.333333
	DEC	Saarland	5.166667
	ES52	Comunidad Valenciana	5.166667
	FR62	Midi-Pyrénées	5.166667
	ITA	Sicilia	5.166667
	PT13	Lisboa e Vale do Tejo	5.166667
	SK01	Bratislavský	5
	ES62	Région de Murcia	4.833333

	GR3	Attiki	4.833333
	GR42	Notio Aigaio	4.833333
	CY	Kypros	4.666667
	DED3	Leipzig	4.666667
	FR42	Alsace	4.666667
	FR63	Limousin	4.666667
	DED2	Dresden	4.5
	FR3	Nord - Pas-de-Calais	4.5
	FR52	Bretagne	4.5
	FR71	Rhône-Alpes	4.5
	FR81	Languedoc-Roussillon	4.5
	FR82	Provence-Alpes-Côte d'Azur	4.5
	GR43	Kriti	4.5
	FR41	Lorraine	4.333333
	FR51	Pays de la Loire	4.333333
	FR53	Poitou-Charentes	4.333333
	GR14	Thessalia	4.333333
	GR21	Ipeiros	4.333333
	PL0C	Slaskie	4.333333
	DED1	Chemnitz	4.166667
	GR11	Anatoliki Makedonia, Thraki	4.166667
	GR22	Ionia Nisia	4.166667
	GR23	Dytiki Ellada	4.166667
	ES43	Extremadura	4
	FR43	Franche-Comté	4
	GR13	Dytiki Makedonia	4
	GR24	Sterea Ellada	4
	HU03	Nyugat-Dunántúl	4
	MT	Malta	4
	PL0F	Wielkopolskie	4
	PT11	Norte	4
Lagging telecoms regions	ES42	Castilla-la Mancha	3.833333
	FR21	Champagne-Ardenne	3.833333
	FR22	Picardie	3.833333
	FR23	Haute-Normandie	3.833333
	FR24	Centre	3.833333
	FR26	Bourgogne	3.833333
	FR83	Corse	3.833333
	GR12	Kentriki Makedonia	3.833333
	GR25	Peloponnisos	3.833333
	CZ02	Strední Cechy	3.666667
	EE	Eesti	3.666667
	ES13	Cantabria	3.666667
	ES23	La Rioja	3.666667
	FR25	Basse-Normandie	3.666667
	FR72	Auvergne	3.666667
	HU02	Közép-Dunántúl	3.666667

	PL01	Dolnoslaskie	3.666667
	PL02	Kujawsko-Pomorskie	3.666667
	PL06	Malopolskie	3.666667
	PL0B	Pomorskie	3.666667
	PT12	Centro (PT)	3.666667
	PT14	Alentejo	3.666667
	SI	Slovenija	3.666667
	PL04	Lubuskie	3.333333
	PL05	Lódzkie	3.333333
	PL0G	Zachodniopomorskie	3.333333
	GR41	Voreio Aigaio	3.166667
	PT15	Algarve	3.166667
	CZ06	Jihovýchod	3
	ES7	Canarias (ES)	3
	PT3	Madeira (PT)	3
	CZ03	Jihozápad	2.666667
	CZ04	Severozápad	2.666667
	CZ07	Strední Morava	2.666667
	CZ08	Moravskoslezko	2.666667
	HU04	Dél-Dunántúl	2.666667
	HU05	Észak-Magyarország	2.666667
	HU06	Észak-Alföld	2.666667
	HU07	Dél-Alföld	2.666667
	PL09	Podkarpackie	2.666667
	PL0E	Warminsko-Mazurskie	2.666667
	SK02	Západné Slovensko	2.666667
	SK03	Stredné Slovensko	2.666667
	SK04	Východné Slovensko	2.666667
Highly lagging telecoms regions	CZ05	Severovýchod	2.333333
	LT	Lietuva	2.333333
	LV	Latvija	2.333333
	PL03	Lubelskie	2.333333
	PL08	Opolskie	2.333333
	PL0A	Podlaskie	2.333333
	PL0D	Swietokrzyskie	2.333333
	BG04	Yugozapaden	2
	PT2	Açores (PT)	2
	RO08	Bucuresti	2
	BG01	Severozapaden	1.666667
	BG02	Severen Tsentralen	1.666667
	BG03	Severoiztochen	1.666667
	BG05	Yuzhen Tsentralen	1.666667
	BG06	Yugoiztochen	1.666667
	RO01	Nord-Est	1.666667
	RO02	Sud-Est	1.666667
	RO03	Sud	1.666667
	RO04	Sud-Vest	1.666667
	RO05	Vest	1.666667

	RO06	Nord-Vest	1.666667
	RO07	Centru	1.666667

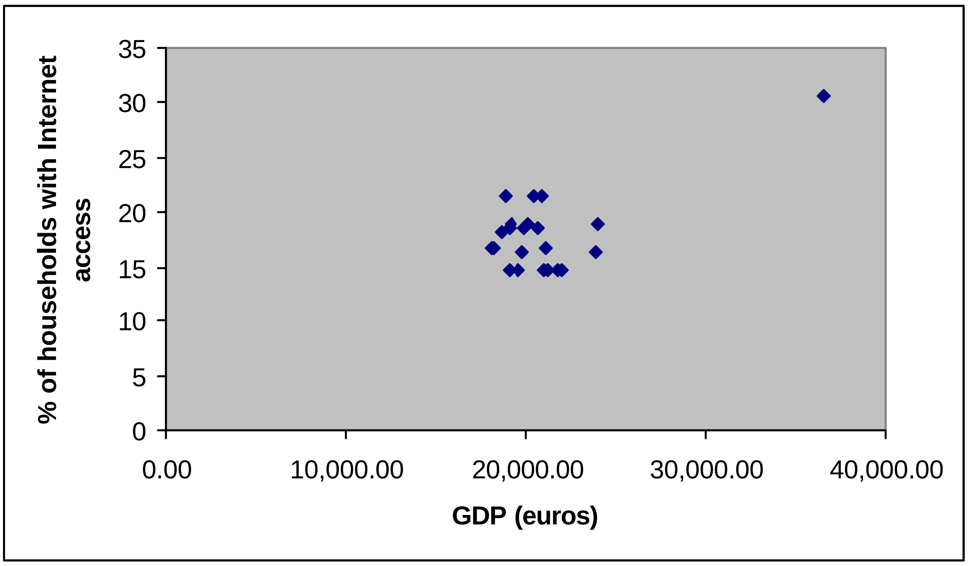
* It should be noted that these categorisations of regions depict the situation as of the time of the data we have used to construct them (for example, the INRA household survey was conducted in 2002). In such a fast-moving environment as telecommunications, therefore, some regions may have moved up or down this categorisation. It should thus be read with some level of caution.

Source: CURDS

Annex 13 – Scatter plots of the respective relationships between household telecommunications uptake and socio-economic-geographic variables for France, Germany, Spain and Sweden

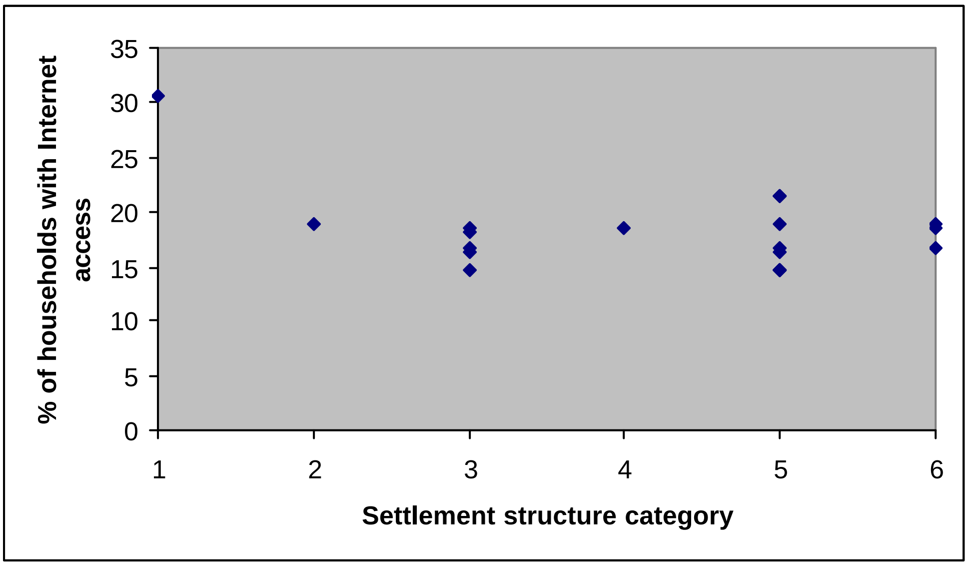
1. France

Figure A13.1: The relationship between household Internet access and GDP level in French regions



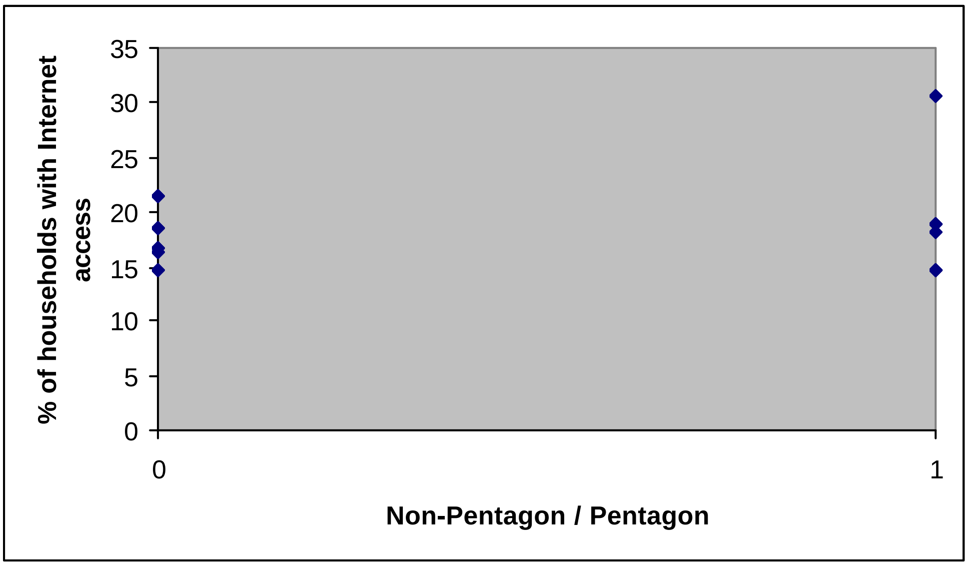
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.2: The relationship between household Internet access and population density/urban status in French regions



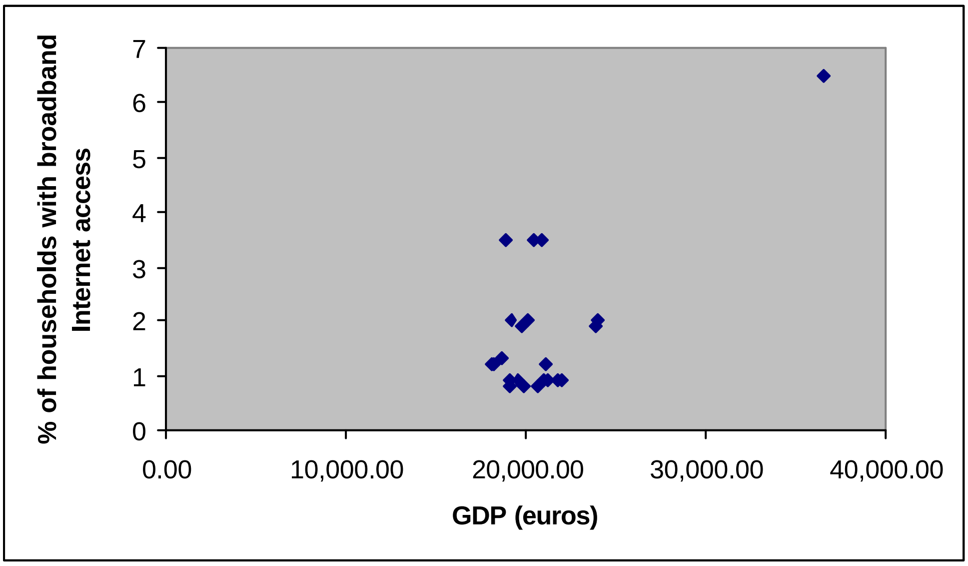
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.3: The relationship between household Internet access and Pentagon location in French regions



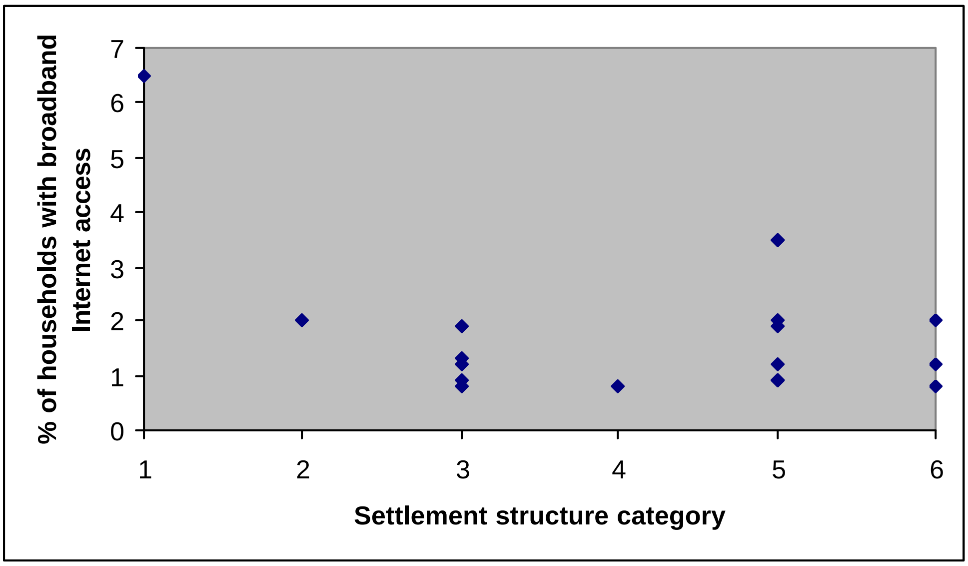
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.4: The relationship between broadband Internet access at home and GDP level in French regions



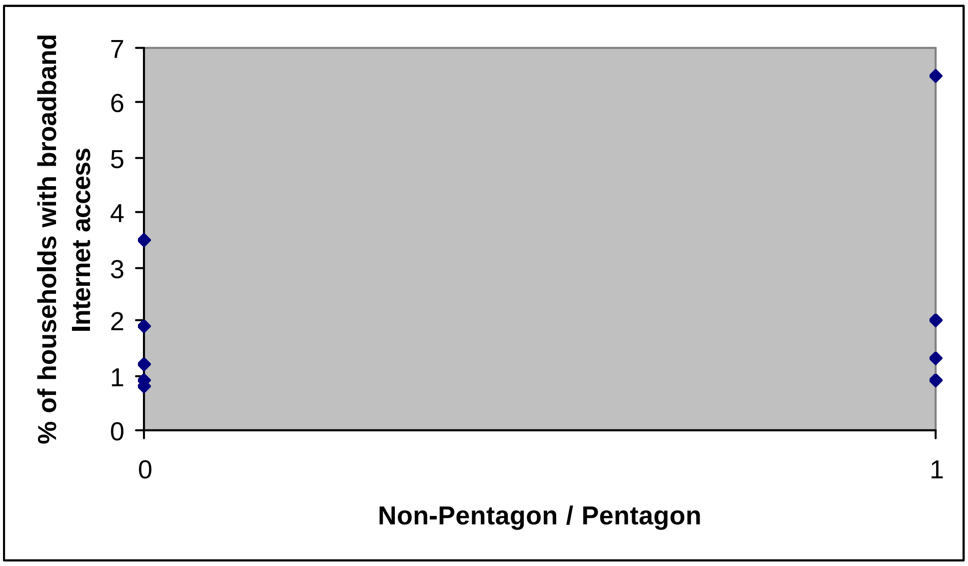
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.5: The relationship between broadband Internet access at home and population density/urban status in French regions



Source: CURDS; based on data drawn from INRA (2004)

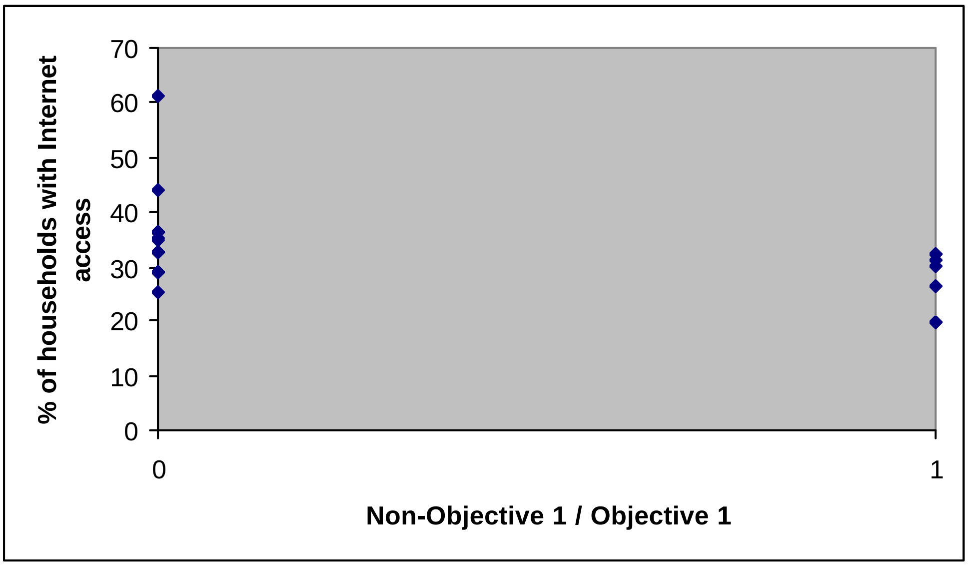
Figure A13.6: The relationship between broadband Internet access at home and Pentagon location in French regions



Source: CURDS; based on data drawn from INRA (2004)

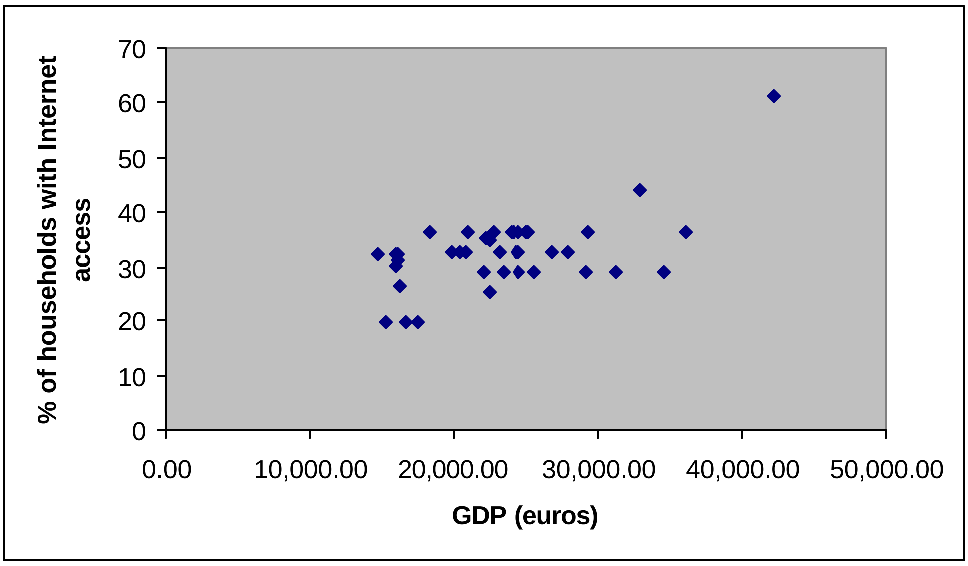
2. Germany

Figure A13.7: The relationship between household Internet access and Objective 1 status in German regions



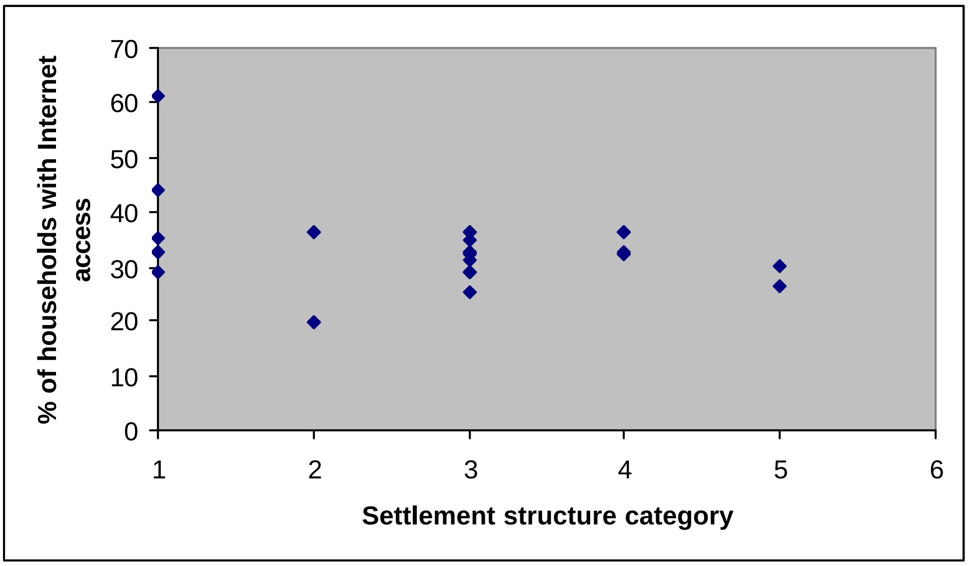
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.8: The relationship between household Internet access and GDP level in German regions



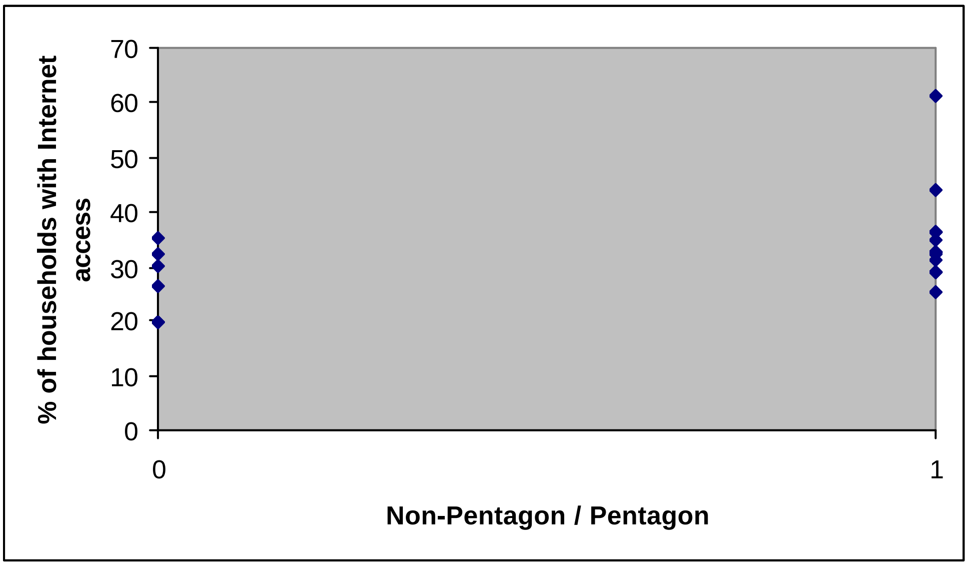
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.9: The relationship between household Internet access and population density/urban status in German regions



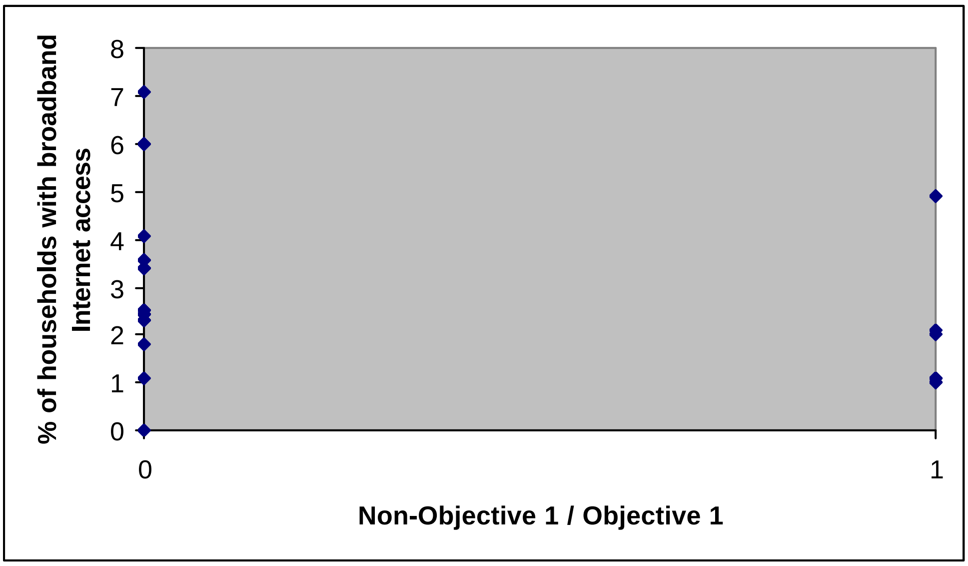
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.10: The relationship between household Internet access and Pentagon location in German regions



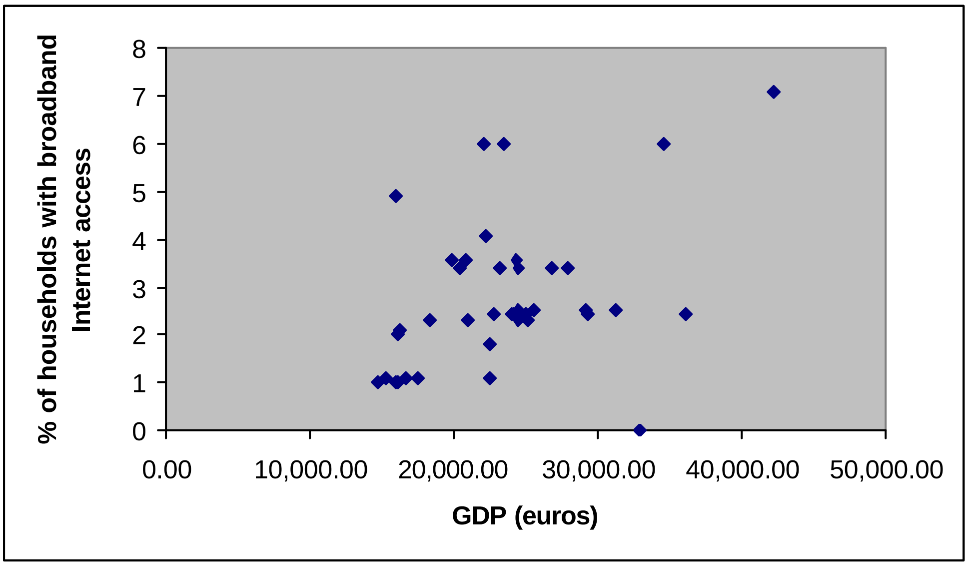
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.11: The relationship between broadband Internet access at home and Objective 1 status in German regions



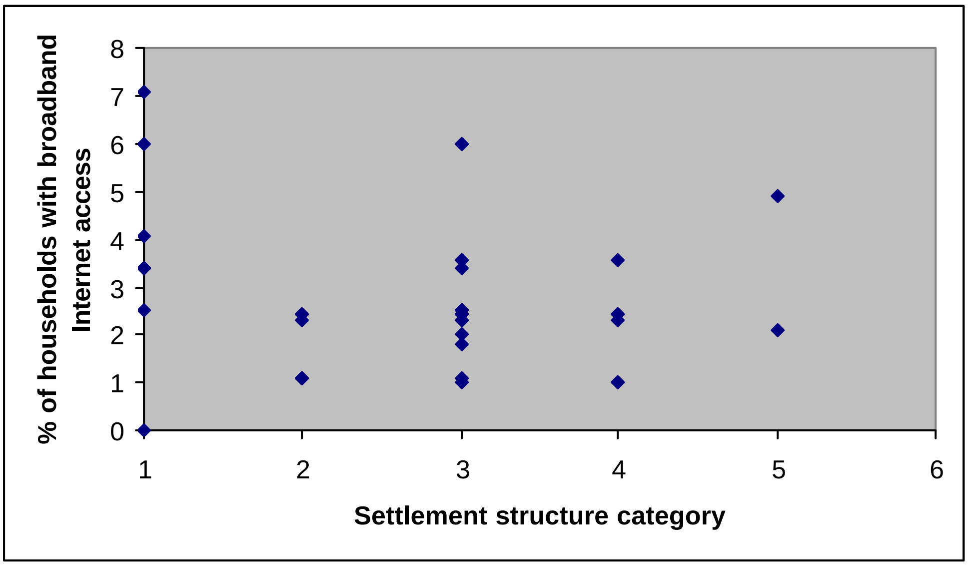
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.12: The relationship between broadband Internet access at home and GDP level in German regions



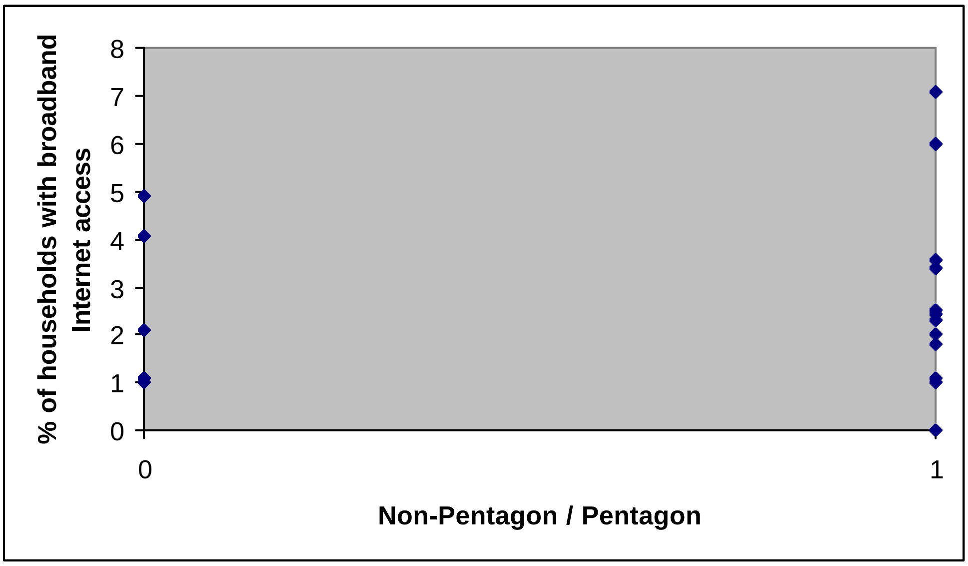
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.13: The relationship between broadband Internet access at home and population density/urban status in German regions



Source: CURDS; based on data drawn from INRA (2004)

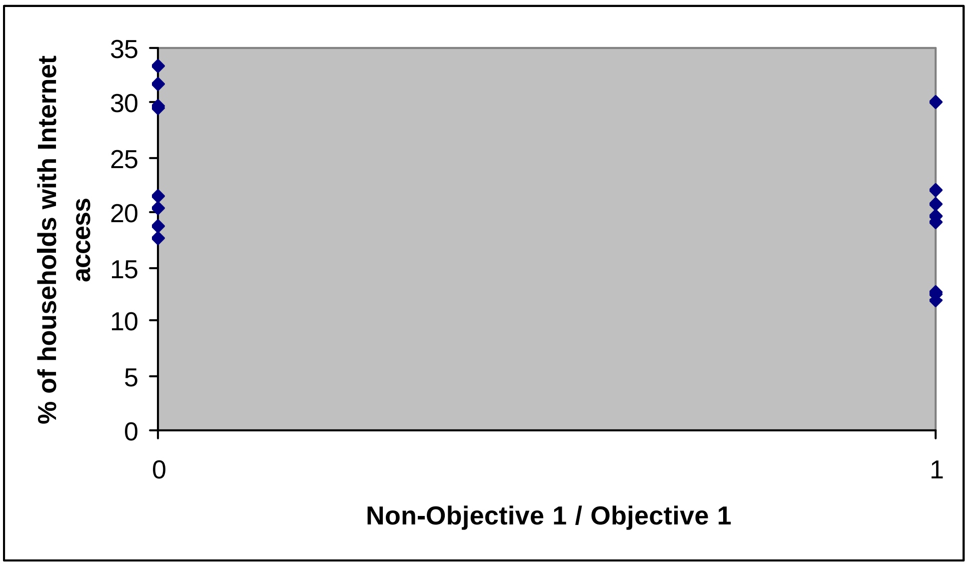
Figure A13.14: The relationship between broadband Internet access at home and Pentagon location in German regions



Source: CURDS; based on data drawn from INRA (2004)

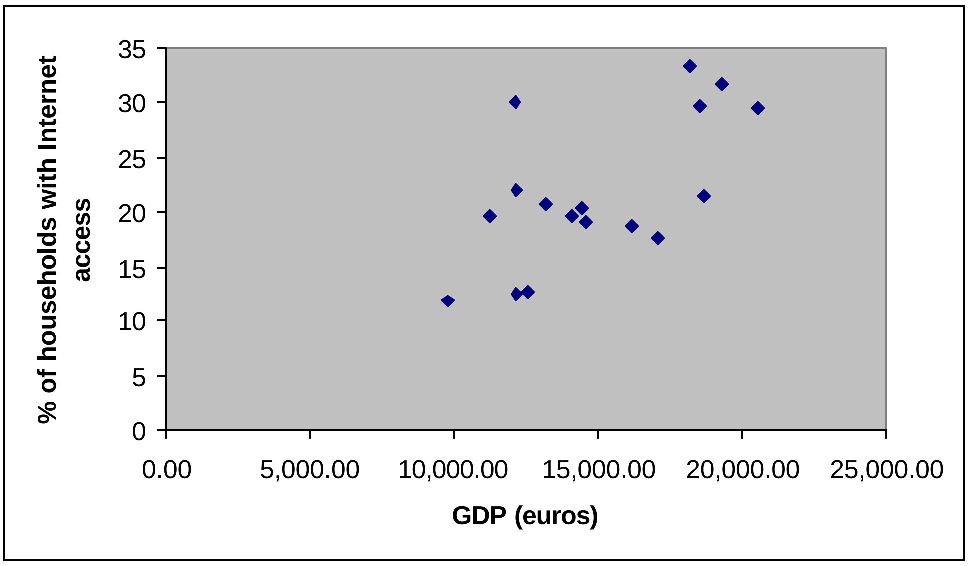
3. Spain

Figure A13.15: The relationship between household Internet access and Objective 1 status in Spanish regions



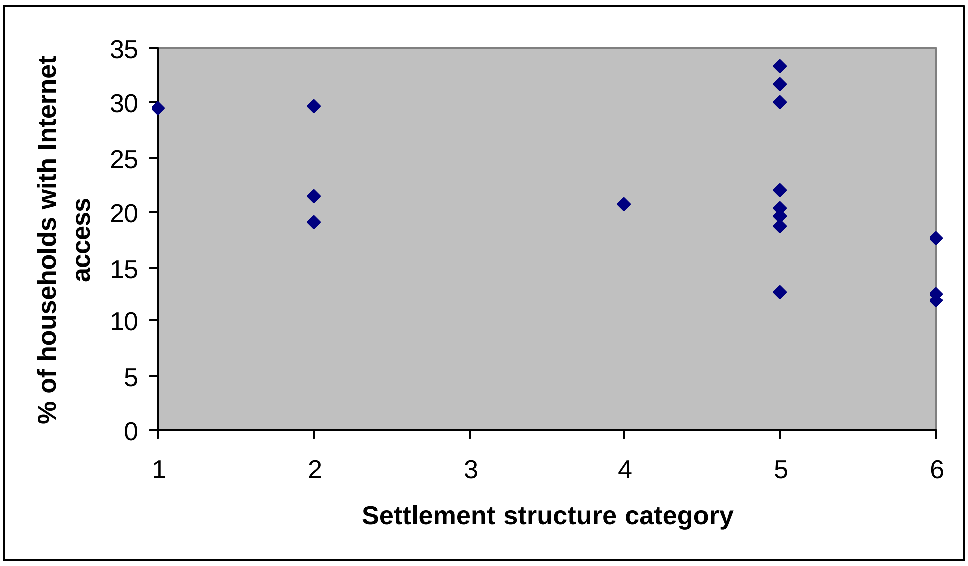
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.16: The relationship between household Internet access and GDP level in Spanish regions



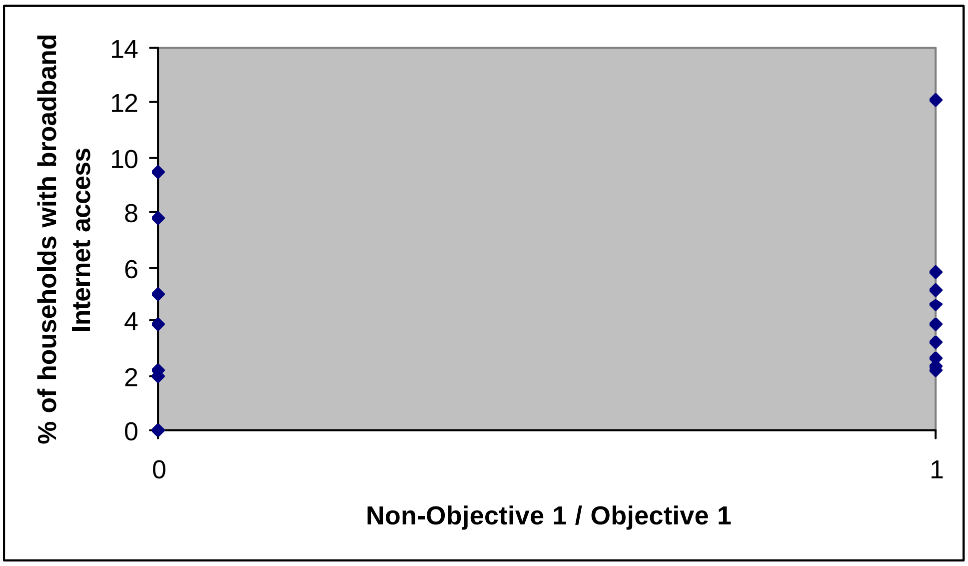
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.17: The relationship between household Internet access and population density/urban status in Spanish regions



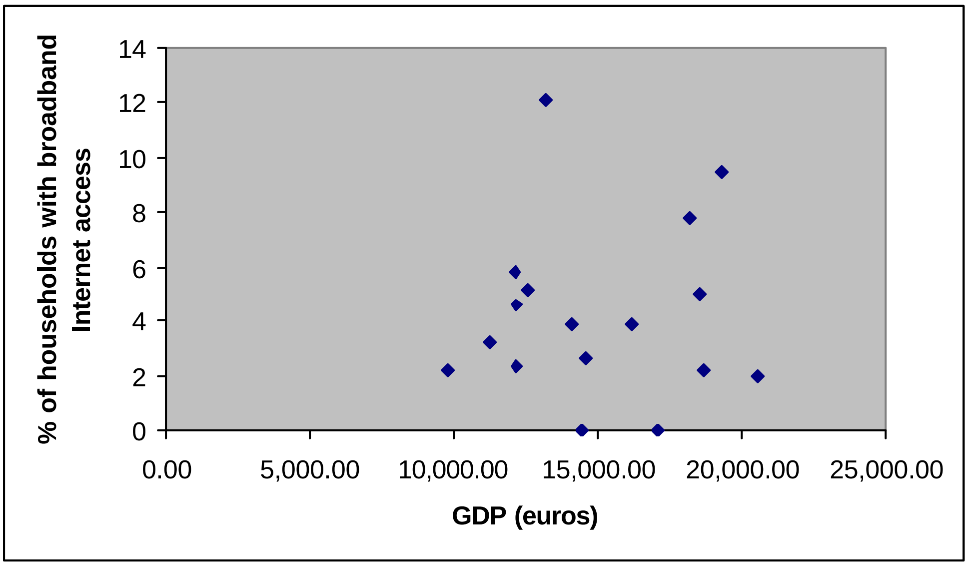
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.18: The relationship between broadband Internet access at home and Objective 1 status in Spanish regions



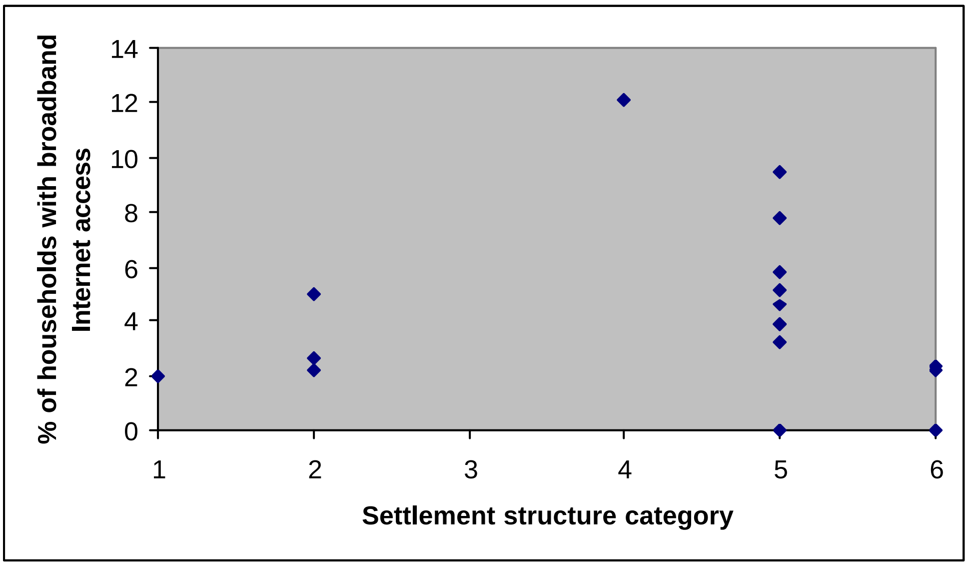
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.19: The relationship between broadband Internet access at home and GDP level in Spanish regions



Source: CURDS; based on data drawn from INRA (2004)

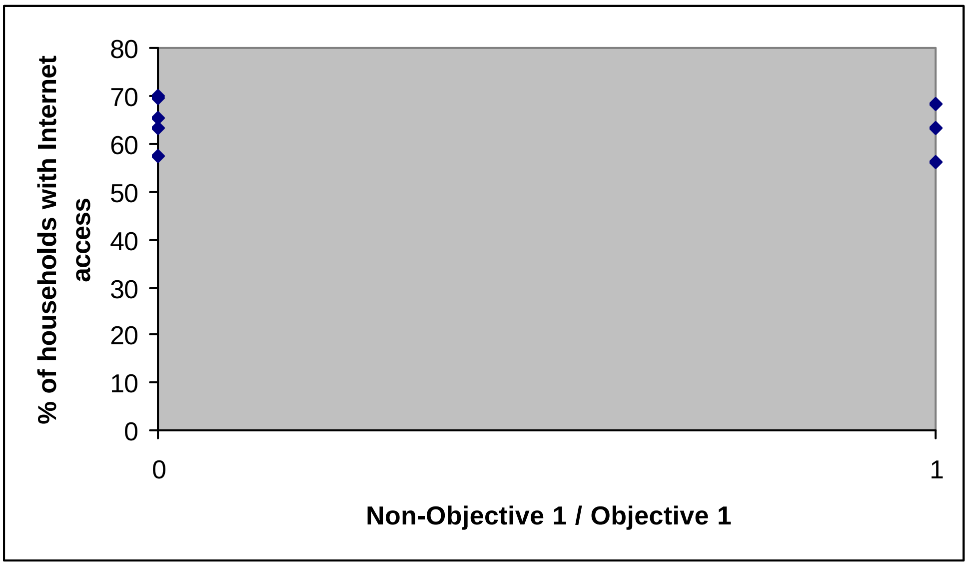
Figure A13.20: The relationship between broadband Internet access at home and population density/urban status in Spanish regions



Source: CURDS; based on data drawn from INRA (2004)

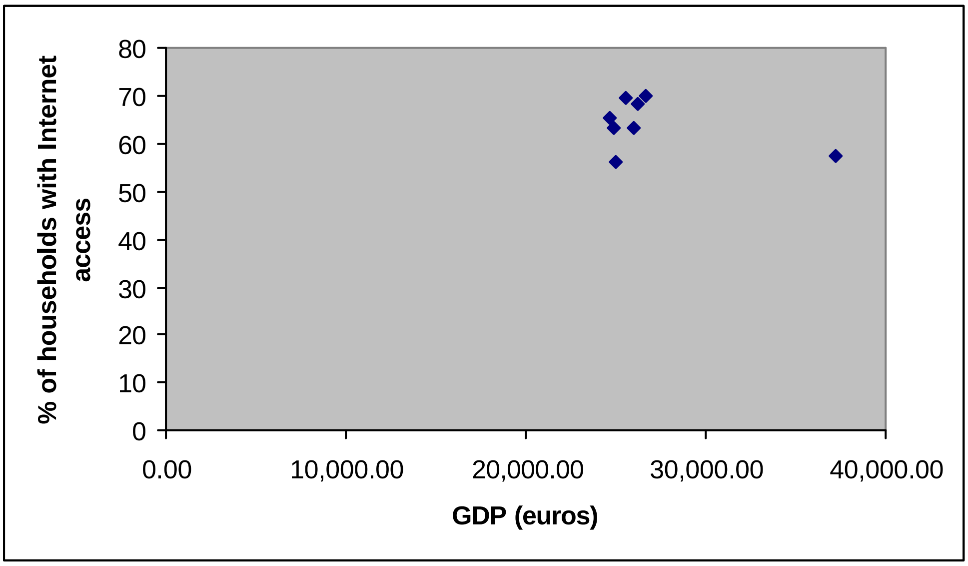
4. Sweden

Figure A13.21: The relationship between household Internet access and Objective 1 status in Swedish regions



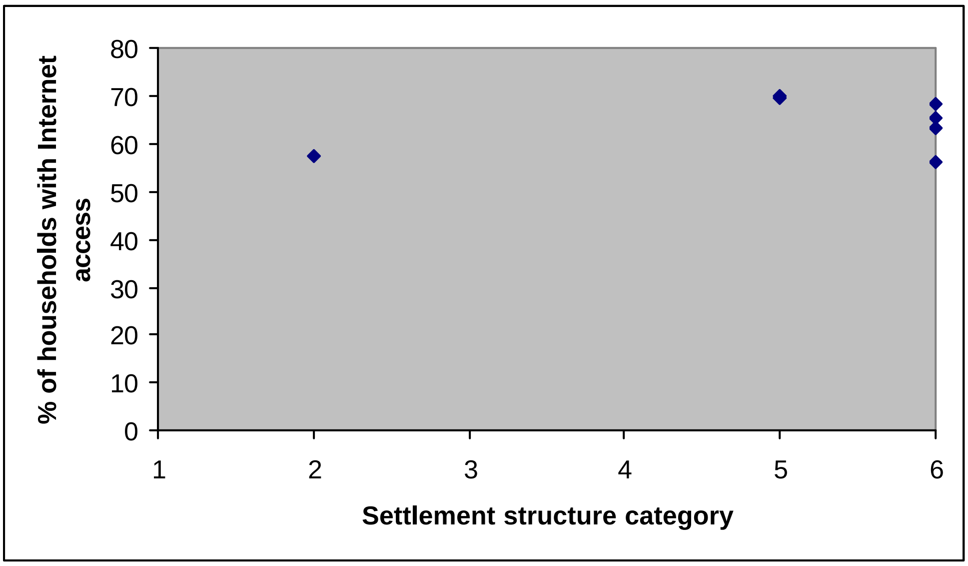
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.22: The relationship between household Internet access and GDP level in Swedish regions



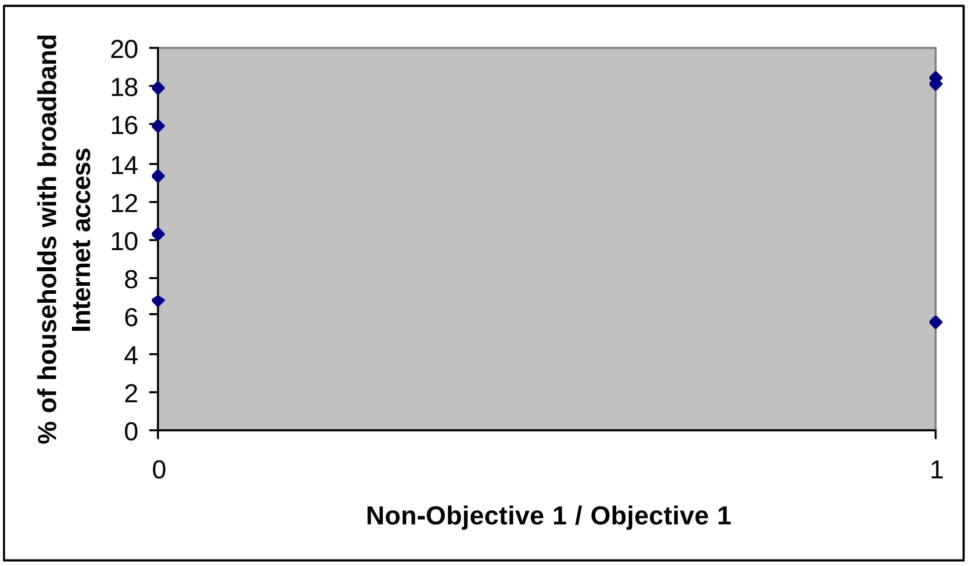
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.23: The relationship between household Internet access and population density/urban status in Swedish regions



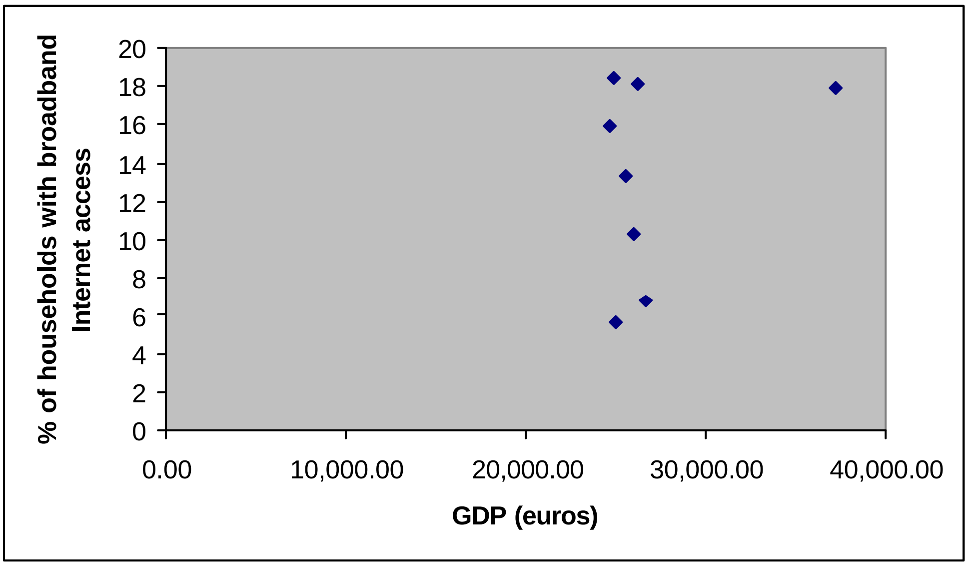
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.24: The relationship between broadband Internet access at home and Objective 1 status in Swedish regions



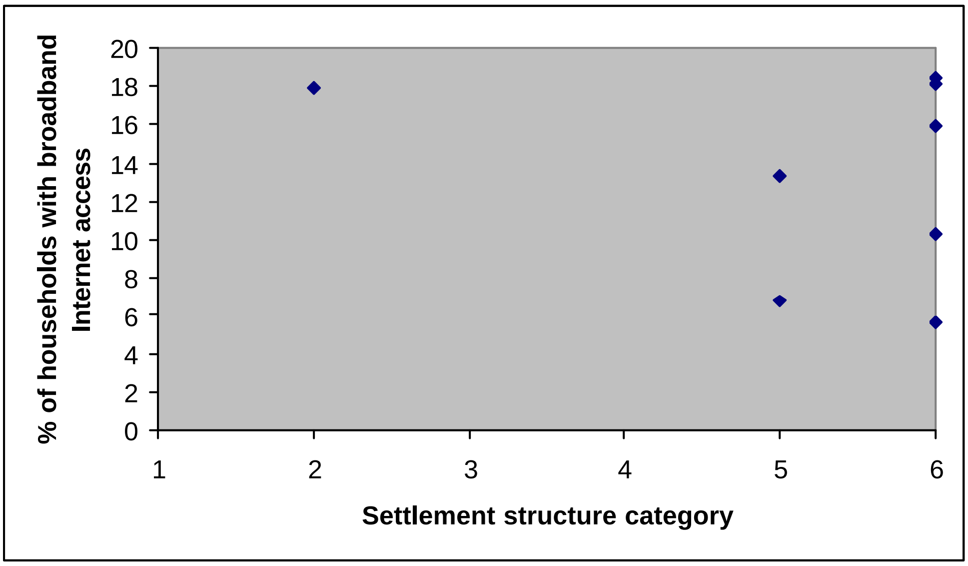
Source: CURDS; based on data drawn from INRA (2004)

Figure A13.25: The relationship between broadband Internet access at home and GDP level in Swedish regions



Source: CURDS; based on data drawn from INRA (2004)

Figure A13.26: The relationship between broadband Internet access at home and population density/urban status in Swedish regions



Source: CURDS; based on data drawn from INRA (2004)

Annex 14 – List of abbreviations and glossary

ADSL	Asynchronous Digital Subscriber Line – a means of offering fast Internet access by signal compression, through the use of existing copper analogue networks in the local loop, and thereby necessitating a modem for the user and a modem at the local exchange. A line can be simultaneously used for voice and data communications.
Bandwidth	The quantity of spectrum needed for a particular purpose.
Broadband	Networks and/or services capable of handling large volumes of data.
CLEC	Competitive Local Exchange Carrier – a competitive, or new entrant, telecommunications operator, as opposed to an incumbent.
Coaxial cable	Cable used for the transmission of wideband information and data, although its capacity is less than fibre optic cable.
Dark fibre	Unactivated fibre optic cable.
DSLAM	Digital Subscriber Line Access Multiplexer – the piece of equipment installed at a telephone exchange that links many customer DSL connections to a single high-speed ATM line for access to the Internet, then back through the DSLAM and ADSL modem before returning to the customer's PC.
Fibre optic networks	Networks founded on the transmission of light-based signals (rather than electric ones), which are capable of providing very high communications capacities, but which need very great local investment for deployment.
Fixed wireless access	See Wireless local loop.
Gbps	Gigabits per second, roughly equating to 10^9 bits per second.
Incumbent	The former monopoly operator in a particular country, eg BT in the UK or France Télécom in France.
IP	Internet Protocol – the definition of transmissions of data packets between network systems.
ISDN	Integrated Services Digital Network – one of the first attempts at offering simultaneous digital voice and data transmission through the conversion of a traditional analogue telephone line.
Kbps	Kilobits per second, roughly equating to 10^3 bits per second.
LAN	Local Area Network – a network focused on exchange and transmission within a small area, such as a building or cluster of buildings.
Leased line	A line dedicated solely to a private user. These are used particularly by large businesses and financial institutions for transmission of high volumes of data.
Local loop	Alternatively the 'last mile' or 'last kilometre', or the copper pair, which is the part of the network where the operator directly provides a line from the local exchange to the final client. Until the process of unbundling, this was completely under the control of the incumbent operator.
LLU	Local Loop Unbundling – the process which allows competitive operators to lease lines in the 'last mile' of the incumbent's network, and to have access to the latter's local exchanges for the deployment of their own equipment. The local loop is the last vestige of the PTT network monopoly era, and thus, its unbundling will theoretically create a fully open market in telecommunications networks.
MAN	Metropolitan Area Network.
Mbps	Megabits per second, roughly equating to 10^6 bits per second.
Packet switching	A transmission method relying on the division of the data or information into specific sized packets.
POTS	Plain Old Telephone Service – the traditional basic voice telephony service.
PSTN	Public Switched Telephone Network.
Shorthaul	Point to point fibre links over a short distance.
3G	Third generation mobile networks.

UMTS	Universal Mobile Telecommunication Standard – the industry basis for third generation mobile networks.
Wireless local loop	Recent broadband communications technology which uses very high frequency Hertzian wavelengths to provide fast Internet access through radio links instead of through a telephone line.

Annex 15 – List of indicators developed and datasets provided to the ESPON Database

Datasets provided to the ESPON Database

NUTS 0 level

Telephone subscribers per 100 inhabitants (ITU, 2001)
Internet users per 10,000 inhabitants, 2001 (ITU, 2001)
Estimated PCs per 100 inhabitants, 2001 (ITU, 2001)
Largest city teledensity, 2000 (ITU, 2001)
Rest of country teledensity, 2000 (ITU, 2001)
Overall country teledensity, 2000 (ITU, 2001)
Residential main lines per 100 households, 2000 (ITU, 2001)
New telephone lines added 2000-2001, CAGR in percent (ITU, 2001)
New mobile subscribers added 2000-2001, CAGR in percent (ITU, 2001)
New Internet hosts added 2000-2001, CAGR in percent (ITU, 2001)
Proportion of households subscribing to cable TV (ITU, 2001)
Main telephone lines per 100 inhabitants, 2001 (ITU, 2001)
Main telephone lines CAGR in percent 1995-2001 (ITU, 2001)
Share of main lines connected to digital exchanges (ITU, 2001)
Cellular subscribers per 100 inhabitants (ITU, 2001)
Cellular CAGR in percent 1995-2001 (ITU, 2001)
Share of broadband penetration to population, 2002 (ITU, 2002)

Main telephone lines per 100 inhabitants, 2003 (ITU, 2003)
Cellular subscribers per 100 inhabitants, 2003 (ITU, 2003)
Estimated PCs per 100 inhabitants, 2003 (ITU, 2003)
Internet users per 10,000 inhabitants, 2003 (ITU, 2003)

NUTS 2 level

Share of Internet users to 100 inhabitants (CEIDET regression, 2003)

Proportion of firms with their own website (CEIDET regression, 2003)

% of households with fixed and/or mobile, EU15, 2002 (INRA, 2004)
% of households with a fixed line, EU15, 2002 (INRA, 2004)
% of households with at least one mobile, EU15, 2002 (INRA, 2004)
% of households with a PC, EU15, 2002 (INRA, 2004)
% of households with Internet access, EU15, 2002 (INRA, 2004)
% of households with broadband Internet access, EU15, 2002 (INRA, 2004)
% of households with broadband DSL, EU15, 2002 (INRA, 2004)
% of households with broadband cable, EU15, 2002 (INRA, 2004)

Estimated proportion of firms with Internet access, 2003 (CEIDET regression, 2004)
Estimated proportion of firms with their own website, 2003 (CEIDET regression, 2004)

A typology of levels of household telecommunications uptake (CURDS, 2004)
A typology of estimated levels of business telecommunications access and uptake (CURDS, 2004)
A typology comparing levels of household and business telecommunications uptake (CURDS, 2004)
An overall typology of combined household and business telecommunications development into a single index (CURDS, 2004)

Annex 16 – List of missing data

The table below presents a list of indicators against which we had hoped to obtain data. As described in our Third Interim Report, we were unable to obtain data for most indicators below the national level. Where we did obtain data this was for a small number of countries and was obtained at different territorial levels. This process is discussed in detail in our Third Interim Report. Data has been obtained for some indicators via the INRA study but only at NUTS 2 level (NUTS 1 or 3 for a few countries) and only for EU15. In terms, therefore, of achieving harmonised data across the ESPON space, therefore, most data can be interpreted as missing. In Chapter 1 of the main report we suggest amendments to the indicators to concentrate on demand side indicators at NUTS 0-3 as a realistic approach to data collection.

Indicators developed for data collection in WP3 of 1.2.2 project

Indicators	NUTS 0	NUTS 1	NUTS 2	NUTS 3	NUTS 4	NUTS 5
Development of TN&S • Number of telephone access lines per 100 inhabitants • Faults per 100 main lines per year • Investment in communication network by operators per 100 inhabitants • Net change in number of main lines (+/-) in previous year • Proportion of exchanges digitised • **Proportion of main lines connected to digital exchange** • Proportion of exchanges ISDN enabled • ISDN lines as a proportion of total main lines • Proportion of exchanges ADSL enabled • **ADSL lines as a proportion of total main lines** • Homes passed by cable per 100 residencies • Homes passed by digital cable • **Cable modem lines as a proportion of total lines installed** • **Proportion of exchanges with co-located equipment (local loop unbundling)** • **Availability of Internet service with (a) local rate charges (b) unmetered access** • **Number of PIAPs per 1000 inhabitants** • Number of secure servers per						

10000 inhabitants (using IP address look up tables) • Competition in fixed network infrastructure (number of licenses; number of active providers?) • Competition in cellular phone infrastructure (number of licenses; number of active providers?) • Number of fixed network operators offering local national telecommunications • Number of fixed operators offering long distance national telecommunications • Number of operators offering international telecommunications • Number of cable service and satellite service providers • Maps of network configuration?						
Up-take and use of TN&S • Telephone subscribers per 100 inhabitants (i.e., fixed and mobile) • Percentage of households with a telephone • Installed PCs (with modem?) per 100 inhabitants • **Cellular subscribers per 100 inhabitants** • Proportion of households subscribing to Cable services • ISDN subscribers per 100 inhabitants • **ADSL subscribers per 10,000 inhabitants** • **Proportion of households with Internet access** • **Proportion of households with broadband Internet access** • Internet users per 1000 inhabitants (at work, at school or at home) Up-take and use by business • **Proportion of firms with access to the Internet** • Proportion of firms with own website • Proportion of firms making sales via e-commerce • Proportion of firms making purchases using e-commerce • Value of sales by businesses made via the Internet • Value of purchases made by businesses via the Internet • Use of broadband to access the internet by size of business • Level of business activity by type of internet access						

Annex 17 – List of publications of the TPG members resulting from the research undertaken

Eskelinen, H., Frank, L. & Hirvonen, T.: Fine-grained patterns of digital divide: differences of internet access within Finland. Paper presented in 43rd ERSA Congress, Jyväskylä, Finland, 27-30 August 2003.

Eskelinen, H., Frank, L. & Hirvonen, T.: Broadband strategies in thin milieux: comparing Nordic experiences. Paper presented in the 44th ERSA Congress, Porto, Portugal, 25-29 August 2004.

Eskelinen, H., Frank, L. & Hirvonen, T.: Laajakaista kaikkien ulottuville? (in Finnish) [Broadband accessible to everybody?].Yhteiskuntapolitiikka 69 (2004): 171-176.

Nemeth, S.: Hungary and the Information Society: getting a grip on territorial impacts. Paper presented in 43rd ERSA Congress, Jyväskylä, Finland, 27-30 August 2003.

Nemeth, S. & Frank. L.: Telecommunications networks and services in Estonia. Lessons to other European countries. Paper presented in the 44th ERSA Congress, Porto, Portugal, 25-29 August 2004.

Richardson, R., Rutherford, J. and Gillespie, A. (2004) "Telecommunications and Territorial Cohesion: Experiences from Europe". Paper presented at the WISICT Conference, Cancun, Mexico, 5-8 January 2004

Richardson, R. (2004) "Territorial trends and basic supply of infrastructure for territorial cohesion: the ESPON project". Paper presented at the Learning from benchmarking technical workshop on existing initiatives for benchmarking regions on information society, Bordeaux, 24th May 2004

Rutherford, J., Gillespie, A. and Richardson, R. (2004) 'The territoriality of pan-European telecommunications backbone networks'. Globalization and World Cities Study Group and Network Research Bulletin 136, available at http://www.lboro.ac.uk/gawc/rb/rb136.html (forthcoming in Journal of Urban Technology).

Rutherford, J., Gillespie, A. and Richardson, R. (forthcoming) 'Telecommunications and the world city network'.

Schintler, L., Gorman, S., Reggiani, A., Patuelli, R., Gillespie, A., Nijkamp, P. and Rutherford, J. (2004) 'Scale-free phenomena in telecommunications networks'. Paper presented to the Sustainable Transport in Europe and Links and Liaisons with America (STELLA) project synthesis meeting of focus group 2 on ICT, innovation and the transport system, Budapest, 22-23 April.

Annex 18 – Indication of ESPON performance indicators achieved

Table Annex 18.1: Number of performance indicators achieved

Number of spatial indicators developed: - in total covering - EU territory - More than EU territory	 41 41 0
Number of spatial indicators applied: - in total covering - EU territory - More than EU territory	 41 41 0
Number of spatial concepts defined	6
Number of spatial typologies tested	18
Number of EU maps produced	78
Number of ESDP policy options addressed	4

Annex 19

BROADBAND STRATEGIES IN THIN MILIEUX:
COMPARING NORDIC EXPERIENCES

ESPON 1.2.2.

Telecommunication Services and Networks:

Territorial Trends and Basic Supply of Infrastructure for Territorial Cohesion

7.5.2004

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ABSTRACT

Broadband infrastructures with a high transmission capacity are seen as a key precondition for the development of an information society, and therefore, their supply and availability have become important issues in public policies. The paper analyses the policy strategies applied in Finland and Sweden for promoting territorial rollout of broadband infrastructures. The experiences of these two countries can be seen to be of scientific interest and political relevance especially for the following two reasons: Both countries have been forerunners in the development of information society in general, and telecommunications in particular. Secondly, these two countries are sparsely populated, which is a most relevant conditioning factor in the rollout of broadband infrastructures characterised by nodal features. Despite the above-mentioned similarities of the two countries, they have applied quite different strategies in the rollout of broadband. In Sweden, the public sector has taken a more interventionist role than in Finland. This implies the question whether and how this difference can be seen in the territoriality of broadband supply. The paper attempts to answer this question, and provide conclusions for effective policy strategies.

introduction

Broadband connections with a high transmission capacity are commonly seen to form the key infrastructure of Internet connections, and also of an information society. For this reason, public organisations at various levels - from the European Union to individual municipalities - have shown keen interest in their development.

The present paper investigates broadband policies in Finland and Sweden with a special reference to the geographical coverage of this new network infrastructure. The comparative setting is interesting from an academic point of view, and also due to its policy relevance. Both these countries are seen in the spearhead of information societies in general, and they have a considerable technological capacity in the IT sector. Yet they have chosen quite different policy approaches with respect to broadband. In Finland, the role of markets in the supply of broadband is emphasised, whereas the Swedish approach relies more on the public sector. Here, the contrast between Finland and Sweden is especially striking due to the fact that these countries have much in common in their policy and planning traditions, and both are characterised by scattered settlement structures with a low number of potential customers in the rollout of broadband. This implies a comparative - even quasi-experimental - setting, which is analysed in the following: Why have the two countries chosen different policy strategies? How have their strategies been implemented, and which differences are visible in the actual supply of broadband? And finally: are there any lessons to be learnt on how to advance broadband in the most effective way in the conditions of thin demand in sparsely populated areas?

It should be noted that broadband is not a well-established term, and its different interpretations have to be taken into account also in the present comparison. In the Finnish policy context, as usually in literature on the topic, broadband is understood as a wide umbrella concept, covering a spectrum of different transmission technologies with a capacity upwards from 256 kb/s, and based on a fixed monthly fee. In contrast, the Swedish IT Infrastructure

Commission, which investigated the accessibility of advanced information and communications technology infrastructure in a regional and social perspective, defined only a transmission capacity of at least 2 Mb/s in both directions as a broadband (SOU 1999:85, 14). This conceptual difference has important implications for the choice of technologies and policies. For the present purposes, it is worth special attention that existing fixed telephone lines can be utilised in supplying broadband with a lower transmission capacity (ADSL). This links the broadband market closely with market for telecommunications.

Another important qualification concerns the scope of the present investigation. It is clear that the availability of information transmission infrastructures with a sufficiently high capacity is only one of the factors having influence on the development of information society in general, and the use of Internet in particular. In the present paper, however, various lines of action in developing information societies – and overcoming the digital divide - are discussed only as contextual factors: the focus is on the rollout of broadband infrastructures.

Clearly, the public sector can utilise several instruments in broadband policies, including direct investments, regulation and competition policy, public demand for infrastructures, and various training and development initiatives (for a more detailed discussion: see Steineke 2003). Here, the investigation is confined to the setting investments (including investment subsidies) vis-à-vis market regulation by means competition policies, which will be analysed in the market failure framework. This focus is well-grounded due to the fact that as leading information society countries, both Finland and Sweden have actively developed public sector demand for high-capacity data transmission, and also implemented a large number of various training and developments initiatives. Essentially, the difference in their policy strategies boils down to the classical dichotomy: policy-led vs. market-driven development.

This paper is structured as follows: Section 2 discusses market failure in the supply of broadband, with special reference to low demand in sparsely populated areas, in "thin milieux". In Section 3, the Finnish and Swedish telecommunication policies and broadband strategies are introduced, and the aims and effectiveness of these national strategies are compared. In Section 4, the two main policy options aiming for broader territorial broadband supply on the local level are evaluated. Finally, Section 5 provides conclusions rising from this analysis.

market failure in telecommunications

The telecommunications markets were historically formed of natural monopolies because of large fixed costs, and universal service obligations were imposed on incumbent operators. The aim was to increase the provision of a service to areas and regions, which were not attractive in market conditions. The operator financed the provision of telecommunications services in non-profitable areas by cross-subsidies.

The economic justification for a universal service obligation is market failure, meaning that the market fails to reach a socially optimal situation because of, for example, imperfect competition, missing markets or externalities. In telecommunications, the main reasons behind regulatory actions are natural monopoly situations, network externalities and universal service (equity) reasons (Faulhaber and Hogendorn, 2000). Figure 1 illustrates the telecommunications market failure.

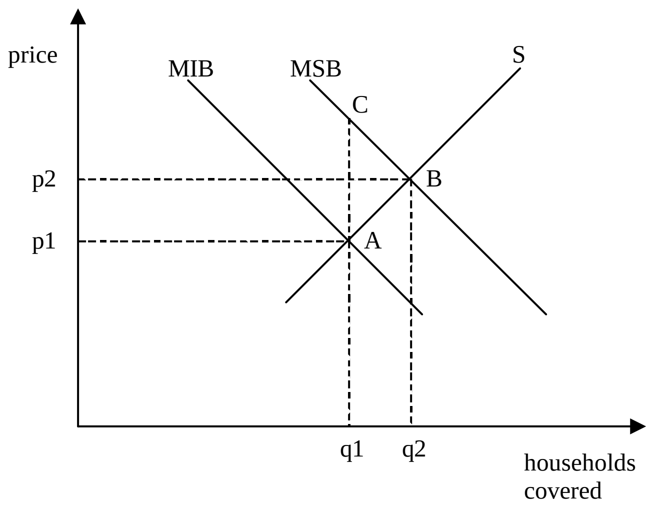

Figure 1. Market failure in telecommunications.

In Figure 1, MIB represents an individual's marginal benefit of subscribing to a telecommunications service, and forms the demand curve of an individual. MSB is the marginal social benefit of the society, and S depicts supply. As it can be seen, in this situation the society's benefit is greater than the individual's benefit. This is due to the above mentioned reasons why the market fails to provide a social optimum: The market settles at point A with only q1 households covered, even though the socially desirable situation would be point B, with a household coverage of q2. As a result, the welfare loss is ABC.

The question is how to reach the social optimum household coverage of q2? This may be done in the following two ways, which are not exclusive. Firstly, the market outcome can be manipulated by increasing an individual's demand, i.e. increasing the benefit of an individual subscriber. Secondly, the supply can be upgraded by lowering the operator's cost by a tax subsidy or cross-subsidy.

The possible measures aiming at shifting curve MIB towards MSB include the improvement of individual's motivation and skills, for instance by providing more useful content and/or a lower price, and education. (Viherä 1999) Also network externalities tend to increase the motivation of an individual subscriber, as (s)he gets more utility when there are more subscribers.

The measures for increasing supply aim at providing better access possibilities for individuals. The costs of an operator, which form its supply curve, might be cut down by subsidies. Traditionally, incumbent operators used cross-subsidies for meeting the universal service obligation, but placing such an obligation on one operator is not applicable in a competitive environment. However, a government still faces the problem of how to extend services beyond the market-based supply, and how to finance this extension (Wellenius, 2000). For instance, it can subsidise an operator's investments, which would shift the supply curve as depicted in Figure 2.

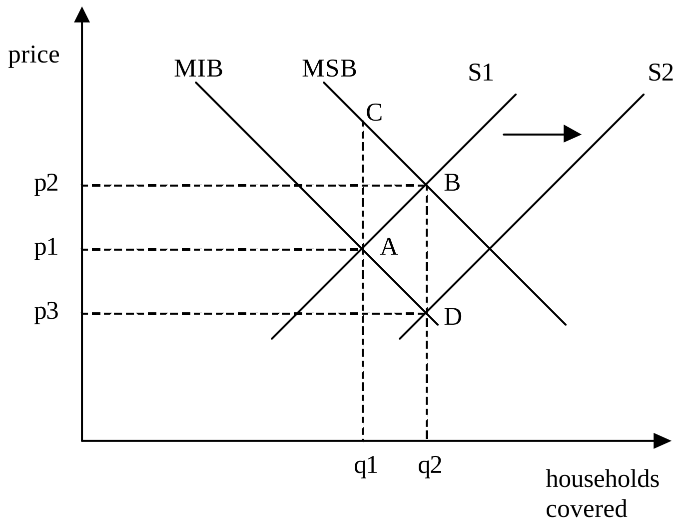

Figure 2. Correcting market failure by supply increasing measures.

Figures 1 and 2 present a static view. In the real world, an operator´s costs usually decline, and demand increases, with time. This has obvious implications for the problem of a market failure: one has to ask whether time will correct it. This dynamic setting is illustrated in Figure 3.

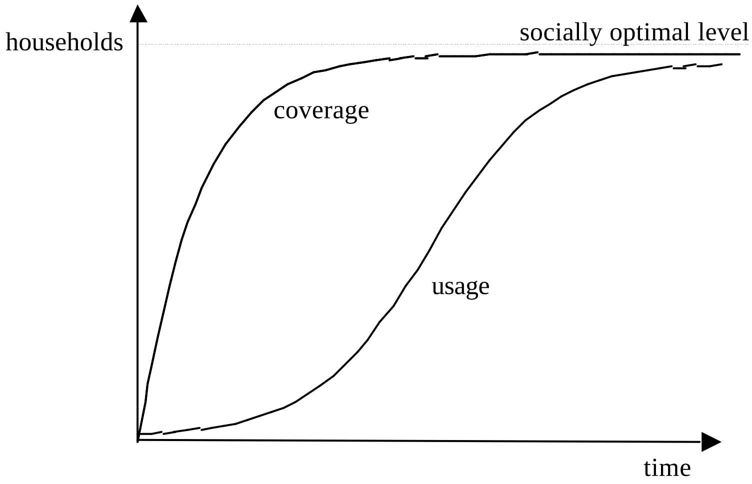

Figure 3. Market failure in telecommunications: a dynamic view.

In Figure 3, the difference between the coverage and the socially optimal level in the end of the diffusion process illustrates market failure in the supply of network infrastructures. Usually, the coverage evolves relatively fast in the beginning, and thereafter slows down, as the network has been built in the most densely populated areas. Another implication from Figure 3 concerns the length of the required time period: the faster the coverage becomes more universal, the smaller the welfare loss from the society´s point of view.

Of course, the coverage of network infrastructures and its demand are two different things. This can be seen in Figure 3 as the difference between a household coverage and household usage (or diffusion) at each point of time. Given typical diffusion curves such as in Figure 3, concerns of a (territorial) digital divide are usually characteristic for early phases of the process: then both components of the digital divide - the gap between the actual v. socially optimal level in the coverage of network infrastructures, and the gap between the usage v. coverage of network infrastructures - tend to be great.

In practice, the supply and demand of network infrastructures are intertwined in a complex way as infrastructure investments have often been observed to lead to a vicious circle: facilitating infrastructure investments also tend to facilitate demand for them (Johansson, 1989). The demand, in turn, is conditioned by the motivation and skills of potential customers (Viherä, 1999).

Overall, this leaves a government with several strategic options in overcoming a digital divide. As already noted, the measures which are intended to have an impact on the evolution of (territorial) network coverage are the main focus of this paper.

Telecommunications policy and broadband in finland and sweden

Historically, the regional provision of telecommunications services in Finland and Sweden has been good, despite the fact that they are the most sparsely populated countries in the European Union. As far as broadband is concerned, the recent figures for Finland indicate a penetration of approximately 25 % of households (February 2004), and the respective rate is even somewhat higher in Sweden. In both countries, the highest growth rates are found in the largest cities, and in the capital city region, which have the best availability of different access technologies. In most Finnish cities, the growth has been mainly based on cable modem, whereas fibre optic access has been the leading technology in Swedish urban areas. Also, the diffusion of ADSL, which is the only access technology available in most parts of the countryside, and in remoter parts of these countries, has been rapid. In Finland, for example, ADSL was not introduced until 1999, but already in 2002 it was available in (at least in some parts of) 98% of the municipalities (MINTC 2002). In Sweden, the availability of ADSL has increased at about the same rate, and currently the coverage of ADSL is close to 80% of the Swedish telephone subscribers (PTS 2003).

The figures above suggest that the achievement of an information society for (practically speaking) all, using the fixed line telephony networks for connecting to the internet, is not a very faraway aim in these countries. For policymakers, however, these developments have not been sufficiently fast, or the infrastructure technologies which are utilised in them are not seen to represent any final route to the information society proper. Thus, both Sweden and Finland have established ICT-policies with a particular focus on increased and universal access to advanced broadband infrastructures. As already noted (see Section 1), these policy strategies are different from each other. In general, this difference concerns the role and activity of a central government and the style of policymaking in general. In more practical terms, competition policies and their fine-tuning to suit to the specificities of national markets display quite distinctive features. These differences derive from the differences in the history and telecommunications policy traditions of the two countries.

The development of the Finnish telecommunications markets differs to some extent from the usual case. Unlike many other countries, Finland has not had a single true incumbent operator, although there was a state-owned telecom company which had a nationwide network. This company was responsible for interregional services, and local services in the more rural parts of the country (cross-subsidising the latter ones). Other actors in the telecom market were local and regional monopolies. These did not have the same protection by law as incumbents normally have, and they were also exposed benchmark competition and a continuous take-over threat. (MINTC, 2003a)

Due to the distinctive market structure, the liberalisation process has been in Finland somewhat different from the countries such as Sweden, where incumbents have had exclusive rights to networks. Thus, instead of fostering the competition at the national level, the main focus in the Finnish telecom policy has been to increase competition in the local markets. The measures have included, among others, a removal of local entry barriers established by licences, a mandatory lease of access loops, and loop sharing. Yet the results are not impressive: the current prices of both broadband and local calls seem to be lower in Sweden although there is more competition – or at least more operators – in Finland (MINTC, 2003b).

The Swedish government has taken an exceptionally active role in the construction of the information society's physical infrastructure. Its strategy is based on the statement of the state's overall responsibility to ensure that broadband infrastructure is available throughout the whole country. Derived from this, a specific national ICT infrastructure programme was drawn up in the year 2000 so that Sweden was probably the first European country to implement an active broadband policy (MIECS, 2000). In this programme, the Swedish government decided to build a competing fibre optic alternative to the existing monopoly network owned by the state-owned telecom incumbent Telia, i.e. the government itself. In particular, the experiences derived from the Stockholm city municipal fibre network (Stokab) served as an example how public infrastructure investments may contribute to both economic and social success. In explaining the specific features of the Swedish policy strategy, it is also worth noting the important role that shared visions have had in the country's policy-making culture. In this sense, the chosen approach with massive nationwide infrastructure investments could be seen as a necessary component in achieving a consensus on the priorities of Swedish information society policy. In any case, this decision was and has been the subject to much debate (see, for example, Andersson 2000).

The Swedish government has set the accessibility objective that every household and business, regardless of location, should have access to IT infrastructure with high transmission capacity, making Sweden the first country with "an information society for all". (MIECS, 2000). In addition to the construction of a new nationwide fibre network, this was seen to presuppose support for the development of IT infrastructure in municipalities (and measures for developing services and upgrading demand, of course).

In contrast, the Finnish broadband strategy proposal, published in December 2003 (MINTC, 2003b) is very much in line with the historical Finnish telecommunications policy, relying on market forces and emphasising technological neutrality. According to its operational aims, by 2005 there should be 1 000 000 households (= approx. 40 % penetration) subscribing to broadband, all citizens should have access to high-speed, easy-to-use and affordable data transfer, and Finland should be among the leading European countries measured by communication network demand and accessibility. These aims of the Finnish strategy are pursued by means of 50 action points, which deal with issues such as fostering competition in communications networks, promoting the provision of services and content in the networks, strengthening the demand of broadband, and developing special actions for low-demand areas. (MINTC 2003b).

Table 1. The Finnish and Swedish broadband policies in a nutshell

	Finland: "The national broadband strategy" (2003)	**Sweden: "An information society for all" (2000)**
Policy vision	"To become a European leader in the availability and use of high-speed telecommunications"	"The first country to succeed in implementing an information society for all"
Broadband concept	High-speed connections based on "all technologically and economically feasible" access modes	Fibre optic cable with a capacity of at least 2 Mb/s
Market environment	Multi-operator market structure, partly dominated by the local monopolies	Incumbent's (Telia) monopoly and its close ties with government
Operative targets	Access for all to high-speed, easy-to-use and affordable data transfer, and one million broadband households (~40% penetration) by the end of 2005.	To connect every municipality to a fibre optic base network. Access for all within the next few years (in 2000). Overall, the goals are not expressed in quantitative terms.
Strategic measures	Competition stimulating: • Legislation and regulation to foster market-based expansion Public infrastructure investments • No Government funding or co-ordinated approach: given to the hands of local authorities Demand stimulating: • Emphasis on "soft infrastructure" and "demand pull": network services and content, information security and users' skills	Competition stimulating: • Restricting Telia's monopoly position by legislation Public infrastructure investments • A national infrastructure programme: construction of a fibre optic base network and Government support to its regional/local extensions Demand stimulating: • Subsidies and tax allowances for fibre connections
Policy co-ordination and implementation	State / Government: • Regulation and loosely defined recommendations by a programme of fifty action points Local authorities (municipalities): • May draw up broadband plans based on local priorities and regional strategies	State / Government: • Funding, regulation, recommendations, and targeted programmes for implementing the national vision Local authorities (municipalities): • Draw up broadband programmes and channel government support to the market

The Finland vis-a-vis Sweden setting is summarised in Table 1. As striking as the stated differences may seem, the actual developments may not be that different. Firstly, one has to keep in mind that there are a number of similar features in the strategies of these two countries. Both countries have liberalised telecom markets supported by pro-competition regulation to stimulate private investments in broadband, and they also actively upgrade the demand side. Secondly, despite of the innovative introduction of extending the Swedish fibre-optic network, ADSL is still the only broadband option expected to give (close to) universal coverage within a near future in both of these countries. Thirdly, due to the absence of a direct investments or subsidies by the central government in Finland, local authorities have taken a more active role, subsidising the broadband infrastructure investments along the same lines as their Swedish counterparts. This raises the issue on the impact of the subsidies on the functioning and territorial coverage of the market for fixed line network infrastructures. This issue will be analysed next, and the conclusions will be discussed with respect to pro-competition strategy in broadband policy.

INVESTMENT SUBSIDIES AND LOCAL MARKET STRUCTURE

As already mentioned, there are two main policy options to widen the availability of broadband in sparsely populated areas: investment subsidies and competition policy. Clearly, they are not mutually exclusive, and actually these both are applied both in Finland and Sweden. In the following, the effectiveness of these strategies is evaluated.

Investment subsidies

Even though the rules of subsidy are different in Finland and Sweden, in both countries the decision concerning broadband infrastructure investment subsidy is made by a local authority. In Finland, the current practice seems to be that municipalities (or regional authorities) subsidize the operator's investment costs by 50%. In Sweden, the municipality adds on the state's subsidy and directs this to the operator. In the end, however, it is the operator who decides whether it is profitable to invest into the construction of broadband infrastructure. This decision is clearly affected by the possible public subsidy to the operator's investment costs. In general, the sequential decision-making process can be illustrated by the simple game-tree: see Figure 4.

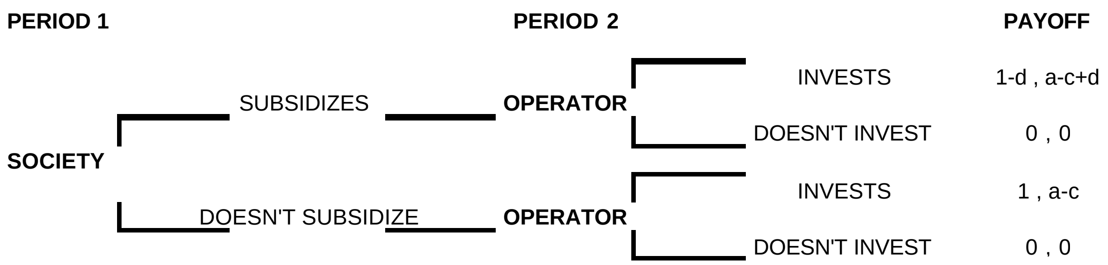

Figure 4. Broadband subsidy game.

In the game depicted in Figure 4, the benefit of investment to the society is 1. The cost of the investment is *c*, resulting to an increase of *a* in the operator's net income. The society must decide whether to subsidize the operator's investments by an amount of *d*.

The best outcome of the game for the society is the investment without the subsidy. If the operator's investment is not profitable, the society loses its benefit. This can be seen as the current case in areas of low population density. Thus, the society may correct the operator's profitability by a subsidy of $d = c\text{-}a$ if $a\text{-}c < 0$ and $1\text{-}d > 0$, i.e. the operator is subsidized only if it does not invest and the society's benefit exceeds the amount of the subsidy.

While these conditions for the efficient subsidy policy are trivial, they impose very large requirements for information. These requirements are hard to be met in practice. Moreover, when taking into account the operator's strategic behaviour and capacity constraint, public subsidies may result both in a delayed market-based roll-out and an excessive compensation for operators.

Unlike most explanations of the claimed delayed roll-out of broadband (Woroch 1998; Faulhaber 2003), the subsidy policy may only cause a temporary delay in investments. The logic for a slower roll-out here relates to the operator's rational strategic behaviour in a sequential setting illustrated in Figure 4. Efficiency requires $d = c\text{-}a$, but both c and a are only known by the operator. Thus, regardless of whether it is profitable or not, passive investment profile in the first period may serve as a credible signal for the need of subsidies in the second period.

Since it is beneficial for the operator to wait and see the subsidy decision, the faster the society makes its decision, the faster the operator makes its investment decision. If the subsidy decision comes late after the introduction of broadband, such as in the case of Finland, it may slow down the evolution of broadband. Yet, on the other hand, it seems that the early subsidy decision of the Swedish government has not lead to any better territorial coverage.

The question of a proper and "as early as possible" timing is, of course, irrelevant if market-based diffusion has reached its limits. If so, the policy implication for both Sweden and Finland is just to increase the level of subsidies to make the remaining infrastructure investments profitable. This, however, seems not to be the case: rather than motivated by an abrupt sharp decline in private investments, the subsidy policy is aimed at speeding up the rate of market development. This raises the question about what happens if broadband investments are subsidized in the case of the operator's capacity constraint.

To see this, let us assume an operator with n investment plans in broadband infrastructure, and a capacity constraint of only one investment per period. The investments are identical in all other respects, but investment costs are different. This leads to a very simple investment strategy in which the plans are realized according to their profitability. In this setting, the only effect of an optimal subsidy is that the nonprofitable investments are included in a waiting list, to be realized as the more profitable plans have been implemented. The implication is that in the case of operator's capacity constraint, and below the saturation point of market-based deployment, the subsidies having an immediate effect on the investments have to exceed the amount of *c-a.* This means overcompensation for the operator, and also results in the crowding out of commercially profitable investments by the subsidized ones.

In general, instead of speeding up, the current investment subsidies in both Finland and Sweden may only contribute to the ordering of investments. And as the decision concerning subsidies is made at the local level – by the authorities that tend to compete with each other – the operators seem to have found it rational to make this order of investments by an auction. Thus, it seems that in sparsely populated areas the local policy – which can be affected by, for example, the availability of EU-funds and needs of the political elite – is taking the place of market forces as a prime driver of broadband roll-out.

Local market structure and territorial availability

In Finland, the historical market structure comprising local operator monopolies continues to have implications for the current evolution of broadband. The local telecommunications operators have been required to split their functions into network and service operations, and the local networks have been made open for competitive service operators[2]. Despite these measures, some local network operators seem to be able to exercise monopoly pricing in leasing out their lines to other service operators. High prices can block out competitive entrants from that territory.

As the local operator exercises its (monopoly) power by setting high leasing prices, it simultaneously forces the entrant to set high consumer prices. If the

[2] This is known as unbundling: incumbents are forced to give other firms access to the copper wires running from the central office of exchange into homes.

competitive service operators decide not to enter the local markets because of the high leasing prices, the local operator is able to retain its monopoly pricing. Thus, whatever the competitive situation, the consumer prices are high. As regards to territorial coverage, these higher prices probably result in a narrower territorial accessibility, as demand remains low. This effect is manifold in sparsely populated areas, as the required demand to induce broadband network investments in a specific territory is easily left unfulfilled.

The different market structure is thus probably one factor behind the earlier mentioned fact of consumer prices being higher in Finland than in Sweden. As a policy measure, the Finnish Communications Regulatory Authority is considering the setting of price caps for broadband network leasing prices. This, of course, involves the problematic decision: on which level the price cap should be set. The local network operators may be inclined to exaggerate the costs. As average costs of network operations also greatly vary by area, neither seem nationwide average prices suitable – operating a network in a sparsely populated area tends to be more expensive than in densely populated cities.

This situation is, however, not unique in the sense that also the mobile telephony markets in Finland have been in a similar phase, and actually might have gone trough a fairly similar process.[3] The companies had to split their operations into network and service functions, and then lease their networks to competitive service operators. However, it took several years before competitive service operators started their businesses, and prices sank. This suggests that while the network is evolving, i.e. it is built by new investments, the investing operator is not willing or even able to lease the network to other service operators. In a way, the network operator seems to cross-subsidize its network investments with the monopoly revenues from the service operator functions. If this is the case, price caps might have the undesired result of reducing new network investments and hindering the territorial evolution of broadband network.

[3] It has to be kept in mind, however, that the cost structure of mobile telephony market is different from the broadband market.

To summarize the above discussion from the point of view of sparsely populated areas, the main aim for the regulators in the long run is to lower prices and thus increase the demand and attractiveness of these areas. In Finland, low prices are pursued through private competitive markets, while it seems that the regulator has accepted - at least in the short run - higher network leasing charges (and consumer prices) in order to promote the upgrading of existing networks and to foster ADSL rollout processes. In Sweden, the publicly-run nationwide network disables the other telecom network operators to ask high leasing prices. This seems to be the case also in Finnish regions where public local (municipal) broadband networks exist. Yet it is unclear whether the investments in those companies are financed through taxes instead of cross-subsidies from the service operator to the network operator[4]. Table 3 summarizes the main points of the comparison.

4 It is also interesting to note that Finnish local authorities, such as municipalities, often own the local telecom network and service operators. Thus, even though they are indirectly publicly owned monopolies, they do seem to behave more like a monopoly than a publicly owned operator.

Table 2. Policy Conclusions

Policy option	**Subsidizing infrastructure investments**	**Promoting competition in the local network**
Primary aim	Regional coverage	Price level
Pros	+ Only option in very sparsely populated territories + Acts quickly + Can be based on local needs and priorities	+ An encouraging example of mobile telecom markets: permanent incentives to cut costs + Promotes competition in services between the Internet access suppliers
Cons	- “Wait and see” before launching the subsidy policy - Imperfect information (timing, amount of subsidy) likely leads to overcompensations for the operator - If capacity constraints exist, leads only to reordering of investments and zero-sum game between the subsidizing authorities - Without unbundling, subsidized capital investments may increase the financial barriers of entry	- Trade-offs between a) Early competition vs. full coverage: the earlier the unbundling, the slower the rollout as the competition concentrates on access services b) Price level vs. investment rate: the smaller the territorial unit of the network leasing, the less the operator can cross-subsidy to its investments c) Equity vs. effectiveness: the more complete the unbundling, the more variation in the price level

In general, a publicly-run network seems to result in lower consumer prices immediately, as the public sector has no incentive to keep up monopoly prices. In the long run, the mobile telephony example shows that service operator competition seems also to lead to low prices, and to a broad territorial coverage. The decision thus culminates on who should finance the network investments: all the citizens through taxes (the Swedish model), or only the current users of broadband through paying temporary high (monopoly) prices (the Finnish model). This relates to the political decision on whether broadband should be considered as a universal service. If yes, tax-based financing of network investments is justified, otherwise not.

CONCLUSIONS

As members of the Nordic family, Finland and Sweden share some indisputable similarities also in their policy and planning doctrines and regimes. This does not concern only history, but these two countries still have many similarities: both are unitary states, in which the public sector has provided a wide range of basic services. The aim has been to treat citizens on an equal basis irrespective of where they live. Yet these two countries have chosen quite different strategies in the construction of the key infrastructure of an information society: even if both emphasise the need to promote information society developments for competitiveness, they seem to advance along quite different routes.

Infrastructure networks - both their construction and utilisation - are typically characterised by scale economies, and broadband infrastructures make no exception. This implies that investments tend to cluster in the regions with a sufficient amount of potential customers. Also the findings on the geographical diffusion of broadband accessibility are in line with this hypothesis: the urban/rural disparity is clearly visible in, for instance, the EU (see CURDS et al 2003). The present comparison derives much of its impetus from this background. Both Finland and Sweden are seen in the spearhead of information societies, but their settlement structures are scattered - this is the fact that emphasises the need for strategic policy intervention in advancing broadband infrastructures.

In general, infrastructure investments can either be seen as demand driven, or they are based on supply decisions; strategic considerations concerning equity, innovativeness, or other wider societal motives. The government may also intervene in this infrastructure market, if it sees that the market supply does not provide enough from the society's point of view. The intervention can, for example, take the form of competition policy or subsidies. The Finnish-Swedish comparison has been outlined in terms of this setting.

As far as market demand is concerned, the factors bearing relevance on it can be assumed to be relatively similar in Finland and Sweden. The average income levels and educational levels of these two countries are close to each other. In addition, both have practised active policies for providing Internet based services and upgrading citizens' skills to utilise information technologies. The spatial circumstances are quite similar in Finland and Sweden, and set constraints to a market driven diffusion of infrastructure networks. Population density, which is the most commonly referred indicator in this context, is very low in a European comparison. However, the key conditioning factor is the share of population living in tightly built settlements; concentrations of demand quite far away from each other can be reached more easily than scattered demand of the same size in a relatively small area.

The supply side, however, is dissimilar in the sense that the institutional structures of the telecommunication sector have followed quite different development paths. In Finland, in contrast to Sweden and most other countries, there has never been a clear national champion, but local operators have provided the bulk of teleservices. This has resulted in that no company has had a nationwide monopoly in telecommunications networks, which has obvious implications for the market supply of any new telecommunication technology.

Overall, it seems that universal and nationwide access of broadband is somewhat lower on the political agenda in Finland than it is in Sweden. According to this orientation, a particular priority in the Finnish broadband strategy is given to the demand and supply side factors of private investments. While special measures for areas which lack the potential for market-based roll-out is one of the four main objectives of the government's broadband programme, a vast majority of the practical measures are targeted to decrease prices, increase demand and other conditions to encourage markets to finance the expansion of broadband. This implementation strategy represents a quite optimistic view of markets and technological change. The existing uneven spatial pattern of network expansion is seen more or less as a temporary phenomenon: differences in terms of access are perhaps pertinent in the ongoing rapid infrastructure development, but they can be expected to decrease even in a very near future.

The Finnish broadband policy takes the view that government funding for infrastructure investments is not necessary. The development of technical infrastructure is not included into the domain of the central government; it is seen mainly as a responsibility of local authorities to support network investments. Yet in comparison to Sweden, much less money is provided by the Finnish municipalities for the IT infrastructure investments. From this perspective, the Finnish broadband policy faces a significant challenge to achieve a widespread geographical coverage by the end of year 2005.

However, it should be kept in mind here that the concept of "broadband" is defined very flexibly in Finland: the set of high-speed connections include all "technically and economically feasible" access modes (MINTC 2003b, p. 4). The properties of such alternatives, in turn, are seen to depend on "the region-specific factors and demand". As there appears to be a lot of variation in these, it seems that in terms of speed, quality and price the expansion of Finnish broadband infrastructure is expected and accepted to develop in an organic, diversified and decentralised way.

In comparison, the Swedish strategy aims at constructing a nationwide fibre-optic network connecting all municipalities with a very high transfer capacity, and reaching out as close to end-user as possible (PTS, 2003). While the construction of the base network was mainly argued on the grounds of competition policy, the plan for the regional and local networks was clearly designed to meet the needs of territorial equity and universal access. The measures for a nationwide coverage include in addition to the construction of a base network, the state subsidies for municipalities to build connections to high-speed IT infrastructure in the areas, which market forces are assumed to leave outside networks within five years.

It is, of course, difficult to determine to what extent the Swedish approach represents the decentralised features of the country's administrative system, or whether it was inspired, for example, by the fine-grained and localised nature of broadband deployment process. In any case, the practical implications from the decentralised planning procedure are twofold. On the one hand, it increased the number of actors involved, and encouraged municipalities to see ICT infrastructure issues as a pertinent part of community planning and development. According to the evaluation report of ITPS (2003, 72), this is, in fact, one of the most positive outcomes of the Swedish broadband strategy so far.

On the other hand, the decentralised planning evidently reduces the potential for government intervention. As a result, the roll-out of broadband in Sweden is developing more through diverse local initiatives rather than in accordance of a standardised top-down strategy. In practice, it seems that the state subsidy is not always enough to motivate municipalities to build connections. When drawing up infrastructure programmes for their own areas, municipalities can rather freely assess to what extent the public investments in local networks may distort competition, or some other way tend to weaken the potential for commercial broadband deployment. It seems that the local authorities have devoted much attention to these issues, since the municipalities have not been willing and/or able to make as high per capita investments in the fibre optic network as it was originally presumed in the government's national programme.

The main options for broadband policies can be simplified into two options, investment subsidies and altering the local market structure. In any case, both these are implemented at a local level. A subsidy aims at widening a territorial coverage directly, whereas competition policy for manipulating the local market works through prices: lower prices are intended to lead to a higher demand, and thus make sparsely populated territories commercially profitable markets. These options are not, of course, mutually exclusive. The Finnish and Swedish policy practices provide ample evidence on how they work in different combinations in practice.

To sum up the disparities in the broadband policies, it can be concluded that the Finnish model aims at more efficient outcomes in the present markets, while the Swedish approach tries to change the market structures by introducing a new nationwide fibre optic base network. Among the reasons for this disparity in the strategies, major factors include the historical differences in market structures and the distinctive telecommunications policies.

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Annex 20

TELECOMMUNICATIONS NETWORKS AND SERVICES IN ESTONIA

LESSONS FOR OTHER ESPON COUNTRIES

ESPON 1.2.2.

Telecommunication Services and Networks:

Territorial Trends and Basic Supply of Infrastructure for Territorial Cohesion

31.5.2004

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INTRODUCTION

The three Baltic States, located in the northeastern ESPON (27+2) space, reclaimed their independence in 1991. While history binds the Baltic States, and to some degree, all Central and Eastern European countries (CEEC) together, there have also been divergent processes. The comparatively faster progress of the northernmost Baltic country, Estonia had become obvious already by the early nineties. Recently Latvia and Lithuania had the lowest, and Estonia the fourth lowest GDP per capita of the new ten EU member countries in 2003. Estonia has generally been considered as the most successful in reconstructing its political and economic systems among the three Baltic States. It has also even exceeded other so-called ´transition countries' in the CEE region in several areas. Estonia's cornerstones in building a market economy have been a stable currency, a balanced state budget, a liberal trade policy, and rapid privatisation (EC – DG Enterprises, 2000).

Estonia has shown somewhat remarkable developments in the telecommunications – or more precisely, building up an efficient network of modern information and telecommunications technologies (ICTs) for the Information Society:

> I am truly amazed with how far Estonia has gone in its efforts to develop the Information Society. Such success gives me hope that the entire Baltic region, including my home country -- Latvia, will one day once again become a land of developed as opposed to developing countries. (Snetkov, 2001)

This paper takes a look at the development of telecommunications infrastructure networks and services in Estonia. The study also evaluates what other countries could learn from Estonia. More specifically, by this study we attempt at answering the following questions:

- Is Estonia really as successful as data suggests and if so, have these achievements been realised across and benefiting the whole territory of the country?

- What have been the factors behind Estonia's success? Is it only the geographical – and cultural – proximity of Finland, or the Nordic countries in general, to which this rapid development can be attributed?
- What are the lessons for the entire ESPON territory, and especially for the ten new member states and the "peripheral" countries?

The paper starts with an introduction to the development of the telecommunications infrastructure and services in Estonia, by presenting facts and figures, and comparing the progress of the country with that of other ESPON countries. This is followed by a section on measures that have helped Estonia on the road to Information Society. The final section provides the conclusions of this paper, and some lessons from the telecom development in Estonia.

TELECOMMUNICATIONS IN ESTONIA: FACTS AND FIGURES

Estonia is one of the smallest of the EU countries: its area is only 45.266 km^2 and population some 1.4 million (July 2003, estimate). The population consists of several different ethnic groups: besides Estonians (65.1%), there are Russian (28.1%), Ukrainian (2.5%), Byelorussian (1.5%), and Finnish (1%) people (CIA Fact Book, www.cia.gov).

Estonia inherited a poorly developed telecommunications infrastructure from the Soviet Era. In 1992, all calls from the country were still routed through Moscow and a rotary-dial phone was a distinguished possession. In the next year Eesti Telefon was founded, and it received the copper-pair network and a queue of almost 150 thousand people waiting for a phone hook-up (Eesti Telefon / Elion, 2002).

The development in this sector has been remarkably rapid since: the telecommunications market in Estonia has become comparable with many of the EU15 countries. The incumbent Eesti Telefon (Elion, since 2003) invested 5.4 billion kroons (€345 million at 12.2002 exchange rate) over ten years in the network, and as a consequence digitalisation reached 77% and queuing had ceased by 2002 (see

Figure 1). Already in the beginning of 1995, there were 97 registered telecommunications enterprises, most of them privately owned. The telecommunications sector had been completely liberalised by January 2001, when the monopoly of the Elion ended. At this time, the market was also opened to foreign investments.

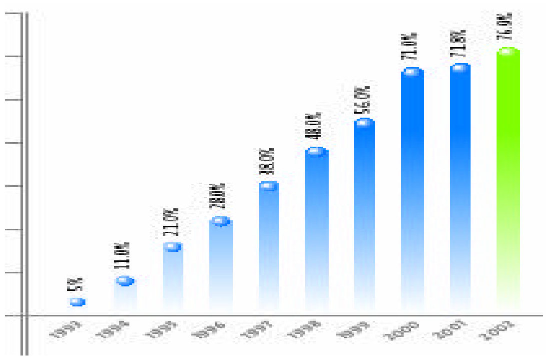

Figure 1. Network digitalisation in Estonia. (Source: Eesti Telefon / Elion, 2002)

Estonia is presently one of the best connected countries in Europe, and also in terms of 'teledensity', this country is among the top 20 worldwide. In basic telecommunications, Estonia ranks among the ESPON countries as presented in Figures 2 and 3.

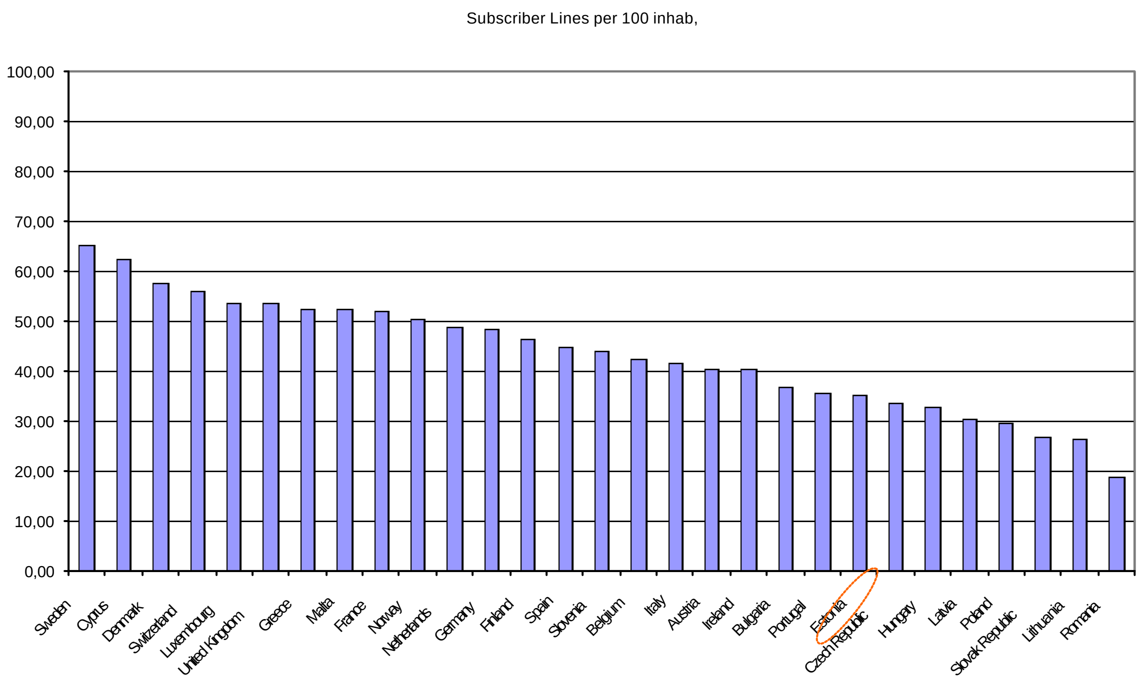

Figure 2. Subscriber lines per 100 inhabitants, 2002 (Source: ITU, 2003)

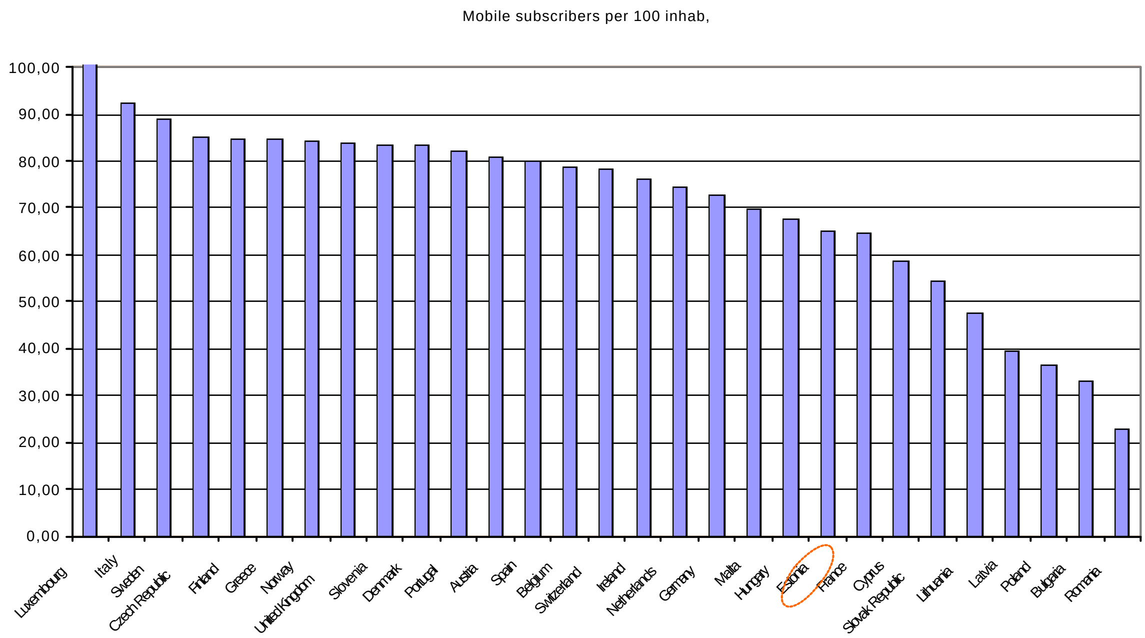

Figure 3. Mobile subscribers per 100 inhabitants, 2002 (Source: ITU, 2003)

As can be seen from Figures 2 and 3, the success of Estonia does not show in the penetration of fixed telephone line subscriptions: the country was ranked no. 22 among ESPON countries in 2002, with only 35% penetration of fixed subscription lines. However, this is easily understandable in the case of CEE countries in general, where basic telecommunications infrastructure started to be upgraded only in the early 1990s, and wireless applications took over very soon after: the number of fixed phone lines started decreasing as many consumers switched from fixed phones to mobile phones, and this happened at an earlier stage in the penetration of fixed lines. However, in the diffusion of mobile subscriptions, Estonia's position was #21 (see Figures 2 & 3), yet with 65%, which was close to the West European average, and considerably higher than the figures in the other two Baltic States. In this respect Estonia outperforms, for example, France. Recent estimates of March 2004 show a penetration of over 80% (MOFA). The ranks of ESPON countries in more advanced telecommunications, broadband and Internet use, are presented in Figures 4 and 5.

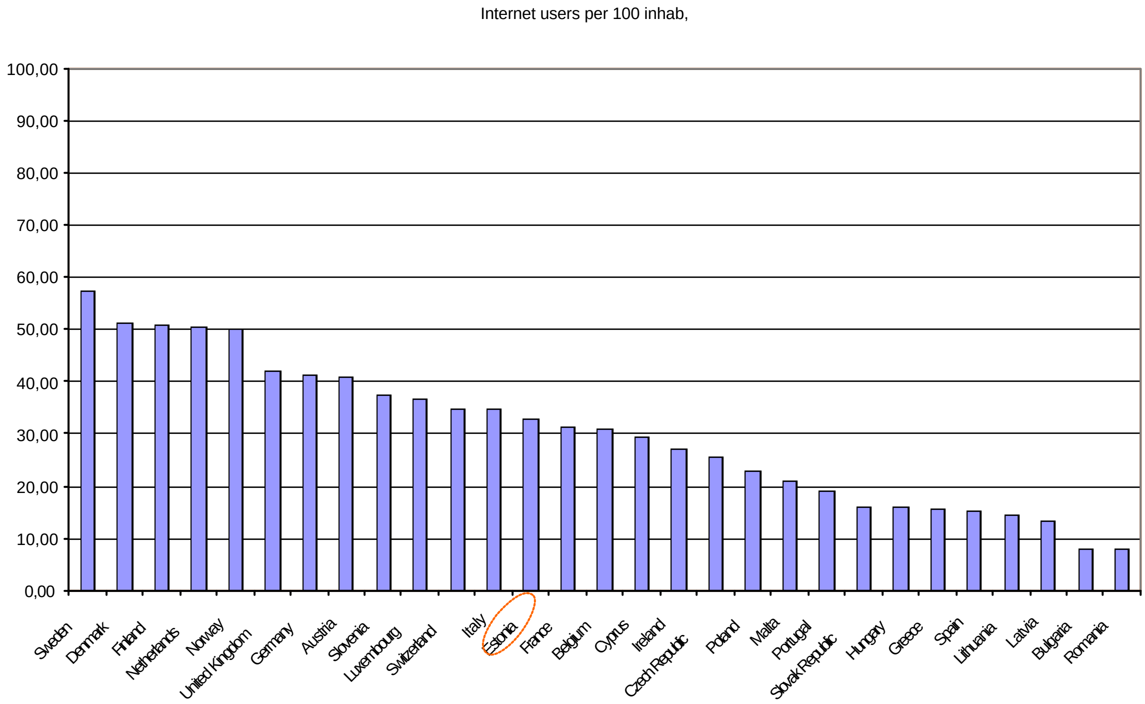

Figure 4. Internet users per 100 inhabitants, 2002 (Source: ITU, 2003)

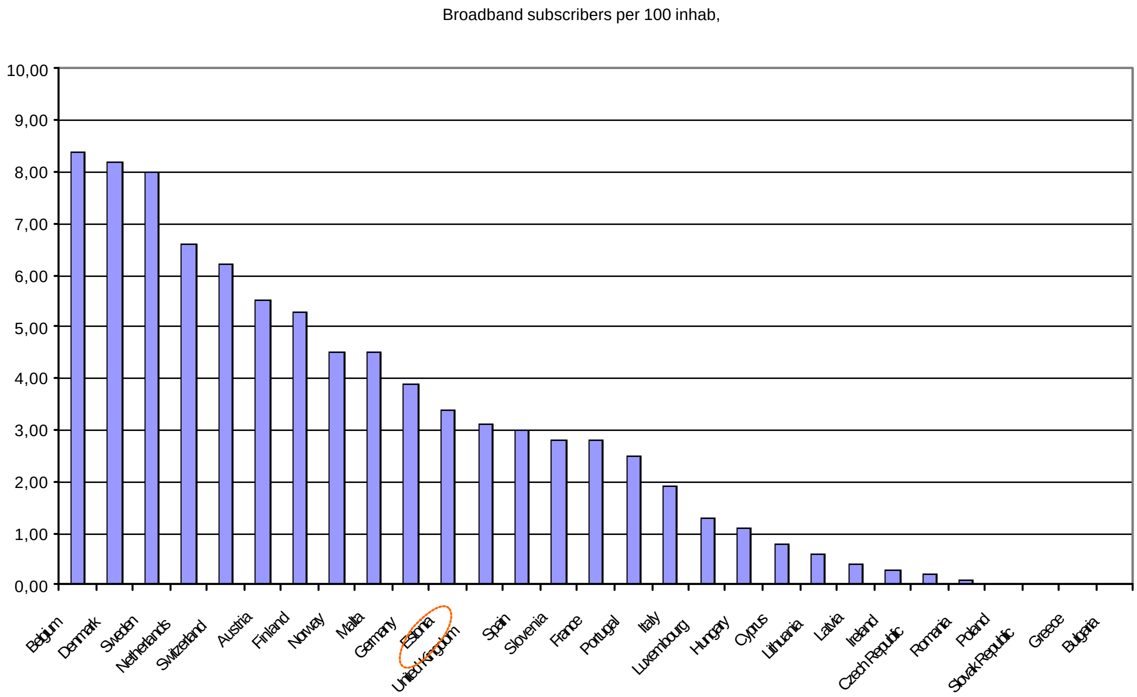

Figure 5. Broadband subscribers per 100 inhabitants, 2002 (Source: ITU, 2003)

As the Figures 4 and 5 show, Estonia did strikingly better in the penetration of more advanced ICTs: In Internet usage it ranked #13 and broadband penetration #11 in 2002. Estonia ranks also well in world telecommunications statistics: with 3.5 % it had the 16th highest DSL penetration in June 2003 (Telecommunications in the Baltics, 2004), and it was ranked 12th in terms of ADSL lines per regular phone lines (Point Topic, 2003; MOFA, 2003). A survey accomplished in Autumn 2003 by TNS EMOR showed that 47%r cent of the Estonian population aged 15-74 regarded themselves as active Internet users (MOFA, 2003). ITU has combined Digital Access Index (see Figure 6), which can be regarded as an IS index since it includes education and affordability as well. ITU has found these two factors to be equally important with infrastructure access. By this index, Estonia ranks #18 among the ESPON countries and outperforms other CEE countries except Slovenia.

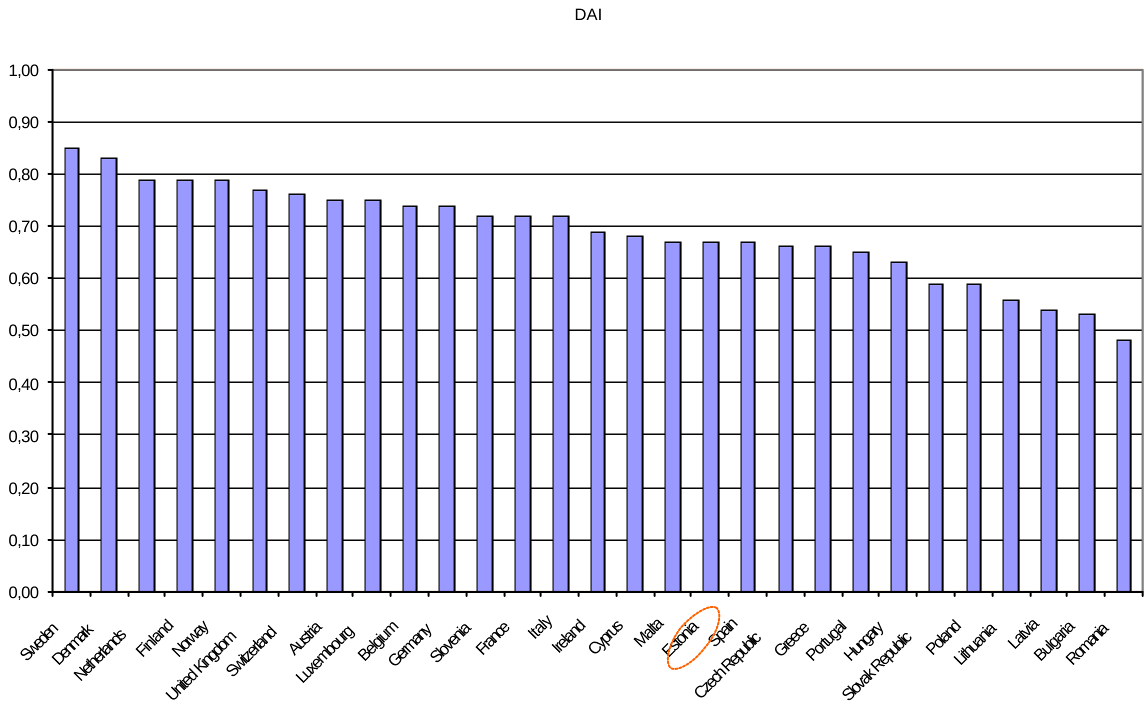

Figure 6. Digital Access Index, 2002 (Source: ITU, 2003)

DEVELOPMENT OF TELECOM NETWORKS AND SERVICES IN ESTONIA

The good rankings of Estonia displayed above are the result of a number of factors. This section highlights some key factors in the development of Estonian telecommunications markets. The section is divided into two parts, the first part concentrates on the development of infrastructure access, the provision of telecommunications networks, and the second part on the key measures aimed to increase the demand of telecommunications.

Infrastructure Access: Nordic Presence, Improving the Fixed Network and Technology Leapfrogging

Foreign investments – and especially Nordic ones – are often seen as the major reason for the rapid development of telecommunications in Estonia:

> "Estonia is benefiting from its geographical position and close links with Scandinavian countries to share some of their high take-up levels for new technologies such as broadband." (Point Topic, 2003)

In fact, several telecommunications operators from the Nordic countries have been actively investing in the Estonian (and also in the Latvian and Lithuanian) telecommunications sector: Currently, TeliaSonera (Swedish-Finnish) dominates the market with major shares in the Estonian fixed-line incumbent, and the mobile market leader. Tele2 (Swedish) is also in the fixed-line, mobile and cable-TV businesses of Estonia. A great innovator in wireless communications in Estonia is Radiolinja Eesti, the subsidiary of the Finnish operator Elisa. (Telecommunications in the Baltics, 2004). These investments must have had hastened the usage of new technology, but also to have reinforced Estonia's ICT industry in low value added activities (Kalkun and Kalvet, 2002).

However, it seems not only to be Nordic presence which is behind the rapid infrastructure development. Estonia was also active in regulating its telecommunications. It first formed an incumbent operator in the early 1990s, which had a very important role in building the basic telecommunications infrastructure. Probably one of the most important measures was the concession agreement between the government and the incumbent Elion (former Eesti Telecom), which guaranteed it a monopoly position for at least 8 years in basic telecommunications, starting from 1992 (Concession

Agreement, 1992). It was aimed to rapidly modernize the existing telecommunications network and to ensure connectivity in rural and scarcely populated – and hence unattractive for ICT investments – areas in return for profitable urban contracts. This concession agreement enabled the incumbent to finance these unprofitable investments by cross-subsidies from profitable businesses. The deregulation of the monopoly took place in 2001, and has been rapid, since Estonia was also the only EU applicant country to have fully unbundled the local loop by January 2003. New operators entered into these markets immediately after the end of monopoly, and they have succeeded in taking relatively high market shares by introducing lower tariffs.

In mobile communications, the strategy seems to have been quite different than in fixed lines telecommunications: Estonia seems to have had a liberalized mobile telecommunications right from the start. In mobile telecommunications, it seems that competition between operators has ensured access to mobile networks for the whole country. Mobile telecommunications in Estonia also provides a prime example technology leapfrogging – to which the presence of Nordic operators probably has had a great effect on. Technology leapfrogging becomes an attractive option in a country with a bad or non-existent fixed telecom infrastructure, as more flexible mobile alternatives are set up and provide connectivity more rapidly. So, instead of first waiting that the fixed telecommunications network would have been finished, the mobile networks were built simultaneously. Estonian operators were relatively early in the GSM markets, among the first in introducing WAP services, and more recently, positioning services. (Information Technology Landscape, 2001). Currently, Estonia is actively building a wifi network (WLAN); the first wifi hotspots were launched in the spring of 2001. Estonia had 107 wifi hotspot areas in 5/2003, and 293 in 5/2004 – wifi is now present in all Estonia's territories, however with more hotspots in more populated areas (see Figure 7). Indeed, 6.8 % of all wireless Internet areas in Europe were located in Estonia in 2003. (Telecommunications in the Baltics 2004; www.wifi.ee).

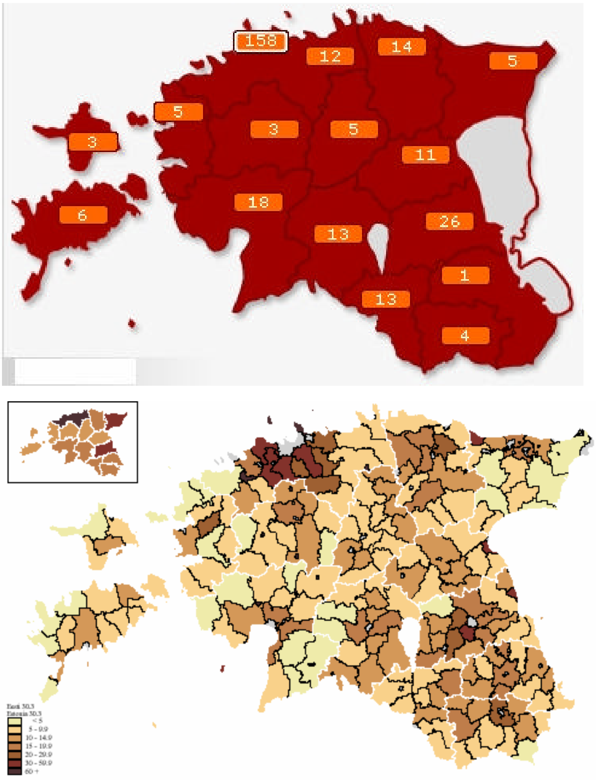

Figure 7. Wifi hotspots in Estonia and population density. (Source: wifi.ee; www.stat.vil.ee)

Currently, it seems that the Estonian telecommunications markets are restructuring again, as the mobile telecommunications has become to provide a worthwhile alternative for fixed telephony:

> “In the Baltic countries, we further developed the mobile business and initiated a restructuring of the fixed network operations. The mobile operators showed positive growth and a good earnings trend and we strengthened our market positions. The fixed network operations are facing stiff competition from the mobile sector. Restructuring efforts were initiated on these operations in order to reduce cost levels and fortify the Internet and data communications businesses where we see good growth opportunities. ” (TeliaSonera, 2003)

Increasing Telecom Demand: Provision of Public Access and Education

More or less after building the basic telecommunications infrastructure, the countries’ policies in general seem to have shifted from focussing on the supply side to the demand side, or to the whole market - ‘Information society’.

All three Baltic States had adjusted their telecommunications regulation to meet the EU requirements by May 2004. Also, all of the states have ambitious Information Society plans. However, relevant legislation is seen to be more deliberate in Estonia than in the case of Latvia and Lithuania (Telecommunications in the Baltics, 2004). The IS policy of Estonia was approved by Parliament in May 1998, and the Action Plan was accepted by the government in April 1998 and May 1999. The Strategy (1999) included a broad set of topics from market regulation to education programmes.

Although almost all public employees have computerized workplaces in Estonia, and 38 % of the population have computers, of which 71 % are connected to (usually high-speed) Internet (MOFA, 2003), there exists a socio-economic and geographical digital divide. To diminish this divide, and to promote Internet usage, Estonia has provided a Public Internet Access Points (PIAPs). These have proved to be successful in making people familiar with the Internet. The PIAP project was funded by an aid project of the UN Development Programme. The first PIAP was opened in 1997, and currently there are over 700 PIAPs throughout Estonia, meaning 51 PIAPs per 100 000 people (autumn 2003) - the highest ratio in Europe (MOFA, 2003). Most of the PIAPs are located in libraries and other municipal buildings. The territorial distribution of PIAP's compared to population density is shown in Figure 8.

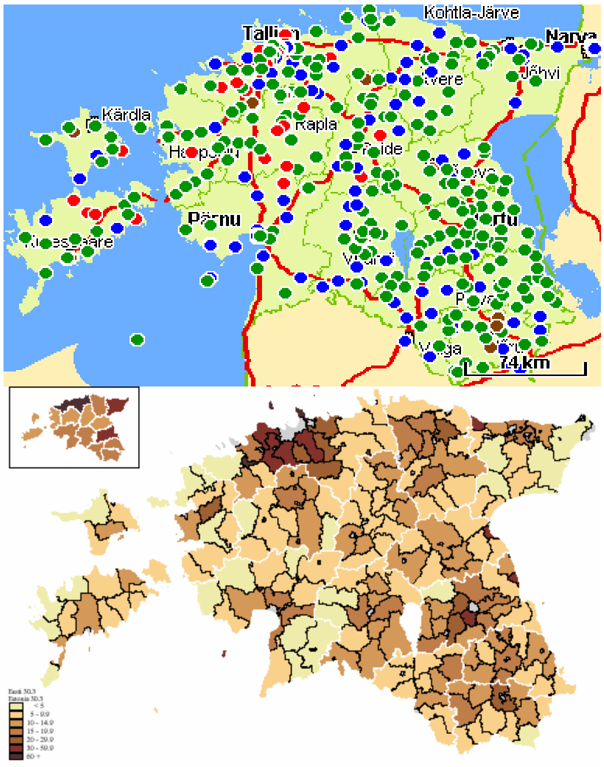

Figure 8. Public Internet Access Points (PIAP) and population density (Sources: www.regio.delfi.ee/ipunktid; www.stat.vil.ee)

The significance of the promotion of ICT skills in education was recognised relatively early: First, all Estonian schools were connected to the Internet, by the state-run "Tiger Leap" programme (1997-1999) (Tiger Leap, 2004). Even the three-student school on the isolated Ruhnu Island (about 40 inhabitants) has an Internet connection. As a result of this programme, school children are above-average users of the Internet, and the Estonians now in school will be 100% computer literate (MOFA, 2003). Teachers are enthusiastically reporting that students are highly motivated to learn computing, out of personal interest, and also because they know it will help them to find better jobs (Accenture et al., 2001). There has been also an emphasis on ensuring that the university prepares students with relevant and practical ICT skills. The high level of Internet usage in Estonia is thus largely correlated to the early adoption of Internet in research and higher education.

More recently, the government has been active and introduced smart cards to facilitate applications in, for example, public administration, hospitals and public transport. The Internet is also being used extensively to deploy e-government and e-banking functions: over 280 public services were available on-line, and 80% of commercial banking transactions were conducted via the Internet already in 2000. An interesting curiosity is that farmers from the remote island of Hiiumaa are offering their products through Internet auctions. (Accenture et al., 2001).

CONCLUSIONS AND LESSONS FOR OTHER ESPON COUNTRIES

The aim of this paper was to evaluate Estonia's success in telecommunications networks and services, and the key factors behind the possible success. From the analysis in the second section it is obvious that Estonia is doing well in terms of telecommunications, by some of the indicators its situation is comparable to the EU15 countries, especially in broadband and Internet use.

Although the Nordic operators have been eager in investing and developing Estonia's telecommunications markets, they have not been the only factor behind rapid development. Estonia's active policy actions which ensured the modernization of the fixed network, made possible competition of foreign operators in the mobile network, and improved computer and Internet skills of citizens, have been important steps in the development. The mix of fixed and wireless technologies, and regulated and liberal markets have probably also been the key to a good rural connectivity. However, Northeast Estonia does not seem to be that well covered (see Figures 7 and 8) which would suggest that there is a social digital divide not separate from the ethnic or language dimension of Estonians and Russians.

There might also be other reasons behind the high broadband penetration rate in Estonia, related to closeness of the Nordic countries:

> Clearly broadband Internet appeals to customers in Northern countries with long winters, where indoor hobbies will be popular. Canada's high penetration of DSL

supports this analysis and the relatively high penetration in Estonia has already been mentioned. (Point Topic, 2003)

But, besides measures aiming to cool climates in order to get longer winters, what are the lessons which other countries may learn from Estonia to get high penetrations in telecommunications services? The key lessons can be summarized as follows:

- Provide the fixed telecom operator with enough investment possibilities in order to have the fixed telecommunications network modernized. These investments can be financed, for example, through cross-subsidies, if the operator runs a national monopoly.
- Make international presence and investments possible in the development of new telecommunications networks. Early liberalization makes the market attractive for foreign operators: With limited resources, international operators are needed to provide the investments for new telecommunications networks and, more importantly, to generate competition in the provision of networks. Competition seems to lead to a relatively early and good territorial coverage, and to lower prices in a small country such as Estonia with relatively densely populated rural areas.
- Do not only concentrate on improving access to telecommunications networks, but also be sure to improve general computer knowledge and citizens' computer skills. This can be done, for example, through provision of public access points and education programmes. We easily overestimate the role of top-down government policy, and forget the impact of grassroots activities (and national culture in general) on the overall development.
- Be sure that relevant content is provided over the telecommunications networks. Without content potential users of telecommunications networks remain non-adopters, as they do not see the point of adopting. The public sector should at least consider providing of some of its own services through telecommunications networks. Subscription to telecommunications might even be made more attractive through encouraging private content provision, for example, by means of subsidies.

In the end, it seems that the technology-mix of telecommunications may well vary in countries with different historical and institutional developments and territorial structures, and this implies different policy packages. But when Estonia is compared to other Baltic states, what has been the key strength of Estonia to attract investments inflows in the region? To summarize and in general, the success in this sense may have been a result of three things: Proximity of Finland and Sweden, active regulation and relative early liberalization, and a competition and entrant friendly market environment.

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