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

ESPON 1.2.2

Third Interim Report

August 2003

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

We see this report as having two inter-related purposes. First, to contribute to the Third Cohesion Report, through the provision of information, analysis and policy ideas. Second, to help in the process of building towards the ESPON Common Platform.

Although this is an Interim Report we have written it as though it were a Final Report in the sense that we draw together findings from our First and Second Interim Reports, as well as introducing new information from our recent work, in an attempt to provide as comprehensive a picture on the territoriality of telecommunications networks and services as we can, given the extreme data limitations which we reported on in our Second Interim Report.

The report is two parts. Part 1 is contained in a single concise chapter (chapter 1), structured as requested by ESPON CU in its Response to 1.2.2 SIR, date 12\textsuperscript{th} June 2003.

Part 2 draws together work from our previous reports with the results of new research carried out under WP3. In Chapters 3 and 4 we consider regional variations in the availability and use of telecommunications networks and services. In Chapter 3 we consider ‘mature’ technologies: fixed line telephony and digitisation of those networks, mobile telephony and the Internet. In Chapter 4 we consider the new broadband technologies. In Chapter 5 we concentrate on pan-European fibre-optic networks, carrying out further analysis of the data presented in the SIR. In this report we are able to draw on the typology of over 1500 FUAs developed by TPG 1.1.1, thus not only standardising the varying network data which we have uncovered from different sources, but also building a crucial link with other ESPON projects and offering further validation of these new data sets. In chapter 6 we summarize our findings from chapters 3, 4 and 5 from an ESPON perspective. We present a model, or typology, which describes the rollout of technologies from a territorial perspective.

We then go on to explore in detail how our findings regarding telecommunications networks and services relate to ESDP and ESPON concepts, particularly the concept
of polycentricity. In the final chapter, chapter 7, we turn to explore a number of policy issues which emerge from our analysis of the territoriality of telecommunications networks and services. We then present a ‘menu’ of policy options for consideration by policymakers.
PART 1
Chapter 1: Part 1 of ESPON 1.2.2 Third Interim Report

1.1 Introduction

Part 1 of this Third Interim Report (TIR) follows the structure set out in the ESPON CU Response to our Second Interim Report (SIR), dated the 12th June 2003 (section 3) in terms of the Framework and Structure used. It is organised in a series of (mainly) short sections. In turn these are:

- Summary of main findings
- Short presentation on concepts, methodologies and typologies used/developed
- A list of indicators developed/provided
- A list of maps and tables in the report
- Short reports on:
  - Application of Common Platform and the Crete Guidance Paper
  - On the Integration of the points raised in response to the Interim Report from March
  - Benefits of networking with other ESPON projects
  - Revised SWOT analysis

1.2 Summary of main findings

1.2.1 Context of territorial developments

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, to some extent represent a ‘snapshot’ of the current (or rather 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 section we draw out the key findings from our work to date as described in part 2 of this report. Where appropriate we refer the reader to the particular section (or figure or table) in the report to which the key finding relates.

Our study suggests that it is important to consider a range of network technologies and services when exploring the complex patterns of telecommunications territoriality. 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. These technologies, at least from a developmental point of view should, therefore, be seen as complementary rather than competitive technologies. This means that we need to explore both mature technologies, such as basic fixed voice telephony and more advanced technologies such as broadband. It also means exploring backbone networks and those which link the backbone to businesses and consumers. In terms of thinking about policy, it also means considering those technologies that have not yet been fully commercially developed, such as Wi-Fi and Satellite. In this section we pull out the main findings in respect to these technologies from an ESPON perspective before going on to outline some of key policy issues which emerge from our study.

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.

- 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 (i.e., 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 a set of small regional incumbents; different start points, rates of, and attitudes towards liberalisation, some EU15 states began the liberalisation process in the 1980s, by contrast some EUCCs are only now coming to terms with this process, for example, Romania only liberalised its telecommunications market in January 2003 and some EUCC telecom markets remain only partially liberalised.

• Fourth, different technologies exhibit different geographical patterns and rates of rollout.

• Finally, individual countries have their own particular attitudes to intervention in the market.

Telecommunications networks have some distinctive characteristics which influence strongly their territorial dynamics. Firstly, they are invariably nodal (except for satellite communications, which is very much a special case in telecommunications), in that they rely on (usually expensive) fixed pieces of equipment (switches, exchanges, masts, etc) in order to provide service to a particular area – telecommunications are never ubiquitously available, therefore, but are based on particular nodal technologies, which can then connect up customers through wires or wireless links.1 Secondly, and equally importantly, these nodes are parts of networks, with their network characteristics applying at different levels; the node has to have a local access network in order to connect individual users to the node, and the node has to be connected to other nodes (usually in complex hierarchies involving interconnection with other networks) to meet the communications requirements of users.

1 In terms of transport analogies, this nodality of telecommunications networks makes them more like railways than roads, in that they require fixed points of access to the network to be provided, equivalent in this analogy to the station or freight yard.
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.

Despite these complexities a number of general patterns emerge and a number of dimensions of territorial disparity across the European space can be identified in respect of TN&Ss. The main such general disparities are between cities (and countries) across Europe in respect of pan-European Internet backbone infrastructure networks, depending on size, but also on functions of particular cities and their location. So the major global cities of London and Paris which have always been privileged in terms of telecommunications infrastructure investment remain so. Some smaller centres such as Hamburg, Dusseldorf and Amsterdam, however, are more or less equals in terms of backbone networks and bandwidth provision. There are also a number of ‘regional capitals’ emerging in these networks, such as Madrid, Copenhagen and Vienna, and cities which are acting as ‘gateways’ between national territories (such as Lyon with respect to France, Italy and Switzerland). Further, the evidence suggests that although there are ‘tunnel effects’ with respect to these backbone networks, there are many instances of smaller cities along major routes being connected.

A ‘north-south divide’ exists across existing member states in relation to most technologies. This can also be interpreted as a divide between cohesion countries and non-cohesion countries (and the former east German Länder). It is notable, however, that this pattern does not hold for mobile telephony, the adoption of which is much more evenly spread. In the case of new broadband services (ADSL and cable modem) the situation is complex. Again the north leads the way, with a group of 5 northern member states, plus Austria and Switzerland, being the most advanced countries. However, by contrast to the situation in respect of more mature technologies the
southern countries Spain and Portugal have higher take up than do the UK and France (see figure presented below, figure 4.2 in report; for further discussion see section 4.3 of the report).
Proportion of population subscribing to broadband (DSL and Cable Modem) in European Countries, 2002

Source: Figures provided by ITU, mapped by CURDS

In the case of use of ICT by business (section 3.7) the north-south divide is again apparent in Europe. There is evidence of a pronounced ‘digital divide’ between territories in Europe, in terms of their business usage of the Internet, which is likely to have significant implications for regional development disparities. 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 e-commerce as a tool of business competitiveness, while firms in Greece, Italy and Spain are making very limited use of the new opportunities. Portugal is an unusual case in that although many of its firms are connected to the Internet, often by DSL or
broadband connection, they appear to be making little commercial use of these connections.

A west-east divide exists, with the EU 15 average being far higher than EUCCs average penetration rates for all technologies. As would be expected existing member states have higher levels of penetration in all the technologies considered in this report. This is well illustrated in respect of the Internet. Penetration in respect of personal computers is lower in EUCCs and there are fewer users of the Internet (the figure is presented below, and appears as figure 3.8 in the report).

*Internet users in Europe per 10,000 inhabitants 2001*

Source: ESPON 1.2.2 FIR: Data drawn from ITU World Telecommunication Indicators 2001, mapped by CURDS
As can be seen, five candidate countries fall within the lowest category of Internet users. Two countries, however, Slovenia and Estonia exhibit higher than anticipated Internet users.

There is some evidence, however, that the ‘gap’ between EU15 and EUCCs is closing. The demand for several key technologies, such as mobile telephony, is growing more rapidly in the EUCCs than in EU15. Table 3.1 (presented below, for fuller discussion see section 3.8 of the report) illustrates this point clearly in relation to PCs, the Internet and mobile telephony. Mobile telephony has been particularly successful in EUCCs and several countries are now experiencing a more rapid growth of mobile than fixed telephony (see figure 3.2). As was shown in our SIR the fastest growth in cellular telephony was in the EUCCs (data reproduced in the TIR report as Figure 3.6). This ‘catch-up’ process is partly a result of EU15 markets opening up earlier and, as a result, reaching a demand plateau sooner. It is encouraging that EUCCs seem to be exhibiting significant growth in respect of several technologies, but it is not clear whether economic constraints in at least some countries will mean that growth will stall at a lower plateau.
**Comparison of penetration and growth rates of key IS technologies in EU15 and CC**

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<td>Dec 2001</td>
<td>7</td>
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<td>- per 100 inhabitants</td>
<td>Dec 2001</td>
<td>8</td>
<td>32</td>
<td>38.9</td>
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<tr>
<td><strong>Mobile phones</strong></td>
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<td>- per 100 inhabitants</td>
<td>Dec 2001</td>
<td>31</td>
<td>72</td>
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Source: Eurostat (2002)²

In the case of broadband technologies there is again a significant gap in rates of penetration, with the EU 15 average again being far higher than that for the EUCCs (see figure 4.3, presented above). Again, however the situation should not be oversimplified. Some EUCCs, notably Malta, Estonia and Slovenia, are in advance of Member States, notably the UK, France and Italy, and Greece and Ireland lag several other EUCCs.

There are also considerable differences between EUCCs. For example, in 2001 the number of Internet users in Estonia and Slovenia was only slightly below the EU average whereas it was less than one-fifth of the EU average in Romania (see figure 3.8). A similar pattern is emerging in respect of broadband (see figure 4.3) with some countries, notably Bulgaria, Romania and Slovakia only beginning to roll out the new broadband technologies over the past few months. There are also differences between countries in respect of the degree of liberalisation undertaken.

We have very limited comparable data in respect of business use of ICTs in EUCCs. A regression analysis carried out on the limited data which we did uncover during WP3 of our study (see chapter 3), however, suggests that these countries lag EU 15, at least as measured by companies with their own website. There are, however, noticeable differences between EUCCs as there are between EU15 member states.

There are disparities within countries, with, generally speaking, metropolitan areas (particularly the largest cities) being in advance of the rest of the country. The exceptions to this rule are likely to be particularly prosperous and economically dynamic areas. This applies to both supply and demand. This appears true of basic technologies as was clear from our SIR, where it was shown that ‘teledensity’ (based on numbers of fixed lines) of the largest city in most countries tends to be above that of the rest of the country (see figure 3.2 presented below, see Section 3.3 of report for fuller discussion), with the exceptions being those countries with a more even urban structure.

*Comparison of ‘Teledensity’ between largest cities and rest of country in European countries (Euro 27 plus 2)*
Similarly, access and use of the Internet appears higher in ‘metropolitan’ areas (figures 3.10 and 3.11). The highest levels of use of the Internet appear to occur in the capital city regions of the most Internet-adoptive countries – Vienna, Brussels, Helsinki, Ile de France, London, Stockholm and Luxembourg. The emerging evidence also suggests that in most countries the new broadband technologies have been (are being) rolled out first to the largest urban areas (chapter 4, particularly table 4.1) and then spreading to other urban areas (though see point below regarding the need to explore these technologies at a fine territorial unit of analysis).

One of the most significant, and apparently most persistent, divides with respect to TN&S supply and demand is the urban–rural divide, with rural areas lagging in relation to most technologies and particularly in relation to the latest technologies. This difference is particularly pronounced if metropolitan-rural comparisons are made. This situation holds true for all technologies considered in this report, though lags in respect of mobile technology appear to be shorter, and only those rural areas which have natural topographical barriers such as mountains appear to be uncovered by this technology, though choice of mobile provider may be more limited in some rural areas. The rapid rollout of mobile technology to date is promising in that, potentially, it will form a platform (both in terms of infrastructure and a consumer base) to migrate to the new, third generation (3G) mobile technologies, based on UMTS, which promise to give broadband access to multimedia services. Whether rollout for 3G will be as rapid as for 2G will, of course, depend on the state of the mobile telecommunications companies and their ability to meet license obligations. To date, the speed of commercial rollout of 3G has been slow (fuller discussion in section 3.5).

A digital divide between urban and rural can be seen in respect of a key technology, the Internet. Figure 3.10 (presented below) shows this divide clearly, in terms of households with connections to the Internet. The evidence which we present in section 3.6 of this report suggests that this divide has been persistent over time and is continuing. The data which we were able to call upon at the European level do not allow us to distinguish clearly between types of rural area, but the limited data we do have suggests that there will be differences between prosperous and less prosperous rural areas and rural areas according to their location in core or periphery (but again see point made below regarding the need to analyse networks at a fine spatial scale).
In respect of new broadband technologies there also remains a significant metropolitan-rural territorial dimension to the deployment of new fixed wire technologies, with rural areas tending to be considerably more poorly served than metropolitan areas. Of the three main delivery mechanisms for broadband services, for example (DSL, cable modems and wireless), the first two have a very marked territoriality, with the up-grading of networks to provide broadband services being considerably more advanced in metropolitan areas than in rural areas. In part, this differential will begin to narrow if broadband services are rapidly adopted; at present, the telecommunications companies are reluctant to invest in network upgrades in rural areas without first seeing clear evidence of buoyant demand in the cities, a situation which has not yet been reached. This problem may well be compounded by lower levels of adoption of the Internet in rural areas than in metropolitan areas, a disparity which is showing no signs of narrowing. The jury is still out on whether DSL and cable technologies will rollout to all rural areas or how long this process will take if left to the market. Some analyses suggest that some rural and remote areas will

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1 CEC (2002c) “Eurobarometer Flash 135: Internet and the Public at Large”. Figure based on data in Technical Annexes Parts A/B.
remain commercially unviable and therefore unserved unless an interventionist approach is developed.

Our study suggests that the new generation of wireless technologies may have a role to play in extending access to broadband technologies to remote and rural territories (and indeed could be used to serve some urban areas). We provide examples of where strategies around these wireless technologies have been introduced (chapters 4 and 7). The hope is that these technologies will provide a commercially viable platform from which to introduce services to rural areas. Beyond certain technical advantages these technologies also have cost advantages, in particular they do not require the very labour intensive, and therefore costly, installation of kilometres of cables and wires. This makes it more cost effective for new companies to enter the market. Further, incumbents tend not have a dominant position in respect of wireless technologies which they often retain in respect of more mature technologies and their broadband successors such as ADSL.

A note of caution should be added, however, and care must be taken not to develop a technologically determinist approach to these technologies. Firstly, they are still expensive, even if they prove cheaper than DSL and cable. Secondly, they still rely to some extent on being connected to fixed line networks – for example, satellite delivers broadband to the home, but does not carry it from the home. Thirdly, wireless providers are still most likely to direct investment to urban areas, as has been the case with Wi-Fi where a number of urban (and transport corridor) hotspots have emerged. Finally, rural areas are still likely to exhibit low demand for these new technologies. It is only by combining (probably subsidised) investment in these technologies with other measures (both short-term and longer-term) to stimulate demand that these technologies will have the potential to provide a more balanced urban-rural pattern of technology rollout.

To sum up there is evidence of north-south, west-east, EU15-EUCC, and core-periphery divides in supply and demand for telecommunications networks and services. At a sub-national level, there are important capital city-rest of country, major cities-other cities and urban-rural divides. Looking at the evidence from the ESPON
3-scale perspective, i.e., macro, meso and micro, our findings suggest the following descriptive classification.

**Main disparities in supply and demand of TN&S in European Space at Macro, Meso and Micro levels**

<table>
<thead>
<tr>
<th>Spatial level of analysis</th>
<th>High supply and demand</th>
<th>Low supply and demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Macro</td>
<td>North</td>
<td>South</td>
</tr>
<tr>
<td></td>
<td>West</td>
<td>East</td>
</tr>
<tr>
<td></td>
<td>Core</td>
<td>Periphery*</td>
</tr>
<tr>
<td>Meso</td>
<td>Capital/major city</td>
<td>Rest of country</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>Rural</td>
</tr>
<tr>
<td>Micro</td>
<td>Urban</td>
<td>Rural hinterland</td>
</tr>
<tr>
<td></td>
<td>Urban core</td>
<td>Urban periphery</td>
</tr>
</tbody>
</table>

* It is important to note that the Nordic periphery is an important exception to this rule, indeed it is the most advanced part of Europe in respect of most technologies.

The table presented above (table 6.1 in the report) provides a very rough description of supply and demand for telecommunications networks and services at three European spatial scales. As with any model it misses some important nuances. As is pointed out above, for example, although there is a clear core-periphery disparity, the northern periphery is the most advanced area in Europe, in terms of take-up. Similarly, though there is a clear West-East disparity some countries are catching up in respect of newer technologies, notably Estonia and Slovenia.

Clearly, then, there are a range of disparities across European territories. Some of these disparities appear to be closing. Others, such as the urban-rural gap are not closing and in some respects may be widening. If the deployment is left solely to the market it is unlikely that these gaps will be closed. It follows, therefore, that if more even territorial development is a policy goal, means of public intervention will have to be found. In chapter 7 of the report we suggest a number of ways in which
intervention could be undertaken. We put forward a number of actions which could be
taken to help ameliorate the situation. These include:

- Stimulating competition further, focusing in particular on those territorial
  areas where, evidence to date suggests, that it is unlikely to occur
  spontaneously;
- Amending the Universal Service Directive to increase the number of
  technologies and operators covered by the Directive (and associated national
  regulations);
- Requiring telecommunications regulators to take greater account of territorial
  development issues rather than concentrating on pricing and competition
  issues only;
- The aggregation of demand within a territory. This can be done in several
  ways; through aggregated telecommunications procurement by public
  (regional) authorities in order to ‘pull through’ broadband technologies into
  regions or localities by creating a critical mass in the territory; through
  aggregating demand from local businesses; or by creating local ‘hot spots’ by
  creating business centres, telecentres or public internet access points;
- Direct intervention by regional and local authorities to ensure the construction
  of broadband networks and services in territories where the market will not
  provide or needs a ‘kick start’. Examples of how this might be done include:
  providing direct subsidies to telecommunications providers; creating public
  partnerships with telecommunications providers; constructing networks
  themselves and providing access to operators; creating a permissive land use
  environment.
- One area in which there is much work to do is in establishing greater
  symmetry of knowledge between public authorities and telecommunications
  providers. We feel that this is a crucial element in creating the infrastructure
  required for the development of information regions, particularly in those
  regions where the market is not working.
- Finally, as we stressed in our FIR and SIR. There is the need for a more
  rigorous approach to territorial data on ICTs. A common set of indicators
  should be established, accompanied by an improved and standardised
approach to a regional data collection. Without such measures we will only have a poor basis for informed policy-making with respect to regional telecommunications.

1.3 Short presentation of concepts, methodologies and typologies used/developed

The general approach deployed during project 1.2.2 to date has largely involved trying to uncover quantitative and qualitative data. WP1 and WP2 mainly involved gathering and analysing data at the European level, from the Commission, from telecommunications companies, from international agencies such as OECD and ITU, from consultants and from other relevant research projects, such as SIBIS and BISER. This was reported on in our SIR so we will not detail the issues and problems which emerged during these WPs. WP1 and WP2 were initially envisaged as stand alone, time limited, workpackages. It has become clear, however, that in the rapidly changing telecommunications environment, some resource needs to continue to be devoted to keeping in touch with the organisations approached earlier in the project in order to gain access to the latest data. This approach is particularly important given the difficulties which we have experienced in gaining comparable data from national agencies (see approach to WP3 below). We have, therefore, continued to review the key data sources identified in our SIR. This approach has resulted in new data from ITU and OECD, as well as new data from sources which we were not able to utilise in our SIR, notably a report on broadband rollout by the consultancy Point Topic. We have continued to chase the Commission for access to the key 2001 report on regional demand for ICTs (the follow up to the EOS Gallup Report of 1999), both through direct contact and through the ESPON CU, without success.

The main element of approach over the past six months has been to contact appropriate agencies and companies at the national level, in an attempt to seek out comparable data relating to the supply and demand for data. A list of organisations contacted through this process is provided in the Annex Volume to this report (Annex 5). As anticipated, this labour intensive exercise resulted in a limited amount of
information which was or could be made comparable. We encountered a number of problems in gaining comparable data. Some of these difficulties would be common to all research projects where data gathering is required, for example, difficulties in identifying the appropriate agencies or individuals who could supply information and the tardiness of respondents in responding to enquiries. Beyond this a number of specific difficulties can be identified, examples include:

- Lack of data availability which covered our agreed indicators. Simply put, some countries did not collect data for the indicators which we had developed under WP1 and WP2. Data on proximate indicators were available in some cases, but these were not necessary close enough to allow comparison;
- Paucity of regional data on nearly all our indicators. Only a few indicators relating to the Internet (the current hot topic) were commonly collected (see regression analysis in Chapter 3 of this report for details);
- Data is collected at different regional levels in different countries. In some case these related to NUTS levels, in other cases data is reported at other administrative levels which are not comparable. By imposing a particular NUTS level (2 or 3) on the data collection exercise would have led to an even more limited data set than we have obtained;
- Data is collected at different times in different countries, i.e., there is no common census date. This is particularly important in a rapidly evolving environment such as telecoms. We initially tried to set a census data of final quarter of 2002, but it was clear that by adhering to this we would have an even more limited data set with which to work.

Given the problems identified in collecting regional data at the national level, and following discussion with the ESPON CU, it was decided to put on hold the data collection exercise. This does not imply that we discontinued the exercise altogether, as we continued to follow up contacts and leads and to collate data as it came in. We did not, however, aggressively chase data or interviews where we had not previously had a response or where the response had been unsatisfactory. Instead of chasing date we turned to analysing the limited data which we had collected. This involved:
• Analysing our data to identify which indicators we had useable data for (see Annex 1 in Annex Volume for table of indicators and data collected by country);
• Carrying out a regression analysis on those indicators (see Chapter 3 for the results of that regression analysis and Annex 3 in Annex Volume for full methodology and approach adopted), in part in order to provide estimates of missing data;
• A synthetic analysis of data provided through our survey in attempt to draw out common trends and differences (e.g., in approach of regulators to territoriality) (see Annex 4 in Annex Volume for full methodology and outcomes);
• An analysis of the data in an attempt to empirically validate the typologies of territoriality of telecoms which we have constructed;
• An analysis of qualitative data which emerged from our interviews and surveys in order to identify commonalities and differences between countries.

We have developed a number of typologies of telecommunications territoriality trends. These are listed below, with the number of categories and the spatial level of each typology shown in brackets:

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

For further discussion see section 6.4 of the report.
1.4 List of indicators developed/provided

*Indicators developed for data collection in WP3 of 1.2.2 project*

<table>
<thead>
<tr>
<th>Indicators</th>
<th>NUTS 0</th>
<th>NUTS 1</th>
<th>NUTS 2</th>
<th>NUTS 3</th>
<th>NUTS 4</th>
<th>NUTS 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of TN&amp;S</td>
<td></td>
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<tr>
<td>• Number of telephone access lines per 100 inhabitants</td>
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<tr>
<td>• Faults per 100 main lines per year</td>
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<td>• Investment in communication network by operators per 100 inhabitants</td>
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<tr>
<td>• Net change in number of main lines (=/-) in previous year</td>
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<td>• <strong>Proportion of main lines connected to digital exchange</strong></td>
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<tr>
<td>• Proportion of exchanges ISDN enabled</td>
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<td>• ISDN lines as a proportion of total main lines</td>
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<tr>
<td>• Proportion of exchanges ADSL enabled</td>
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<tr>
<td>• <strong>ADSL lines as a proportion of total main lines</strong></td>
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<tr>
<td>• Homes passed by cable per 100 residencies</td>
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<td></td>
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<tr>
<td>• Homes passed by digital cable</td>
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<tr>
<td>• <strong>Cable modem lines as a proportion of total lines installed</strong></td>
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<tr>
<td>• <strong>Proportion of exchanges with co-located equipment (local loop unbundling)</strong></td>
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<tr>
<td>• <strong>Availability of Internet service with (a) local rate charges (b) unmetered access</strong></td>
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<td></td>
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<tr>
<td>• <strong>Number of PIAPs per 1000 inhabitants</strong></td>
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<tr>
<td>• Number of secure servers per 10000 inhabitants (using IP address look up tables)</td>
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<tr>
<td>• Competition in fixed network infrastructure (number of licenses; number of active providers?)</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Competition in cellular phone infrastructure (number of licenses; number of active providers?)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>• Number of fixed network operators offering local national</td>
<td></td>
<td></td>
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</tbody>
</table>
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
The table set out above provides the list of indicators developed by 1.2.2. for the collection of regional data from national organisations in WP3. Indicators marked in bold are priority or core indicators. The data returned was collected into a spreadsheet and appears as Annex 1 in the Volume Annex.

1.5 List of Figures and Tables in the Report

See list of Figures and Tables.

1.6 Short report on Common Platform and Crete Guidance Paper

Our view is that the Common Platform has become more solid as the project and the ESPON Programme has proceeded. The Crete Guidance Paper was a particularly useful document and helped bring clarity to the concept of a Common Platform, describing well the general idea and philosophy. We believe our TIR will make contributions to the Common Platform as elucidated in the Crete Guidance Paper in the following respects:

- We have produced a set of core indicators (see 1.4 above).
- We have produced a number of typologies of regions (see 1.3 above, and section 6.3 of the TIR)
- We have contributed to the ESPON map database. Not all maps which we have produced in our report will be suitable for the ESPON database, for copyright and other issues. We will, however, submit a number of maps to the database in September as requested in the email from BBR dated 18th August. If we are able to obtain access to the follow up report to the EOS Gallup Report, used extensively in our SIR, we will be able to deliver further regional maps to the ESPON database.

4 Although, as several TPGs, pointed out the deliverable timetables put forward in the document were unsustainable.
• We have undertaken an analysis of territorial trends in telecommunications networks and services in each of our reports to date and reflect on how these differ across different types of regions (e.g., core-periphery, urban-rural);
• We analyse a number of ESPON concepts, most notably, as requested in ESPON response to our SIR, the relationship between telecoms and polycentricity (see chapter 6 in particular);
• In chapter 7 we look in detail at a range of policy issues putting forward a menu of policy options and providing empirical examples of initiatives in these areas.

1.7 Integration of points raised in Response to Interim Report from March 2003

The two main comments on our SIR were:

• When examining [the] impact of ICT supply and policy please include the approach to the potentials of ICT improvements and regions and FUAs, which might support the competitiveness of areas.

We have covered this point in several places in our TIR most notably in Chapters 3, 4, 5, and 7.

• Please include in your territorial analysis the concept of polycentrism (at three scales)

We have covered this point, particularly in Chapter 6.

1.8 Progress made at Lead Partner meeting on 16 June 2003
Our view is that the LP meeting in June 2003 was a very useful meeting. This presented the opportunity for the first time for TPGs to learn of the research and progress of other TPGs. From a ‘scientific’ point of view, therefore, this was a useful meeting. Progress was also made in developing the Common Platform in that the purpose and structure of the Common Platform was clearly elucidated for the first time. We believe that this will form a useful base for further work during the following phases of ESPON. The meeting was also useful in terms of networking (as was the Crete meeting) with other TPGs. Finally, from the ESPON 1.2.2 perspective it was useful in that we could start to interface directly with the appropriate Commission officer, leading to a more tailored and productive interchange and input into policy. This process is continuing.

1.9 Networking

We have been involved in general networking and exchanging ideas at all the ESPON seminars and at the Lead Partner meetings and welcome the opportunity to continue this process in the coming months.

During the past few months we have networked with three TPGs in particular;

- TPG 1.1.1 where we have been involved in bilateral contacts regarding use of FUA typology ahead of formal release, where they were very helpful. Also 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, but there may be further room for collaboration in this area.
- TPG 2.1.1 where we have a number of contacts to exchange data, to see what synergies could be developed, and, latterly, to ensure that we are not duplicating work, particularly in relation to modelling.
- 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 to date during the next phase of our report.
1.10 Revised SWOT analysis

Our revised SWOT analysis is presented as Annex 1 to this report.
PART 2
Chapter 2: Introduction to Part 2 of ESPON 1.2.2 Third Interim Report

ICTs have brought opportunities and challenges for many enterprises and regions. Firms face ICT induced changes that include increased access to a wide knowledge base, as well as creating new market opportunities and new forms of industrial organisation. Regions face a rapidly changing technological landscape which will have a profound influence on the living and working conditions of their citizens and in the territorial distribution of economic activity.

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 economic enterprises, a necessity for their economic viability. Examples of how, in a few short years, firms have come to depend on telecommunications networks within their competitiveness strategies include:

- 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;
- Web sites 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 at over 200 billion € in 2002 in
From a territorial perspective, such developments offer enormous opportunities for reducing the ‘friction of distance’ and/or the problems of remoteness which many peripheral regions and rural areas have suffered from. At the same time, however, concerns are arising 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 than 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 up-take 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, as the following selection of quotes from recent literature makes clear.

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5 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.
“The ability of regions to have access to and exploit the possibilities offered
by new ICT affects their capacity to exploit human resources, technology and
their development potential” (BISER, 2002, D.D1, p8)

“The now evident economic, social and cultural importance for all parties
(households, businesses, schools, public administration), wherever they are
based, to have access to modern information and communication networks,
underlines the territorial stakes of entry in the information society. From now
on, the key factor is no longer only the offer of new technologies, but the rate
of diffusion of these technologies to territories and their cost, given their
contribution to local development” (DATAR website 2003).

“A city’s [or region’s] attractiveness as a telecom hub is a major determinant
of whether it will be a prosperous place in the 21st century. In the same way
that access to maritime and overland trading routes determined prosperity in
the past, access to affordable and bountiful bandwidth services will be the
marker of the future” (Lynch, 2000).

In this, Part 2, of our Third Interim Report we pull together the evidence from our
work to date to try and describe the emerging territorial patterns of
telecommunications networks and services supply and demand. In this chapter
(chapter 2) we set out a brief introduction to part 2, outlining the content of the
subsequent chapters.

In Chapters 3 and 4 we consider regional variations in the availability and use of
telecommunications networks and services. We stress the need to explore territorial
patterns for both mature technologies and new broadband technologies. In chapter 3
we consider the more mature technologies. In turn, we look at fixed telephony and
digitisation of the telephone network (3.3 and 3.4), mobile telephony (3.5), personal
computers and the Internet (3.6). We then look at business use of the ICTs,
particularly the Internet, for e-commerce. The evidence presented shows that there are
a number of disparities. These are apparent between Member States and EUCCs, in
respect of all the more mature technologies, though there is also evidence to suggest
that the gap is closing in respect of several technologies, including the Internet and mobile telephony. There are also disparities between member states and between EUCCs. There are clear differences within individual countries. The urban-rural divide is particularly apparent, especially the metropolitan-urban divide. Worryingly, this gap is clear in respect of Internet use, a key tool in linking individuals and places to the information society. Furthermore, this gap appears to be growing.

In Chapter 4 we explore the rollout of new broadband technologies which are currently the main focus of policymakers in respect of telecommunications networks and services. We first reflect on the growing importance of broadband (4.1). We then go on to consider what is meant by broadband, pointing out that the term tends to be used loosely by policymakers and in the marketing literature of telecoms companies and that ‘broadband’ technologies currently being rolled out commercially have relatively low bandwidth capacity in comparison to some alternative technologies (4.2). We also point out that these most commercially developed technologies (ADSL and Cable Modem) appear to have an urban bias. This is partly due to technical limitations, but is also due to cost of rollout. We then present evidence to show that there are clear regional disparities in respect of those technologies (4.3). There are disparities between countries, with north-western countries, together with Austria and Switzerland, in the lead. Although there is, in general terms, an East-West divide, certain EUCC countries, Estonia and Slovenia, are more advanced than are a number of EU 15 countries. Within individual countries the dominance of key cities, including the capital city, in the early stages of the rollout process is very clear. It seems that a rollout dynamic is underway and it is likely that most urban areas will be covered in the relatively near future. There is also, however, some evidence to suggest that some remote and rural areas may not be covered if investment is left to the market alone, as telecom companies do not envisage these areas being profitable. We then go on to explore alternative broadband technologies, suggesting that wireless technologies might be more appropriate than DSL and cable modem for more remote areas. We point out, however, that wireless technologies should be seen as complementary to fixed technologies.

In Chapter 5 we turn our attention to pan-European fibre-optic networks. These ‘backbone’ networks, which offer businesses the fastest, highest-capacity and most
seamless broadband connections available, are vitally important in linking the European space and are in some ways analogous to motorways or inter-city railway lines. Here we reanalyse the data presented in chapter 5 of our SIR. When preparing our SIR the ESPON list of functional urban regions (FUA) was not available. We therefore drew on other sources to form a list of 138 European cities (see chapter 5 of 1.2.2 SIR for details). In this report we are able to draw on the typology of over 1500 FUAs developed by TPG 1.1.1, thus not only standardising the varying network data which we have uncovered from different sources, but also building a crucial link with other ESPON projects and offering further validation of these new data sets. We also reanalyse some of the data presented in chapter 5 of our SIR at the NUTS 2 level. In addition to reanalysing the data used in our SIR, we carry out further analysis. In particular, we explore potential connections between the presence of network ‘nodes’ in particular cities and the presence of company headquarters, to underline the economic development implications of these backbone infrastructures.

In chapter 6 we summarize our findings from chapters 3, 4 and 5 from an ESPON perspective. We present a model, or typology, which describes the rollout of technologies from a territorial perspective (6.1). We then consider cultural and institutional factors which help explain differential roll out patterns between countries (6.2). We then go on to explore in detail how our findings regarding telecommunications networks and services relate to ESDP and ESPON concepts, particularly the concept of polycentricity (6.3). Here we consider three levels – the macro, the meso and the micro. We then turn to further develop our ESPON typologies (6.4). We provide a commentary and a set of maps which put some empirical flesh on the abstract typologies.

In the final chapter, chapter 7, we turn to explore a number of policy issues which emerge from our analysis of the territoriality of telecommunications networks and services. We are aware that different Member States and the candidate and accession countries have different histories and cultures, are at different stages in the deployment of ICTs and may have different attitudes to regulation and intervention. We assume, however, that all countries have the objective of more even territorial development and would argue that, if this is the case, then a more even deployment of telecommunications infrastructure will be required. We therefore present a ‘menu’ of
policy initiatives, covering: changes in the regulatory and competitive environment, the aggregation of territorial demand of telecommunications (particularly broadband) infrastructure), methods by which regional and local authorities can intervene to work with or as a substitute for private sector telecommunications companies to ensure the provision of networks in their region or locality. In each case we provide boxed examples of existing initiatives. Finally, we suggest that, regardless of the particular initiatives undertaken (or not undertaken), there is a need for the spatial development community to increase its awareness of and knowledge about telecommunications. We argue that it is only through developing a more symmetrical relationship between public authorities and private sector telecoms companies (who will remain the main providers of the infrastructure) will public authorities be able to ensure that territorial development goals can be met. As part of this process a common set of indicators and standardised mechanisms for the collection of telecoms supply and demand data at the regional level, and below, need to be established.
Chapter 3: Regional variations in ICT availability and use: the case of ‘mature’ technologies

3.1 Note on the organization of Chapters 3 and 4

In this chapter and the following chapter (Chapter 4), we draw on our findings to date from WP1, WP2 and WP3 to explore the territorial patterns of telecommunications networks and services in Europe. In the present chapter, we first present a general introduction in which we summarise our key findings in respect of the territoriality of both ‘mature’ (essentially narrowband) technologies and ‘new’ (essentially broadband) technologies in Europe (section 3.2). In the rest of chapter 3 we concentrate our attention on a number of technologies of varying degrees of maturity: fixed telephony, including the digitisation of fixed networks, mobile telephony, personal computers and the Internet.

In chapter 4 we turn our focus to broadband technologies. We devote considerable space to broadband as this set of technologies is currently of most interest to policymakers, reflecting their perceived importance to the development of information society applications in domestic, public service and business spheres and the competitiveness of countries and regions. The division into two chapters is somewhat artificial, as (as we stress in section 3.2) the ‘mature’ and ‘new’ technologies are closely linked and historical patterns of investment in the former may condition investment in the latter. We feel, however, that the division into two chapters will be more convenient to the reader.

3.2 Introduction

Examining territorial disparities in the up-take of ICTs can focus on mature and widely deployed technologies, in which disparities can be largely interpreted as reflecting variations in the level of demand and usage, or can focus on the most

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6 See discussion of our methodology in Part 1 of this report.
advanced technologies, such as broadband. Although the more advanced technologies are regarded as the most important for policymakers, it needs to be remembered both that advanced technologies usually depend on the infrastructure and usage platform created by earlier technologies, and that at the very early stages of deployment of a technology, supply-side constraints, as reflected in the geographical ‘roll-out’ of communications infrastructure, will often have a significant influence on levels of up-take. To take a current example, the relatively low level of up-take of broadband in Europe’s rural areas tells as much about the non-availability of broadband services as it does about the demand for these services by rural businesses and households. We need, in consequence, to look at a spectrum of ICTs, from mature to advanced, in order to understand the territorial variations in usage and up-take. This is what we set out to do in this chapter and in the following chapter. In order to do so, we summarize the key points from our FIR and SIR as well as introducing new quantitative and qualitative data gathered through our work under WP3.

The shape of supply and demand for telecommunications in Europe is complex and different territorial patterns can be discerned for individual technologies. In general terms, however, a number of dimensions of territorial disparity across the European space can be identified in respect of ICTs:

- A ‘north-south divide’ across existing member states in relation to most technologies. This can also be interpreted as a divide between cohesion countries and non-cohesion countries (and the former east German Länder). It is notable, however that this pattern does not hold for mobile telephony, the adoption of which is much more evenly spread. Similarly, in the case of new broadband services (ADSL and cable modem) a group of northern member states lead the way, but the southern countries Spain and Portugal have higher take up than the UK and France.
- A west-east divide, with the EU 15 average being far higher than the EUCC average penetration rates for all technologies. Demand for several key technologies is, however, growing more rapidly in the EUCCs than in EU 15. In the case of broadband technologies some EUCCs (Malta, Estonia and

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7 See, for example, the emphasis on the Internet and broadband in eEurope Action Plan 2005
Slovenia) are in advance of Member States, notably the UK, France and Italy, and Greece and Ireland lag several other EUCCs.

- There are also considerable differences between EUCCs. For example, in 2001 the number of Internet users in Estonia and Slovenia was only slightly below the EU average whereas it was less than one-fifth of the EU average in Romania. A similar pattern is emerging in respect of broadband.

- There are disparities within countries, with, generally speaking, metropolitan areas (particularly the largest cities) being in advance of the rest of the country. In respect of the new broadband technologies the evidence suggests that in most countries initial roll-out plans are dominated by the largest urban areas.

- There is an urban–rural divide, with rural areas lagging in relation to most technologies and particularly in relation to the latest technologies. There is evidence that this lag is continuing, and in the case of certain key technologies, such as the Internet, may be growing.

In the rest of this chapter we consider territorial patterns of several mature technologies in Europe. The term ‘mature’ is, of course, relative. Here we use it to refer to fixed telephony, including digitised networks, first and second generation mobile telephony, and narrowband Internet.

### 3.3 Fixed Telephony

#### 3.3.1 The continued importance of the basic network

Although the main focus of ICT policy relating to networks and services now tends to be the Internet and broadband, terrestrial fixed line networks remain important. Not only are they still crucial for most users of basic voice telephony, but the historical investment patterns in fixed telephone networks also have an impact on patterns of investment in newer technologies. For example, in countries where extensive terrestrial networks have been rolled out over a number of decades and where exchanges have been digitised, the opportunity exists to introduce broadband technologies by upgrading these existing networks and their nodes (exchanges) in an
evolutionary way: for example, by introducing ADSL technologies into exchanges and utilising existing wires. Thus historical investment can be capitalised upon, with potential cost savings. On the other hand this historical investment can lead to a degree of ‘path dependency’. These upgraded networks might not represent the optimum way of delivering the latest services. Further, their presence may reduce the return to be expected by investors in more advanced technologies capable of delivering higher bandwidth. This is particularly the case where the incumbent provider owns the basic network.

It should be borne in mind that for large numbers of European citizens it is only relatively recently that they have been able to take the existence of good fixed telephony systems for granted. In the 1980s, there were very marked supply side constraints in Europe even in the provision of basic telephony, with Greece, Spain and Portugal having long waiting lists for the installation of a telephone line.\(^8\) Substantial investment in telecommunications networks – much of it supported by the Structural Funds – has largely removed these supply-side bottlenecks, at least in EU15. As Figure 3.1 suggests, however, some of the candidate countries do have relatively few installed telephone lines, with Poland, Slovakia and Romania having fewer than 30 main telephone lines per 100 inhabitants. The figure for Romania is as low as 19 per 100 inhabitants. They do tend to have higher growth rates in the number of lines, however, suggesting some ‘closing of the gap’. This is not surprising as fixed telephony may have reached saturation point in Member States, particularly in the light of the growth of mobile telephony. The ‘gap’ in fixed telephony may not close completely, however, as EUCCs may substitute investment in mobile telephony for investment in fixed telephony. Table 3.1 shows that a number of countries in both EU15 and in EUCC are beginning to experience a decline in fixed telephony, as measured by main telephone lines per 100 inhabitants. It is, thus, likely that some EUCCs will not reach the level of fixed telephony experienced by EU15 countries as alternative technologies will be used. A recent report on ICTs in Slovakia, for example, showed that the number of mobile subscribers passed the number of fixed

line subscribers in that country in mid-2000 (UN Economic Commission for Europe, 2002b). There is reason to suppose, therefore, that fixed *voice* telephony will become relatively less important as time passes. As a result the nature of network investment (and perhaps the focus of public support for investment) will differ from that of the recent past.
Figure 3.1: main telephone lines per 100 inhabitants

Table 3.1: Countries experiencing an increase or decrease in fixed telephony penetration (lines per 100 inhabitants) between 2000 and 2001

<table>
<thead>
<tr>
<th>EU 15 countries experiencing increase</th>
<th>EU 15 countries experiencing decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Denmark, Germany, Ireland, Luxembourg, Netherlands, Spain, Switzerland</td>
<td>Austria, Belgium, Finland, France, Greece, Italy, Norway, Portugal, Sweden, UK</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EUCC countries experiencing increase</th>
<th>EUCC countries experiencing decrease</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgaria, Czech Republic, Latvia, Malta, Poland, Romania, Slovenia</td>
<td>Cyprus, Estonia, Hungary, Lithuania, Slovakia</td>
</tr>
</tbody>
</table>

Source: Based on data from ITU, Yearbook of Statistics (2002)

As was pointed out in our SIR there are differences within countries in respect of uptake of fixed telephony. To a large extent these differences map on to GDP/ph, but this does not explain all differences and the situation is complex. One clear pattern described in our SIR, however, is the difference between the largest cities and rest of country in the case of fixed lines. Figure 3.2 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.
3.4 The Digitisation of the Basic Network

The most important technological advance in telecommunications networks over the past 20 years has been the digitalisation of switching and transmission, which has provided the basis for the wide range of advanced digital services with which we are now familiar. As Figure 3.3 demonstrates, this first stage digitalisation process has been completed in most, but not all, of the EU 15, remaining to be completed in Greece, the Netherlands and Spain. A number of the candidate countries still have substantial efforts to be made to complete the digitisation of the exchanges in their basic networks, with Romania, Bulgaria, Latvia and Lithuania having less than 50% of their main telephone lines connected to digital exchanges. Strategies are in place to digitise the networks in these countries, but the process may take some time. In the case of Bulgaria the incumbent has a target of 60% digitalisation by 2005 (United Nations, 2002a).
Figure 3.3: Proportion of main lines connected to digital exchanges


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 EU 15 that exchanges tended to be digitised first in urban areas and that exchanges in many rural areas were 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 in rural areas where there tended to be no alternative suppliers (Richardson and Gillespie, 1996). Evidence gathered during the present study suggests that a similar pattern is apparent in EUCCs. In Hungary, for example, the proportion of ISDN lines to the total number of main lines shows considerable regional unevenness, with the capital city having the highest proportionate share of ISDN lines and with the West of the country having higher penetration rates than the East (see figure 3.4).
Figure 3.4 Distribution of ISDN lines in Hungary (ISDN Lines as % of total main lines, 2001 at NUTS 3 level.

Source: Data HSCO, mapping Karelian Insitute
3.5 Mobile Telephony

One very significant technology which has become rapidly diffused through both domestic and business markets is mobile telephony; not only is mobile significant in terms of its integration into ways of life and doing business, it also provides a user platform for more advanced 3rd generation services. In 1999, the penetration of mobile telephony across the regions of EU 15 displayed very wide disparities (Figure 3.5), with very high levels of penetration in the Nordic countries, in Italy and in Portugal, and very low levels of penetration in France and Germany. Mobile penetration in France, which still stood at only 62.6% in September 2002, is the lowest level of all EU15 countries (ART, 2003), although take-up is growing faster than in many other countries. Interestingly then, mobile telephony appears to break with the conventional pattern of a rich-poor disparity.
Further evidence for the ‘mould-breaking’ effect of mobile telephony is provided by Figure 3.6, which shows the situation in 2001, for EU27+2, but only at the national level. Italy remains in the highest penetration category, and countries such as Greece, Slovenia and the Czech republic are in the same category as Sweden, Finland and the rest of Western Europe (notice too that France and Germany have ‘caught up’). Although most of the EUCCs are at the low end of the adoption spectrum, they are displaying the highest rates of growth in their subscription base.
Figure 3.6: Cellular subscribers per 100 inhabitants 2001 (and compound annual growth rate (CAGR) 1995-2001)

Source: ESPON 1.2.2. FIR. Data abstracted from ITU World Telecommunications Indicators 2001, Mapping by CURDS, Copyright, CURDS.

Turning to the situation within countries the position also seems to be quite positive in terms of territorial coverage. In all countries which we are considering in this report most of the territory is covered, the exceptions being very remote and mountainous areas and some border areas. Maps for individual countries and operators can be found at [http://www.cellular-news.com/coverage/](http://www.cellular-news.com/coverage/).

This does not mean that there was no lag in rollout or uptake in mobile, but it does suggest that the lag was of relatively short duration. It should be added that not all areas are covered by all operators as licenses granted to operators have different requirements in terms of population coverage. Those operators with more limited coverage will tend to concentrate on urban areas and business users, thereby leaving differences in levels of choice in different regions.
We have only limited data for penetration (i.e., use as opposed to coverage) of mobile telephony. Evidence from our interview with the French regulator suggests that regional patterns within countries are complex. It is interesting to note, for example, that penetration is slightly higher in the French overseas territories than it is for the main French territory. Within metropolitan France Ile-de-France leads (with a penetration of 91%), but there is no clear urban-rural or core-periphery divide in mobile penetration as Corse ranks second (87.2%) and other relatively urban and/or core regions (eg Nord-Pas de Calais, Centre, Basse-Normandie) do not rank very highly.

We can conclude that mobile is then a technology which is (a) widely diffused, in a very short space of time; (b) is not confined to the more prosperous regions; and (c) is facilitating a ‘catch up’ process in those countries and regions 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 increase⁹. The speed of rollout of first and second generation mobile, its widespread territorial coverage and its rapid uptake suggests that future mobile technology will provide opportunities for citizens and businesses in more sparsely populated areas to gain access to the Internet. The situation regarding 3G investment, however, remains uncertain. Licenses have been issued across most member states, but the current state of the telecommunications market has delayed roll-out. 3G licensing in EUCCs has been slower and by June 2002 only the Czech Republic, Poland and Slovenia had granted licenses (CEC 2002b) and thus there may be disparities between countries in terms of the pace of 3G roll-out. Within countries it is also likely that there will be a territorial lag. In most cases licenses require that a certain proportion of population will be served within a given time and urban population coverage will represent an ‘easy win’ in most countries. Whether the lag is short, as was the case with first and second generation mobile, or long will depend on the general health of the sector and the identification of demand in rural areas.

⁹ Transmission speeds are expected to range from 384 kbit/s to 2 mbit/s.
3.6 The Internet

When we turn to a computing-based user environment the more conventional territorial differentiation once again asserts itself. The estimated number of PCs per inhabitant at national level in 2001 (Figure 3.7), for example, divides Europe into two territorial blocks. Above average levels of per capita PC adoption are found in northern and north-western Europe, and below-average levels are found in southern and eastern Europe. Italy is in the same category as Spain, Portugal, Hungary, the Czech Republic, Slovakia, Estonia and Latvia, while the lowest levels of PC adoption are found in Greece, Bulgaria, Romania, Poland and Lithuania.

Figure 3.7: Estimated PCs per 100 inhabitants 2001

Source: ITU World Telecommunication Indicators 2001, mapped by CURDS

\footnote{The data presented in Figure 5 for Austria and Germany are ITU estimates.}
Perhaps the most important current differentiator of IS participation is usage of the Internet. Figure 3.8 shows the number of Internet users per 10,000 inhabitants in 2001, at the national level for EU27+2. When compared with their PC adoption starting point, Ireland, Belgium, Luxembourg and France have lower levels of Internet up-take than might have been anticipated, while Portugal, Austria, Slovenia and Estonia have above anticipated levels.

Figure 3.8: Internet users per 10,000 inhabitants 2001

Source: ESPON 1.2.2 FIR: Data drawn from ITU World Telecommunication Indicators 2001, mapped by CURDS
Figure 3.9 The limited availability of sub-national data: Internet users per 100 inhabitants

Figure 3.9 illustrates clearly the paucity of European-wide regional data on Internet usage levels (beyond the 1999 analysis for EU15 presented in our SIR – see Figure 4.8 in that report), and the paucity of regional data on telecommunications in general. The map is based on the best indicator we were able to collect sub-national data for

Source: Data collected by 1.2.2 partners, mapped by CURDS
under WP3, and covers less than half the total number of NUTS 2 regions in the ESPON space. As a result of these limitations, we have used regression analysis to provide estimates of missing data, at the NUTS 2 level, of two key Internet usage indicators: the number of Internet users per 100 inhabitants, and the proportion of firms with their own website (the second of these indicators is considered in Section 3.7 below). The method used (described in more detail in the Annex volume) is to calibrate a regression model, relating the Internet usage for regions which we do have data for (the dependent variable), to a set of ‘explanatory’ independent socio-economic variables. The calibrated regression coefficients are then used to ‘predict’ the missing Internet usage data, based on the independent socio-economic data for each region.

For the number of Internet users per 100 inhabitants, the regression model explains 68.9% of the variance in the dependent variable, meaning that the model is likely to provide reasonable estimates of the missing data. The results of the model – ie the predicted levels of Internet users per 100 inhabitants for EU27+2 at NUTS 2 - are shown in Figure 3.10.
The highest levels, with in excess of 50 Internet users per 100 inhabitants (the top two categories in Fig. 3.10), are estimated as occurring in the capital city regions of the most Internet-adoptive countries - Vienna, Brussels, Uusimaa (Helsinki), Ile de France, London, Stockholm and Luxembourg; and in a few other particularly prosperous and economically dynamic regions in Germany (Oberbayern; Bremen; Hamburg), the UK (Berkshire, Bucks and Oxfordshire) and in Switzerland.
The next highest levels, with between 35 and 49 Internet users per 100 inhabitants, are estimated as occurring in all of the rest of Sweden; Denmark; a number of Dutch regions, including Utrecht, Noord-Holland and Suid-Holland; a number of Belgium regions, including Antwerp; in a number of regions in the north-west and south-west of Germany, including Stuttgart, Karlsruhe, Darmstadt, Hannover, Dusseldorf, Detmold and Rheinhessen-Pfalz; the Alsace region of France; the region of Southern and Eastern Ireland; most of the regions in southern and eastern England and the English midlands, along with Cheshire, Manchester, West Yorkshire, East Wales and Eastern and North Eastern Scotland; Salzburg and Vorarlberg in Austria; and Lombardia in Italy. In summary then, the highest levels of predicted Internet penetration are dominated by regions in Sweden, Denmark, the Netherlands, Belgium, the UK, Germany, Austria and Switzerland. There is, therefore, a strong association (also demonstrated in the regression analysis) between the prosperous metropolitan regions of the ‘Blue Banana’ and the regions of the Nordic countries, and high levels of Internet penetration.

At the opposite end of the spectrum, the lowest levels of predicted Internet penetration (less than 15 Internet users per 100 inhabitants) are found in the two poorest regions of Spain (Galicia and Extramadura); in the regions of Portugal, excepting Lisboa and the Algarve; in all of the regions of Greece, excepting Attiki [Athens] and Notio Aigaio [North Aegean]); in Slovenia; in all of the regions of the Czech Republic except for Praha [Prague]; in all of the regions of Slovakia except for Bratislavsky [Bratislava]; in all of the regions of Hungary except for Kozep-Magyarorszag [Budapest]; in all of the regions of Romania and Poland; and in Estonia, Latvia and Lithuania. The estimated pattern of low Internet usage is, therefore, starkly defined in geographical terms; it encompasses the poorer parts of the Iberian peninsular, most of Greece, and most of the regions of the candidate countries, with the exception of some capital cities.

The distinction which emerges from this analysis at NUTS 2 between the regions with major cities and other regions can also be explored by data sets which distinguish between the Internet adoption rates of urban and rural areas. As figure 3.11 shows rural areas lag behind metropolitan and urban areas in the current Member States.
This gap is not new. 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\textsuperscript{11}. The results of a recent Euroflash Barometer survey on the Internet point to the more limited competition in the provision of Internet services in rural areas and this may also be a factor. This urban-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 (see Chapter 4).

\textit{Figure 3.11: Level of household access to Internet by degree of urbanisation}

![Level of access to Internet (%) by degree of urbanisation](image)

Source: Based on Eurobarometer Flash 135, November 2002 (Volume B/1)\textsuperscript{12}

Figure 3.12 is derived from the answers to a question in the same survey which asked how often the Internet was used by individuals. It shows that users in urban areas were more likely to use the Internet on a daily basis. Further it suggests that the gap is widening over time rather than narrowing.

\textsuperscript{11} 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.

\textsuperscript{12} CEC (2002c) “Eurobarometer Flash 135: Internet and the Public at Large”. Figure based on data in Technical Annexes Parts A/B.
We are not aware of any study on aggregate analysis of Internet uptake having been undertaken for the EUCCs. 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 is highest among residents of larger cities. Access is limited in rural areas and small towns….and [according to a survey in the year 2000] fewer than 3 pc of internet users were residents of small towns (p15).

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13 The report cited is “Conditions, Trends and Problems for the Development of Information Society Technology and Services in Bulgaria” by Vitosha Research, 2000. At the time of writing we are still trying to obtain this report.
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 3.13 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 (see Chapter 4) suggesting that regions leading in the use of one set of technologies will be the first to 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.
3.7 Territorial variations in the business use of ICT

Although the household and population up-take 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 up-take and usage of ICTs by enterprises, including SMEs, that is of prime importance in contributing to competitiveness. Although there is a distinct lack of regional level data, Eurostat have undertaken (in 2000/01) comparable pilot surveys of e-commerce at the member state level for EU15. Table 2 in the Annex presents a summary of the results obtained.

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14 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.
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.

At the time of the pilot surveys (end of 2000), 75% of Europe’s enterprises had web access; 38% had their own web site; 26% of enterprises had implemented e-purchasing, and 19% used e-commerce to make sales. These European averages disguise considerable variation between member states (Table 2, Annex). In summary, the following patterns can be discerned:

- The highest level of enterprises with access to the internet were found in Finland, Denmark and Sweden, the lowest levels are in Greece and Luxembourg. Portugal had a higher proportion of firms with Internet access than either the UK, the Netherlands or Germany;
- The highest level of enterprises with their own websites were found in Sweden, Germany, Denmark and Finland, while very low levels were recorded in Spain and Italy;
- The highest level of firms with DSL or other broadband connections to the Internet were found in Finland, Germany, Austria and Portugal; the lowest levels were found in Greece, Spain and the UK;
- The highest incidence of e-purchasing was found in Denmark, Germany, Finland, Sweden and the UK, the lowest levels were in Greece and Spain;
- The highest incidence of e-sales was found in Germany, Denmark and the Netherlands, the lowest in Italy, Greece, Spain and Portugal;
• The highest *use of specialised B2B marketplaces* was found in Sweden, Finland, Germany, Denmark and the UK, the lowest in Spain, Italy and Portugal;

• The highest levels of *perceived benefits from e-purchasing* were found in Germany and the UK, the lowest in Italy and Greece;

• The highest levels of *perceived benefits from e-sales* were found in Germany, the UK and Finland, the lowest in Spain and Italy.

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 e-commerce as a tool of business competitiveness, while firms in Greece, Italy and Spain are making very limited use of the new opportunities. Portugal is an unusual case in that although many of its firms are connected to the Internet, often by DSL or broadband connection, they appear to making little commercial use of these connections. There is then evidence of a pronounced ‘digital divide’ between territories in Europe in terms of their business usage of the Internet, which is likely to have significant implications for regional development disparities.

Unfortunately, below the national level reported above, 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 pattern, we have applied the same type of regression modelling as discussed earlier 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. Figure 3.14 maps 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 60% of total firms) are to be found in the following regions: Stockholm; Denmark; Ussimaa [Helsinki]; Brussels and Antwerp; Utrecht, Nord-Holland and Groningen; Luxembourg; Ile de France; 9 regions of Germany, led by Hamburg, Bremen and
Oberbayern; Vienna; Switzerland; and 10 regions in the UK, including London and most of the regions adjacent to it, Cheshire, and North East Scotland.

In the next category, with between 50% and 59% of firms estimated as having their own website, are found the remaining Swedish regions; one other Finnish region; a number of regions in north-east and south-east France; all but two of the other UK regions; the region of Southern and Eastern Ireland; all other German regions, except for those in the former East Germany; most of the remaining regions in Austria; all but three of the remaining regions of Belgium; all but one of the remaining regions of the Netherlands; the regions of northern and central Italy; four Spanish regions (Madrid, Catalonia, Pais Vasco and Illes Balears). Although there are then a wide range of regions represented in the ‘top half’ of Figure 3.14, there are no regions represented from Portugal, Greece or any of the candidate countries.

The lowest estimated incidence of firms with their own websites (less than 25%) are found in a number of Greek regions; in many of the regions of Poland; and in all of Romania with the exception of Bucuresti. Of the candidate countries, Bulgaria, the Czech Republic, Slovenia, Slovakia, Hungary, Cyprus, Malta, Latvia and Estonia tend to display a higher estimated incidence of firms with their own websites than do Lithuania, Poland and Romania.

3.8 Summary

In this section we have considered the territoriality of a number of ‘mature’ telecommunications networks and services. As we described in detail in our SIR there is a limited amount of data relating to the territoriality of TN&S, particularly at the sub-national level. The available data suggests a complex and evolving picture. A number of clear patterns do, however, emerge in respect of the technologies considered in this chapter.

At the European level there remains a north-south divide and an east-west divide. The Nordic countries plus the ‘blue banana’ show the highest penetration rates, particularly in relation to the Internet. These gaps are not only clear in relation to
users in general, but also in relation to business use of technology. If this continues to be the case the existing relative competitive position of nations and regions is likely to be reinforced.

The situation is evolving, however, and there is some evidence of a general catch up process. This is illustrated clearly in respect of the East-West divide in table 3.2 below which shows (albeit for one year only) a more rapid average growth rate of ‘mature’ technologies in EUCC than in EU15\(^{15}\).

**Table 3.2: Comparison of penetration and growth rates of key IS technologies in EU15 and CC**

<table>
<thead>
<tr>
<th></th>
<th>% Growth 2000/2001</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CC</td>
</tr>
<tr>
<td>Number of PCs - per 100</td>
<td>7</td>
</tr>
<tr>
<td>inhabitants Dec 2001</td>
<td></td>
</tr>
<tr>
<td>Internet hosts – per 100</td>
<td>1</td>
</tr>
<tr>
<td>inhabitants Jan 2002</td>
<td></td>
</tr>
<tr>
<td>Internet users – per 100</td>
<td>8</td>
</tr>
<tr>
<td>inhabitants Dec 2001</td>
<td></td>
</tr>
<tr>
<td>Mobile phones – per 100</td>
<td>31</td>
</tr>
<tr>
<td>inhabitants Dec 2001</td>
<td></td>
</tr>
</tbody>
</table>

Source: Eurostat (2002)\(^{16}\)

Our evidence for differences between regions within countries is more fragmentary. Nevertheless, a clear message emerges namely that, with the partial exception of mobile telephony, there is a clear metropolitan bias in the adoption of the ‘mature’ technologies considered in this chapter. This is particularly clear in relation to the

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\(^{15}\) Note: these figures include Turkey.

Internet. The most stark contrast uncovered is the urban-rural one, and particularly the metropolitan-rural one, with the poorer rural areas apparently slowest to adopt the Internet. This again has implications for the competitiveness of rural and remote regions.

Nevertheless, the growth of Internet and mobile is particularly encouraging. These developments are, of course, partly related to the earlier plateauing of demand in EU15 and, in the case of mobile, the ‘substitution’ of mobile for fixed telephony. As is noted in section 3.5 (above) mobile seems to have different (or at least accelerated) rollout patterns to fixed telephony. If this pattern of rollout is replicated for UMTS then the spread of broadband access should accelerate. This is discussed in chapter 4.
Chapter 4: Regional variations in ICT availability and use: the case of new ‘broadband’ technologies

4.1 The growing importance of broadband

In the previous chapter, we focused on a range of relatively mature technologies; mature, that is to say, in the context of a rapidly evolving technological environment. We now turn to a newer set of technologies which are increasingly seen by policymakers as a key in unlocking the potential of the information society. These technologies are collectively referred to as ‘broadband’ technologies.

The importance of broadband to economic development is being stressed by policymakers across the world’s advanced economies. Particular attention is paid to their 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 take up (Denmark, Sweden, Belgium, Austria and the Netherlands) are ahead of the United States and Japan.

In Europe the importance of broadband has been recognised by the Commission as well as by several 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 (italics added)”. 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 eAction 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 (eEurope Action Plan, 2005, p2).

In addition to the stimulation of content, competition is seen as a key factor in creating markets for broadband. There is also recognition, however, that there are likely to be territorial disparities in access to broadband if left solely to the market. The eAction 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) (eEurope 2005, p17).

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.

In the next section we seek to define broadband, before turning, in the subsequent section, to describe patterns of broadband deployment and uptake to date.

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4.2 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 4.1 illustrates the capability of existing technologies and the expectations for future technologies.\textsuperscript{20}

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’.

\textsuperscript{20} For a fuller discussion of broadband see, for example, OECD (2001) \textquoteleft The development of broadband access in OECD countries\textquoteright
Figure 1: Data rates for main broadband technologies

- **Fibre** – to 155 Mbit/s and beyond
- **Satellite** – to 80 Mbit/s
- **3G Mobile**
- **Wi-fi** (rate shared between users at hot spot)
- **ADSL**
- **Cable Modem**
- **Dial-up access (0.05 Mbit/s)**

<table>
<thead>
<tr>
<th>Mbit/s</th>
<th>15</th>
<th>10</th>
<th>5</th>
<th>2</th>
<th>0.3</th>
<th>0</th>
<th>0.3</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>15 Mbit/s</th>
</tr>
</thead>
</table>

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 4.2. 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.
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.
4.3 Territorial differences in broadband penetration in Europe

In this section we draw together the limited and fragmentary evidence available to describe the main patterns in broadband investment and uptake in Europe. We use two main data sources to provide a degree of comparability at the European level. For the demand side we use unpublished data from ITU.21 On the supply side (patterns of rollout) we use a report from a private sector consultant Point Topic. We also draw on our own national studies which form part of WP3 to supplement these reports. Although the results of this latter process were limited, taken together with the ITU and Point Topic data they do allow us to form a relatively clear territorial picture of the early development of broadband.

Looking first at demand for broadband, figure 4.3 shows that overall rates of broadband penetration (uptake) remain relatively low in comparison to other more mature technologies. It also shows that there are significant differences in the degree of broadband penetration across Europe. Figure 4.4 maps this data. As can be seen, 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 have higher penetration than France and the United Kingdom. Similarly, some accession countries have higher rates of penetration than do member states. 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 Greece. The EUCCs for which ITU do not provide data for 2002 (Bulgaria, Czech Republic, Poland and Romania) have not yet rolled out DSL or cable-modem broadband or have done so very recently and will fall within the bottom quartile. Based on figures from 2001 we would expect Norway to be in the mid-range.

21 Our thanks are due to Michael Minges and colleagues at ITU for providing the data.
Figure 4.3  Proportion of population subscribing to broadband (DSL and Cable Modem) in European countries, 2002

Proportion of population subscribing to broadband in selected European countries¹

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

Source: Data supplied by ITU through personal correspondence, charted by CURDS
Figure 4.4: Number of broadband subscribers (DSL and cable modem) per 100 of population

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

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.
Figure 4.5: Proportion of broadband subscribers in European countries, divided by cable modem subscribers and DSL subscribers

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

The general picture of broadband take up which emerges from the ITU data is supported by data from OECD (OECD, 2001).

As with the other technologies discussed in this report (and in our FIR and SIR) neither ITU nor OECD collect data at the sub-national level for ADSL uptake. We carried out, therefore, an extensive search for regional data from national agencies. As anticipated the results were disappointing with few agencies providing data on regional differences (see Annex 1). Given that broadband is such a recent technology this is though not surprising.

We turn now to the supply of broadband. Here, it is possible to draw a relatively clear general picture of rollout 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 ADSL. Here the key question is which exchanges have been enabled. We illustrate the importance of considering...
availability of broadband at a very fine spatial level in more detail below (see figure 4.6 and discussion, below).

Table 4.1 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 (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).

Table 4.1: The territorialities of DSL network deployment across Europe

<table>
<thead>
<tr>
<th>Country</th>
<th>Incumbent DSL roll-out</th>
<th>Competitor DSL roll-out</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria (AT)</td>
<td>State capitals, followed by rest of country – now at 75% of households covered</td>
<td>Focus on main cities only – Wien, Graz, Linz, Klagenfurt</td>
<td>Cable modem networks have driven broadband penetration</td>
</tr>
<tr>
<td>Belgium (BE)</td>
<td>Main urban areas, followed by rest of country – now at 98% of households covered</td>
<td></td>
<td>Cable modem networks have offered competition to DSL offers</td>
</tr>
<tr>
<td>Bulgaria (BG)</td>
<td></td>
<td></td>
<td>DSL not yet available</td>
</tr>
<tr>
<td>Switzerland (CH)</td>
<td>Zurich and Geneva, then other cities, followed by rest of country – now at 85%</td>
<td></td>
<td>LLU only initiated in April 2003. Cable modems far more used than</td>
</tr>
<tr>
<td>Country</td>
<td>DSL connections</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------------------------------------------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cyprus (CY)</td>
<td>Incipient DSL roll-out by incumbent which still held monopoly at end of 2002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Czech Republic (CZ)</td>
<td>Prague, Brno and Ostrava, with limited access in ten other cities – 12% of Central Offices covered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Czech Republic (CZ)</td>
<td>Incipient DSL only introduced by incumbent in 2003</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany (DE)</td>
<td>Unbundled offers target the business market. HanseNet only in Hamburg. QSC in 46 cities to cover over 1 million businesses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany (DE)</td>
<td>Relatively limited broadband competition, but low DSL prices</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Denmark (DK)</td>
<td>Odense, Alborg, Arhus and Copenhagen, then rest of country – 95% of households</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Denmark (DK)</td>
<td>Very high DSL competition penetration</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Estonia (EE)</td>
<td>Tallinn first, then rest of country, for business and residential users – all cities covered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain (ES)</td>
<td>Jazztel in Madrid first, then 42 Central Offices, aimed at SMEs Colt network between Madrid, Barcelona and Valencia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finland (FI)</td>
<td>Focus on major cities, with Helsinki first and others after</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finland (FI)</td>
<td>Importance of historical structure of telecoms sector (local municipal operators as well as Sonera)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country (Code)</td>
<td>Description</td>
<td>Status and Notes</td>
<td></td>
</tr>
<tr>
<td>---------------</td>
<td>-------------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>France (FR)</td>
<td>Trials in medium-sized cities and peripheral Paris, before Paris first, and other large city regions (particularly in north) – 74% of population covered</td>
<td>Paris region and business users targeted first</td>
<td>Relatively uncompetitive market dominated by incumbent</td>
</tr>
<tr>
<td>Greece (GR)</td>
<td>Pilot in Athens and Salonika</td>
<td></td>
<td>Slow development</td>
</tr>
<tr>
<td>Hungary (HU)</td>
<td>Budapest, then 10 other cities over a year later</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ireland (IE)</td>
<td>Trials in Ennis and Dublin, followed by roll-out in Dublin, Cork, Kerry, Limerick, Galway and NW – 70 exchanges enabled now</td>
<td>Esat BT with unbundled access to Limerick exchange</td>
<td>One of last European countries to have broadband access</td>
</tr>
<tr>
<td>Italy (IT)</td>
<td>Relatively well distributed urban area roll-out – over 30 cities initially, then rest of country – 80% of population covered</td>
<td>Metropolitan areas</td>
<td>Limited cable network and strong incumbent. LLU trials in Rome, Milan and Turin</td>
</tr>
<tr>
<td>Lithuania (LT)</td>
<td>Vilnius first, then 4 next major cities, and 34 additional regional centres</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Luxembourg (LU)</td>
<td>10 centres for residential and teleworking users</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Latvia (LV)</td>
<td>SMEs in Riga first, then other cities and residential users – 26 regions and 80% of telephone lines covered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malta (MT)</td>
<td>Deployed by incumbent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Country (Abb.)</td>
<td>Status</td>
<td>Details</td>
<td>Remarks</td>
</tr>
<tr>
<td>---------------</td>
<td>--------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Netherlands (NL)</td>
<td>in a number of areas since 2000</td>
<td>Main west coast metropolitan areas, followed by other cities – 85% of population covered</td>
<td>‘Certain regions are expected to be omitted for economic reasons’</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cable ahead of DSL. Possible ‘technical limitations and competitive disadvantages’ for DSL</td>
</tr>
<tr>
<td>Norway (NO)</td>
<td>Trial of business users in central Oslo, before Oslo, Tromso and Baerum covered, and all main municipalities – now 65% of population covered</td>
<td>SME users in municipalities (Catch) – Oslo, Bodo and Tronso, then expanding gradually to more than 80 places</td>
<td>NextGenTel – Bergen before other cities</td>
</tr>
<tr>
<td>Poland (PL)</td>
<td>Warsaw covered first, then 6 other major cities</td>
<td></td>
<td>DSL only recently launched</td>
</tr>
<tr>
<td>Portugal (PT)</td>
<td>Lisbon and Porto, and parts of other cities, then other municipalities – now 50% of country covered</td>
<td></td>
<td>Dominant incumbent (also cable provider). DSL only recently promoted</td>
</tr>
<tr>
<td>Romania (RO)</td>
<td>Incipient DSL roll-out by incumbent, with unbundling yet to start</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sweden (SE)</td>
<td>Trial in Stockholm and Gothenburg, then other cities, and rest of country – now 80% of population covered</td>
<td></td>
<td>90% of population live within 3 km of digital switch, so few technical DSL problems. Fibre LAN as well as cable competes with DSL.</td>
</tr>
<tr>
<td>Slovenia (SI)</td>
<td>First rolled out in Llubjana, Maribor, Medinet – business access in Llubjana and</td>
<td></td>
<td>Slovenia has one of highest</td>
</tr>
</tbody>
</table>
followed by major cities

<table>
<thead>
<tr>
<th>Country</th>
<th>Description</th>
<th>Technology</th>
<th>Timeline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slovakian (SK)</td>
<td>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.</td>
<td>ADSL only introduced 1st June 2003</td>
<td></td>
</tr>
<tr>
<td>United Kingdom (UK)</td>
<td>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</td>
<td>Easynet – trial in Leeds and Edinburgh, then other major cities for business users; Freeserve – Manchester and London; Kingston – Hull</td>
<td>Slow uptake in residential broadband</td>
</tr>
</tbody>
</table>

Source: Drawn from Point Topic, supplemented by national studies by 1.2.2 partners.

Table 4.1 above gives a general view of the rollout process and indicates that, as suggested in the model outlined (in chapter 6) new technologies with nodal properties will follow a hierarchical roll out pattern. Our interview and survey work during WP3 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).

Ideally we would have liked to have obtained data on the actual rollout patterns of ADSL and other broadband technologies but, unfortunately, we are unable to obtain this data as telecommunications providers regarded it as commercially sensitive. We were, however, able to obtain data for two countries: Finland is one of the leading countries in relation to ICTs, Hungary is less developed.

Figure 4.6 shows the importance of considering telecommunications territoriality at the lowest possible spatial scale. The figure maps data for broadband availability (not take up) 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, as can be seen by comparing Figure 4.7 broadband coverage with Figure 4.8 population density. Apparent regional variations in broadband coverage are, therefore, explained primarily by their different composition of urban and rural areas.
Figure 4.6: Broadband Availability in Finland – mapped by NUTS levels 2 - 5

Broadband Availability in Finland

Figure 4.7: Broadband availability in Finland (November 2001)

Mapped at NUTS 4

Source: Finnish Ministry of Transport & Communications
mapped by Karelian Institute

Figure 4.8: Population density in Finland at NUTS 4

Source: mapped by Karelian Institute
A similar picture emerges when we look at the roll out of a single broadband technology – ADSL – in Hungary. Again, comparing Figure 4.9 and Figure 4.10 suggests that the main areas in which ADSL has been rolled out are those with the densest population, though the match is not exact.

The maps in figure 4.11 show the roll out of ADSL in 3 European countries, France\(^{22}\), Italy and the UK. In each case the central map shows ADSL rollout – that is to say the parts of the country covered, not the take up of the technology. The left hand map shows population coverage at NUTS 3 level, the right hand map shows GDP at NUTS 3 level. These maps are included for illustrative purposes only. We do not have the data behind the roll-out maps, as this is regarded as commercially sensitive. They do nevertheless allow the reader to make visual comparisons between rollout, population density and GDP. In the case of the UK and France there is a relatively clear link between population density and rollout and also GDP and rollout. In Italy the situation is more complex. What is clear in all cases, however, is that rural areas tend not to be covered by these technologies. Further, it is also clear that even NUTS 3 provides too coarse a spatial filter examining ADSL roll out, with individual exchanges being enabled or not-enabled at a finer-grained level of decision-making.

\(^{22}\) For more information on the territoriality of ADSL coverage in France, see the ORTEL (IDATE/TACTIS) website (http://www.ortel.fr).
Figure 4.9 ADSL coverage in Hungary

Figure 4.10 Population distribution in Hungary

Source: Mapped by Karelian Institute
Figure 4.11: ADSL coverage, population density and GDP per capita in France, Italy and the UK

France

Italy

UK

Source: Osservatorio Banda Larga / Between 2003

Source: BT/Analysys/BSG

Source: ORTEL 2003
As suggested in section 4.2, for technical and cost reasons ADSL and cable technologies are unlikely to reach all areas of Europe in the foreseeable future. One study carried out in the UK suggests that some areas may not be served at all if rollout is left only to the market. Figure 4.12 shows the results of a prospective study by the UK Broadband Stakeholder Group. It shows areas where more than one type of broadband technology is currently available, areas where only one kind of broadband is available, areas where broadband is expected to rolled out at some (as yet undetermined) time and those areas where no rollout is foreseen. It shows that much of the territory of the UK does not have ‘future provision foreseen’, because these areas are much less commercially viable than the urban areas where more than one broadband technology is available. We are not suggesting that telecoms providers will take this approach in all countries. There is some evidence that in Denmark for example that the incumbent intends to cover the whole country. These differences require further exploration and explanation.
In this chapter we have shown that the patterns of rollout and uptake of the new, most commercially developed, broadband technologies are complex, with, for example, some EUCCs being ahead of member states. The situation also differs from country to country with Denmark, for example, having wide territorial coverage whilst in other countries such as Finland and Hungary it is more concentrated. The general trend, however, appears to be that rural areas are lagging in respect of both sets of
technologies, as providers do not see such areas as commercially at present. In some cases it seems likely that these areas will never be considered commercially viable, thus endangering the European Union’s goal of balanced territorial development in the information society.

It may be that the territorial coverage of these new services can be increased by technical developments; for example, some providers have installed what are know as DSLAM technologies into rural exchanges, though there is a debate as to whether these technologies offer much more than ISDN standards. On the public subsidy side a number of initiatives are under way. These are considered in chapter 7 on policy. For some rural places, however, DSL and cable technologies may not be the most suitable. It has been suggested that wireless technologies may be more appropriate for rural areas and that if supply side intervention is to occur it would be better directed at those technologies. The French telecommunications regulator, the ART, for example, has recently emphasised the importance of diversifying the type and number of technologies available in the local loop, and wireless networks are being viewed as an increasingly crucial alternative to fixed broadband, which has so far been rarely extended beyond urban areas. Indeed, although France Télécom announced in June 2003 a new plan to accelerate ADSL deployment across France to allow 90% of the population to have broadband Internet access by 2005, because the remaining 10% of the population live in less accessible or concentrated areas, the broadband offer for them will be restricted to satellite (Irène Le Roch, France Télécom, personal interview, July 2003). With the development of fixed wireless also being restricted, for economic reasons, to serving SMEs and other businesses in towns and cities of more than 50,000 inhabitants, many ‘communities of rural communes’ have already registered an interest with the ART in developing projects based around wi-fi or satellite networks.

We turn now to briefly explore three of these alternative technologies: satellite, fixed wireless access (FWA) and Wi-Fi (we have already covered UMTS in section 3.5 of this report).

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 now turn to look at each of these technologies in turn, exploring their potential to bring broadband to those areas currently not served. In chapter 7 on policy we provide examples of where the public sector has intervened to stimulate their roll out.

**Satellite** technology remains the type of communications infrastructure theoretically most adapted to serving the most remote areas and 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 around 2 mb/s claimed, though again services are contended and real speeds may be much slower. Further, the consumer must still rely on the telephone line (an analogue modem, ISDN, ADSL, or cable modem) connection for outward communications, i.e., communicating with their ISP.
Box 4.1

France: wi-fi and satellite for rural communes

Felletin is a small commune of 2,000 inhabitants in the department of La Creuse in central France between Limoges and Clermont-Ferrand. This is one of the most rural areas of France, and therefore has had more limited access to telecommunications networks and services than other more densely populated and urban areas. Nevertheless, Felletin managed in December 2000 to attract a fixed wireless access (FWA) offer from France Télécom, and this is on the verge of being supplemented by a joint wi-fi and satellite broadband project from Tiscali. By locating a satellite dish and wi-fi antenna on a tall building, and using the latter to diffuse the signals captured by the former to the ‘patch antennas’ of individual users in a 200-300 metre radius, the amount of bandwidth becomes comparable to the 512 kbit/s of ADSL. The project is at the experimentation stage in Felletin, and so is free for the commune and the users until December 2003. After this period, the cost to the user will be equivalent to an ADSL connection (around 45 euros per month). Although it will require communes to finance the base station (with possible help from the FEDER European funds), Tiscali envisages this type of parallel wi-fi and satellite network becoming a solution for other rural communes deprived of ADSL.

Another example is the ‘community of communes’ of the pays de Sillé in the department of Sarthe, which has 7,000 inhabitants and 1,000 industrial employees. A wi-fi project was developed to link the 10 communes with 60 access points each. Laser transmission provides the 20 kilometre backbone connecting the communes, for a total estimated cost of 420,000 euros.

The departmental council for the Côte-d’Or has initiated a broadband Internet access project based on satellite for two sites (a commercial zone and an agricultural college), with funding from the council and the European Union (the Metafor programme). The aims have been ‘to test the capacity of this technology to bring a collective response to the needs of users located in rural or peri-urban zones with no other broadband Internet access solution, and to explore how satellite broadband could fit within regional broadband infrastructure policy in relation to other technologies’.

Source: Observatoire des Télécommunications dans la Ville at http://www.telecomville.org

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 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, was expected to lead to growth in residential users (ITU, 2003).
Box 4.2

A wireless success story from rural Canada

The small community of Saint Pierre-Jolys in the central Canadian province of Manitoba has been forced to look for an alternative method of broadband access to bypass the exorbitant cost of the deployment of a fibre infrastructure by the incumbent operator. The inter-community Rat River Communications Co-operative has led the way by negotiating the construction of a broadband fixed wireless network (plus the necessary fibre connection and point-to-point wireless links) at a very low cost by two local carriers.

Other cooperative projects have formed around wi-fi networks, whereby users are constructing ‘a mesh of uninterrupted connectivity via a dense clustering of nodes’. Thus, although wi-fi technology has geographical limits to its diffusion, some Canadian projects are extending its range to between 10 and 20 kilometres through a point-to-point linking of ‘hot spots’, suggesting ‘the possible extension of wi-fi as an alternative means for remote community-dwellers to aggregate demand and share backbone connectivity’.

Source: ITU, 2003

Wi-fi (wireless fidelity) or RLAN (radio local 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, using satellite access to provide this broadband connection has been suggested, particularly for rural and mountainous zones.

These differing types of wireless technology can be seen as complementary rather than necessarily competing. The UK Broadband Stakeholder Group, for example, views UMTS as ‘complementing wi-fi and FWA in the UK’s broadband infrastructure, by offering a mobile component’. Indeed, UMTS and wi-fi have been specifically designed to be compatible with each other.

4.5 Summary

It is, then, evident that in respect of broadband there are, again, territorial differences across Europe. These appear between countries, with the Nordic countries, plus Austria and Switzerland, in the lead, and the EUCC countries, plus Ireland and Greece
lagging behind. The situation is complex, however, with some EUCCs not only moving ahead of other EUCCs, but also moving ahead of some EU15 countries.

Based on the fragmentary evidence we have been able to piece together the general pattern emerging within countries is that rollout is occurring first in capital cities and other large urban areas, before spreading to urban areas more widely. Generally speaking rural areas appear to be at the back of the rollout queue. The evidence also suggests that some places will not obtain access to broadband technologies if development is left solely to the market. This is particularly true of those technologies currently being most rapidly rolled out – ADSL and cable modem – which appear to have an ‘urban bias’ in terms of the techno-commercial model adopted by telecoms providers.

Alternative broadband technologies may hold out some hope for more rural areas, though it should not be assumed that there is automatically a market for these new technologies and demand stimulation will also be required to ensure the rollout and penetration (uptake) of any broadband technology. We would wish to strike a general note of caution regarding the extent of the relationship between telecommunications supply and uptake. Although there is clearly a significant link between where networks and services are rolled out and where penetration of these is highest, there may often be intervening factors which mean that the extent of this link is reduced. Figure 4.13, for example, shows the roll-out and uptake of ADSL in NUTS 1 regions of the UK. Here, although, in the main, the regions with highest coverage have the highest penetration levels (London and the South East), the North East stands out as having the third highest level of coverage, but the lowest uptake of all UK regions.
This chapter, together with chapter 3, has shown that there are significant territorial differences in both the supply of and demand for telecommunications networks and services in Europe. This is true both between countries and within countries, although the data we have with respect to differences between countries is more comprehensive than the data we have in relation to differences within countries. The most significant divide appears to be the urban-rural one, both in respect of the Internet and in respect of the broadband technologies which it is assumed will drive the Internet’s further adoption. We return to this issue in our policy chapter (Chapter 7).

In theory telecommunications and networks have the potential to support goals of increased polycentric development at a number of spatial scales. In practice, however, in a market economy telecommunications companies will prioritise investment in places where they perceive there to be the biggest and most profitable market. This
assumption is supported by our analysis of patterns of network supply. It is also supported by our interview and survey results, where commercial criteria, whether measured by population density, density of businesses, anticipated rate of return or historical consumption patterns, was the dominant factor in investment planning. We consider the relationship between telecoms and polycentric development more fully in chapter 6.
Chapter 5: The territoriality of pan-European telecommunications network provision

5.1 The importance of pan-European networks

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 networks of traditional incumbent operators to the emergence of a vast number of alternative infrastructures constructed by new entrant carriers, many on a ‘pan-European’ scale. Thus, telecommunications market liberalisation engendered not only a significant increase in the number of market players, but also to some extent, a new transparency to the saliency of national boundaries as the key spatial scale for backbone infrastructure deployment moved from the national to European level.

The vast sums of capital poured into their planning, construction and management in the last decade by dozens of companies (and the willingness of many of these companies to invest massively often with borrowed money and risk their futures on building these extensive networks) is symbolic of their strategic importance in the overall European telecommunications market. Accessibility to existing and potential clients has been the main driver, as companies have sought particularly to offer increasingly seamless, end-to-end service provision to business customers located in major urban centres. Their own fibre backbone networks have created the capacity to be able to offer the most up-to-date services and by being routed directly between large cities allow businesses to exchange information between their own office locations and with those of clients via fast transmission speeds. These pan-European telecommunications networks are, thus, the major highways of the information society in Europe, and remain the infrastructural foundation to the availability of competitive telecommunications services throughout Europe. 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. Indeed, research has shown that telecommunications are a key factor in the location of economic activities, particularly in the services and knowledge sectors. 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. Telecommunications network infrastructure investment can, therefore, be viewed as both (a) causative of regional and urban economic development; but also (b) highly responsive to patterns of economic development, such that analysis of their geographies can reveal much about urban and regional developmental dynamics in Europe.

Having established the overall importance of the territorial dynamics and implications associated with pan-European telecommunications network provision, it is the intention of this chapter to explore in more detail the relationship between the development of these networks and the development of the European territory as a whole through investigating the pertinence of key concepts such as the European urban hierarchy, polycentrism and gateway cities.

As telecommunications markets have become more liberalised and thus more competitive, data relating to networks – their presence or absence, and their capacity – has become difficult to obtain, as companies see this information as a commercially valuable resource. Nevertheless, some information does exist on the total capacity of

For example, over the period 1997 to 2002 the ‘quality of telecommunications’ consistently appears in the top 5 factors taken into account by companies when deciding on location, according to property consultants Healey and Baker’s annual European Cities Monitor (see Cushman & Wakefield, Healey & Baker (2002) for latest figures).
networks connecting individual urban centres, thus “provid[ing] at least a hint of actual flows” (Malecki, 2003, p8). We will discuss and analyse examples of these data resources for pan-European telecommunications infrastructure deployment in the rest of this chapter, which is divided into three main sections. Section 5.2 offers a brief discussion of our methodology in collecting and analysing data on telecommunications networks at a European level. Section 5.3 goes on to present and examine a territorial analysis of network extensiveness and inter-urban connections in two parts; firstly, it considers the differing importance of functional urban areas (FUAs) as nodes for these networks, and secondly, the differing regional accessibility to pan-European infrastructure bound up in the territorially ‘biased’ distribution of ‘noded networks’ across Europe. Section 5.4 then focuses on the territoriality of network bandwidth capacities between cities and regions, before section 5.5 builds on this pan-European network data and analysis to explore the territorial implications of telecommunications infrastructure deployment for regional economic development through an investigation into possible links between this deployment and the locations of the headquarters of top European companies.

5.2 Methodology for collecting and analysing data on pan-European network coverage

As mentioned above, telecommunications data availability is very restricted. The presence of data resources in the public domain (the Internet and industry reports) is a good starting point, but this must nearly always be supplemented by private resources which have to be purchased. Our first step, then, was to carry out an extensive search for publicly available information about telecommunications networks at the European level, mainly via the Internet. We looked at the websites of major telecommunications companies and industry consultants, regulators and associations. The quality and reliability of the data varied considerably as did its relevance to our study. Nevertheless, from this trawl of websites and reports, an important set of data was uncovered and constructed relating to the territorial roll-out of pan-European networks. The next stage was to decide on a method for charting and mapping this geographical coverage. In our SIR, the territorial coverage of networks was examined in relation to our own list of over 100 European city regions. In this report, however,
we are able to draw on the recent availability of a typology of over 1500 functional urban areas (FUAs) in Europe developed by TPG 1.1.1, thus not only standardising the varying network data we have uncovered from different sources, but also building on crucial links with other ESPON projects and offering further validation of these new data sets. The FUA data set is particularly relevant to this exploration of pan-European telecommunications territorialities because network data in this domain is presented almost invariably in an ‘urban node’ and ‘inter-urban flow’ format. Nevertheless, we also found it useful that the FUA typology was partly related to their NUTS 3 region contexts, allowing us to add a crucial ‘regional accessibility’ dimension to our analysis.

5.3 A territorial analysis of network extensiveness and inter-urban connections

a) Functional Urban Areas (FUAs)

Figure 5.1 plots the population of European Functional Urban Areas (FUAs) against how many of ten of the most extensive pan-European company networks are present in them. The ten networks are BT Ignite, T-Systems (Deutsche Telekom), Cable & Wireless, TeliaSonera, Telecom Italia Sparkle, Colt, MCI, Infonet, UPC and Tiscali.24 Only 341 out of the list of 1609 FUAs have one or more of these main pan-European networks present (21.19%).

If a large population and a higher number of pan-European networks in FUAs are closely linked, we would expect the chart to show a consistent rising curve. However, whilst there is a general upward trend like this, the chart shows a much more even distribution than we might have expected, suggesting that the population of FUAs is probably only one of a series of factors bound up in the number of pan-European networks deployed in them.

Thus, while three of the four most populous FUAs in Europe (Paris, London and Madrid) are well represented on 9 or 10 of the networks, Essen, with its population of

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24 A territorial perspective on the network roll-out and investment strategies of some of these individual pan-European telcos was given in the 1.2.2 SIR (see pp129-142).
nearly 6 million, is only on 3 networks, and Wien, Amsterdam and Bruxelles, with relatively lower populations around the 1-1.5 million mark, are on all ten. In the same way, at the other end of the scale, it is not surprising to find that the majority of the FUAs which are present on only 1 of the 10 networks have populations of less than 300,000, yet there are still seven FUAs in this category with populations over 1 million, including Napoli which has a population of well over 2 million. Indeed, given the population spread for these FUAs with only 1 pan-European network, from the 2.38 million of Napoli down to the 20,000 of Tralee, it is clear that we must look for other reasons behind the territorial deployment of pan-European networks as well as population.

We can note that two FUAs with populations of over 1 million, Porto and Sofia, do not have presence of any of these ten networks. Likewise, capital cities such as Vilnius, Tallinn and Nicosia (as well as Sofia)\(^\text{25}\) are not on any of the main networks.\(^\text{26}\)

\(^{25}\) The situation with regard to major pan-European operators is, however, frequently complicated by the fact that many of these operators have subsidiary companies (which may or may not themselves be pan-European operators), which may have presence in other cities. TeliaSonera, for example, has subsidiary presence in Tallinn and Vilnius in this way (but which is not shown on their network configuration maps on their website).

\(^{26}\) See the 1.2.2 SIR, pp104-107, for a discussion and charts of national territorial differences in the relationship between telecommunications infrastructure and city region populations.
Figure 5.1 – Comparing the population of FUAs with how many of ten of the main pan-European network operators are present

This conclusion about the need to consider other factors as well as population is also largely borne out by figure 5.2 which compares the population of FUAs with their ranking in terms of the quality of their telecommunications infrastructure by the Telegeography consultancy. Essen again stands out for its large population but low ranking, while Dusseldorf, Amsterdam, Hannover and Bruxelles are all considered to be among the top European cities for telecommunications, despite populations of just over or just below 1 million.

Source: Data from company websites, plotted by CURDS
Figure 5.2 – Comparing the population of FUAs with the ranking of the top 60 cities for telecommunications by Telegeography Inc.

Source: Data from Telegeography Inc. website (http://www.telegeography.com), plotted by CURDS
Figure 5.3 illustrates how non-incumbent telecommunications operators have rolled out (or intended to roll out) their pan-European networks\textsuperscript{27} in recent years\textsuperscript{28}. A number of preliminary general points of territorial analysis emerge from this map:

\textsuperscript{27}“KMI’s definition of pan-European network includes those service providers that installed their own fiber optic cable in more than one European country” (Personal communication from Patrick Fay, KMI Research, 21 March 2003).

\textsuperscript{28}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
There is a broad ‘three-level’ core-intermediary region-periphery distinction at the European scale with the largest number of networks focusing on a highly concentrated zone roughly delimited by London, Paris, the Ruhr and Hamburg, some of these networks also covering the rest of the ‘20:30:40 pentagon’ and other areas just beyond, and only a small number of networks extending to the periphery. Despite the small scale of the map above, it can clearly be seen that Greece, southern Italy, Portugal, Scotland, northern regions of the Nordic countries and eastern Europe (beyond Prague and Budapest) have little representation (see figures 5.4 and 5.5).

Figure 5.4 – Pan-European networks in South East Europe

Source: [www.kmiresearch.com](http://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.

years ago 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’.
Figure 5.5 – 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 5.6 – 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.
A similar pattern emerges at the national scale, with the primacy of capital cities, such as London, and other large urban cities and regions, such as Milan, 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 5.6). This, of course, 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 lower territorial level, spatial differences in accessibility of 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 map above already illustrates how gaping regional holes are left in the pan-European telecommunications ‘web’ by the deployment of networks along specific city-to-city infrastructure routes (eg motorways, railways etc) – for example, central France, central Sweden (see figure 5.7), and even central Germany (see figure 5.6 above). 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 European territorial ‘divide’, however, we can also highlight some of the potentially more positive trends which the map shows, particularly around the notion of a polycentric form of territorial development of telecommunications:

- 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 Prague, Budapest and Copenhagen (see figure 5.8). Potentially, then 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, eg. Grapes and Silk Route in southern Italy and Greece, Infigate in eastern Europe, and Song (TelTel) in the Nordic countries.

Source: [www.kmiresearch.com](http://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.
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 5.9), WorldCom in Ireland.

Figure 5.8 – 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 5.9 – The ‘local’ national loop of Energis in Poland

Source: www.kmiiresearch.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 5.10 plots the number of pan-European telecommunications networks present in the 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. 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, ie the number of networks offering the same route and the amount of overall bandwidth present on that route. These issues will be the focus of the next sections.

Table 5.1 shows the inter-city connections with the most number of networks passing along them. We can observe that all the connections take place in a very concentrated core area which extends no further south than Frankfurt am Main, no further east than Hamburg, no further west than Paris and no further north than London. The predominance of large northern and north western German FUAs here stands out, although the fact that Dusseldorf appears more frequently on these links than Frankfurt is quite surprising.
Table 5.1 – Inter-city connections with most networks along them

<table>
<thead>
<tr>
<th>Link</th>
<th>No of networks on link</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hamburg-Düsseldorf</td>
<td>17</td>
</tr>
<tr>
<td>Hamburg-Amsterdam</td>
<td>16</td>
</tr>
<tr>
<td>Hamburg-London</td>
<td>16</td>
</tr>
<tr>
<td>Düsseldorf-Amsterdam</td>
<td>16</td>
</tr>
<tr>
<td>Paris-London</td>
<td>16</td>
</tr>
<tr>
<td>Amsterdam-London</td>
<td>16</td>
</tr>
<tr>
<td>Bruxelles-Paris</td>
<td>15</td>
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<tr>
<td>Bremen-Hamburg</td>
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<td>Bremen-Düsseldorf</td>
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<tr>
<td>Frankfurt am Main-Düsseldorf</td>
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<tr>
<td>Düsseldorf-Paris</td>
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<tr>
<td>Düsseldorf-London</td>
<td>15</td>
</tr>
<tr>
<td>Paris-Amsterdam</td>
<td>15</td>
</tr>
</tbody>
</table>

Source:  [www.kmiresearch.com](http://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.

**Different territorial peripheralities in telecommunications network provision**

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 a few exceptions – Koeln in Germany has 10 networks passing through it, yet only 139 links to other FUAs, which actually makes it less linked than Brno and Bratislava. This is all the more surprising given that Koeln is located in the telecommunications-intensive core between London, Paris, Frankfurt am Main and Hamburg.

The overall situation is much different though 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, eg Athinai, 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.

b) NUTS 2 regions

By re-presenting the data obtained from the KMI map in terms of NUTS 2 regions, we can create another important perspective on pan-European telecommunications territoriality. Although the data relates essentially to the territorial extent to which various networks of (mainly) competitive operators are connecting the urban centres of Europe, the NUTS 2 regional data and maps provide a crucial snapshot of those European regions which are benefiting from having a node on these networks, and conversely those regions which are suffering from pan-European ‘network bypass’. Some level of regional competitive advantage is more likely to accrue in the first case (and disadvantages in the second case) as businesses present in ‘noded’ regions will have a greater possibility of obtaining competitive (in terms of both choice and reduced costs) broadband service offers, whether it be via leased line or DSL connections. The fact that alternative non-incumbent broadband infrastructure is ‘noded’ in some regions offers a range of competitive service interconnection possibilities which may allow competitive services to be extended well beyond the actual nodes themselves, hence part of the reason for extending the FUA level analysis of the previous section to analysis of NUTS 2 regions here. Nevertheless, we emphasise ‘noded’ NUTS 2 regions in particular to distinguish between regions where pan-European networks connect an urban centre and those regions where these networks only pass through, without ‘stopping’ so to speak (hence the analogy with the TGV high speed train). In figure 5.11, the French regions through which a considerable amount of pan-European infrastructure passes (being on the routes
between the Iberian Peninsula and Paris and Lyon), but they do not have a node on this infrastructure to provide a level of ‘regional access’ to this alternative set of network services.

**Figure 5.11 – The number of pan-European networks ‘noded’ in NUTS 2 regions**

![Map of Europe showing the number of pan-European networks 'noded' in NUTS 2 regions.](image)

- **Red**: Over 15
- **Dark Red**: 9 to 14
- **Purple**: 4 to 8
- **Blue**: 1 to 3

Source: Data from KMI Research map, analysed and mapped by CURDS

Figure 5.11 illustrates primarily a general core-periphery pattern at a European level, within the regions which have most networks ‘noded’ in them are to be found in a concentrated core area (Hamburg, London, Dusseldorf, Ile de France, Noord-Holland, Darmstradt, Région Bruxelles-Capitale, Oberbayern and Bremen), and the regions
which have fewest, or indeed no, ‘noded’ networks are mainly 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, Denmark), and most notably, a roughly Mediterranean-bordering telecommunications ‘development corridor’ extending from Cataluna through all the regions of southern France to Piemonte and Lombardia in northern Italy and Région Lémanique and Zurich 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.

In terms of the ‘polycentrism’ concept, we can suggest that very well or relatively well ‘noded’ regions are to be found in a reasonably wide territorial distribution, which includes many core regions clearly (a polycentric territoriality of telecommunications in the Pentagon appears to be well founded), but also the Iberian Peninsula (Comunidad de Madrid, Cataluna), the Nordic countries (Stockholm, Oslo, Denmark) 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, Bratislavsky Kraj and Kozeb-Magyarorszag 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 has only limited attraction for pan-European infrastructure, as figure 5.11 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.
Figure 5.12 – The number of inter-regional connections via pan-European networks between ‘noded’ NUTS2 regions

Figure 5.12 is a second NUTS2 regional map based on data from the KMI map, this time of how connected European regions are to each other via ‘noded’ pan-European telecommunications networks. As we would expect, this map has some similarities to the previous one, because usually the more networks that are ‘noded’ in a region, the more connections to other regions that region will have. Nevertheless, there are a
number of deviations from this broad pattern, which it is particularly interesting to underline in light of possible polycentric territorial developments, because they show that even if certain regions do not have a large number of networks nodded in them, they may still benefit from a territorially extended connectedness if the networks which they are on highly diffuse. Thus, Praha (6 networks), Bratislavsky Kraj (5) and Jihovychod (3) may be on fewer networks than, but are still connected to around the same number of other regions as, Karlsruhe, Languedoc-Roussillon and Koln (all 10 networks). Many of the Polish regions have only 1 network nodded in them, but via this network they are connected to more than 80 other European regions, which is more than Picardie which has 4 networks. The major point here then is that considerations and implications of polycentric telecommunications territoriality across Europe need to take into account not just the presence, availability or access of infrastructure networks, but also the territorial extensiveness or diffuseness of the infrastructure networks nodded in particular regions. A further important measure of the ‘quality’ of these infrastructure networks, their bandwidth capacities, will be discussed in the next section.

5.4 A territorial analysis of network capacities between cities and regions in Europe

In section 5.3.2. of our SIR, we conducted some quite detailed analysis of a map of terrestrial network bandwidth capacities between European cities produced by the Telegeography consultancy. This map and the analysis complimented very well the KMI Research map and analysis which, as above, focused on network presence in nodes and network connections between nodes. By focusing on the capacities of the networks deployed between urban nodes across Europe, we can explore a further layer to the territoriality of pan-European telecommunications networks (beyond where the networks are and how many of them there are), and more importantly, begin to bridge the gap between supply and demand trends, as the differing amounts of demand, particularly from large business users.

From analysis of the Telegeography map, we noted the following important overall territorial trends, which rather confirmed what we learnt from the KMI map:
The predominance of the core area of the EU (the pentagon) as a cluster of bandwidth connections/communication corridors (see figure 5.13).

The most important connections (in terms of bandwidth) are to be found between the major urban (and business) centres of Europe, thus telecommunications can be viewed as largely respecting the traditional European urban hierarchy.

Both the number of intercity bandwidth connections and the bandwidth capacity of connections (and therefore overall telecommunications accessibility) diminish gradually with distance from the core area.

Peripheral (and/or rural) areas of the ESPON territory have therefore relatively reduced accessibility to these intercity bandwidth connections (Internet backbone networks) (see figure 5.14).

The largest national urban centres concentrate the most intercity bandwidth at the European level (eg. London, Paris, Madrid).

Figure 5.13 European terrestrial networks in 2002 – ‘core’ area detail

It was, however, possible to identify a number of other possible trends, which might be viewed as more optimistic for the development of a more polycentric telecommunications territorial system across Europe:

- The emerging importance of urban centres outside the core area of the EU for attracting bandwidth connections (e.g., Prague, Toulouse, Leipzig, and, to a slightly lesser extent, Dublin, Oslo). Whilst not yet suggesting any “shake-up in the urban hierarchy” (Malecki, 2002), these city regions might have the potential to become viewed as both ‘new network cities’ which surpass some traditionally larger city regions (Townsend, 2001; Malecki, 2002), and a crucial part of a more polycentric European urban system.

- 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 (e.g., Copenhagen for the Nordic region, Berlin for Poland, Vienna and Prague for south eastern Europe).

- Smaller urban centres are increasingly connected to the largest European city regions, which offers access to large capacity global bandwidth connections.

- Some important urban centres in the core area have, for various reasons, relatively limited bandwidth connections (e.g., Essen, Dortmund, Rome).

- Unlike the UK, France, Spain or Italy, Germany has numerous urban centres with important intercity bandwidth connections (Frankfurt, Dusseldorf, Cologne, Hamburg, Berlin…), rather than one major centre at which bandwidth concentrates. The urban bandwidth hierarchy for these German centres does not strictly respect the national hierarchy either (e.g., the most populous urban region Essen has only 1 link to other city regions; Leipzig has twice as many links as the much larger Mannheim urban region).
Figure 5.14 Relatively limited backbone network capacities in eastern Europe

Table 5.2 Major bandwidth routes (4.75-6.5 Gbps)

<table>
<thead>
<tr>
<th>Route</th>
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<tbody>
<tr>
<td>London-Paris</td>
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<tr>
<td>London-Amsterdam</td>
</tr>
<tr>
<td>Frankfurt-Dusseldorf</td>
</tr>
<tr>
<td>Frankfurt-Bonn/Cologne</td>
</tr>
<tr>
<td>Frankfurt-Mannheim</td>
</tr>
<tr>
<td>Dusseldorf-Bonn/Cologne</td>
</tr>
<tr>
<td>Dusseldorf-Hamburg</td>
</tr>
<tr>
<td>Dusseldorf-Amsterdam</td>
</tr>
<tr>
<td>Hamburg-Berlin</td>
</tr>
<tr>
<td>Stuttgart-Munich</td>
</tr>
<tr>
<td>Hamburg-Copenhagen</td>
</tr>
<tr>
<td>Lyon-Marseille</td>
</tr>
</tbody>
</table>

Source: Telegeography Inc. map

Table 5.2 shows the main inter-city bandwidth connections in Europe. This indicates the total size or capacity of all the networks that have been deployed by telcos between city regions. They tend to generally confirm the patterns observed earlier in the context of network connections between city regions. We can note immediately an overwhelming ‘core’ area dominance, with concentrations between the key business centres. Within this, the major trend is a German dominance with no fewer than 7 intra-German routes among the densest in Europe for bandwidth links. Given this, these inter-city connections tend to be short haul routes as well, as telcos are evidently keen to maximise bandwidth between important, fairly proximate city regions, rather than deploy it along longer routes at greater cost and which might risk remaining under-used.
5.5 The territorial implications of pan-European networks for economic development

*Figure 5.15 – The number of headquarters of the top 1500 European companies present in NUTS 2 regions*

Source: Data from Amadeus database, analysed and mapped by CURDS

Building on our earlier analysis of the population of FUAs, another interesting way of further exploring the broader socio-economic context and implications of pan-
European telecommunications networks is to investigate the possible correlation between the locations of these networks and the locations of the headquarters of major companies in Europe. The latter make up a significant proportion of the clients of telecommunications companies, frequently accounting in turn for a much vaster percentage of their revenue than residential and small business users put together. We have already noted how surveys have shown that the quality of access to high quality telecommunications infrastructure and services (in terms of cost, competitive choice and technical capability) is one of the major factors in company locational decisions. In turn, it is evident that given the vast revenues to be gained from large business users, telecommunications companies consider the office locations of these users to be a primary factor in their network and service roll-out strategies. We are not suggesting a simple one-way causal relationship here between telecommunications networks and top company locations, but that the inherently relational and mutually dependent link between the two can shed some further illustrative light on the territorial implications of telecommunications networks for economic development.

As we argued in our SIR, “the territorial distribution of telecommunications networks at the European level is at once a presupposition, a medium and an outcome of complex, intertwined supply and demand-side dynamics. Existing coverage can determine where further supply is needed and whether demand is generated and preserved. It can also be seen as the means by which telecommunications services are supplied and demand is met. In addition, and perhaps most importantly, territorial distribution is a result of investment decisions taken by suppliers based on market demand” (1.2.2 SIR, p59).
Figure 5.16 – Comparing pan-European network presence and top company headquarter locations

Figure 5.16 plots and compares the position of NUTS 2 regions according to the number of pan-European networks ‘noded’ in them and the number of headquarters of the top 1500 European companies (based on revenue/turnover last year) located in them. The graph broadly illustrates the general expected trend of the higher the number of company HQs, the higher the number of networks (and vice versa). There is, nevertheless, a surprising amount of deviation from this pattern, with a relatively wide distribution of regions sharing company headquarters. London and Ile-de-France, with a far greater concentration of top company headquarters than any other region, are not particularly significant outliers in themselves (high number of company HQs and networks), but when compared to the regions which have similar numbers of networks ‘noded’ in them, but far fewer company headquarters (Hamburg, Dusseldorf and Noord-Holland have less than half their number of headquarters), it suggests that there is no absolutely clearcut relationship between the two variables. In addition, the examples of Bremen (15 networks, 2 HQs), Aquitaine (11 networks, 1

Source: Data from Amadeus database and KMI map, sorted and plotted by CURDS
HQ) and Languedoc-Roussillon (10 networks, 0 HQs) suggest that pan-European networks do not always attract top company HQs to locate in all regions. Conversely, the example of Bedfordshire and Hertfordshire (34 HQs, 0 networks) suggests that top companies do not always locate their HQs where they have direct access to pan-European networks.

Overall, then, as for our network – population analysis earlier, although we can suggest that there is some level of relationship between the presence of company headquarters and major telecommunications infrastructure in European regions, we must underline that it is clear that we cannot consider individual factors such as headquarters of top European companies as having a major ‘impact’ on telecommunications territoriality by themselves, but that they must be considered in parallel with other factors as bound up in the development and implications of pan-European telecommunications networks for the socio-economic development of the regions of Europe.
Figure 5.17 – A classification of NUTS 2 regions by top 1500 company headquarters and pan-European network presence

Source: Data from Amadeus database and KMI Research, analysed and mapped by CURDS
• The above map demonstrates a clearer relationship between company headquarters and pan-European networks in NUTS 2 regions than the previous graph.
• The European periphery stands out clearly, with many regions being in the lowest category signifying that none of the top 1500 company HQs and none of the major pan-European telecommunications networks are located in them.
• In contrast, the regions which have many HQs and many networks are largely located in an enlarged European core area, with the exceptions of Madrid, Denmark, Stockholm and Oslo.
• It is notable that there are a number of German regions with only few HQs and no networks, in spite of their core or ‘close to core’ location.
• The regions which are classed as having few HQs, but many networks are clustered around southern France and Cataluna.
• Utrecht has many HQs, but no networks.
• Languedoc-Roussillon has no HQs, but many networks.
• Given that the map shows many regions as having many HQs and many networks, few HQs and few networks, and no HQs and no networks, this would suggest that there is a good link between company HQ locations and network presence in NUTS 2 regions.

5.6 Conclusions

In this chapter, we have focused on some of the major ‘backbone’ telecommunications networks, which offer businesses the fastest, highest-capacity and most seamless broadband connections available, and are, therefore, important in linking the European space as a whole, and for the economic competitiveness of individual cities and regions. Unsurprisingly, the deployment of these infrastructure networks is strongly related to demand dynamics (hence the relatively close correlations between population and large company headquarters and presence of these networks in city nodes). Nevertheless, the territoriality of the development of these infrastructure networks in Europe appears to have adopted a polycentric form of development in a number of ways. At one level, although the ‘global cities’ of
London and Paris have always been privileged in terms of telecommunications infrastructure investment (see Rutherford, 2003), some smaller, ‘sub-global’ centres, such as Hamburg, Dusseldorf and Amsterdam are more or less their equals in terms of the presence of backbone networks and bandwidth provision. There are also a number of ‘regional capitals’ emerging in these networks, such as Madrid, Copenhagen and Vienna, and cities which are acting as ‘gateways’ between national territories (such as Lyon with respect to France, Italy and Switzerland). Further, the evidence suggests that, although there are ‘tunnel effects’ with respect to these backbone networks, there are also many instances of smaller cities along the major routes being connected.

In the next chapter, we draw out more of the territorial development implications of the evidence from this chapter within an ESPON and ESDP perspective.
Chapter 6: Summary of findings from an ESPON perspective

The aim of this chapter is to provide a brief summary overview of our work to date, presented in the preceding three chapters, in relation to the key concepts and typologies which make up an important part of the ESPON research project as a whole. This meets the suggestions outlined in section 6 of the Crete Guidance Paper of BBR in June 2003. As we have seen, there are a number of clear patterns or trends of telecommunications territoriality across Europe bound up with the development of different types of technology and infrastructure, but given that the majority of these develop in parallel, both in time and across space, albeit with different levels of maturity and extent, it is important, particularly from a policy-making viewpoint, to be able to draw out the main overall macro trends in telecommunications territoriality and their implications for the promotion of a more cohesive and polycentric form of European territorial development in the future.

6.1 The territorial dynamics of nodal, network technologies

Telecommunications networks have some distinctive characteristics which influence strongly their territorial dynamics. Firstly, they are invariably nodal (except for satellite communications, which is very much a special case in telecommunications), in that they rely on (usually expensive) fixed pieces of equipment (switches, exchanges, masts, etc) in order to provide service to a particular area – telecommunications are never ubiquitously available, therefore, but are based on particular nodal technologies, which can then connect up customers through wires or wireless links. In terms of transport analogies, this nodality of telecommunications networks makes them more like railways than roads, in that they require fixed points of access to the network to be provided, equivalent in this analogy to the station or freight yard.

Secondly, and equally importantly, these nodes are parts of networks, with their network characteristics applying at different levels; the node has to have a local access network in order to connect individual users to the node, and the node has to be connected to other nodes (usually in complex hierarchies involving interconnection with other networks) to meet the communications requirements of users.
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 in this report 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, from the findings presented in chapter 4, and particularly the examples of the maps of France, Italy, the UK, Finland and Hungary, this is very much the pattern for ADSL roll-out.

If we draw a graph of the population coverage of a country over time as a new network technology is deployed, the basic form of the curve will look akin to that presented in Figure 6.1. The curve is relatively steep initially, as network nodes are provided in the largest cities with their sizeable populations. The curve then flattens out, as subsequent additional nodes will add much smaller increments to the population coverage. In terms of territorial or regional disparities in the availability of a network technology, therefore, the tendency will be for regional disparities to be highest soon after the technology is launched, it being available firstly in only one or a few cities, and for disparities to then reduce over time as the roll-out process proceeds.
It follows that if we look at a technology which has recently been launched, and compare it with a mature technology, the extent of regional disparity will almost invariably appear greater with the recent technology. Similarly, if we compare a recently introduced technology in different countries, it is likely that varying regional disparities in provision will be apparent which may be explained by them being at different temporal points on the roll-out curve.

Figure 6.1. The evolution of a technology’s population coverage.

![Coverage vs Time Graph]

A number of features to do with the intersecting dynamics of markets, costs and territories will determine the shape of the ‘roll-out curve’ for any particular network technology. In some, such as curve (a) in Figure 6.2, the curve will be very steep and will reach a high level of population coverage very quickly. For others, such as curve (b), the slope of the curve will be less steep, implying a slower roll-out, and may ‘flatten out’ earlier, implying that roll-out slows to a virtual halt with a much lower level of population coverage. In terms of the networks we have examined earlier in this report, mobile cellular has had a roll-out curve similar to curve (a), whilst ADSL appears to be more akin to curve (b).
Telecommunications policy and licensing decisions can, of course, affect both the slope of a given technology’s roll-out curve and the point at which it begins to flatten out in terms of population coverage, but we need to bear in mind that each type of new network technology will have a distinctive curve conditioned by the nature and costs of the technology, the market conditions under which it is introduced, including the extent of competition, and the extent to which the technology or service is aimed at a general or specific market. For policy to intervene effectively (including cost-effectively) in bringing about a more even territorial balance in the availability of a technology within a country, it is thus important to understand the territorial dynamics of the roll-out of that technology under market conditions.
6.2 Explaining sub-national telecommunications territoriality trends: regulation, geography, culture and institutions

Although in the previous section we have stressed a relatively simple population-based market logic to explaining the territorial dynamics of telecommunications provision, there are likely to be a host of parallel and interlinked factors bound up in patterns of telecommunications territoriality within countries, and 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. As the French regulator made clear, “the key territorial characteristics of France which are important for the promotion of balanced telecommunications development are the rurality of the country, the widespread distribution of the population, and the fact that there are over 36,000 local administrative units” (Guillaume Gibert, ART, personal interview, June 2003). Given the 4-5 kilometre technical limits for deploying ADSL services (even before the probable lack of commercial potential is taken into account), the first two factors explain to a large extent the inherent difficulty (or impossibility?) in achieving anything like a substantial territorial coverage for broadband using this technology (thus explaining the increasing interest in and strategies revolving around the use of wireless and satellite alternatives). In the latter case, multiple government authorities with differing, but overlapping responsibilities can make it difficult to develop coherent territorial ICT strategies for areas requiring some form of public sector intervention: “In administrative terms, one of the problems is that there is a definite lack of actors to drive strategies and policies along. In other words, between the régions and the départements, there isn’t really a clear leader in the telecommunications domain. Maybe the régions can be seen as the major telecommunications actor, but the division of administrative tasks between the two levels means that as soon as the development of any policies and strategies 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).
It becomes clear that 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.

6.3 Polycentric development and telecommunications territoriality trends

Although, in theory, telecommunications seem to offer the potential to create a more balanced European territory, ICT access was one of the six major fields of territorial disparity identified by the Commission in the introductory speech of Patrick Salez in Crete. It should, however, be clear from 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. Chapter 5 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, as was summarised at the beginning of chapter 3, at a European level, there is evidence of north-south, west-east, EU15-EUCC, and core-periphery divides in supply and demand for telecommunications networks and services. At a sub-national level, there are important capital city-rest of country, major cities-other cities and urban-rural divides.
Table 6.1 – Main disparities in supply and demand of TN&S in European space at macro, meso and micro levels

<table>
<thead>
<tr>
<th>Spatial level of analysis</th>
<th>High supply and demand</th>
<th>Low supply and demand</th>
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<tbody>
<tr>
<td>Macro</td>
<td>North</td>
<td>South</td>
</tr>
<tr>
<td></td>
<td>West</td>
<td>East</td>
</tr>
<tr>
<td></td>
<td>Core</td>
<td>Periphery (but see text)</td>
</tr>
<tr>
<td>Meso</td>
<td>Capital/major city</td>
<td>Rest of country</td>
</tr>
<tr>
<td></td>
<td>Urban</td>
<td>Rural</td>
</tr>
<tr>
<td>Micro</td>
<td>Urban</td>
<td>Rural hinterland</td>
</tr>
<tr>
<td></td>
<td>Urban core</td>
<td>Urban periphery</td>
</tr>
</tbody>
</table>

Table 6.1 provides a very rough description of supply and demand for telecommunications networks and services at three European spatial scales. As with any model it misses some important nuances. For example, although there is a clear core-periphery disparity, the Nordic periphery is the most advanced area in Europe, in terms of provision and take-up. Similarly, though there is a clear West-East disparity some countries are catching up in respect of newer technologies, notably Estonia and Slovenia.

Peter Hall has written about how “it is necessary to realise that the central word, polycentric, needs to be carefully defined: it has a different significance at different spatial scales and in different geographical contexts” (Hall, 2001, p9). At a European level, this would mean promoting ‘sub-global’ cities such as Brussels and Frankfurt rather than ‘global’ cities like London. Other activities could be diffused down to ‘regional capitals’ such as Copenhagen, Rome and Madrid, “each commanding a significant sector of the European territory” (Hall, 2001, p9). Further down the scale, polycentricity can also refer to the changing roles of large cities vis-à-vis smaller cities within their hinterlands, as around London, and then in more peripheral regions, the key might be to promote the development of ‘regional capitals’ of between 200,000 and 500,000 people or ‘county towns’ with populations of 50,000-200,000.
In this way, the concept of ‘polycentricity’ becomes a pertinent illustration of the way in which territoriality has become more and more bound up in parallel and intertwined spatial scales, rather than the traditional distinct hierarchy of scales that we are used to.

We can suggest that this vision of a parallel and intertwined scalar polycentricity finds a very good illustration in the deployment of telecommunications infrastructures across Europe. The spatial organisation of this 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). As we saw in chapters 3 and 4, then, the steady enabling of these exchanges for the provision of ADSL services by operators within different countries (even if, as demonstrated in table 4.1, they have concentrated on those of major cities first) is creating a renewed polycentric broadband territoriality by offering businesses and consumers access to ADSL services at various ‘equal’ points within a particular country. The ADSL coverage and population and GDP distribution maps of Finland, Hungary, France, Italy and the UK (figures 4.7 to 4.11) in chapter 4 provided 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 ADSL 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, ADSL coverage is much lower as expected.

In chapter 5, we showed how the broad ‘hub and spoke’ geographies of alternative backbone infrastructure deployment have a crucial ‘polycentric’ component. For example, we highlighted the ways in which alternative backbone infrastructures were increasingly being extended out beyond the European core through ‘gateway cities’ such as Berlin, Vienna and Copenhagen 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. Given then that these networks are part of the ‘infrastructural foundation’ (cf the motorways or high-speed train analogy) to the territorial development of telecommunications in Europe, it is at the very least encouraging that more peripheral cities are increasingly becoming nodes on these networks. From this, within a polycentric form of development, the possibility of interconnection with a number of major backbone networks to provide a relatively diffuse level of territorial connectivity to ‘global’ command and control centres could be expected to drive a certain dynamic of supply and demand of other networks and services within countries, and the emergence of sub-national polycentric territorialities of telecommunications development, ie differing technologies rolled out and taken up in a more balanced regional pattern. However, the major cities-rest of country and urban-rural divides prevalent throughout the evidence presented in chapters 3 and 4 suggest that this lower-scaled polycentrism is rarely taking place so far, as development is concentrating on the capital city and one or two other major cities at best. This may be a question of time, however, as in the case of ADSL roll-out, an initially ‘centric’ pattern of operators focusing on capital cities and one or two other major cities seems to gradually dissolve into a more balanced version of this lower-scaled polycentrism as a more substantial number of urban regions are included in ADSL coverage strategies. Increasing technological maturity appears, therefore, to be highly bound up with increasing territorial diffusion and possible polycentric forms of development.

On a European scale, however, as we saw in chapters 3 and 4, the fact that EUCCs such as Estonia and Slovenia are in advance of the UK and France in broadband technology penetration, and the way in which demand growth in EUCCs in general appears to be often at least the equal of EU15 for a number of technologies, bodes well for promoting a more balanced European information society in the near future.

The observation in chapter 3 that ‘mobile telephony appears to break with the conventional pattern of a rich-poor disparity’ as there are increasingly high levels of penetration across EUCCs as well as EU15 and in some more remote 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 networks have done. The regions of southern and eastern European countries have often relatively similar levels of penetration to Nordic or European 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 territorial development of other wireless technologies such as satellite and wi-fi (as seen in the vignettes of chapter 4) may also very well promote a more balanced form of telecommunications development, 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. At least on one level, then, polycentric telecommunications territoriality in Europe seems to be potentially bound up in the promotion and development 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 and broadband field with core, urban and more prosperous regions.

In addition, our analysis of the KMI and Telegeography maps in chapter 5 began to draw out some of the different territorial dynamics and implications across different spatial scales as Hall suggests above. 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, Dusseldorf and Amsterdam are more or less the equals of London and Paris in terms of network presence, and according to the Telegeography map, routes such as London-Amsterdam and Dusseldorf-Hamburg have similar bandwidth provision (4.75-6.5 Gbps) to London-Paris.

Looking at our research, it is possible to identify a number of ‘regional capitals’ in terms of telecommunications network provision. Madrid, Copenhagen and Vienna, 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).
The development of a polycentric form of telecommunications territoriality at lower levels based around the ‘spheres of influence’ of large cities may be seen to be of two types. Firstly, the national territorial dominance of cities such as London and Paris has been such that telecommunications network deployment in the UK and France has been very much organised in relation to these cities. There is some limited evidence so far of national territorial polycentricity in telecommunications here – Birmingham, Manchester and Bristol are all increasingly important centres for telecommunications concentration, although still in the shadow of the capital, while Lyon, Strasbourg and Bordeaux have all profited from their ‘gateway’ locations (towards Italy and Switzerland, Germany, and Spain respectively) to improve their network presence and connectivities. Secondly, on a finer scale, smaller cities within the wider hinterlands of these key cities can be seen to have been able to participate in telecommunications network deployment, eg Reims and Rouen in the Bassin Parisien, and Reading and Cambridge around London, albeit largely through profiting from their proximate links to the capital city.

In countries without a real single dominant and influential large city such as Germany, a more tangible polycentric form of telecommunications territoriality has been able to develop. For example, many of the most important direct bandwidth connections in Europe are between German cities according to the Telegeography map, and there are no less than six German city regions with more than 15 alternative networks present according to the KMI map (Hamburg, Rhein-Ruhr North, Rhein-Ruhr Middle, Bremen, Rhein-Main, and Munich). Both the overall centrality of these city regions and their particular ‘gateway’ locations (eg Hamburg and Bremen link towards Scandinavia, Munich towards eastern Europe, the Rhein-Ruhr cities towards France and the Benelux) are principal reasons for the promotion of this polycentricity.

Within this enlarged territorial notion of differing ‘polycentricities’, the concepts of ‘development corridors’ and ‘gateway cities’, also discussed in the ESDP, would appear to offer some resonance as possible means to promote polycentric forms of telecommunications territoriality throughout Europe.

Peter Hall talks about ‘development corridors’ from a public transport perspective, suggesting the need for decentralised ‘clusters of urban developments’ around train...
stations and motorway interchanges at quite a fine spatial scale (Hall, 2001, p9). A telecommunications perspective on ‘development corridors’ may equally take a smaller territorial approach, focusing on groups of (broadband enabled) local exchanges and network interconnection points as potential decentralised ‘cluster zones’, where access to infrastructures and services can be facilitated, but wider scale ‘development corridors’ related to current and future pan-European telecommunications network deployment could well be a more preliminary approach given the inherent ‘territorial corridor’ nature of this deployment generally.

A brief look at the KMI and Telegeography maps, plus the maps of individual pan-European telecommunications companies, suggests a broad pattern of connected ‘corridors’ and ‘rings’ across Europe along which networks are deployed. These are, then, already the main telecommunications ‘development corridors and rings’ on a European scale. However, many of the networks deployed along these corridors are meant purely to connect the two urban centres at either end without offering any kind of connection to the intermediate territory, thus they are characterised by a so-called ‘tunnel effect’, which is rarely beneficial for territorial cohesion. The largest inter-city bandwidth connections will always be routed directly between key cities such as London and Paris, Paris and Frankfurt etc to serve as efficiently as possible the most profitable customers of telecommunications companies located in those cities. The parallel is often drawn here with the high-speed train, by explaining how if a high-speed train starts to stop at all the intermediate points on its route, it stops being a high-speed train. Beyond these ‘fat pipe’ routes however, the KMI map, for one, illustrates quite clearly that many pan-European networks are deployed to serve not only the key cities but those smaller cities which are located along their routes, thus reducing the ‘tunnel effect’ of their deployment strategies. This pattern can also be seen from our analysis of the number of connections to other places which each city has via pan-European networks, where we saw that despite quite large variations in the numbers of networks present in cities, there was not really a similarly large variation in the number of inter-city connections, therefore the likes of Brno and Gdansk were still connected to a large number of other European cities in spite of being on very few networks. There appears, therefore, to be some potential for conceptualising and taking into account in policy development the ways in which European cities, and perhaps more peripheral cities in particular, are benefitting from
being located along telecommunications network ‘development corridors and rings’. Being connected via these corridors and rings to many other places is a significant factor which could promote a more ‘polycentric’ telecommunications territoriality in the future.

‘Gateway cities’ would also appear to be a key concept for discussion of forms of ‘polycentric’ telecommunications territoriality. In the same way as the ‘polycentricity’ concept itself, ‘gateway city’ must have ‘different significance at different spatial scales and in different geographical contexts’. London and Paris may be viewed as networked cities which are on one level ‘gateways’ to the global ‘space of flows’. Equally, and at the same time, by being the primary focus of important bandwidth connections to the UK and France, they are the national ‘gateways’ for pan-European networks to reach other cities in their respective countries. They are also gateways to their own urban hinterlands and the further development of connectivity of smaller cities within these hinterlands.

However, the major meaning of ‘gateway cities’ would appear to be at a regional European level, where certain cities concentrate networks and bandwidth connections which ‘pass through’ them or are re-routed from them to significant sectors of the European territory. Copenhagen does this for many of the pan-European networks which come from Germany and are destined for Nordic countries. Vienna has good network presence and quite large bandwidth connections because it acts as a ‘gateway’ between the core area of western Europe and the relatively new telecommunications markets of eastern Europe. Southern French cities such as Bordeaux and Montpellier must be passed through for those pan-European networks which have been deployed in Spain and Portugal. This trend has already had important polycentricity implications because all these ‘gateway cities’ have become more crucial to the overall functioning and roll-out of pan-European telecommunications infrastructure than they would have been previously.

In summary, as suggested earlier, the development of telecommunications networks and services across Europe shows some evidence of taking a polycentric form of territorial development at macro, meso and micro scales, although this is particularly
the case at the macro scale, where more territorially extensive infrastructures have been deployed by major companies, which, with the inherently nodal or ‘hub and spoke’ properties of these networks, has promoted polycentricity through the emerging importance of particular ‘development corridors’ and ‘gateway cities’.

6.4 Typologies of telecommunications territoriality trends

Within the ESPON ‘common platform’, typologies are a means of summarising the regional disparities for each of the specific themes, in this case of the provision of and access to telecommunications networks and services. ESPON 1.2.2 has developed 7 typologies in the course of our work. These are listed below, with the number of categories and the spatial level of each typology shown in brackets:

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

Some of these typologies have been presented earlier in the report, but for completeness, we reproduce the figures, and their accompanying text, below.
### 6.4.1 Mobile penetration / Internet penetration (national level)

**Figure 6.3: Categorisation of EU27+2 according to their levels of mobile telephony and Internet penetration**

<table>
<thead>
<tr>
<th>MOBILE PENETRATION</th>
<th>High</th>
<th>Low</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Sweden, Finland, Norway, Denmark</td>
<td>• France, Belgium, Luxembourg</td>
<td></td>
</tr>
<tr>
<td>• UK, Germany, Netherlands, Switzerland, Austria</td>
<td>• Ireland</td>
<td></td>
</tr>
<tr>
<td>• Portugal</td>
<td>• Spain, Italy, Greece</td>
<td></td>
</tr>
<tr>
<td>• Slovenia, Estonia</td>
<td>• Czech Republic</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>INTERNET PENETRATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
</tr>
<tr>
<td>• Malta, Cyprus</td>
</tr>
</tbody>
</table>

One way of summarising the territoriality of European telecommunications is to produce a typology of countries [and, once we have the data from the up-dated EOS-Gallup survey, regions as well] according to their level of penetration of the two most important communications services, mobile telephony and the Internet. As Figure 6.3
shows, a typology of European countries according to whether they are ‘high’ or
‘low’ on mobile and the Internet penetration reveals a clear pattern of variation.

The ‘high-high’ category includes all of the Nordic countries, along with the UK,
Germany, the Netherlands, Switzerland and Austria. Of the Cohesion countries, only
Portugal is represented, while of the EUCCs, both Slovenia and Estonia ‘make the
grade’.

The next category is ‘high’ in terms of mobile penetration, but ‘low’ in terms of the
Internet. The Francophone countries of France, Belgium and Luxembourg are in this
category, as are Spain, Italy, Greece, Ireland and, of the EUCCs, the Czech Republic.
There are no countries which are ‘high’ in terms of Internet penetration and ‘low’ in
terms of mobile; all of the low penetration countries in mobile telephony are also low
in terms of the Internet. None of the EU15 are in this category, but most of the
EUCCs are: Malta, Cyprus (only just in the case of these two), Slovakia, Hungary,
Poland, Latvia, Lithuania, Romania and Bulgaria.
6.4.2. Broadband penetration (NUTS 2)

Figure 6.4: A typology of broadband penetration

Figure 6.4 is a map representing the results of a typology of NUTS 2 regions in terms of likely broadband penetration. In the absence of any available regional broadband data for European regions, a number of documents including the latest national broadband figures from ITU and the OECD and the fragmentary evidence from our
own research in WP3 were considered in an attempt to categorise regions as having high, medium or low broadband penetration. Regions with high broadband penetration are concentrated in the Nordic countries, particularly Sweden and Denmark, the Swiss-Austrian central Europe axis, and in the Benelux countries. Individual regions correspond to the major metropolitan regions of Europe (London, Ile-de-France, Comunidad de Madrid, Berlin, Hamburg).

The pattern of regions with low broadband penetration is dominated by the majority of the eastern Europe / EUCC region (with the exception of Praha, Estonia, Kozep-Magyarorszag and Slovenia). Southern Europe tends to have low broadband penetration as well (the whole of Greece, southern Italy, southern Spain and Portugal). Elsewhere pockets of low broadband appear to correspond with more rural and / or less prosperous regions of EU15 (Mecklenburg-Vorpommern and Magdeburg in Germany, Limousin and Auvergne in France, Merseyside, Cornwall, Wales and south western Scotland in the UK).
6.4.3 Introduction of competitive provision (NUTS 2)

Figure 6.5: *A typology of the introduction of competitive provision*

Figure 6.5 is a map representing the results of a typology of NUTS 2 regions in terms of early or late introduction of competitive provision of fixed services. As well as our own knowledge of national regulatory situations and contexts, this typology is based on the ‘Fixed telephony: competitors penetration’ map from the 1999 EOS Gallup survey (see the 1.2.2 SIR, p66), which provided a good snapshot of the territorial extent of competition for 1999, thus allowing us to distinguish clearly between...
regions which already had a good level of competition at that time (early) and those which did not (late).

Regions with early introduction of competitive provision correspond strongly with those countries which opened up fixed markets earlier and most efficiently, hence much of the UK and nearly all of Nordic countries, and some of Germany, Italy and Spain dominate here.

Regions with late introduction of competitive provision include all of eastern Europe, but also French and the majority of Finnish regions stand out here. France was a notably late liberaliser of markets, and Finland has a very specific local telecommunications market structure organised around a number of traditional incumbent providers, which explain their positions in the second category.
6.4.4 Broadband penetration / Introduction of competitive provision (NUTS 2)

Figure 6.6: A typology of broadband penetration/introduction of competitive provision

Figure 6.6 is the result of a composite typology of the previous two typologies, i.e., representing a classification of NUTS 2 regions based on their levels of broadband penetration and introduction of competitive provision.

Regions with high broadband penetration and early competitive provision are dominated by Denmark and Swedish regions where national culture, a dynamic
regulatory context and national government policy support has promoted competition and broadband strongly for a number of years. Other regions in this top category are major metropolitan regions such as London, Berlin, Hamburg, Dusseldorf and Comunidad de Madrid.

Regions with high broadband and late competition are mostly clustered in Benelux regions and the Swiss-Austrian central Europe axis, with Ile-de-France being a notable exception to this. In these regions, it is evident that competition has either developed very quickly recently to produce a dynamic broadband market (Ile-de-France could be explained by this), or has had relatively little influence on the development of broadband penetration (in which public sector support must be strong).

Regions with low broadband penetration and early competitive provision have conversely not seen the benefits of mature liberalised markets diffuse to their development of broadband. Many of these regions are relatively rural (southern Italy, La Rioja, Mecklenburg-Vorpommern, Cornwall), suggesting that despite the regulatory advantage of an open market, operators have not judged it to be commercially viable enough to roll their broadband services out here due to lack of demand.

Regions in the lowest category with low broadband and late competition are again dominated by eastern European regions, although southern European regions (all of Greece, eastern Italy, the south west part of the Iberian peninsula) and more remote regions of EU15 (Ireland, Wales, south western Scotland, Limousin, Auvergne) also appear here. These regions have not benefited, and still are not benefiting, from either open telecommunications markets or a broadband demand dynamic, suggesting that it is these regions of Europe in which some form of public intervention is most necessary in order to stimulate the information society.
6.4.5 Telecoms supply and demand characteristics based on core/periphery, urban/rural, rich/poor (NUTS 2)

Figure 6.7: A typology of telecoms supply and demand characteristics based on core/periphery, urban/rural, rich/poor (NUTS 2)
### Table 6.3 – Expected telecommunications supply and demand characteristics for NUTS 2 regions

<table>
<thead>
<tr>
<th>Region Type</th>
<th>Access to full range of advanced networks and services driven by strong market competition and presence of pan-European operators (fibre MANs)</th>
<th>High levels of uptake, driven by demand from large companies (leased lines) and other leading edge consumers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Core Urban Rich</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Core Urban Poor</strong></td>
<td>Proximity to richer core regions ensures reasonable availability and choice of advanced services, but slower uptake from both business and households (regions of industrial restructuring)</td>
<td></td>
</tr>
<tr>
<td><strong>Core Rural Rich</strong></td>
<td>More limited access to advanced networks and services (eg DSL), mostly deployed by the incumbent within technical limits. Still reasonably robust demand and uptake driven by SMEs, with reasonably high levels of household demand.</td>
<td></td>
</tr>
<tr>
<td><strong>Core Rural Poor</strong></td>
<td>Limited availability of more advanced networks and services, and limited demand and uptake</td>
<td></td>
</tr>
<tr>
<td><strong>Periphery Urban Rich</strong></td>
<td>Good levels of competition between national operators (and some pan-European companies) promotes access to advanced networks and services for large companies, with reasonably high levels of uptake by SMEs and households</td>
<td></td>
</tr>
<tr>
<td><strong>Periphery Urban Poor</strong></td>
<td>Deployment of advanced networks and services limited to incumbent, with slow</td>
<td></td>
</tr>
<tr>
<td>Periphery Rural Rich</td>
<td>Deployment of advanced networks and services limited to incumbent and to urban centres, with reasonable uptake by SMEs and households (particularly in Nordic countries)</td>
<td></td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
</tbody>
</table>
| Periphery Rural Poor | Very limited availability of more advanced networks and services, as even the incumbent rarely sees it profitable to roll out in these regions  
Very limited demand from business and households, and very slow uptake of those services available |

Figure 6.7 and Table 6.3 are the results of a typology of NUTS 2 regions attempting to suggest expected telecommunications supply and demand dynamics based on the geography and economic performance of these regions (core or periphery, urban or rural, rich or poor).

The core-periphery classification is based on the location of each region within or outside of the well-known Pentagon zone, the urban-rural classification is based on the categorisation of regions by BBR into levels of urban or rural, and the rich-poor classification is based on GDP data from the BBR database. As we have seen throughout this report, the urban-rural distinction is particularly important in terms of telecommunications development (although it might have been preferable to be able to use a NUTS 3 regional classification rather than NUTS 2). Adding the rich-poor dichotomy to this allows us to make crucial distinctions between the multiple ‘peripheries’ of the European space with vastly different telecommunications supply and demand characteristics (rich Nordic regions versus less prosperous southern and eastern European regions). It is the core-periphery category which, in the domain of telecommunications territoriality, is most complex and problematic, as we have already noted earlier in the chapter how it is the northern ‘periphery’ which is most
advanced in broadband supply and take-up. Telecommunications territoriality in Europe suggests both a more extended core area including Denmark, and more of the UK, northern Italy and France rather than the traditional Pentagon, and multiple peripheries (northern, southern, eastern).

Nevertheless, taken together, the map of this overall classification and the table explaining telecommunications supply and demand for each type of region supports and underlines much of the evidence from the rest of this study. There are evidently limits to dichotomising the characteristics of European regions in this way, but it is clear that such geographical and economic characteristics are highly bound up in the extent and type of supply and demand of telecommunications.

In summary, the map reveals a starkly differentiated territoriality of European telecommunications. The most dynamic telecommunications environments, possessing virtuous circles of high quality supply and sophisticated demand, competing suppliers and multiple backbone networks, are found in the ‘blue banana’ extending from southern England though north-eastern France, the Benelux countries and Germany to northern Italy (the Core-Urban-Rich category). Similarly high quality environments, though with perhaps less dense coverage of backbone networks are found in much of the rest of the UK, south-east France, north-central Italy, and in major cities such as Madrid, Barcelona and Wien (the Peripheral-Urban-Rich category).

At the opposite end of the spectrum, the least dynamic telecommunications environments, with vicious circles of poor supply and limited demand, few competitive offerings and limited backbone networks, are found in much of the Iberian peninsular, Greece, parts of Poland, the Czech Republic, Hungary and Slovakia, most of Romania and Bulgaria, and the Baltic states (the Peripheral-Rural-Poor category). Similarly under-developed telecommunications environments but with greater potential for market-led developments due to urban concentration are found southern-Italy, in Porto and Lisbon, Athens, parts of the former east Germany, Prague, Bratislava, and a number of Polish regions (the Peripheral-Urban-Poor category). It is regions in these two categories that are likely to have the strongest need for structural fund interventions, both to support the deployment of advanced
infrastructures (backbone networks, broadband) and to stimulate the demand for telecommunications, particularly in the business and commerce sectors of the economy.

Between these two extremes, of particular interest are those peripheral rural regions which are relatively wealthy, found mainly in the Nordic countries, Scotland, Ireland and France (the Peripheral-Rural-Rich category). These regions perhaps have made the most impressive use of telecommunications to overcome or ameliorate problems of remoteness and low population density; as such they may provide approaches to infrastructure development or demand stimulation which could provide pointers to less prosperous regions wishing to move in similar directions. These regions appear to be innovative both in terms of the deployment of alternative technologies such as wireless, and in the development of strategies which integrate the information society with broader development objectives.
6.4.6 Network richness and head office concentration (NUTS 2)

Figure 6.8: A classification of NUTS 2 regions by top 1500 company headquarters and pan-European network presence

Source: Data from Amadeus database and KMI Research, analysed and mapped by CURDS
Based on the data presented in chapter 5, we developed a simple typology of the network richness of NUTS 2 regions (with categories of high, low and no networks). This was then combined with a similar categorisation of head office concentration in NUTS 2 regions, to create a composite typology of company head offices and network richness which further explores the relationship between the two variables.

- The above map demonstrates a relatively clear relationship between company headquarters and pan-European networks in NUTS 2 regions.
- The European periphery stands out clearly, with many regions being in the lowest category signifying that none of the top 1500 company HQs and none of the major pan-European telecommunications networks are located in them.
- In contrast, the regions which have many HQs and many networks are largely located in an enlarged European core area, with the exceptions of Madrid, Denmark, Stockholm and Oslo.
- It is notable that there are a number of German regions with only few HQs and no networks, in spite of their core or ‘close to core’ location.
- The regions which are classed as having few HQs, but many networks are clustered around southern France and Cataluna.
- Utrecht has many HQs, but no networks.
- Languedoc-Roussillon has no HQs, but many networks.
- Given that the map shows many regions as having many HQs and many networks, few HQs and few networks, and no HQs and no networks, this would suggest that there is a good link between company HQ locations and network presence in NUTS 2 regions.
Chapter 7: Policy Issues

7.1 Introduction

The evidence presented in this report and in our FIR and SIR clearly demonstrates differences in terms of supply and demand in TN&S across the European territory. These divisions can be seen between EU 15 and EUCCs, between existing member states and between individual EUCCs. These differences can also be seen within individual countries, that is to say between regions and between urban and rural areas. Some of these differences will clearly relate to GDP. A CID Harvard study, however, shows that ‘enabling factors’ are very important as well. In relation to network use, for example, the report suggests that:

“While income appears to be important in getting a nation to a certain level of Network Use, after reaching that point, further increases in income are less relevant and Enabling Factors play the dominant role” (CID-Harvard, 2002).

The CID Harvard report suggests that a complex range of factors, of which physical infrastructure is only one, account for the take up and use of ICTs and they conclude that it is difficult to disentangle the individual contributions made by each enabling factor. This is likely to be true at the regional as well as the national level. This, of course, has implications for policy. In short, a complex policy response covering a range of areas from the promotion of human capital to appropriate regulatory regimes is required. This is increasingly recognised in European policy (see, for example, the eEurope 2005 Action Plan). We do not address the wider set of policy areas which will be required if regions and localities are to take full advantage of the Information Society as this is beyond the brief of this study.

It is also increasingly recognised, however, that places which do not have access to the latest technologies, particularly broadband technologies, are likely to be at a disadvantage in accessing the opportunities presented by the Information Society.
Consequently, since the late 1990s the question of infrastructure has moved up the regional development policy agenda and after several years of debate the Commission appears to have concluded that investment in telecommunications infrastructure represents a legitimate use of Structural Funds. In July 2003 guidelines were adopted to aid regions eligible under ERDF who wish to co-finance investments through structural funds in the electronic communications sector (CEC, 2003a).

In this policy section we concentrate on the question of what steps can be taken to stimulate the supply and demand of infrastructure and service provision in those areas which appear to be lagging. We look at four policy areas: in section 7.2 we look at how the competitive and regulatory environment might be adjusted to be more sympathetic to territorial development; in section 7.3 we consider how the public sector can aggregate demand for broadband in order to stimulate rollout in a region; in section 7.4 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. In the penultimate section, 7.5, we stress the need for increased knowledge amongst public authorities in relation to telecommunications networks and services. Finally, we end with a plea for an improved system of data gathering and dissemination in respect of telecommunications networks and services.

7.2 The competitive and regulatory environment

In this section we look briefly at some areas in which regulatory environments might be adjusted to take account of territorial development issues rather than merely focusing on competition and pricing issues. We look at three policy areas: stimulating competition in non core parts of the Union, amending 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.
7.2.1 Stimulating competition

In a recent report on the development of broadband access in OECD countries, the OECD suggested that:

The most fundamental policy option open to OECD governments to boost broadband access is infrastructure competition (OECD, 2001, p4).

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 an 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. 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.

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 the 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 point concerns the general question of licenses which (in the case of most technologies) 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 territory are not served, the target figure being met through serving the more urbanised areas of the territory. One policy option is to issue licenses 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’. This initiative has been judged, by some, to have only had a limited effect due to the power of the incumbent and the failure of regulators to enforce the regulations (see, for example, OECD 2001; 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 were the initiative a success in terms of increasing LLU overall, however, it is likely that local loop unbundling would take place in those areas which were adjudged by new entrants to be profitable, that is to say those with dense consumer and SME populations. It was clear from the interview and survey work carried out under WP3 of our study that density of population was seen as a key factor in their investment strategies. 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.

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

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30 LLU in EUCC countries is very low, but will become compulsory in some in 2003 (CEC, 2002b), though as in existing member states the attitude of the incumbent will be crucial to its success. In late 2002 three EUCC countries – Czech Republic, Slovakia, Poland – had not introduced LLU (OECD, 2003)

31 Ironically, these incumbents are often new entrants in other countries where they, themselves, are accused of denying access to their competitors.
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 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.

7.2.2 Amending the Universal Service Directive

From a territorial point of view one of the most potentially important European directives in relation to telecoms is the Universal Service Directive (USD). The USD lays down minimum requirements for EU Member States (and will also cover EUCCs on accession). States can go beyond this minimum though there are certain provisos regarding competition distortion. Our survey and interviews of regulators suggested that few regulators have actually gone beyond the minimum requirements of the USD. One goal of the USD is to ensure availability of certain minimum services to citizens at affordable levels regardless of geographical location. It requires that users should be provided on request with a connection to the public telephone network at a fixed location, at an affordable price. The USD, however, relates only to a basic level of service and requires only a single narrowband network connection. It does not cover ISDN let alone broadband services. Leased lines are covered by the USD, but again it is minimum set of services which is mandated. The Union, therefore, effectively excludes this regulatory tool as a means of achieving the territorial cohesion goals of its eEurope Action Plan. Revising the USD in the context of rapid technological change is, of course, not easy: five years ago proponents of raising the service threshold would have argued for ISDN to be included in the terms of the USD, today the inclusion of broadband would be the goal. A revision would also have to take into account the question of technological neutrality. It would also have to cover non-
incumbents. An additional complication is whether the same basic levels should be applied to accession and candidate countries as to current member states. Nevertheless, a review of the USD, taking more fully into account territorial differences and the way the market is working in different regions and in different types of place (e.g., urban and rural), in the context of rapid technological change should be undertaken.

7.2.3 Requiring the regulator to take greater account of territorial development issues

In addition to considering the USD from a regional perspective 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 EU(CC) countries. 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 ministry32 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.

32 Minister for Communications, Marine and Natural Resources.
7.3 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. Ideally, the broadband aggregation would be complemented by initiatives to organise the private sector purchasing (particularly SMEs) on the same basis in these regions. The UK government introducing a system which potentially addresses this issue (Box 7.1)
Box 7.1: 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. RABs focus 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/

This 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? 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’ 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 EUCCs private sector
involvement in telecentres and PIAPs seems to be emerging. 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 7.2).

Box 7.2: 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 with the provision of ICTs, linked 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.
7.4 Examples of forms of intervention of by regional and local authorities in creating broadband networks and services

7.4.1 Direct public subsidies to telecommunication providers

Direct subsidy to individual telecommunications providers remains an option of policy makers. A well known 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. This 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.

7.4.2 Public partnerships with telecommunications providers

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 to garner expertise in respect of ICT networks and services. We return to this question in section 7.6.

In addition to telecommunications companies public-private partnerships can also involve private companies based in a particular region, this has the advantage of creating a guaranteed market for the technology. Box 7.3 provides an example of one such partnership in a peripheral and rural area of Europe.

Box 7.3: 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

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 7.4).
Box 7.4: Private driven public-private initiative – PIAPs in Lithuania

The ‘Window to the future’ initiative was launched in 2002 by the countries 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/.../a87216857c6755b685256ce0006e95e6/
SFILE/lithuania%20case%202010.doc

7.4.3 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 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 7.5 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.
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 kilometre squared. 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 7.6). 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 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 which strives to offer smaller regions the same communication capacities as in the big cities and ultimately links to Stokab.

33 http://gigaman.gigaport.nl/en_stokab.html
34 http://english.gavleregionen.com/focus/broadband.regnet.aspx
Box 7.6: 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.


The Swedish model has been particularly influential. Austria’s telecoms regulator RTR broadband ‘status report’, 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 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.
7.4.4 Creating a permissive land planning environment

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 7.7).

Box 7.7: 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.


7.5 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 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 member state (and the accession and candidate countries) will have its own government structures, including
regional and local governance structures. 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 directory” to act as a policy and implementation policy 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:

- 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;

- Knowledge of the technical aspects of telecommunications. The examples provided in the preceding sections and also in Chapter 3 of the report illustrates 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’ (CEC, 2003b). 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;
- 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.

7.6 Development of common indicators and improved and standardised collection data with a regional focus

Finally, it has become clear from our study to date that there is paucity of data on ICT from a regional perspective. It is particularly disturbing that the Union, whilst recognising the importance of the regional question in the eEurope Action Plan 2005 has developed a minimalist approach to benchmarking this aspect of the plan. Initiatives are underway within FP5, including BISER and NEsis, 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. There is need to ensure that these processes are integrated, that outcomes are agreed and that standards are implemented. There is a need to, then, 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. 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

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35 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.
36 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.
level immediately below the national level, providing a very poor basis for informed policy-making with respect to regional telecommunications.
References


CEC (2002c) “Eurobarometer Flash 135: Internet and the Public at Large”. Technical Annexes Parts A/B


CEC (2003b) ‘Electronic Communications: the Road to the Knowledge Economy’


Eurostat’s Statistics in Focus, Industry, Trade and Services, Theme 4 -12/2002


Helsinki KEF, available at http://www.helsinkikef.org/.../a87216857c6755b685256ce0006c95e6/$FILE/lithuania%20case%2010.doc


KMI Research website. Available at http://www.kmiresearch.com


Observatoire des Télécommunications dans la Ville website, available at [http://www.telecomville.org](http://www.telecomville.org)


Osservatorio Banda Larga website, available at http://www.osservatoriobandalarga.it/


PriMetrica Inc website, available at http://www.telegeography.com


Annex 1: (Revised) SWOT Analysis: ESPON 1.2.2

0. ESDP Context

The ESDP’s policy aims with respect to telecommunications services and networks are stated in Section 3.3 ‘Parity of Access to Infrastructure and Knowledge’. The relevant sections are reproduced below:

3.3.1 An Integrated Approach for Improved Transport Links and Access to Knowledge

(107) Urban centres and metropolises need to be efficiently linked to one another, to their respective hinterland and to the world economy. Efficient transport and adequate access to telecommunications are a basic prerequisite for strengthening the competitive situation of peripheral and less favoured regions and hence for the social and economic cohesion of the EU. Transport and telecommunication opportunities are important factors in promoting polycentric development. Efficient transport and telecommunication systems and services have a key role in strengthening the economic attractiveness of the different metropolises and regional centres.

(108) The mobility of people, goods and information in the EU is characterised by concentration and polarisation tendencies. Increasing competition in the transport and telecommunication markets can intensify this development. Policy must ensure that all regions, even islands and peripheral regions, have adequate access to infrastructure, in order to promote social and economic and, therefore, spatial cohesion in the Community. It should also ensure that high quality infrastructure, for instance high-speed/high-capacity rail lines and motorways, do not lead to the removal of resources from structurally weaker and peripheral regions ("pump effect"); or that these areas are not crossed without being connected ("tunnel effect"). Spatial development policy should work towards having high quality transport infrastructure supplemented by secondary networks to bring about their positive effects in the regions.

(110) These problems cannot be solved solely through building new infrastructure, however important it may be for all regions. Transport and telecommunication
structures are not sufficient prerequisites on their own for regional development. Accompanying measures in other policy areas, such as regional structural policy or promotion of education and training, in order to improve the locational advantages of the regions are required. This applies especially to structurally weak regions.

3.3.2 Polycentric Development Model: A Basis for Better Accessibility

(111) The future extension of the Trans-European Networks (TENs) should be based on a polycentric development model. That means, in particular, ensuring the internal development of the globally important economic integration zones and facilitating their integration into the global economy. In addition, more attention should be paid to regions with geographical barriers to access, especially islands and remote areas. Spatial differences in the EU cannot be reduced without a fundamental improvement of transport infrastructure and services to and within the regions where lack of access to transport and communication infrastructure restricts economic development. A fundamental improvement of infrastructure and accessibility requires more than just providing the missing links in the TENs.

(116) Telecommunication networks can play an important role in compensating for disadvantages caused by distance and low density in peripheral regions. The relatively small market volumes in regions with low population density and correspondingly high investment costs for telecommunication infrastructure can thus lead to lower technical standards and high tariffs, which bring competitive disadvantages. In many spheres (tele-working, distance education courses, tele-medicine, etc.) the provision of high-quality services at affordable prices is a key factor for regional development. Nevertheless, the application of modern technologies does not depend solely on the availability of advanced infrastructure, equipment or services and their affordability, but also on the development level of each region. Particular attention should, therefore, be focused on measures to stimulate demand, the development of application-related knowledge and the fostering of awareness of opportunities in order to stimulate investment. A prerequisite for all infrastructure projects should be an early assessment of the anticipated spatial impacts and a fine-tuning of Community, national and regional or local measures.
Policy Options

27. Improvement of access to and use of telecommunication facilities and the design of tariffs in accordance with the provision of “universal services” in sparsely populated areas.

3.3.3 Efficient and Sustainable Use of the Infrastructure

Telecommunications, information and communications technologies are important supplementary instrument for regional integration. Thus, they cannot be seen as substitutes for transport development. A major focus should be on co-ordination between decision-makers for transport and for telecommunications. Regional planning and transport planning should also be more strongly integrated with each other.

Policy Options

30. Better co-ordination of spatial development policy and land use planning with transport and telecommunications planning

3.3.4 Diffusion of Innovation and Knowledge

Information and communication technology can help to reduce deficits in the field of access to innovation and knowledge and, by this means, support the settlement of companies in rural regions. This creates investment incentives in regions which normally have lower relative location costs. A polycentric development of the territory of the EU can support this policy.

The dissemination of the new information technologies in all regions involves the provision of a general basic service of equally high quality and the adoption of an appropriate policy of charges. As the northern countries demonstrate, low population density is not an insurmountable obstacle to the provision and widespread use of high-quality telecommunications services. In addition to regulative measures, strategies aimed at stimulating demand for knowledge promote the operation and use of
information and communications technologies. This includes, for example, awareness-raising campaigns and better training opportunities.

(131) Policy Options
39. Development of packages of measures which stimulate supply and demand for improving regional access and the use of information and communication technologies.

1. In the light of the policy aims of the ESDP: What are the main strengths identified by your TPG?

The main strengths are:

- The combination of liberalisation of telecommunications markets and the development and deployment of new technologies has created a highly dynamic environment. Competition is providing pressures which are leading to reduced costs of network access and to service improvements. Rates of Internet penetration and use, and of mobile telephony uptake and use, are very rapid, and thus at the European scale, the supply of telecommunications networks and services is improving markedly. It is not yet clear, however, whether these same competition dynamics are extending to the deployment of broadband networks; the early evidence does suggest that competitive offerings accelerate the deployment of broadband technologies by the incumbent operators.

- The rapid roll-out of digital mobile telephony networks has had particularly significant positive territorial implications, in that almost universal service coverage has been achieved across the whole of the European territory in a very short space of time (less than a decade). For peripheral regions and rural areas, which have tended to find themselves under-provided by advanced networks which rely on wires and cables, the development and very rapid deployment of wireless telephony has transformed the supply of telecommunications services. In central and eastern Europe, wireless networks
have had similarly important impacts, and very high rates of adoption, helping to overcome the legacy of inadequate fixed wire networks.

- The Internet has provided a very strong stimulus to the up-take of advanced telecommunications services. In a very real sense, the bundle of generic applications which the Internet delivers, particularly but not confined to the World Wide Web, has overcome much of the resistance to the up-take of advanced telecommunications services which was so prevalent until the late 1990s. Competition between ISPs has aided the adoption process considerably, by driving down the real cost of accessing the Internet and by facilitating marketing-led strategies aimed at different segments of both business and domestic subscriber markets. The widespread availability of the Internet across Europe will have provided an important boost to the communications capabilities and access to information of regional SMEs.

- The territoriality of the development of Internet backbone infrastructure networks in Europe appears to be supporting polycentricity in a number of ways. At one level, although the ‘global cities’ of London and Paris have always been privileged in terms of telecommunications infrastructure investment, some smaller centres, such as Hamburg, Dusseldorf and Amsterdam are more or less their equals in terms of the presence of Internet backbone networks and bandwidth provision. There are also a number of ‘regional capitals’ emerging in these networks, such as Madrid, Copenhagen and Vienna, and cities which are acting as ‘gateways’ between national territories (such as Lyon with respect to France, Italy and Switzerland). Further, the evidence suggests that there although there are ‘tunnel effects’ with respect to these backbone networks, there are also many instances of smaller cities along the major routes being connected.

- The market-led developments in the fields of mobile telephony and the Internet have been complimented at the regional level by considerable interest in the promotion of both the supply and demand for telecommunications services, within the context of regional information society strategies. The stimulation of the information society at regional level can be said to have been successfully ‘mainstreamed’ within the current round of Structural Funds.
2. In the light of the policy aims of the ESDP: What are the main weaknesses identified by your TPG?

The main weaknesses are:

- In general, the candidate countries are lagging behind the existing member states in terms of the deployment of new telecommunications technologies, particularly with respect to the Internet and broadband. In some countries, such as Poland and Romania, there are major deficiencies even with respect to established technologies, such as fixed telephony services.

- The adoption of e-commerce applications, which are likely to have importance for firm competitiveness and effective market presence, reveals a marked territoriality at the European scale, with firms to the north and west of the Alps having a clear ‘head start’ over firms to the south and east.

- At the metropolitan-rural scale, there remains a significant territorial dimension to the deployment of new fixed wire technologies, with rural areas tending to be considerably more poorly served than metropolitan areas. Of the three main delivery mechanisms for broadband services, for example (DSL, cable modems and wireless), the first two have a very marked territoriality, with the up-grading of networks to provide broadband services being considerably more advanced in metropolitan areas than in rural areas. In part, this differential will begin to narrow if broadband services are rapidly adopted; at present, the telecommunications companies are reluctant to invest in network upgrades in rural areas without first seeing clear evidence of buoyant demand in the cities, a situation which has not yet been reached. This problem may well be compounded by lower levels of adoption of the Internet in rural areas than in metropolitan areas, a disparity which is showing no signs of narrowing.

- This situation with respect to broadband reflects a more general weakness from a territorial perspective that market-driven telecommunications networks (which is what liberalised telecommunications markets in Europe have become) are always likely to discriminate between metropolitan and rural areas in their investment priorities. Not only are the former seen as having the critical mass upon which new services can be launched, but they are also
deemed to have the type of sophisticated consumers (in both business and domestic markets) that will generate the most revenues. Rural and peripheral areas are further handicapped by being more expensive to serve, particularly for wire based networks.

• An additional weakness is that there is as yet little evidence for the existence of mechanisms linking telecommunications planning with either transport planning or spatial planning.

3. In the light of the policy aims of the ESDP: What are the main opportunities resulting from the identified frame conditions?

• At the regional level, the deployment of broadband networks is likely to provide a very substantial improvement in the telecommunications environment of peripheral and remote regions. Although the ‘death-of-distance’ is unlikely to be realised, the advances currently underway in telecommunications do offer significant opportunities for peripheral and less-favoured regions to enhance their levels of integration with the core regions of Europe.

• For rural areas, the deployment of new wireless based technologies (both mobile and fixed) could offer a real opportunity for reducing the service-supply gap they suffer from in relation to metropolitan and urban areas. The widespread availability and use of mobile telephony across all of Europe’s regions, and incorporating the smaller towns and rural areas within each region, has created a platform for the introduction of new technologies and services, including 3G mobile and Wi-Fi, which will provide new points of entry to the Internet.

4. In the light of the policy aims of the ESDP: What are the main threats resulting from the identified frame conditions?

• The main threat in the identified frame conditions is that rural areas lag persistently behind metropolitan and urban areas in the level, quality and cost of telecommunications services to which they have access. In the highly uncertain telecommunications markets which are likely to prevail for some
time (in the wake of the bursting of the dot-com bubble and the realisation that telecommunications companies have considerably over-invested in 3G mobile licences), there is a real risk that rural areas are not only placed low-down on a roll-out queue, but may fall-off the queue altogether.

- This risk is likely to be a real threat if broadband fails to be adopted on an appreciable scale; in this circumstance, broadband may only be deployed in ‘islands’ where demand is sufficiently concentrated. If this situation persisted, then communication-intensive SMEs operating in rural areas might find it increasingly difficult to communicate with their customers and suppliers, in which broadband communications capability will be likely to be taken for granted. A new urban-rural divide could emerge, in which only lower level, non-communications intensive activities can be undertaken from rural areas.

5. Looking back on the questions 1) to 4): What are the 3-4 driving forces dominating the thematic sector? Please explain each driving force in one or two paragraphs.

The main driving forces are:

- **Liberalisation/Competition** – without doubt, it is liberalisation, in conjunction with new technologies, which have transformed the territoriality of telecommunications markets; the stable pattern of universal service provision in a basic telephony service context has been transformed by dynamic, contested (albeit to degrees which vary considerably according to territory) and multiple markets. The focus of telecommunications provision has shifted from an engineering, supply-driven condition to a market-pulled provision. The result of this is a major differentiation between territories in terms of their demand for telecommunications, with ‘hot spots’ of multiple, competing suppliers in locations such as the financial services centres of Europe, contrasting with the uncontested markets of rural areas, in which there is little incentive for (de facto) monopolistic suppliers to invest.

- **The deployment of new technologies** - Technological innovation - represented most obviously by the Internet and mobile wireless technologies – in conjunction with liberalisation has opened up new services which have
diffused considerably more rapidly than any previous communications technologies have done. These innovations are opening up new opportunities for peripheral and rural areas, but are at the same time serving to accentuate the inherent territoriality of telecommunications networks (in the sense that these networks require investments in fixed infrastructures – wires, cables, switches, wireless masts, etc – in order to provide services to particular places). The roll-out of new technologies and the services based upon them is, then, one of the main driving forces accentuating the territoriality of telecommunications networks. Currently, it is the roll-out of broadband technologies (in addition to specialised networks targeted at large firms and institutions, there are currently three different delivery technologies which can deliver broadband services for domestic consumers – digital subscriber lines [DSL], cable modems and broadband wireless) which are most amply demonstrating the territoriality of telecommunications networks, with a strong urban bias evidence in the initial deployment of these technologies.

- **National regulatory and support policies** – although the European telecommunications market has now been predominantly liberalised, there remain marked national differences in the extent to which ‘the state’, broadly defined to include national and local governments, choose to intervene in telecommunications provision in order to achieve territorial equity, or ‘universal service’. As is evidenced in the Nordic countries, territorial equity in telecommunications provision can be achieved even in liberalised markets, through the use of the regulatory and licensing system, through e-government policies, through subsidies to operators where market-failure is expressed territorially, and through the ‘state’ becoming directly involved as a telecommunications supplier in instances where the market is not providing the required level of network access. Clearly this provides significant scope for the Structural Funds to contribute to territorial equity in telecommunications provision, as is already evidenced by the increasing share of Structural Funds investment being devoted to Information Society measures, including telecommunications provision. The opposite example is provided by much of central and eastern Europe, where the past legacy of under-investment in telecommunications remains a significant feature of the current telecommunications landscape.
These driving forces can be measured in the following ways.

*Liberalisation* can be measured in terms of the extent to which territorially-defined markets are subject to competition, measured either in terms of the number of competitors present in a market, or in terms of the new entrants’ share of the market. Such measures can be applied to fixed telephony services, mobile telephony services, and broadband services.

*The deployment of new technologies* can be measured with respect to whether particular technologies – such as, in the case of broadband, ADSL – are available in particular territories (and, if they are, what the costs of accessing the services are). The geography of such availability is finely differentiated, with decisions effectively being made by the telecommunications companies at the level of individual exchanges. For regional aggregates, therefore (such as NUTS Level 2 or even Level 3), the indicator would need to specify the proportion of the population able to access ADSL services. At least as important as the availability of new network technologies, however, is their up-take and usage. The former can be measured by survey-based adoption rates, standardised on population, households or firms, and usage can be measured, again by means of user surveys, through concentrating on the intensity of up-take of particular types of application, such as e-commerce.

It must though be recognised that such information is distinctly lacking at the sub-national scale within Europe, reflecting a complex set of influences including the reluctance of telecommunications operators to part with information that they deem commercially sensitive, through to the failure of the policy community, at national and European scales, to afford sufficiently high priority to the collection of such information.

*National regulatory and support policies* can be measured in terms of the degrees of political commitment and associated resourcing for ensuring that all territories share in the benefits of the information society, and, specifically, the extent to which interventions are made in telecommunications markets to ensure that telecommunications networks and services are deployed across all parts of the
territory. Although the national level of decision-making is in most cases the most significant (due to regulatory policy usually being determined at the national level within Europe), regional level (and indeed urban and municipal levels) can also be significant in stimulating the IS and the introduction of new telecommunications networks and services. The appropriate indicators would therefore deal with degrees of state commitment to ensuring that territorial disparities in telecommunications provision are minimised (ie to universal service), on a qualitative scale ranging from strong to weak. For a given territory, such an indicator would need to be a composite reflecting the role of different levels of government in meeting this objective, which can be expected to vary between member states (in Spain, for example, the regional government’s role in telecommunications regulation and provision is particularly strong).

6. Commencing from these driving forces please develop a typology which can be used to classify the European regions.

The three factors – liberalisation or competition, the deployment of broadband technologies and national regulatory and support policies – could each can be dichotomized according to whether they are above or below the European (EU27) average.

Competitive markets – Highly contested vs. uncontested or limitedly contested markets;

Deployment of broadband – Widespread availability of broadband vs. limited or no availability of broadband; and/or high vs. low up-take of broadband services;

Universal service policy – High policy commitment to universal, high quality service vs. weak commitment to universal, high quality service.

Combining these typologies into a 2 x 2 x 2 matrix gives 8 possible classes, into which Europe’s regions can in principle be classified:

- High competition, high broadband availability, high universal service commitment
- High competition, high broadband, low universal service
• High competition, low broadband, high universal service
• High competition, low broadband, low universal service
• Low competition, high broadband, high universal service
• Low competition, high broadband, low universal service
• Low competition, low broadband, high universal service
• Low competition, low broadband, low universal service

In attempting to operationalise this typology, however, data deficiencies mean that a considerable degree of subjective judgement needs to be exercised, even at the NUTS 2 level. At NUTS 3, there are in effect no sources of data which can be used to provide a typology of European regions, and we have thus confined the analysis to the NUTS 2 level. Further, there is insufficient information available, either from secondary sources or from our own WP3 data collection activities, to confidently categorise Europe’s regions in terms of the universal service policy indicator, and we have not in consequence attempted to operationalise this indicator. Instead we have relied on the competition and broadband indicators to provide a typology of NUTS 2 regions.

In operationalising the competitive markets indicator, the distinction was made between those regions in which the competitive supply of fixed telecommunications developed relatively early (by 1999), and those in which competition has been later to emerge. The ‘early’ category includes much of the UK, most of Scandinavia, and some of Germany, Italy and Spain. The ‘later’ category includes all of eastern Europe, but also France and the majority of Finland.

In operationalising the deployment of broadband indicator, insufficient information was available to reliably categorise regions according to the availability of broadband services, due mainly the lack of consistent national benchmarks. Using a range of sources, however, including the latest national figures from ITU and the OECD and our own WP3 material, it proved possible to provide estimates, for NUTS2 regions, of the extent of broadband penetration, using a three-fold categorisation (high, medium and low penetration).
Regions with high broadband penetration are concentrated in the Nordic countries, the Swiss-Austrian central Europe axis, the Benelux countries, and major metropolitan centres such as London, Ile-de-France, Madrid, Berlin and Hamburg. The pattern of regions with low broadband penetration is dominated by the majority of the eastern Europe/CC region (with Prague, Estonia, Kozep-Magyarorszag and Slovenia providing exceptions), most of southern Europe, Ireland, and a number of more rural and/or less prosperous regions in France, Germany and the UK.

Combining these two operationalised indicators provides a six-fold typology of Europe’s NUTS 2 regions:

1. Early Competition, High Broadband Penetration
2. Early Competition, Medium Broadband Penetration
3. Early Competition, Low Broadband Penetration
4. Late Competition, High Broadband Penetration
5. Late Competition, Medium Broadband Penetration
6. Late Competition, Low Broadband Penetration

*Please map the spatial patterns resulting from this typology*
Regions with early competitive provision and high broadband penetration are dominated by Denmark and Swedish regions where national culture, a dynamic regulatory context and national government policy support has promoted competition and broadband strongly for a number of years. Other regions in this top category are major metropolitan regions such as London, Berlin, Hamburg, Dusseldorf and Comunidad de Madrid.

Regions with late competitive provision and high broadband penetration are mostly clustered in Benelux regions and the Swiss-Austrian central Europe axis, with Ile-de-
France being a notable exception to this. In these regions, it is evident that competition has either developed very quickly recently to produce a dynamic broadband market (Ile-de-France could be explained by this), or has had relatively little influence on the development of broadband penetration (in which case public sector support must be strong).

Regions with early competitive provision and low broadband penetration have conversely not seen the benefits of mature liberalised markets diffuse to their development of broadband. Many of these regions are relatively rural (southern Italy, La Rioja, Mecklenburg-Vorpommern, Cornwall), suggesting that despite the regulatory advantage of an open market, operators have not judged it to be commercially viable enough to roll their broadband services out here due to lack of demand.

Regions in the lowest category with late competition and low broadband penetration are again dominated by eastern European regions, although southern European regions (all of Greece, eastern Italy, the south west part of the Iberian peninsula) and more remote regions of EU15 (Ireland, Wales, south western Scotland, Limousin, Auvergne) also appear here. These regions have not benefited, and still are not benefitting, from either open telecommunications markets or a broadband demand dynamic, suggesting that it is these regions of Europe in which some form of public intervention is most necessary in order to stimulate the information society.

Another approach to typologising the regions of Europe from a telecommunications perspective is to combine key territorial descriptors – core/periphery, urban/rural and rich/poor – each of which appear on the basis of our analysis to be related in important ways to the nature of a region’s telecommunications environment, to provide a composite ‘prediction’ of any regions’ telecommunications position.

The core-periphery classification is based on the location of each region within or outside of the well-known Pentagon zone, the urban-rural classification is based on the categorisation of NUTS 2 regions by BBR into levels of urban or rural, and the rich-poor classification is based on GDP data from the BBR database.
As is evident in the project’s TIR, the urban-rural distinction is particularly important in terms of telecommunications development (although it would have been preferable to be able to use a NUTS 3 regional classification rather than NUTS 2, this was only available for EU15). Adding the rich-poor dichotomy to this allows us to make crucial distinctions between the multiple ‘peripheries’ of the European space with vastly different telecommunications supply and demand characteristics (rich Nordic regions versus less prosperous southern and eastern European regions). It is the core-periphery category which, in the domain of telecommunications territoriality, is most complex and problematic, as it is the northern ‘periphery’ which is most advanced in broadband supply and take-up. Telecommunications territoriality in Europe suggests both a more extended core area including Denmark, and more of the UK, northern Italy and France rather than the traditional Pentagon, and multiple peripheries (northern, southern, eastern).

Taking each of the above dichotomised variables produces an 8-fold categorisation (2x2x2) of Europe’s NUTS 2 regions. Table 1 translates each of these 8 categories in terms of the predicted telecommunications environment likely to prevail in a region with this combination of characteristics, and Figure 2 maps the categories. There are undoubtedly limits to typologising the characteristics of European regions in this way, but it is also clear that such geographical and economic characteristics are highly bound up in the extent and type of supply and demand of telecommunications.

Table 1: Expected telecommunications supply and demand characteristics for NUTS 2 regions

<p>| Core Urban Rich | Access to full range of advanced networks and services driven by strong market competition and presence of pan-European operators (fibre MANs) High levels of uptake, driven by demand from large companies (leased lines) and other leading edge consumers |
| Core Urban Poor | Proximity to richer core regions ensures reasonable availability and choice of |</p>
<table>
<thead>
<tr>
<th>Area</th>
<th>Network Access and Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core Rural Rich</td>
<td>More limited access to advanced networks and services (e.g., DSL), mostly deployed by the incumbent within technical limits. Still reasonably robust demand and uptake driven by SMEs, with reasonably high levels of household demand.</td>
</tr>
<tr>
<td>Core Rural Poor</td>
<td>Limited availability of more advanced networks and services, and limited demand and uptake.</td>
</tr>
<tr>
<td>Periphery Urban Rich</td>
<td>Good levels of competition between national operators (and some pan-European companies) promotes access to advanced networks and services for large companies, with reasonably high levels of uptake by SMEs and households.</td>
</tr>
<tr>
<td>Periphery Urban Poor</td>
<td>Deployment of advanced networks and services limited to incumbent, with slow uptake by SMEs and limited household demand.</td>
</tr>
<tr>
<td>Periphery Rural Rich</td>
<td>Deployment of advanced networks and services limited to incumbent and to urban centres, with reasonable uptake by SMEs and households (particularly in Nordic countries).</td>
</tr>
<tr>
<td>Periphery Rural Poor</td>
<td>Very limited availability of more advanced networks and services, as even the incumbent rarely sees it profitable to roll out in these regions. Very limited demand from business and...</td>
</tr>
</tbody>
</table>
households, and very slow uptake of those services available.

The above figure reveals a starkly differentiated predicted territoriality of European telecommunications. The most dynamic telecommunications environments, possessing virtuous circles of high quality supply and sophisticated demand,
competing suppliers and multiple backbone networks will be found in the ‘blue banana’ (the Core-Urban-Rich category), extending from southern England though north-eastern France, the Benelux countries and Germany to northern Italy. Similarly high quality environments, though with perhaps less dense coverage of backbone networks are likely to be found in much of the rest of the UK, south-east France, north-central Italy, and in major cities such as Madrid, Barcelona and Wien (the Peripheral-Urban-Rich category).

At the opposite end of the spectrum, the least dynamic telecommunications environments, with vicious circles of poor supply and limited demand, few competitive offerings and limited backbone networks, will be found in much of the Iberian peninsular, Greece, parts of Poland, the Czech Republic, Hungary and Slovakia, most of Romania and Bulgaria, and the Baltic states (the Peripheral-Rural-Poor category). Similarly under-developed telecommunications environments, but with greater potential for market-led developments due to urban concentration, are to be found in southern-Italy, in Porto and Lisbon, Athens, parts of the former east Germany, Prague, Bratislava, and a number of Polish regions (the Peripheral-Urban-Poor category). It is regions in these two categories that are likely to have the strongest need for structural fund interventions, both to support the deployment of advanced infrastructures (backbone networks, broadband) and to stimulate the demand for telecommunications, particularly in the business and commerce sectors of the economy.

Between these two extremes, of particular interest are those peripheral rural regions which are relatively wealthy (the Peripheral-Rural-Rich category), found mainly in the Nordic countries, Scotland, Ireland and France. These regions perhaps have made the most impressive use of telecommunications to overcome or ameliorate problems of remoteness and low population density; as such they may provide approaches to infrastructure development or demand stimulation which could provide pointers to less prosperous regions wishing to move in similar directions. These regions appear to be innovative both in terms of the deployment of alternative technologies such as wireless, and in the development of strategies which integrate the information society with broader development objectives.
Please prepare a data set which contains the data of the driving forces and the regional classification.

[attached]

Refer to the concept of sustainable development and regional competitiveness: Please describe on a half page how the spatial pattern and developments in your sector outlined above relate to sustainable development and balanced competitiveness as overall aims in the field of spatial development and EU policies.

In significant respects, developments in telecommunications networks and services are contributing very positively to sustainable development and regional competitiveness. The deployment of advanced telecommunications networks is occurring in both the core and periphery of Europe, and the geography of telecommunications networks reveals a highly polycentric rather than centralised form. The main qualification to this positive assessment concerns the distinction between metropolitan areas and rural areas, for the combination of market-driven provision and the deployment of new technologies, notably broadband, is creating uncertainties about how far down the urban hierarchy the new services will be made available. However, the Nordic experience demonstrates the effectiveness and viability of policy interventions to ensure that spatial disparities are not widened, even in liberalised telecommunications environments.

It must further be recognised, however, that the contribution of telecommunications networks and services to balanced competitiveness depends primarily on the innovative use of these technological capabilities in firms, large and small. There is a considerable volume of evidence to suggest that the extent and effectiveness of usage is widely differentiated between firms, with larger firms tending to make more intensive and effective use than smaller firms, and firms in peripheral regions and rural areas tending to make less intensive and effective use than firms in core regions and metropolitan areas. Whilst the provision of infrastructure and services is a prerequisite for effective usage, effective usage does not necessarily follow from having these services available. Indeed, the widely differentiated contribution of
telecommunications to regional competitiveness appears to be explained much more by variations in usage than by variations in the supply of services.

The implications for the environmental aspects of sustainable development of advances in telecommunications are further complicated by the complementarities between electronic communications and physical movement. All the evidence suggests a very limited scope for substituting electronic for physical movement; indeed, it is clearly apparent that telecommunications networks are underpinning increasingly mobility-intensive forms of interaction.

*Please name for both aims the three or four most important indicators you use to measure and assess these trends.*

It follows from the above comments on the contribution of telecommunications to balanced regional competitiveness that the most appropriate indicators would lie on the demand or up-take side of the telecommunications market, rather than on the supply-side. The most important population-based demand side indicators we have used in this report are:

Number of Internet users per 10,000 inhabitants
Number of broadband users per 10,000 inhabitants

Although regional data is by no means widely available for these two indicators, it is relatively easy to collect through the types of household survey that statistical agencies regularly deploy, and with a degree of political will it should be possible to develop consistent data on these indicators for all of Europe’s regions.

Additionally, however, from a regional economic development perspective it is also necessary to understand the adoption of key telecommunications services by business enterprises. Eurostat have begun pilot surveys of e-commerce at the member state level for EU15, and such surveys need to be extended to the whole of Europe, and provided with a regional level of disaggregation. The most important regional indicators would be:
11. **Refer to sustainability and its economic, social and ecological dimension:**

*Please give an intuitive assessment to what degree the spatial patterns in your sector comply with the three dimensions of sustainability*

On the economic axis, we have provided an estimate just above the mid-point; although there are very positive aspects of telecommunications development in Europe from the perspective of balanced spatial development, there are also a number of concerns with respect to the position of rural areas, for example with respect to the deployment of broadband networks and services.

On the ecological side, we have provided a ‘cautious’ mid-point estimate. Although some would (naively in our opinion) assume that telecommunications is invariably good for the environment, due to the potential for substituting electronic communications for physical movement, alongside this substitution potential there are also serious issues concerning the role of telecommunications in expanding ‘activity
spaces’ and, consequently, the distances over which physical movements and journeys are made. There is, as yet, no reliable empirical basis for determining the implications of e-activities for travel and movement; hence our mid-point estimate.

On the social axis, we have provided a high estimate of the contribution of telecommunications to sustainability, due primarily to the very widespread diffusion of mobile telephony under competitive market conditions, including those countries of central and eastern Europe in which fixed telecommunications have been both expensive and, in places, unavailable due to supply-side constraints. We would contend that mobile communications are likely to be contributing positively to social inclusion.