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

## ESPON 1.2.2

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# 1 INTRODUCTION

This report is the first of four reports to be delivered under ESPON Project 1.2.2. – Telecommunication Services and Networks: Territorial Trends and Basic Supply of Infrastructure for Territorial Cohesion.

ESPON 1.2.2 has two overarching aims:

- To provide a better understanding of the relationship between telecommunications infrastructures and services and balanced spatial development, and;
- To create a platform (data, indicators, concepts and methodologies) upon which future research and policy can build.

This report is based on work carried out under WP1. This workpackage was carried out over a shorter period than envisaged in the original proposal as a result of ESPON reporting requirements and delays in the contractual process.

The key component of WP1 has been a wide and thorough review of existing data, statistical sources and indicators of territorial trends and basic supply of telecommunications infrastructures at the European level. The work draws mainly on official reports from European and international agencies, in particular from the European Commission, Eurostat, the Organisation for Economic Co-operation and Development (OECD), and the International Telecommunication Union (ITU). We have not attempted to cover infrastructure investment under TENS as this work is being undertaken under ESPON project 2.1.1. We intend to liase with the relevant project partners to consider the best way of exchanging and synthesising our respective findings in the later stages of the project.

The structure of the report is as follows. Section 2 briefly explores the key territorial issues which information and communications technologies might be expected to impact upon. It introduces a number of concepts such as the 'digital divide', advanced networks and broadband and networked readiness.

Section 3 discusses the need for new indicators for the Information Society and potential sources from which data can be drawn. It considers what data is available at the European level in relations to European countries and in relation to the European regions.

Section 4 then goes on to describe and map selected data, concentrating on data which is available on a relatively comparable basis across Euro 27 plus 2 (i.e., the 29 countries with which ESPON is concerned).

Section 5 provides a preliminary list of indicators which we would hope to use (or at least test) in the coming stages of ESPON.

Section 6 suggests a preliminary list of data collection requests for European and national agencies.

Section 7 outlines our early thinking on telecommunications networks and services from the perspective of regional development policy.

Finally, in Section 8 we briefly outline the next stages in the project.

# 2 TERRITORIAL DEVELOPMENT IN THE INFORMATION SOCIETY

> "The Information Society promises new 'digital opportunities' for the inclusion of socially disadvantaged people and less favoured areas…On the other hand, new risks of 'digital exclusion' need to be prevented. In an economy increasingly dominated by the usage of information technologies across all sectors, Internet access and digital literacy are a must for maintaining employability and adaptability, and for taking economic and social advantage of on-line contents and services (SEC, 2001, p4).

It is now widely recognised that advanced economies are moving towards an Information Society and that information and knowledge will be key elements in the competitiveness of places and people. This fundamental change in the way in which economies and societies work has potentially profound implications for territorial development. It is still unclear exactly what these changes are and no comprehensive attempt has been made, to date, to map the territorial outcomes. A significant body of case study research has, however, been carried out in Europe and elsewhere. What this work suggests is that new territorial patterns are likely to be complex, with both centripetal and centrifugal forces being underpinned by ICTs simultaneously (Gillespie et al, 2001).

## 2.1 Telecommunication networks and territorial development

A key element in the territorial spread, or otherwise, of the Information Society will be the availability of the technologies that allow access to information and knowledge, namely information and communications technologies (ICTs). As the ESDP points out:

> 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 disadvantage (CEC, 1999, p27).

Despite the predominately liberal approach to telecommunications adopted by the EU, it is long been the aim of policy makers within Europe to use ICTs to further territorial cohesion by supporting regional and local development and promoting integration and empowerment (CEC, 1996a, 1996b, 1997). A number of programmes commencing with STAR and Telematique and running through TENS have addressed this issue. In addition, guidance for programmes in Objective 1 and 2 regions has since the 1996-99 programming period emphasised the importance of ICTs as a developmental tool (CEC, 1997).

A number of studies have pointed to remaining territorial disparities with regard to access to these new technologies in Europe. These disparities are apparent between countries (see, for example, Nexus/CURDS, 1996; OECD, 2000; DG Information Society, 2000; ITU, 2001). They are also apparent between regions (see, for example, OECD, 2000b). One on-going study suggests that:

> "..there is clearly unequal access between regions to the technologies that drive the new Information Society. The ability of regions to have access to and exploit the possibilities offered by new ICT affects their capacity to exploit their human resources, technology and their development potential. This clearly means that the development of the Information Society has important implications for economic and social cohesion in Europe, understood as cohesion between, as well as within, regions. This is all the more true in a globalising environment, where regions have to compete not only at the EU but also at the global level" (BISER, 2002a, D.D1, p8).

The same study, however, laments the lack of available data at the regional level. Whilst we do not in any way doubt the above assertion made by the BISER team, there is clearly need for a more robust and systematic database upon which to base these claims[1]. A key goal of ESPON 1.2.2 is to draw together and build upon existing studies through collecting and mapping data showing the differential territorial spread of telecommunication networks and services. The aim is to uncover and map data at the sub-national level where possible.

The main focus of territorial debates in Europe around new technologies has been regional disparities. This is understandable, but in the largely demand-led, liberalised telecommunications market significant differences appear to be emerging at the finer spatial scale and it is worth noting that there are likely to be substantial disparities *within* regions, though here the evidence tends to be even more partial (see, for example, ASPECT, 2001; Richardson, 2002; Comminudad Valenciana, 2001). So within a region, certain technologies – such as Asymmetric Subscriber Digital Lines (ADSL) – basic broadband over copper wires – can be available in a heavily urbanised area but unavailable in less urbanised areas or rural areas a short distance away (ASPECT, 2001; Richardson, 2002). Even within a single urban area telecommunications can be concentrated on a single node (for example, a business park) whilst there is no access to other potential users within a few yards of that node. Gillespie and Cornford (1995) suggested that 'hot spots, warm haloes and cold shadows' of technological infrastructure were emerging as liberalisation proceeded. Graham and Marvin (2001) see this differentiated access to infrastructure and services as a central manifestation of 'splintering urbanism'.

It has been observed that a 'digital divide' has emerged as we move towards an Information Society, with digitally included and digitally excluded populations. As suggested above this clearly has a territorial component (see, also for example, SEC, 2001). The concept of the digital divide has been criticised on several accounts. Most fundamentally it has been argued that, in reality, the digital divide really only represents yet another manifestation of deep social divisions which characterise all modern societies. Others have suggested that the divide should be viewed in a more positive light. The OECD (2002) suggests, for example, that what we are witnessing by and large is digital delay or time gap. It is implied that this gap will be overcome in due course, mainly by means of a more concerted drive to competition. The DEESD Project (2002) also suggests a less binary approach to the digital

[1] Indeed, this is the key goal of the BISER project.

disparities, introducing the concept of a ‘digital ladder’ whereby there are degrees of exclusion and where the possibility of climbing up the rungs of the ladder is possible.

## 2.2 Basic and Advanced Telecommunication Networks and Services

### 2.2.1 From POTS to Multiple Telecommunication Platforms and Networks

Until the early 1980s telecommunications were virtually synonymous with the basic fixed-line telephone, now referred to as POTS (Plain Old Telephony Service) (Graham and Marvin, 1996). Telephone services effectively meant voice telephony, with some small additional (non-voice) flows from telex, telegraph and data communications over mainly private networks. This situation has changed radically in recent years and is still changing. Today the digitisation of information and the convergence of information and communication technologies mean that telecommunications networks now embrace a range of technological platforms and carry not only voice, but also data and images. Most telecommunication networks now carry far more data than they do voice. Another radical change is the on-going migration from fixed line telephony to other forms of telephony. Although fixed line telephony remains the most significant delivery mechanism, cellular mobile, wireless LANS and satellite are becoming increasingly important. At the same time there has been a degree of convergence across industries with telecommunication and media becoming increasingly entwined as their technological platforms and service offerings merge.

In purely technological terms, which side of the digital divide (or which rung of the digital ladder) an individual or territory is on will depend on access to ICT technologies described in the previous paragraph, to levels of digitisation of local exchanges and to the level of bandwidth available to them when using these technologies.

The regulatory regime has also changed. Rather than telecommunications and broadcasting in Europe being in the hands of a few state-owned monopolies or quasi monopolies, serving essentially national markets, a more liberalised regulatory regime has seen the emergence of a number of new players. Some of these focus on particular technologies, such as mobile communications or Internet access, but many offer multiple technologies and services either alone or in partnership with other firms.

In practice, the degree of liberalisation and the degree of competition in liberalised markets varies. Some contend that there is some way to go before we reach a truly competitive market situation and that competition is inhibited by the power of incumbent providers, together with the attitude of national regulators. In some territories – particularly rural ones – liberalisation appears to have had only a limited impact, with new entrants failing to invest in these ‘non-profitable’ markets.

### 2.2.2 The Broadband 'Revolution'

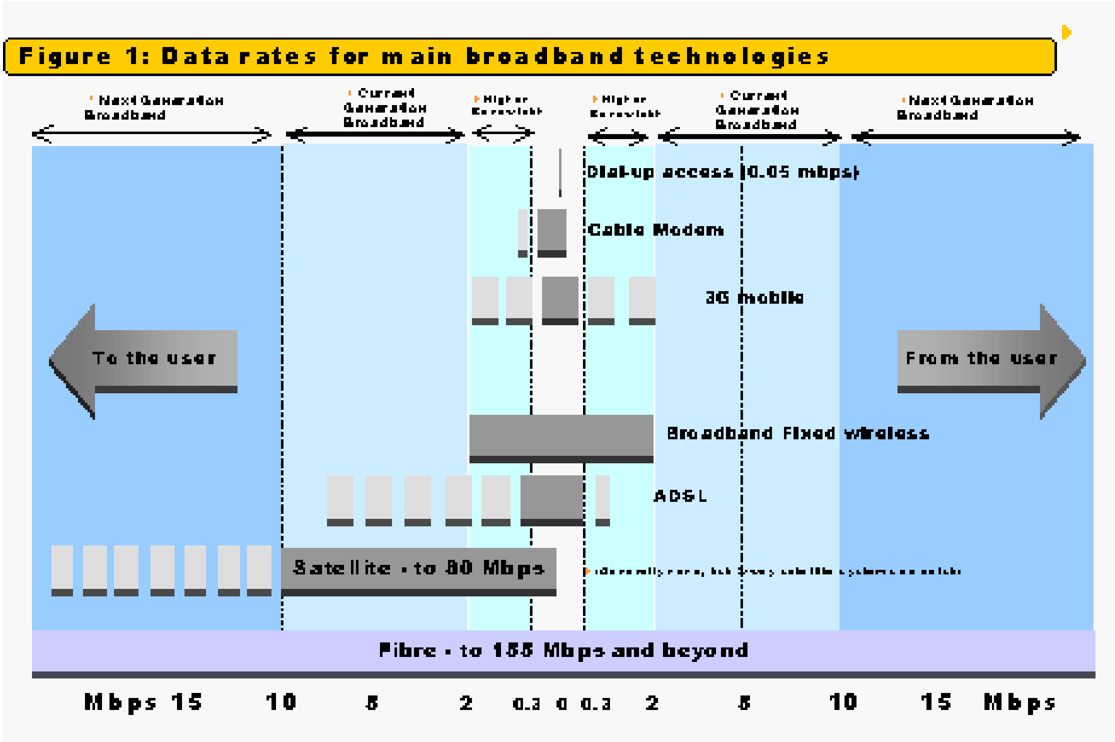
*Defining Broadband*

Access to higher bandwidth is now seen as a major factor in pushing forward the Information Society, and some commentators are now referring to the Broadband revolution. Precise definitions of 'high speed' and broadband vary widely. The UK e-envoy (in UK Online, 2001) distinguishes between:

- Higher bandwidth: services provided at speeds of greater than 384 kbit/s;
- Current generation broadband: services provided at speeds of 2 megabits per second (Mbt/s) and over; and
- Next generation broadband: services provided at speeds of 10Mbt/s and over.

Until recently access to higher bandwidth and broadband services has largely been limited to large firms, mainly via leased line products. These firms either lease telecommunications lines from telecommunications companies (telcos) and build and manage their own private network linking company sites together; or, increasingly, they pay for telcos to provide a Virtual Private Network (VPN). Here telcos supply communications capacity on their own (inter)national VPN infrastructures and use intelligent software to provide customised (and reprogrammable) capacity and connectivity between sites, obviating the need for firms to purchase capital equipment. For large corporations with heavy communications traffic these solutions are likely to remain the norm, and the number of suppliers in the market has increased rapidly to meet the growing demand for corporate telecommunications.

*Figure 1: Theoretical data rates for main broadband technologies*




Source: UK OnLine 2001

*Broadband and Higher Bandwidth for SMEs and Citizens*

Until recently few small firms or citizens had access to higher-bandwidth or broadband technology. Rather, transmission of non-voice communications has been via one of two technologies – analogue modems and Integrated Services Digital Network (ISDN).

Analogue modems (MOulator DEModulator), attached to each end of a standard twisted pair copper telephone cable translate digital data (text, still and moving images, sounds) created by a computer into an analogue signal that is transmitted over the wires and translated back into digital form by the second modem at its destination. By using a central Internet Service Provider (ISP), a dialup modem can connect a computer to the internet. The maximum theoretical speed of current dial-up modems is 56 Kilobits per second (kbt/s), although in practice speeds nearer to 44 kbt/s per second are achieved. Dial-up modems have other drawbacks including the requirement for a lengthy process of setting up a connection and the substantial telephone usage charges (each connection is charged by the supplier of the telecommunication service at the same rate as a single voice call).

ISDN, by contrast is an all-digital technology and has taken over from modems in some contexts. Instead of a modem, the customer requires an ISDN Terminal Adapter (TA). Basic rate ISDN provides the user with two channels which can be used flexibly for voice or data communications, each supporting 64 kbt/s. The two connections can, if suitable equipment is available at each end of the connection, be pooled to create a single 128 kbt/s connection. The main advantages of ISDN concern the much quicker set up times for initiating communication. However, ISDN connections are billed at the same rate as voice calls. ISDN availability requires digital exchanges (now almost universal at least in western Europe) and the installation of ISDN equipment at the local exchange (still not installed in some rural exchanges). Like some other digital technologies using standard copper twisted pair, ISDN is highly reliant on the quality of signal carried over the copper wire connecting the customer with the exchange. Because signal quality generally varies inversely with the length of wire between the customer and the local exchange, ISDN is not reliable in some rural areas where such distances are greater than 4-5 km. Both dialup modems and ISDN are now considered as 'narrowband' technologies, with a maximum data throughput of 64 kbt/s (or 128 kbt/s for ISDN with both channels combined).

A range of new products have started to appear which allow speeds in excess of 128 kbt/s – at least in the direction of the subscriber – and these technologies are sometimes loosely labelled as broadband or higher bandwidth services. In addition to speed, these services generally have two further features. First, they are "always on" eliminating the need for time consuming process of connecting to the internet. Second, they are billed at a flat rate with no call charges.

Some of these technologies exploit existing installed infrastructure to connect to the subscriber, thus potentially radically increasing the levels of access for those who have been excluded to date. Others require new wireless or satellite infrastructures to be built but, by avoiding the requirement to dig new trenches to each subscriber, radically reduce the cost of providing a broadband service and increase the speed with which such services can be rolled out. Basically, there are four such channels through which broadband can be delivered[2]:

*Cable broadband services* utilise the cable television co-axial cable to provide an '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 premise and 128 kbt/s per second out of the subscribers premises (e.g., downloads are faster than uploads). Cable broadband services are, however, 'contended' with the effective line capacities dependent on the numbers of local subscribers making use of the system and what they are using the system for. Effective speed might therefore be half those quoted above during periods of heavy usage.

*DSL Technologies* – Digital Subscriber Line (DSL) technologies allow multiple services to be delivered down a single twisted pair copper telephone line that has been split into two channels – one for voice use and one for data. The currently most popular form of DSL technology is Asynchronous DSL (ADSL). ADSL provides maximum data transfer rates of approximately 250 kbt/s upstream (i.e., out of the customer premises) and approximately 500 kbt/s, 1 mbt/s or 2 mbt/s downstream (the higher values are restricted to

[2] This following points are based on information obtained from the 'Broadband Britain' website (wysiwyg://8/http:www.zdnet.co.uk)

business tariffs and versions of the technology that provide high speed in both directions are in development). ADSL is, like cable modems, a contended system in which effective transmission capacity is conditioned by other users connected to the same exchange. A key advantage of ADSL that it is an 'always on' service so there is no need to spend time making a connection.

DSL, making use of existing telephone wires, has a wider geographical potential than cable modems[3]. However, the roll out of ADSL is dependent on the installation of ADSL equipment in the local exchanges. A further disadvantage of DSL is that it downgrades with distance, meaning a user must be within 6km or so of the telephone exchange in order to get it. The farther away the customer is from the exchange, the slower the service. Again this has potentially negative implications for rural users.

*Satellite* – here the user downloads information from the internet via the satellite link (in effect broadcasting the information and relying on a decoder to filter out the information not required by the consumer) but still needs a telephone line (an analogue modem or ISDN connection) to communicate with their ISP (limiting the capacity of the back channel from the subscriber to the internet).

Satellite technologies have few geographical limitations beyond that of the satellite footprints. However, the need for signals to travel up into space and back down to earth can make them slow and they can be adversely affected by the weather conditions.

*Broadband fixed wireless access* (BFWA) – which uses wireless spectrum to transmit information. Bit rates for domestic and SME subscribers range from 64Kbt/s (basic Rate ISDN services) up to 2 mbt/s, dependent on the technologies used. Users will need an external aerial or dish and a transmitter, together with decoder cards or boxes inside the building to utilise this mode of information delivery.

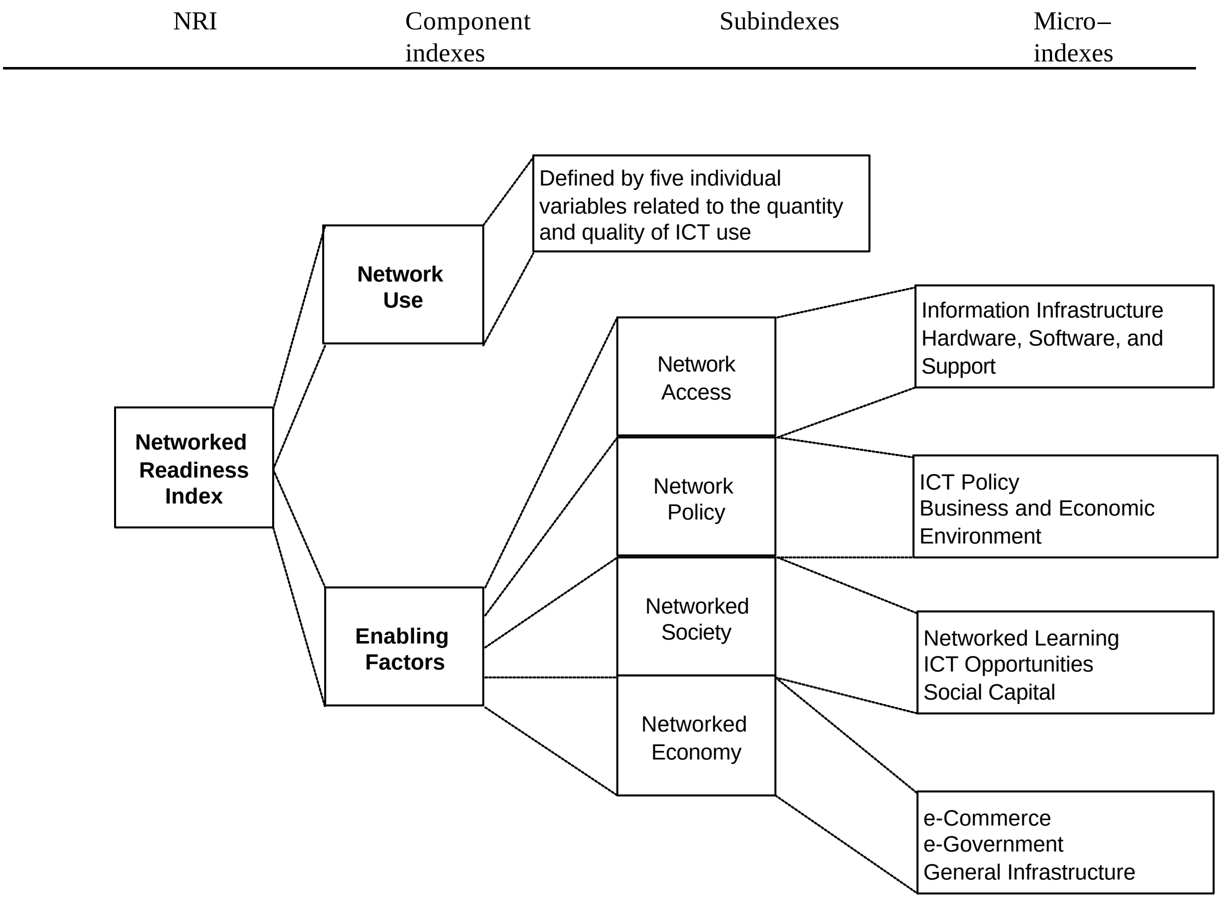
## 2.3 Beyond Infrastructure – the 'Enabling Environment'

Although the focus of ESPON is on telecommunication networks and services, it should be noted in passing that although the presence of ICT technologies are a *necessary* condition for participation in the Information or Knowledge Society, telecommunications networks and services are not a *sufficient* condition for doing so. This fact led policymakers to move away from the infrastructuralist approach typified by, for example, the EU STAR programme in the late 1980s towards a wider approach. At first, the focus moved towards awareness raising and demand aggregation, for example, under TELEMATIQUE. Latterly, the focus has widened still further (through programmes such as the Regional Information Society Initiative- RISI) to stress the need to create an 'enabling environment' – good education and training to promote human capital, governance structures to ensuring transfer of knowledge, etc. – in order to optimise the impact of the new technologies (BISER, 2002a; DEESD, 2002).

[3] Because interactive cable networks have tended to be built out only in more urbanised areas, though this varies from country to country.

One model which adopts this wider understanding of the Information or Knowledge Society is the *Network Readiness* Index created by the Information Technologies Group at the Centre for International Development (CID), Harvard University (see Figure 1). The Index is constructed using a range of 'hard' and 'soft' indicators. Network Use is a straightforward measure of ICT proliferation of the type we discuss in Section 5 of this report. The Enabling Factors Index is more complex and is constructed to "reflect the preconditions for high quality Network Use as well as the potential for future Network proliferation" (CID, 2002, p 14). Enabling factors include ICT policy, business and economic environment, social capital and role of governments.

*Figure 2: The structure of CID's Network Readiness Index*




Source: Information Technologies Group, Centre for International Development at Harvard University (2002)

As suggested above ESPON 1.2.2 does not have the brief or the resources to give detailed consideration to all the enabling factors set out in the Network Readiness Index. It is will be important to bear in mind the complexity of these relationships when attempting to explain territorial differences in the presence or otherwise of technologies. Our focus will be Network Use and the Information Infrastructure elements of Network Access.

# 3 TERRITORIAL DATA ON TELECOMMUNICATION NETWORKS AND SERVICES

## 3.1 The Information Society: the Need for New Types of Indicators and Data

There is a widespread realisation amongst policymakers in Europe that the tools, indicators and data which were appropriate in the industrial age are failing to capture the complex changes taking place in the economy and in society more generally. This is reflected in several recent initiatives, each aimed at adding to our knowledge of the Information Society, or at least at developing approaches and methods which will assist in this process. For example:

- In 1999 the OECD created a "Working Party on Indicators for the Information Society" which has focused mainly on the economy and e-commerce.
- SIBIS – Statistical Indicators Benchmarking the Information Society – was launched in January 2001 under the FP5 IST Programme. The aim of the project is to develop innovative information society indicators to take account of the rapidly changing nature of modern societies and to enable benchmarking of progress in EU Member States (SIBIS, 2002).
- SIBIS+ – in June 2002 it was announced that the SIBIS project was to be extended to cover 10 Newly Associated States, Switzerland and USA (SIBIS, 2002).
- BISER – Benchmarking Regions in the Information Society: E-Europe Indicators for European Regions was launched in 2001 (again under the FP5 IST Programme) with the key objective of setting up a regional indicator system for the Information Society at NUTS 2 level.
- The Information Society Statistics Pocketbook was launched in 2001 by the European Commission and EUROSTAT to bring together data from a range of sources in one easily accessible place.
- EUROSTAT has started a process aimed at enhancing "the role of Information Society statistics within the European Statistical System". Work is underway to collect existing statistical data on the Information Society from the Member States, to harmonise data and to build up new official data sets where there are important gaps.

These initiatives are beginning to build in a systematic way on previous work in this area, by OECD and the International Telecommunication Union, and by the Commission, in the latter case mainly in the shape of *ad hoc* reports from Eurobarometer and DG Infosoc.

The launch of ESPON 1.2.2 is timely in many respects, therefore, in that it comes at a moment when interest in statistics for the Information Society, the Knowledge Society and the New Economy is high. Hopefully, links can be made between ESPON and these initiatives with a view to ensuring that territorial issues receive appropriate attention. These initiatives all represent 'work in progress', however, and to date they have produced little in the way of new data that can be used by ESPON. They have, however, suggested indicators that might be useful to the ESPON project. These are discussed in section 5 below.

## 3.2 Telecommunications Networks and Services: Overview of Data Available at the European Level

A key task of WP1 is to review existing data, statistical sources and territorial trends and basic supply of telecommunications networks at the European level, through a study of reports and other documentation from bodies such as the European Commission, Eurostat and OECD. In the light of this an extensive search has been undertaken. The search sought to uncover:

- What type of surveys and data gathering exercises have been undertaken on which we can draw?
- Do such studies cover Euro 27 plus Norway and Switzerland or only existing member states?
- At what territorial level is that data available – i.e., what level of territorial analysis does existing data reported at the European level allow us to map and explore?
- How comparable are the various sources and data sets across Europe (EU 27 plus 2) and over time?
- Finally, what kind of indicators are used in these reports and can they be usefully adapted for the purposes of ESPON (this question is considered in section 5).

### 3.2.1 Existing official surveys

Putting to one side case study-based reports which tend only to relate to small areas of Europe and which use different approaches and methodologies, three main types of survey can be identified:

First, those that involve interview surveys of households, individuals, or firms; these, in turn, can be divided into those which report on the existing situation and those which are concerned to establish future trends (both can be included in a single survey). Such studies are carried out in Europe by the European Commission, under the Eurobarometer badge. These surveys provide a useful picture of particular technologies and services, broken down by various demographic indicators. They have several drawbacks from the ESPON perspective, however. First, they tend to be *ad hoc*, i.e., one-off reports on particular topics rather than series. Second, they tend to cover only EU15. Third, they tend to report at the national level only (though see discussion of regional data availability below).

Second, those which carry out surveys of national regulators, ministries and telecommunications companies regarding the availability of technologies and services in order to build a picture of access and usage. The best example of this approach is the International Telecommunication Union (ITU). The ITU reports have a number of advantages. First, their approach and the indicators used areconsistent over time. Second, they cover all the countries with which ESPON is concerned. Third, their data is widely used and respected. For example, many of the figures cited by OECD and by Eurostat are drawn from ITU sources (see Information Society Statistics Pocketbook, for example). From the perspective of ESPON, however, ITU reports do share a crucial limitation with most other sources explored in this section, namely, that they collect data and report at the national level only.

Third, reports which draw on a wide range of publicly readily available sources. Some cover a wide range of indicators. Others concentrate on particular areas of growth – for instance mobile telephony, the Internet or broadband. There are some useful reports in this category in terms of covering indicative trends, but they have some obvious drawbacks. First, these reports, again, tend to be occasional. Second, there is often a lack of standardisation and comparability within and across reports. The best of these reports – for example, the reports prepared on behalf of DG Information Society under the European Survey of the Information Society (ESIS) Project (see, http://europa.eu.int/ISPO/esis/default.htm) – admit these limitations and can be useful if used with care. Other reports which use this approach indicate comparability issues in in a transparent manner, for example, the Information Society Statistics Pocketbook (CEC/Eurostat, 2002). These reports seldom cover all the countries in which ESPON is interested. The ESIS Project covers EU 15, the East European accession countries and Malta and Cyprus across three reports (DG Information Society, 2000, 2001b and c). They employ similar methodologies across the studies, but warn that, the data "depend on definitions which are not standardised in all countries, or, in some cases on estimates, [and that] they should be considered only as indicative of trends and general tendencies" (http://europa.eu.int/ISPO/esis/default.htm).

As is demonstrated above, to date there is no single approach or methodology for collecting data on the Information Society at the European level. At present even Eurostat, which has a considerable range of statistics covering a large number of areas of European economic and social life, collects a relatively limited amount of data on the Information Society in general and infrastructure in particular. Correspondence with EUROSTAT suggests that data on communications comes mainly from annual enquiries directed at the National Statistics Institutes. The original source may vary by country with the NSI sometimes forwarding the data request to the regulatory authority etc. Eurostat is seeking to address this issue and to enhance the role of Information Society statistics within the European Statistical System. For example, annual surveys on ICT usage and e-commerce in enterprises co-ordinated by Eurostat were undertaken in 2001. This, however, was a pilot study and coverage in terms of target population and detailed list of question asked by each statistical authority varied. Further only 12 of EU15 participated. The survey did not extend to candidate countries. Euorstat is also seeking to co-ordinate studies on ICT usage by citizens through annual household surveys on ICT usage (CEC/EUROSTAT, 2002). This got underway in 2002, though at the time of writing data was not available.

### 3.2.2 Other sources

These 'official' sources described above rely on a range of data sources. Two key sources are telecommunication consultants and industry organisations. There is in fact considerable overlap between these organisations, with most of the latter also selling data on a commercial basis. ITU, for example, draw on RIPE, NUA and ISC for data on Internet usage. Some of these organisations also provide data and maps showing spatial patterns of telecommunication roll-out and traffic flows.

*Table 1: Examples of consultant and trade organisation web sites producing data on telecommunication infrastructure and services.*

| Organisation | Expertise | Web address |
|---|---|---|
| RIPE (Resaux Internet Provider European) | Internet domain surveys | http://www.ripe.net/ripencc/pub-services/stats/hostcount/#intro |
| KMIResearch | Research and publish fibre optic backbones data and maps | http://www.kmiresearch.com/fiberoptics_route_maps.htm |
| ISC (Internet Software Consortium) | Internet domain surveys | http://www.isc.org/ds/ |
| NUA | Surveys of numbers online | http://www.nua.ie/surveys/how_many_online/index.html |
| Telegeography | Research and publish data on telecoms routes, providers and traffic | http://www.telegeography.com/ |

Again data produced by these organisations relate to the national and international scale rather than to the situation across regions. We could find no instances of such data at sub-national level. The comparability of the data even at this level is, however, problematical. The example of a NUA report (NUA, 2002) used in the Digital Europe Report (see Figure 2.1, DEESD, 2002) to illustrate Internet penetration in Europe (EU 27 plus Turkey) by country demonstrates some of the problems. As NUA itself points out the art of measuring how many are online is an inexact one and the organisation makes an 'educated guess from reviewing published surveys'. The source table upon which the figure is based throws up a number of problems:

- It draws on more than fifty separate sources
- These sources use a variety of methods, and extensive searching is required to establish methods
- It uses a variety of census time-points across countries
- Different sources are used from year to year within individual countries

These reservations are not expressed in order to criticise the organisations involved – the companies listed above have high reputations and are widely used as sources in government studies. They are expressed to illustrate some of the difficulties and issues that arise in producing consistent and comparable data on the telecommunication network and services, even when comparing across nations as a whole rather than regionally – disaggregated cross–national data.

### 3.3 Telecommunications Networks and Services: Sub-regional Data available at the European level.

A key task of WP1 was to explore the availability of regional data at the European level. As anticipated we were able to find very little comparable data which was collected at or disaggregated to the regional level. The vast majority of studies reported at only the national or European level. This paucity of available regional data was confirmed by several sources.

- The BISER study is one of the few studies which has attempted to explore the presence or absence of information society data at the regional level in Europe. BISER reports that few data exist at regional level regarding the information society and that existing national indicators cannot necessarily be applied at regional level (Wickel and Gareis, 2002). In the area of most direct concern to ESPON, i.e., ICT infrastructure supply, no regional data was uncovered (see BISER, 2002, D2.2).
- Equally worryingly BISER suggested that *member states* collect only limited data relating to the information society, particularly relating to uptake and use of ICT, at the regional level. This is something which we will explore in the coming months. We know from our early research that data on some aspects of the regional IS are available at the national level at least for some countries, but the situation regarding data on networks and services is less clear.
- The ESPON 'data navigator' also suggested that there is no regional data available on telecommunications networks or services at the European level (ECOTEC, 2002). They identify several data sets collected by Eurostat under the themes – telecommunications, IT market, access and use, but suggest that in each case that data is only available at EU 15 aggregate and national level.
- Further investigation for this project suggest that data sets have been updated to cover at least some of the candidate countries[4]. Direct correspondence with EUROSTAT also, however, confirmed that "In EUROSTAT the communications statistics (COINS) only operate on the national level, without any regional breakdown" (Personal communication with Euro Datashop, 2002).

We did find two reports carried out on behalf of ISPO by the polling group Gallup Europe which had a regional component (ISPO, 1999a and 1999b). These documents report on the findings of telephone interviews with SMEs and with households which amongst other subjects sought to find out rates of take up of various telephone technologies and services. We were only able to uncover part of these reports in our search. They appear to have been a one-off survey and it is not clear whether the sampling frame used was sufficiently

[4] Data was obtained from EUROSTAT and further enquiries were made to ensure that no data was available at sub-national level.

robust to allow us to draw firm conclusions on regional patterns. We will explore this issue further with the relevant officers in the Commission in WP2.

# 4 TERRITORIAL PATTERNS OF TELECOMMUNICATIONS NETWORKS AND SERVICES IN EUROPE – MAPPING SELECTED INDICATORS AND DATA

This section highlights some of the territorial differences across Europe at the national level. The section draws on three main sources. In section 4.1 it draws on the Centre for International Development's Network Readiness Index (CID-Harvard, 2002). In section 4.2 it draws mainly on ITU's World Telecommunication Indicator Report, 2000/2001 (ITU, 2001). These two sources are chosen because they cover all or most of Euro 27 plus 2[5] on a consistent basis. Section 4.2 also draws to a limited extent on other sources to cover important technologies – for example, broadband – not covered by CID and ITU. Section 4.3 briefly turns the attention to flows over telecommunications networks, using data from the commercial provider TeleGeography Inc.

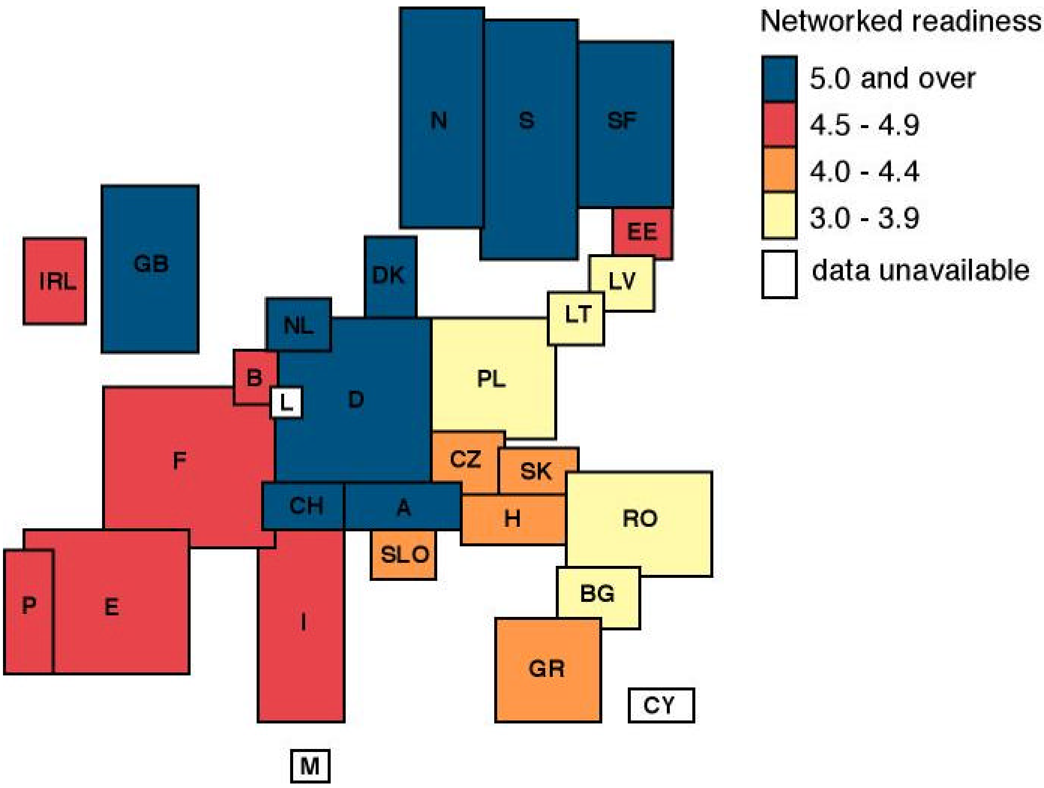
## 4.1 Network Readiness Index

The Networked Readiness Index created by the Information Technologies Group at the Centre for International Development, Harvard University, seeks to show a country's potential to participate in "the Networked World". The Index is constructed using a range of 'hard' and 'soft' indicators (see Figure 1 of this report). The Networked Readiness Index is divided into two component indexes, 'Network Use' and 'Enabling Factors'. The former is a straightforward measure of ICT proliferation, based on five variables. The latter is more complex and is constructed to "reflect the preconditions for high quality Network Use as well as the potential for future Network proliferation" (CID, 2002, p 14). Enabling factors comprise Networked Access, Networked Policy, Networked Society and Networked Economy. These break down further into micro-indexes (see Figure 1 of this report). Of most interest to us here are the Network Use component index and the Information Infrastructure micro index.

Figure 3 illustrates the relative position of European countries in terms of 'Networked Readiness', taking all the factors of the model into account. In broad terms the map suggests that existing member states are more ready than candidate countries. The Northern member states are most ready, with Finland judged as most ready. Of the candidate countries Estonia is judged to be most ready; indeed it is more ready than Greece.

[5] The CID-Harvard report actually does not provide figures for Malta, Cyprus or Luxembourg.

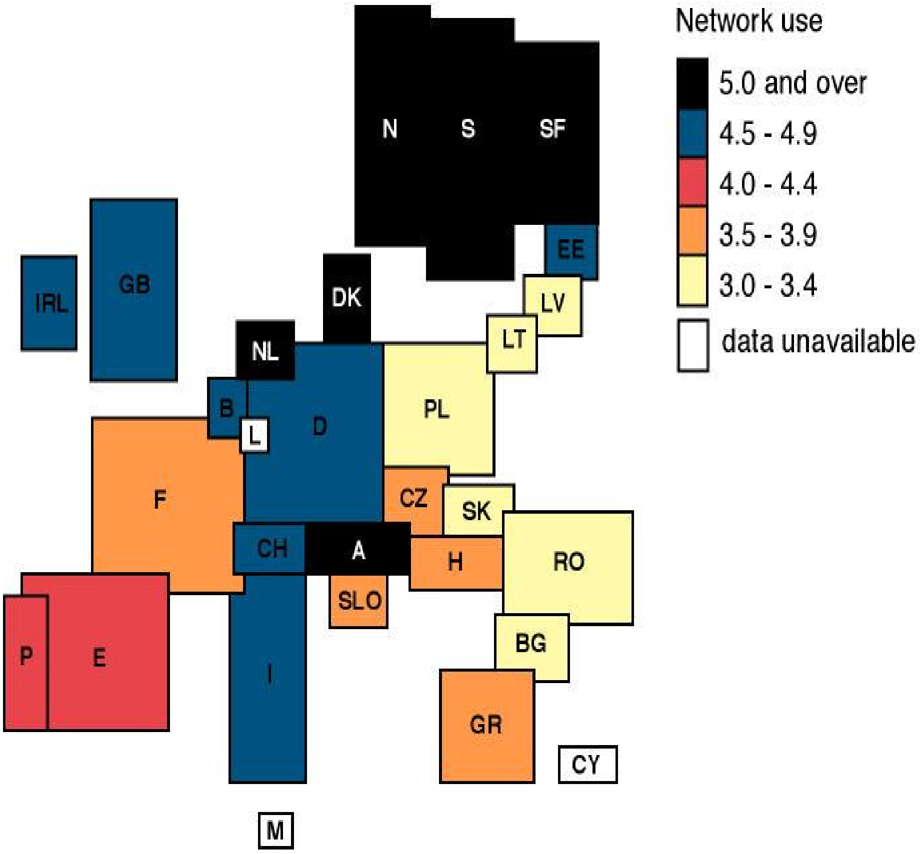
*Figure 3: Degree of Network Readiness' of European countries (EU27 plus 2)*




Source: Figures drawn from Networked Readiness Index, Information Technologies Group Centre for International Development (CID), Harvard University (CID, 2002): mapping CURDS.

Figure 4 shows illustrates the degree of Network Use across Europe. The Network Use component index measures the extent of ICT use in specific countries, using five variables: Internet users per 100 inhabitants, cellular subscribers per 100 inhabitants, Internet users per host, percentage of computers connected to the Internet, and the availability of public access to the Internet. This index suggests that the Nordic member states together with the Netherlands and Austria are most ready, followed by the other members states. France and Greece are behind the rest of the member states. The surprisingly lowly position of France is accounted for by the relatively low PC and Internet penetration resulting from the earlier high up-take of the Minitel system. The candidate countries are adjudged to be less ready than member states, though again there is variation between these countries, with Estonia again coming out on top, ahead of Greece and on a par with several member states.

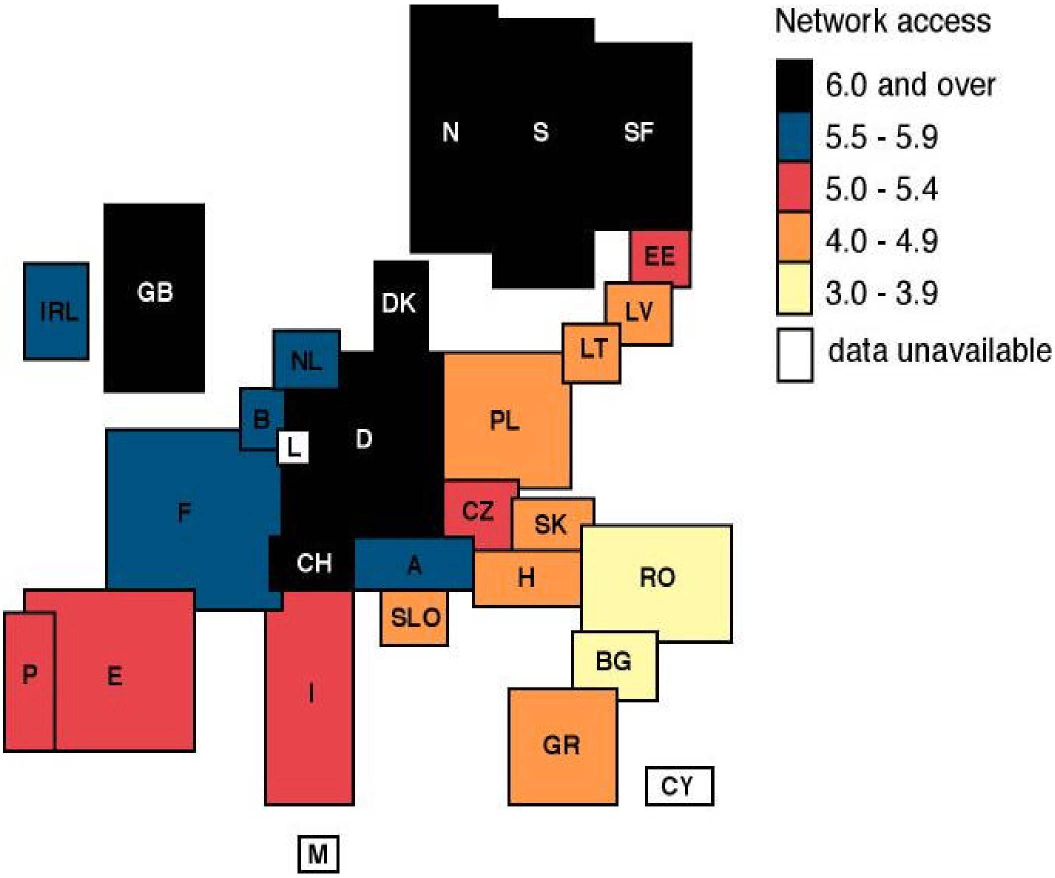
*Figure 4: Networked Readiness Indicator: Network Use across European countries (Euro 27 plus 2)*




Source: Figures drawn from Networked Readiness Index, Information Technologies Group Centre for International Development (CID), Harvard University (CID, 2002); Mapping CURDS.

Figure 5 shows the relative position of European countries in relation to the Network Access component of the NRI. This component considers the extent and quality of the network infrastructure and the existence of the equipment, programs, and support services that allow ICTs to be used. Again the northern Member states are adjudged most ready, with southern member states lagging behind. Candidate countries are generally less ready, though Estonia (again) and the Czech Republic are close to the levels of readiness attained by southern Member states and in advance of Greece.

*Figure 5: Networked Readiness Indicator: Network Access*

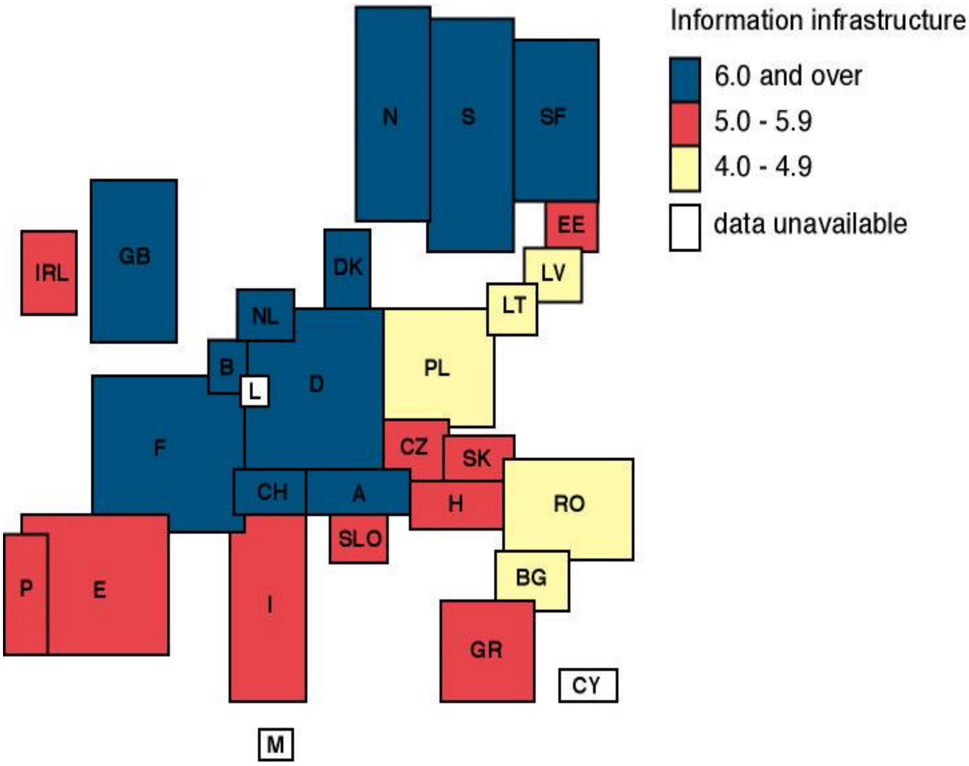



Source: Figures drawn from Networked Readiness Index, Information Technologies Group Centre for International Development (CID), Harvard University (CID, 2002); mapping CURDS.

Figure 6 illustrates the position of European countries based on access to Information Infrastructure. This measure is one of two micro- indexes which together form the Network Access subindex (the other is hardware, software and support). Here the northern member states (again led by the Nordic countries) have the most developed infrastructure. The Cohesion member states, plus Italy, together with the candidate countries the Czech Republic, Slovakia, Slovenia, Hungary and Estonia, are middle ranked, with the remainder of candidate countries appearing in the bottom tier.

Overall the picture of the Networked Readiness Indicator shows a pattern across Europe in with a division from north to south and west to east, with the Nordic countries the most Network Ready.

*Figure 6: Information Infrastructure Access across Europe (Euro 27 plus 2)*




Source: Drawn from Networked Readiness Index, Information Technologies Group Centre for International Development (CID), Harvard University (CID, 2002); mapping CURDS.

## 4.2 Mapping Individual Key Technologies and Services

This subsection presents mapped data showing the differential presence and up-take of a number of telecommunication technologies and services across Europe. The data is mainly drawn from the International Telecommunication Union's World Telecommunication Indicators which covers 206 economies with populations greater than 40,000. Telecommunication data are supplied by annual questionnaire sent to telecommunication authorities and operating companies, supplemented by data from yearbooks of various organisations. Broadcasting data are supplied by annual questionnaire sent to national broadcasting authorities or industry associations (ITU, 2001a). In this subsection we also draw on sources other than ITU in order to show developments and trends in technologies not covered by ITU.

We concentrate mainly on ITU figures here because they:

- Are based on same methodology over time and space
- Provide a consistent time series over a sustained period
- Are transparent and clearly annotated
- Have the most complete and consistent geographical coverage from an ESPON perspective (i.e., cover all Euro 27 plus 2)
- Are widely used by other agencies including Eurostat

ITU has compiled a set of Broad Indicators (see: Statistics Yearbook and World Telecommunication Indicators, ITU, 2001b). These are shown in Table 2.

*Table 2: ITU Broad Indicators of Telecommunications Services*

| | |
|---|---|
| Telephone Network (fixed) | Mobile Services |
| Other Services: e.g., ISDN lines | Traffic |
| Staff | Quality of Service |
| Revenue and Expense | Capital Expenditure |
| Broadcasting | Information Technology |

Source: ITU Yearbook of Statistics, 2001

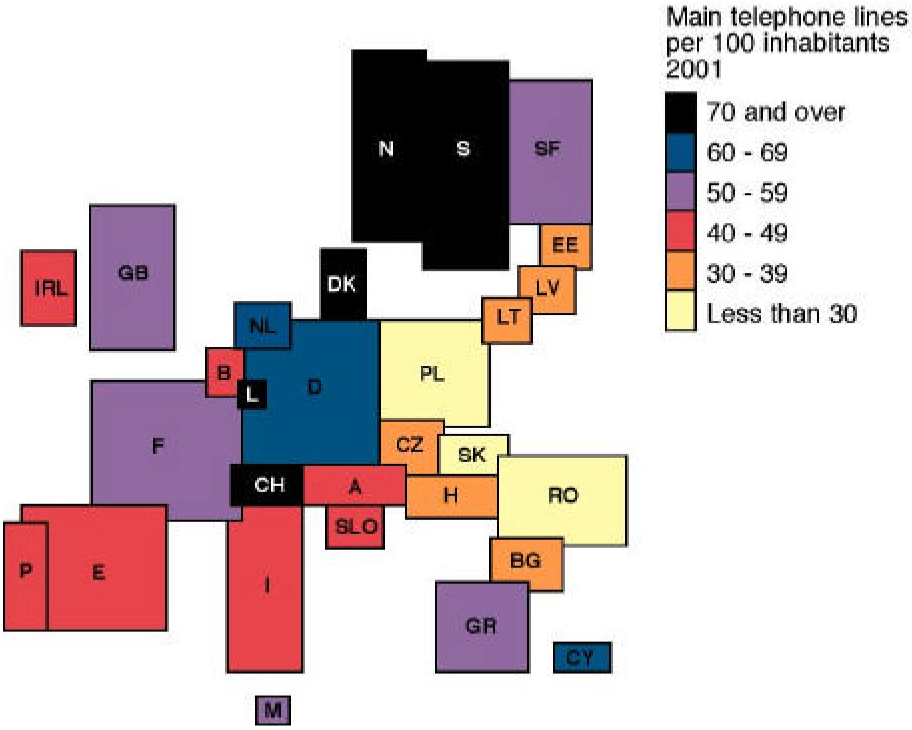
For reason of space, in this subsection we have selected only those indicators which (a) relate directly to networks and services, as opposed to other measures such as numbers employed or revenue and (b) those which we think would also be meaningful at the regional level.

*Fixed Line Telephony*

The first technology to be considered is the fixed telephone line. Despite the rapid growth of satellite, mobile and cable technologies over the past few years the fixed line telephone remains crucially important. Not only does the fixed telephone provide a basic support mechanism for many citizens in itself, it also underpins the growth of the Internet services as modem and telephone line remains the main means of accessing the Internet from home and for small businesses.

The telephone, together with the PC and the modem, therefore, are a key technology underpinning access to the Information Society.

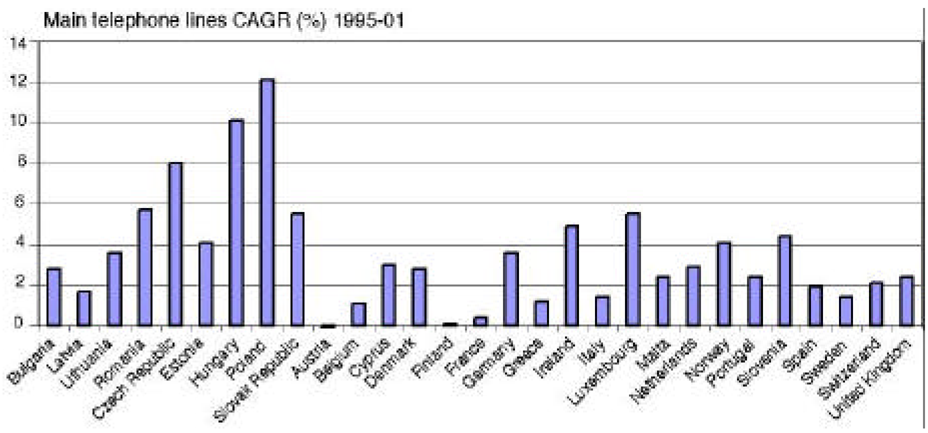
*Figure 7: main telephone lines per 100 inhabitants*




Source: ITU 2001. Figures abstracted from World Telecommunication Indicators (2001), mapped by CURDS

Figure 7 shows the number of main telephone lines in operation per 100 inhabitants. Main telephone lines refers to fixed telephone lines connecting customer's equipment (e.g., telephone set, facsimile machine) to the Public–Switched Telephone Network (PSTN) and which have a dedicated port on a telephone exchange. This figure includes business telephone lines as well as residential. In most cases these figures also include public pay phones.

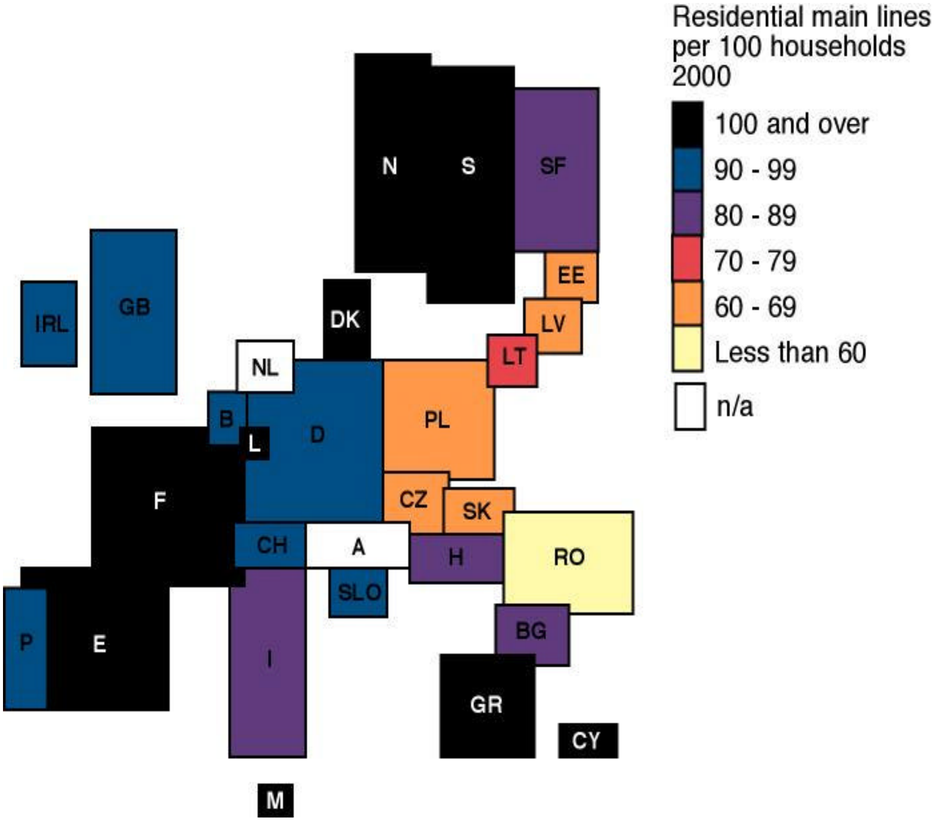
*Figure 8: Growth in main telephone lines in Europe (Euro 27 plus 2)*




Source: ITU 2001. Figures abstracted from World Telecommunication Indicators (2001)

Figure 8 illustrates the growth in main lines during the period 1995 to 2001. A varied picture emerges here, but the overall story is of a mature market with generally low growth (relative to mobile) in both member states and candidate countries, but with higher rates of growth in the candidate countries, implying some 'closing of the gap' evident in figure 7. The most rapid growth among candidate countries is found in Poland and Hungary.

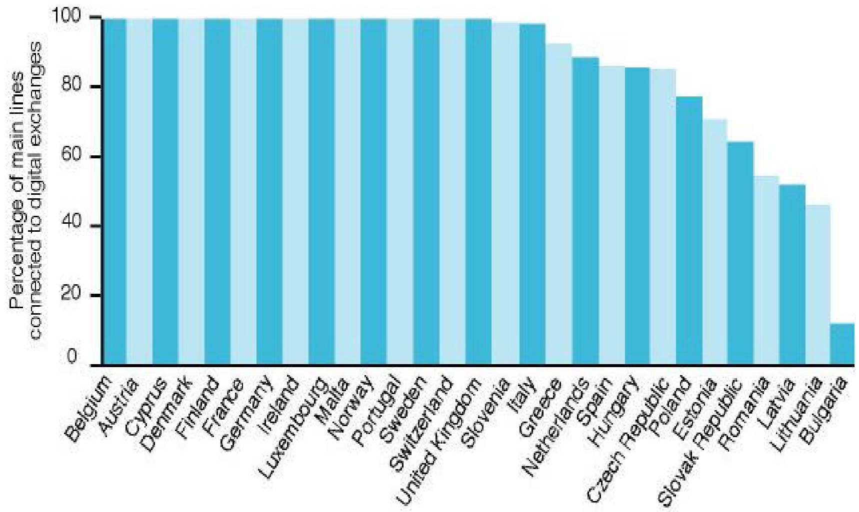
*Figure 9: Residential main lines per 100 households (figures for year 2000)*




Source: ITU 2001. Figures abstracted from World Telecommunication Indicators (2001)

Figure 9 relates only to residential customers, and is on a household rather than per Capita basis. Most member states have close to or above 1 telephone per household on average. An interesting exception, given its position in the NRI index, is Finland which has only 80 lines per 100 households, explained by mobile phones beginning to displace fixed residential lines. Malta and Cyprus lead the candidate countries where, again, there is wide variation.

*Figure 10: Proportion of main lines connected to digital exchanges*




Source: ITU 2001. Figures abstracted from World Telecommunication Indicators (2001)

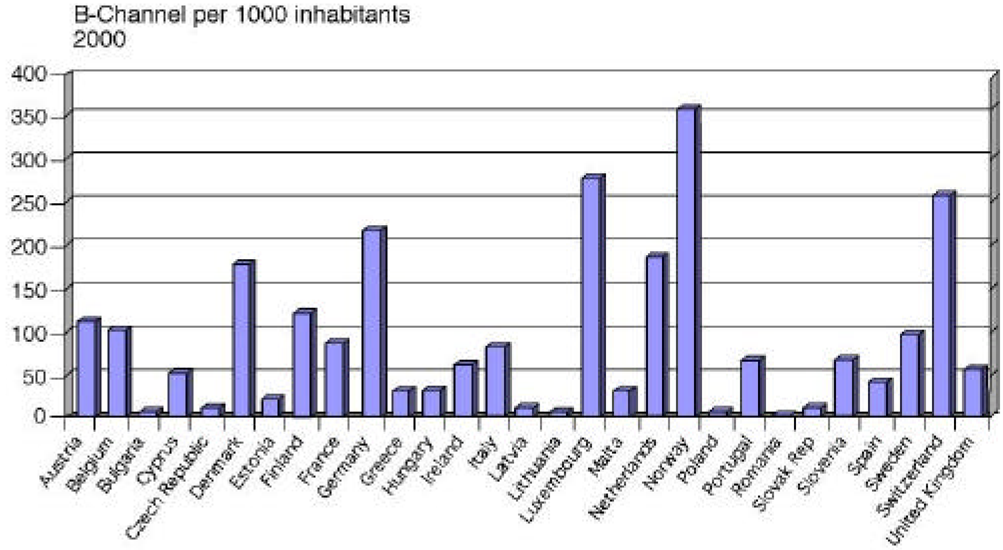
Figure 10 shows the number of main lines connected to digital telephone exchanges[6]. Connection to a digital exchange should mean that service is faster, clearer, that additional functions are possible, and that there are fewer faults. It represents a reasonable, if crude, proxy for the range of services which can be found in a particular area. In most member states 100% of lines are connected to digital exchanges. This contrasts with the situation a decade earlier when only France, Ireland and the Netherlands had over 50% of their main lines being connected to a digital exchange. The Netherlands figure in 2000 is an ITU estimate. There is considerable variation across the candidate countries with Malta and Cyprus having 100% of their lines connected to a digital exhange, with Slovenia just under 100%, whilst Lithuania and Bulgaria (with only 12%) have under 50%.

Figure 11 shows the presence of ISDN (Integrated Subscriber Digital Network) in Europe[7]. ISDN allows the integrated transmission of voice, data and still pictures in digital form. ISDN is interesting in that in the early to mid-1990s it was seen as the great hope for bringing advanced telecommunications services to the public. By and large, however, expectations of a huge uptake have been disappointed, though as figure 9 shows the picture varies across Europe.

[6] ITU make it clear that this indicator does not measure the number of exchange lines which are digital (ITU, 2001b).

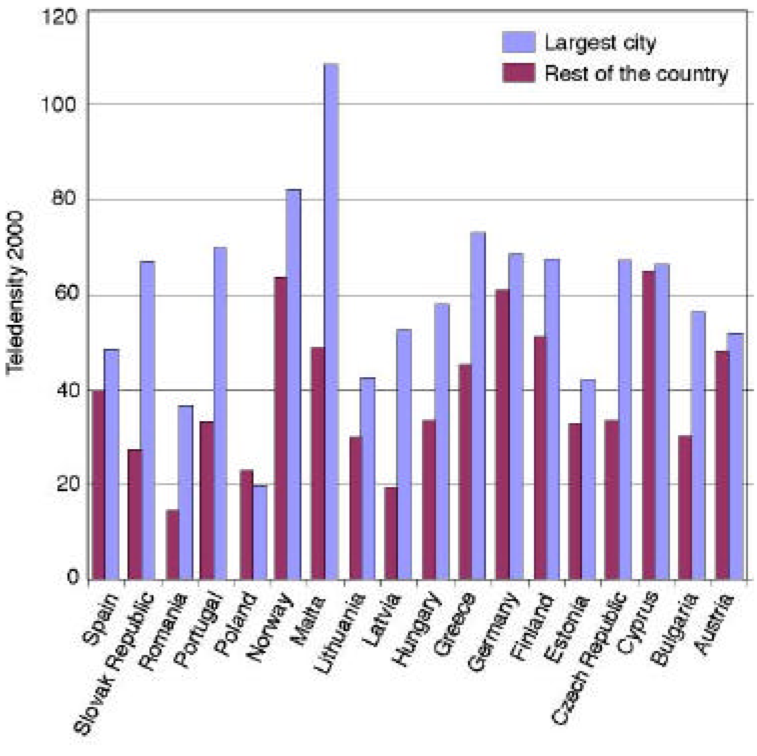
[7] Two measures normally used to measure ISDN

*Figure 11: ISDN presence in Europe (Euro 27 plus 2)*




Source: ITU 2001. Figures abstracted from World Telecommunication Indicators (2001)

*Figure 12: Comparison of 'Teledensity' between largest cities and rest of country in European countries (Euro 27 plus 2)*



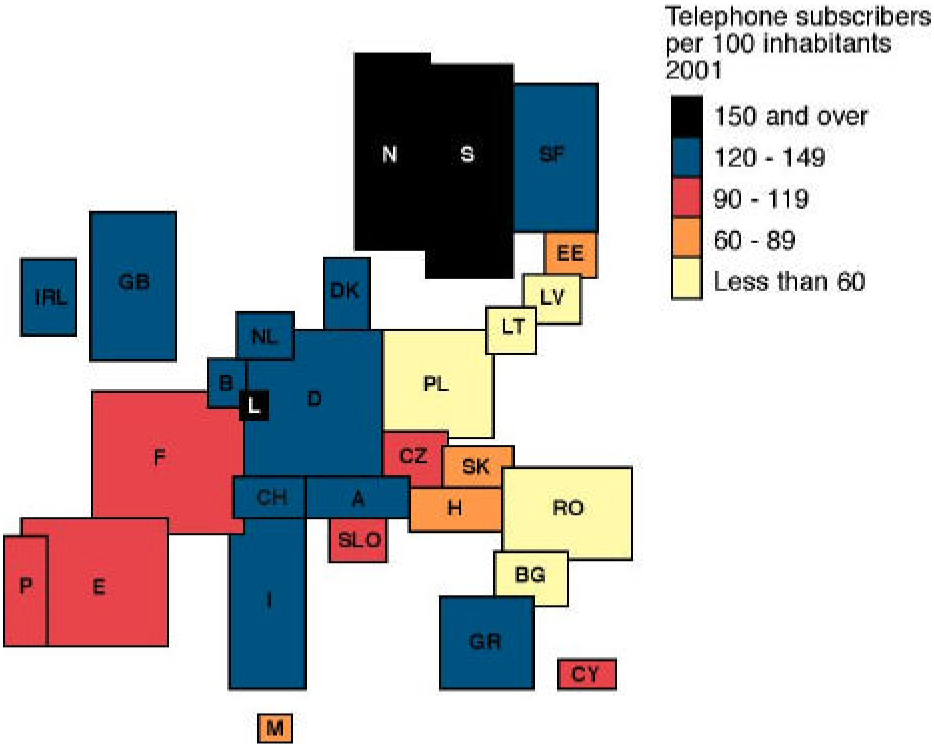

Source: ITU World Telecommunication Indicators 2001, mapped by CURDS

Figure 12 illustrates the comparative 'teledensity' of the largest city in each European country in relation to the rest of the country. Largest city teledensity is obtained by dividing the *main lines* in the largest city by the population of the largest city and multiplying by 100. Rest of country teledensity is obtained by subtracting the main lines of the largest city by from the main lines of the country, dividing that amount by the largest city population and the population of the country and multiplying by 100. This is the only data provided by ITU that gives an indication of differences in the spatial distribution of telecommunications *within* countries. In all but one case (Poland) the largest city has a higher teledensity than the rest of the country.

The notion of teledensity is a potential useful concept for ESPON and it is encouraging that it is used to differentiate the situation within countries. It is a useful starting point, but has several limitations. First, data is missing for several countries. Second, the area covered by the largest city for telecommunication purposes may differ from the definition used for the population of the largest city. Third, the binary division of largest city and rest of country gives only a limited picture of territorial differences. Fourth, the data is for *main lines* (i.e., fixed telephone lines) only. Given the growing importance of cellular, cable, and to a lesser extent technologies such as FWI, a composite measure which took these technologies into account would be more useful. A fifth limitation is that it does not take into account quality of infrastructure (exchanges etc.) or services.

*The Growth of cellular telephony*

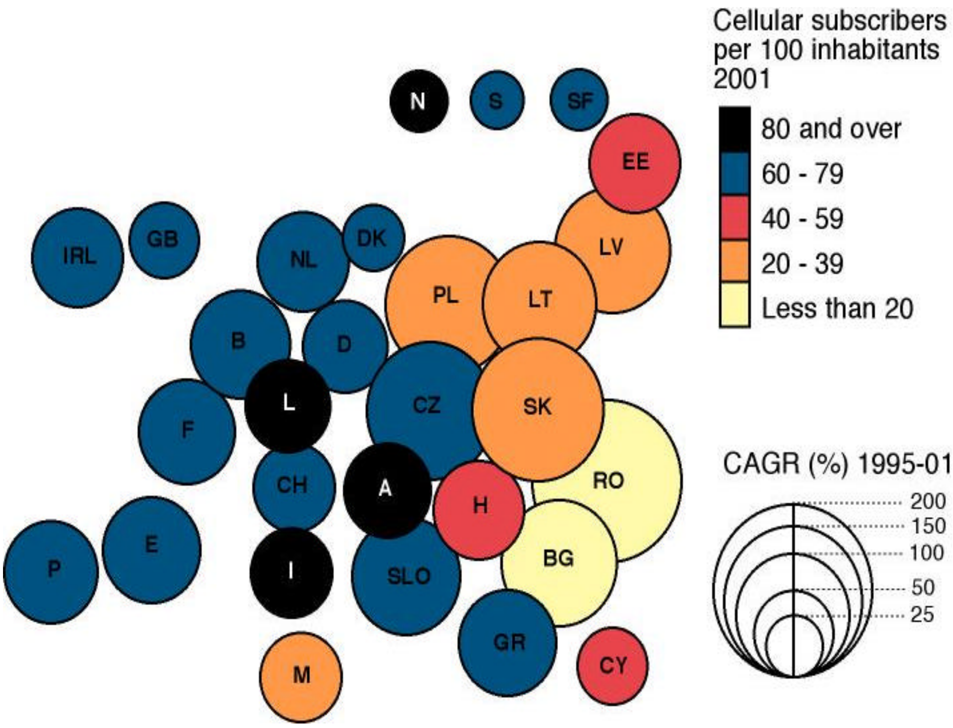
*Figure 13: Telephone subscribers per 100 inhabitants 2001*




Source: ITU World Telecommunication Indicators 2001, mapped by CURDS

Figure 13 moves beyond the fixed telephony to show the total number of telephone subscribers in each country. The figure is arrived at by summing the number of main telephone lines (fixed lines) and cellular mobile telephone subscribers. There is a mixed picture across Europe. Overall, member states have proportionately more subscribers than candidate countries. All member states have over 100 subscribers per 100 inhabitants though there is significant variation with Luxembourg having 175 per 100 inhabitants whilst Spain has only 109. There is also variation across candidate countries with Slovenia, the Czech Republic and Cyprus all having over 100 subscribers per 100 inhabitants whilst five candidate countries have fewer than 60 subscribers per 100, with Romania having only 36.

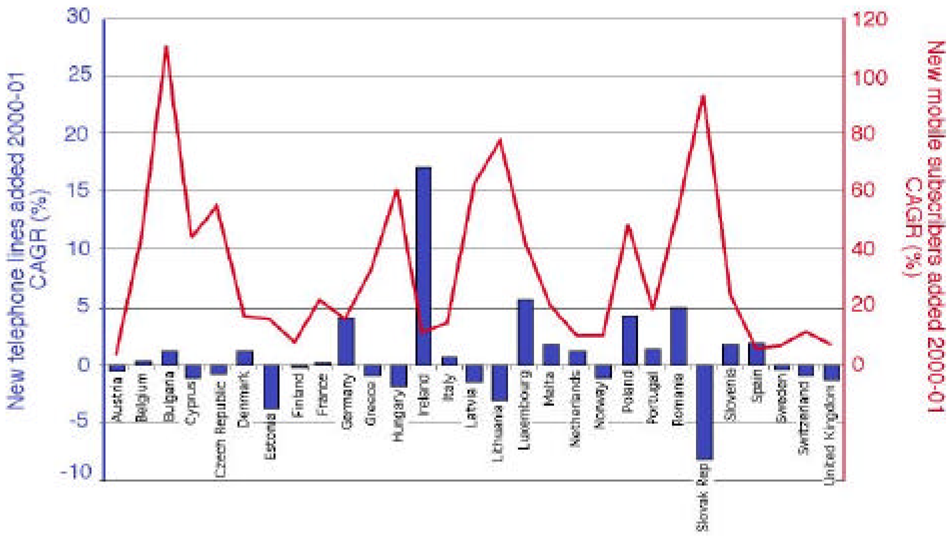
*Figure 14: Cellular subscribers per 100 inhabitants 2001*




Source: Data abstracted from ITU World Telecommunications Indicators 2001, Mapping by CURDS

Figure 14 shows the number of cellular mobile telephone subscribers per 100 inhabitants, and the cellular subscriber growth rates between 1995 and 2001. It can be seen that member states have a higher proportion of cellular subscribers than do candidate countries, though Slovenia and the Czech Republic have rates comparable with most member states. What is noticeable, however, is the differential rate of growth in cellular subscriptions over the past six years where generally candidate countries show the largest percentage increases, again implying a 'catch up' process.

*Figure 15: Comparison of (fixed) telephone and mobile growth 2000 –2001*

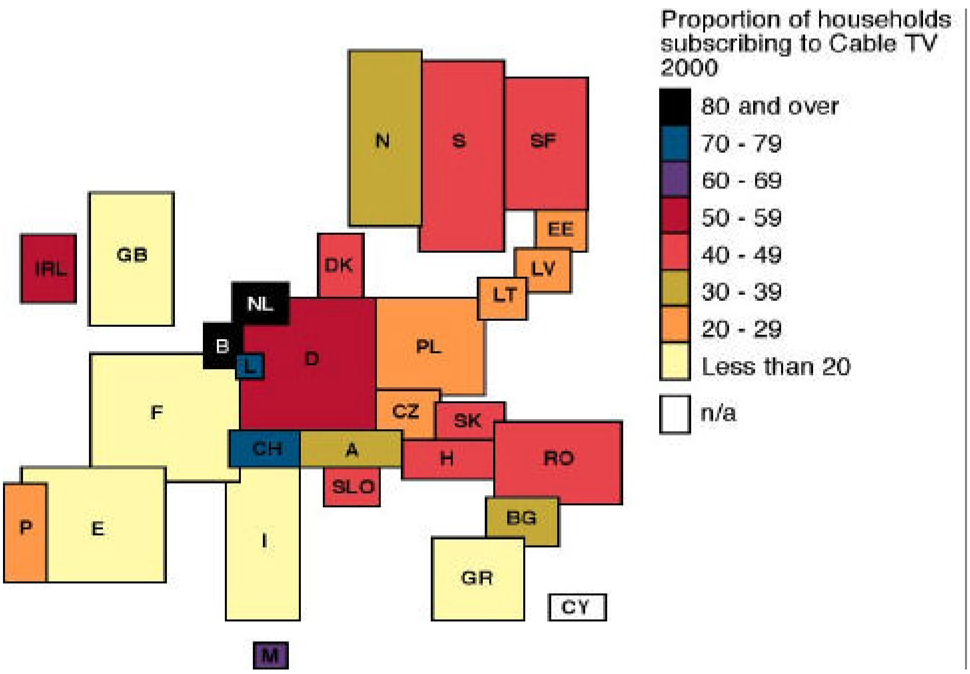



Source: ITU World Telecommunication Indicators 2001, mapped by CURDS

Figure 15 shows relative growth in main line and cellular subscribers for a single year. This suggests that for most countries main line telephones are a mature technology, showing little or no growth, in some instances even declining. By contrast mobile telephone subscription is growing more rapidly across Europe. Ireland is the major exception, until the growth in fixed lines outstripping the growth of cellular subscribers.

*Other technologies*

*Figure 16: Proportion of households subscribing to Cable TV 2000*

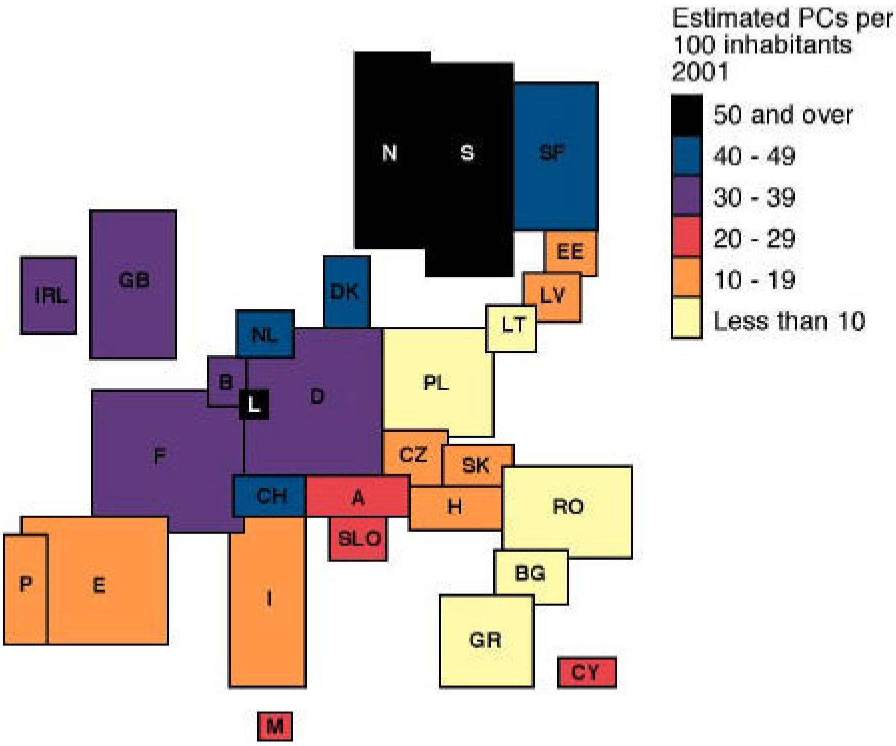



Source: ITU World Telecommunication Indicators 2001, mapped by CURDS

Cable television has been seen by many policy makers, at least until recently, as a key technology in the drive towards providing more advanced services.

Co-axial cable can deliver voice, data and pictures to the home and to a lesser extent from the home. It was also anticipated that cable would provide the opportunity for new firms to enter the market thus stimulating competition with incumbent telecommunications operators, reducing prices and stimulating technological development. Figure 16 shows a complex pattern. Further detailed analysis of individual countries – their regulation, market conditions, history – would be required to explain those patterns. For example, the UK's lack of cable penetration might be explained by the limited presence of traditional cable and by the success of satellite television.

*Figure 17: Estimated PCs per 100 inhabitants 2001*[8]

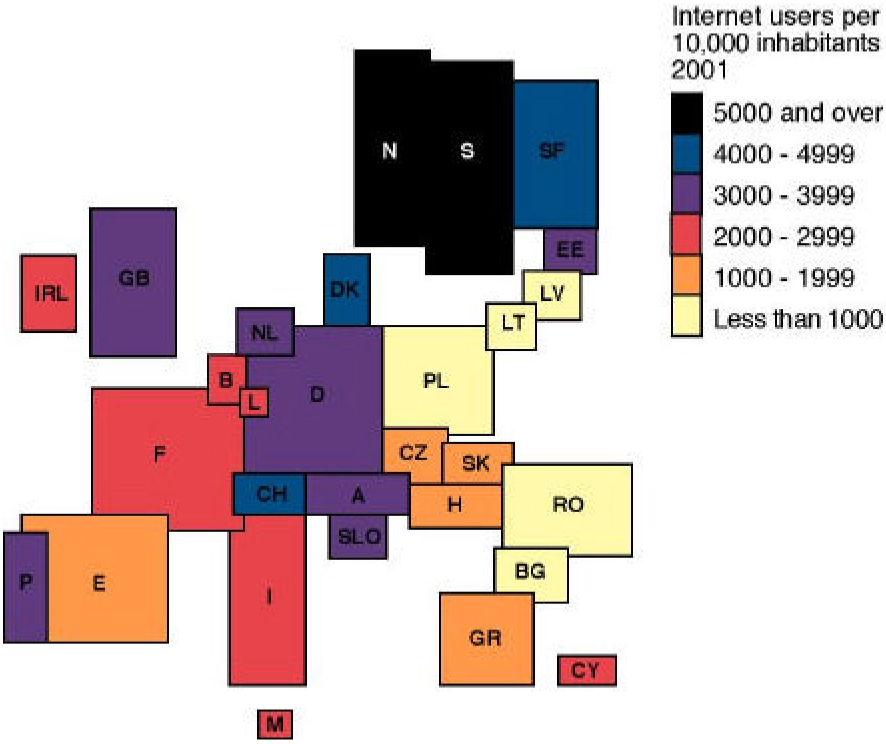



Source: ITU World Telecommunication Indicators 2001, mapped by CURDS

In addition to the telephone connection another basic requirement for access to the Information Society for the majority is a personal computer (PC). Figure 17 shows the estimated number of computers per 100 inhabitants in European countries. The estimates are based on sales figures provided by the IT industry. Again the west-east and north–south patterns appear, with the Nordic countries having the highest PC penetration.

[8] The data presented in Figure 15 for Austria and Germany are ITU estimates.

*Figure 18: Internet users per 10,000 inhabitants 2001*




Source: ITU World Telecommunication Indicators 2001, mapped by CURDS

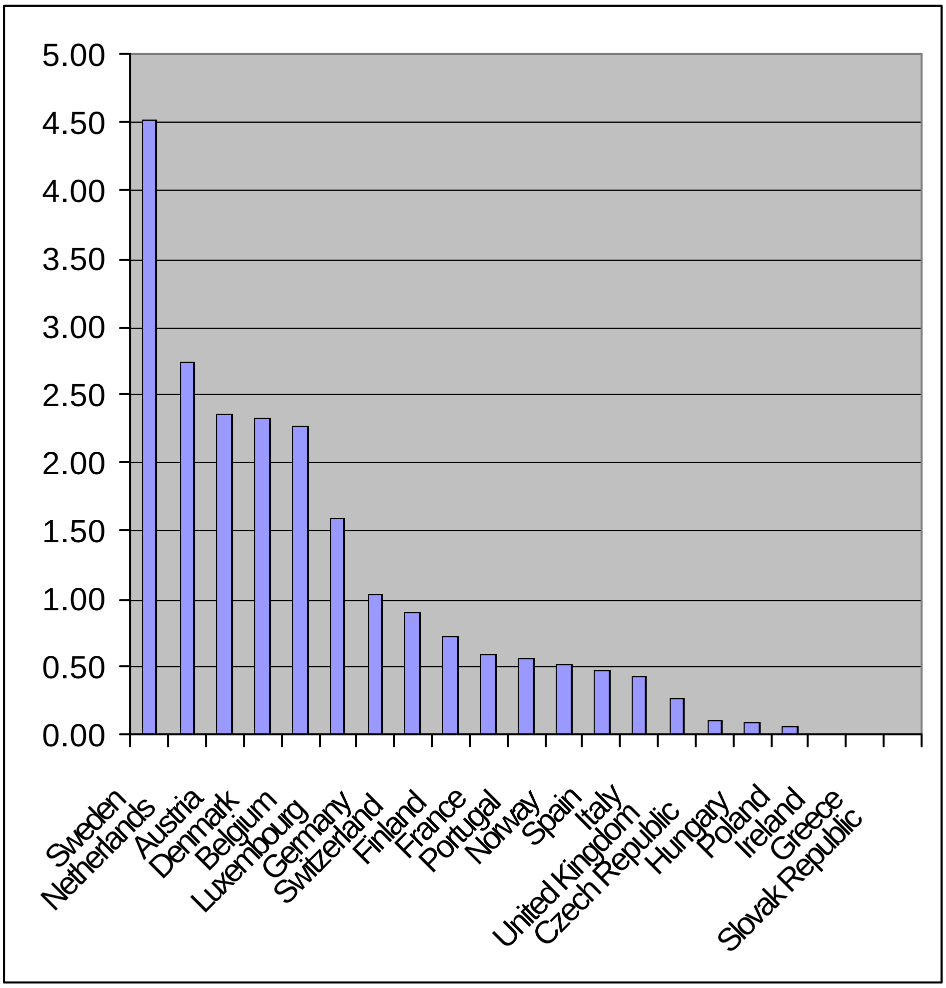
Figure 18 shows estimates of Internet users. The Internet is now seen as the key technology of the networked or information society and many commentators have noted its exponential growth. Again the data suggests that this growth is differentiated across European territories. Figure 18 shows a north-south and west-east divide with Nordic countries leading the way in terms of users.

An alternative indicator of Internet growth is the number of hosts per 10,000 inhabitants and number of hosts in a country. This approach is very problematic, however, for a number of reasons, most notably the confusion between domain names which may suggest that a host in located in a country and the actual location of an Internet host (see Minges, 2000 for a more detailed discussion).

One important set of technologies not covered by ITU in its Yearbook is broadband. Broadband is a term which is widely used to refer to infrastructure which can transmit data at high speeds (see section 2.2.2, above for a more detailed description). Increasingly broadband is discussed in the context of high speed Internet access. It is argued that because broadband gives 'always on' (as opposed to dial up) access and because downloading and uploading speeds are faster that broadband will be an important factor in stimulating use of the Internet (see, for example, UK Online, 2001).

Figure 19 shows 'broadband penetration across a number of European countries. OECD, in the report from which the data upon which the figure is based are drawn, uses a low threshold definition of broadband (64kbps), which might better be termed higher bandwidth. The figure aggregates DSL and Cable Modem penetration per 100 inhabitants. Sweden has by far the highest proportion of broadband penetration, almost half of that is accounted for by the availability of high-speed fibre LAN services rather than DSL or cable modem. Generally, the fastest rate of growth in broadband is in DSL. The combination of broadband will vary from country to country depending *inter alia* on the relative success of cable operators and (often incumbent) providers of DSL services. It is worth noting that the spread of broadband remains limited at present.

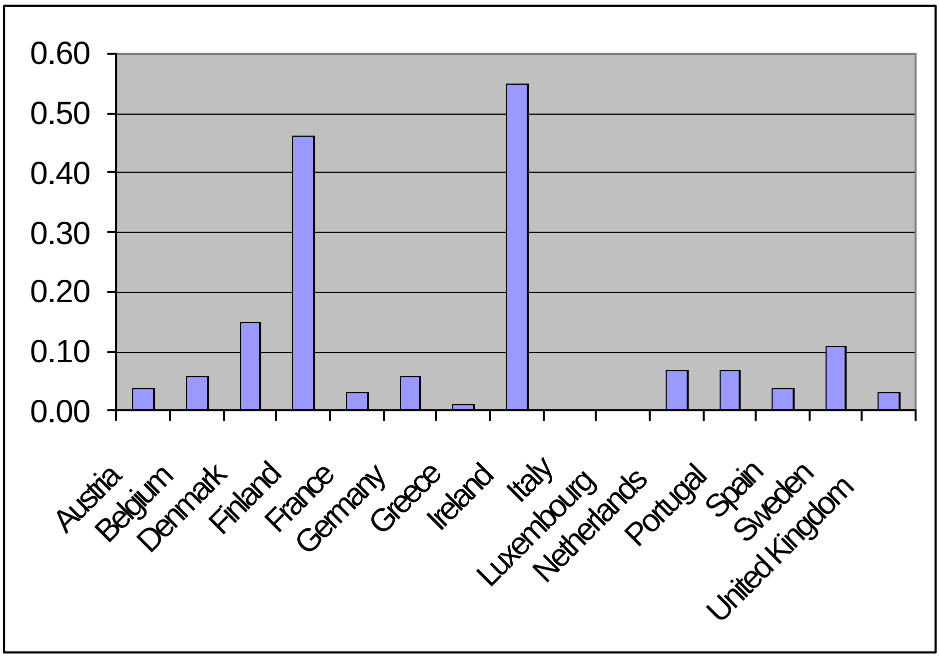
*Figure 19: Broadband Penetration per 100 inhabitants (2001)*




Source: OECD, 2001b

The final figure in this section, Figure 20, is included to shows the presence of Public Internet Access Points (PIAPs) in various European countries (it only covers existing member states). Clearly these are of limited numerical significance in the overall scale of information society technologies and services – the largest percentage per 1,000 inhabitants being 0.55. PIAPs are included here, however, as they are seen by policy makers as a crucial means of securing access to the Internet for all citizens, particularly those who cannot afford access otherwise. A number of governments are promoting public access sites, in both urban and rural areas. Typically PIAPs are sited in libraries, post offices and community centres.

*Figure 20: Public Internet Access Points (PIAPs) per 1,000 inhabitants*




Source: Adopted from e-Inclusion: The Information Society's potential for inclusion in Europe (SEC, 2001).

## 4.3 Mapping Telecommunications Flow Data

The previous section has concentrated on measuring and mapping the level of supply or uptake of particular telecommunications network technologies and services in different (national) territories. It is also possible (data permitting) to measure 'traffic flows' over these networks.

As an example, figure 21 indicates the flow of traffic (measured in millions of minutes) over the public telephone network between pairs of countries in Europe. There is a scale cut–off in the figure, such that minor flows between country pairs are not shown. The figure dominate the extent to which the UK, Germany, France, Spain and Italy demonstrate the pattern of telecommunications traffic in Europe, but also that some smaller countries – notably the Netherlands, Belgium and Switzerland – have much larger flows of international traffic than might be anticipated on the basis of their population sizes.

Other features highlighted in the figure include the existence of strongly linked 'blocks' of countries, based on contiguities but also historical linkages. Examples include: the UK and Ireland; a Scandanavian block of Sweden, Norway, Finland and Denmark; and a block incorporating Germany and its eastern neighbours, Poland, the Czech Republic and Austria.

*Figure 21: European Telecommunication Traffic Flows*

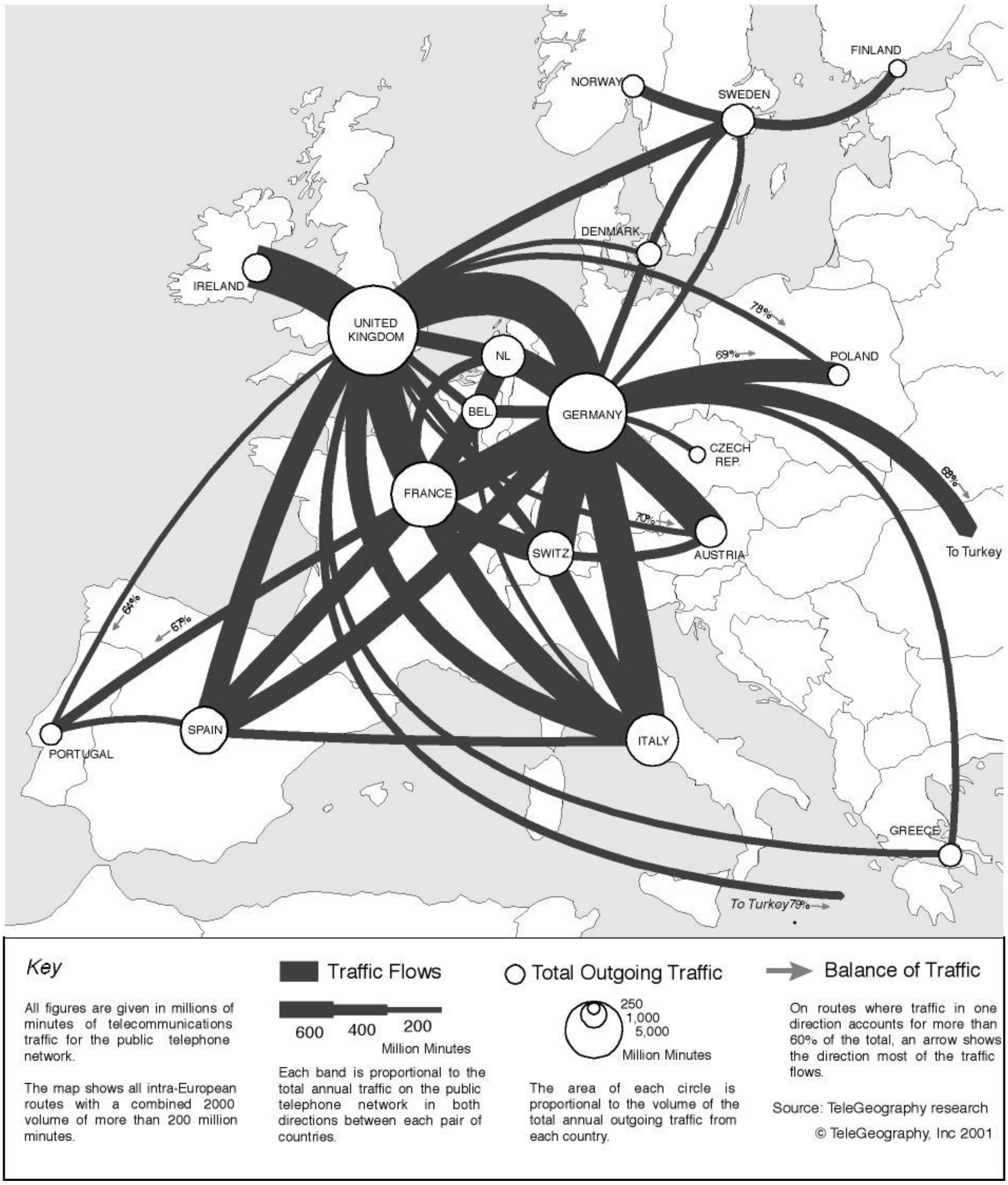
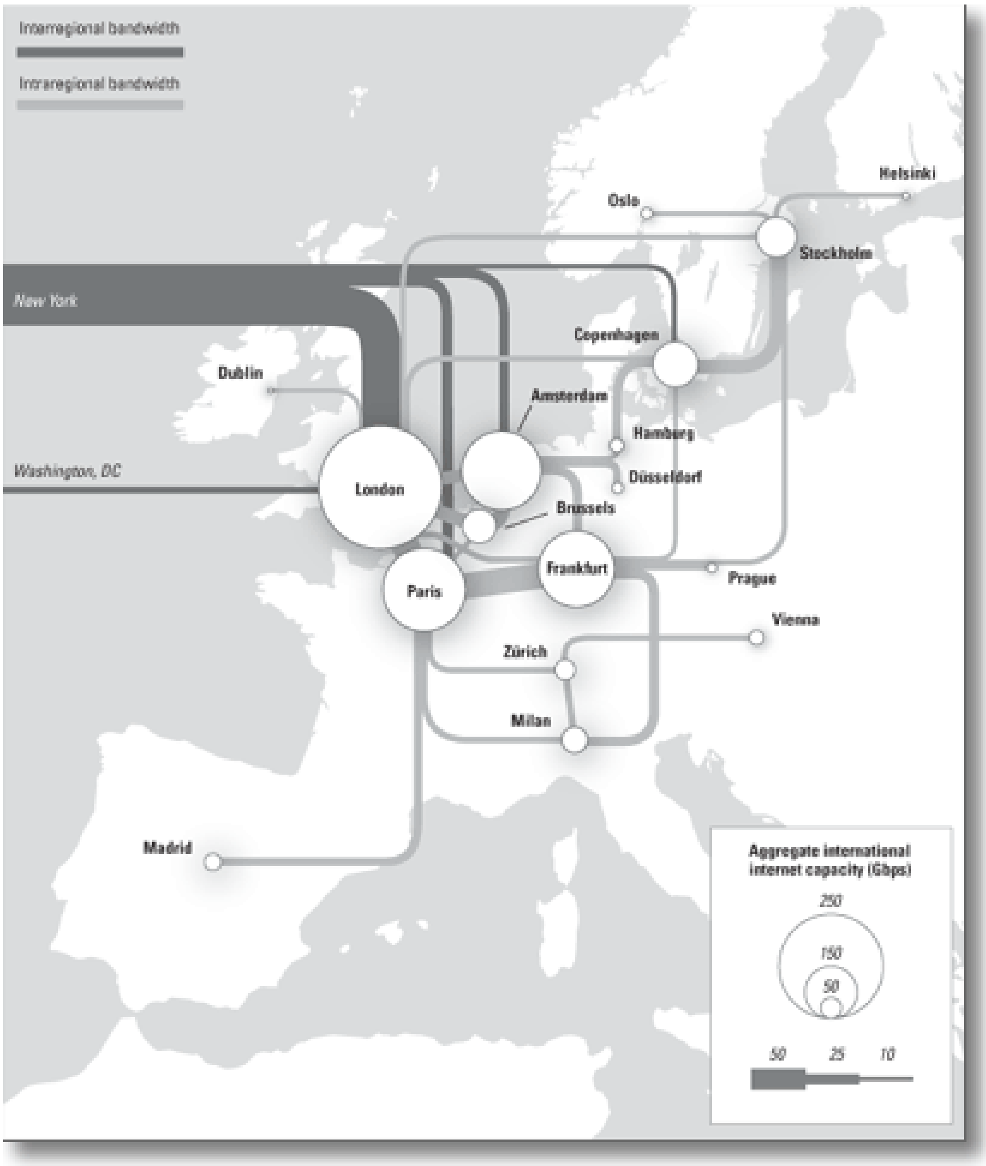



Figure 22 is concerned not with flows per se but with installed capacity in the network – in this case international Internet capacity measured in Gbps – in selected cities in Europe. The proportional size of the circles indicates the aggregate international Internet capacity installed, and reveals that London, Paris, Amsterdam, Frankfurt, Copenhagen and Stockholm dominate the European pattern. Installed capacity *between* selected city pairs are also shown, revealing the importance of the London–Paris, Paris–Frankfurt and Stockholm–Copenhagen links. Finally, the figure shows the amount of installed capacity linking European cities with North America, demonstrating the extent to which capacity on the London–New York link dominates the overall picture.

*Figure 22: International Internet Capacity*

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## 5 PRELIMINARY INDICATORS FOR EXPLORING REGIONAL TERRITORIAL TELECOMMUNICATION NETWORK AND SERVICE PATTERNS

This section supplies a *preliminary* list of the indicators that we think it would be sensible to explore the viability of developing or collecting at the sub–national level. The list is based on a review of indicators used in a range of sources, including the CDI Network Readiness Index, publications of the OECD, the ITU World Telecommunication Indicators and Statistical Yearbooks referred to in the previous section. The indicators from each of these sources, of course, are used by these bodies in order to make cross–national comparisons. Our concern here is with the possible extension of these indicators to examine territorial variations at the sub–national level.

A classification of indicators designed to benchmark the Information or Knowledge Economy at the national level is provided by Selhofer and Lassnig (2001)

*Table 3: Classification of Indicators of ICT Supply and Demand*

| **Global indicators** Diffusion of and demand for ICT and ICT–services | |
|---|---|
| **1 Indicators for supply** | **2 Indicators for demand** |
| 1.1 Development of ICT infrastructure | 2.1 Diffusion of ICT and usage of ICT–services |
| 1.2 Prices of ICT services | 2.2 Expenditures for ICT and ICT services |

Source: Adapted from BISER (WP1 Annex), based on Selhofer and Lassnig classification (2001)

The BISER team conclude that some kind of similar system would make sense on the regional level (see BISER WP1, p54). The BISER team suggest a number of indicators with which to populate this schema. The BISER project has a wider remit than our project and looks at wider informational society trends. We have adapted that model to include only those indicators that relate to the diffusion of and demand for ICT and ICT-services, as well as supply site indicators.

The BISER list was used as a starting point and has been amended following an exchange of views with ESPON partners. The amended list appears below in Table 4. It should be stressed, however, that the list represents very much a preliminary effort. Further discussions will take place at a brainstorming meeting between partners in early November[9] when exploratory work currently being undertaken by partners regarding the availability of data at the national and regional level will be taken into account.

This may result in an increase in the number of indicators initially considered, though clearly the intention will be to move towards a selection of a smaller number of key indicators either through prioritising certain indicators over others or through the amalgamation of indicators to produce composites.

It will be crucial that we develop indicators which are meaningful at the sub-national level and have some prospect of being matched by the availability of data.

[9] The initial project brainstorming meeting, which it was envisaged would have taken place in September, has been delayed as a result of delays in the contractual process.

**Table 4: Preliminary list of indicators for examining the efficacy and viability of at the sub–national level**

**1) Development of telecommunications–infrastructure**

- Internet host density
- Network growth: New Internet hosts added
- Estimated number of ISPs
- Number of secure servers
- Number of (telephone) access lines per 100 inhabitants
- Percentage of capacity used of main telephone lines
- Digitisation of fixed telecommunication networks
- Faults per 100 main lines per year
- Percentage of households with a telephone
- Deployment of fibre optic cable
- Number of public Internet access points
- Investments in communication networks by telecommunication operators
- Competition in fixed network infrastructure
- Competition among different networks for Internet access
- Competition in cellular mobile infrastructure
- Broadband penetration rates
- Network growth: New telephone lines added

**2) Prices of telecommunications services**

- Internet access costs (peak, off–peak, low–band, broad–band etc.)
- Monthly ISP charge (for 20 hours of usage)
- Composite basket of residential telephone charges
- Composite basket of business telephone charges
- Fixed telephone call charges
- Fixed telephone rental charges
- Telephone tariffs: local call
- Basket of consumer mobile phone charges
- Basket of business mobile phone charges
- Cellular tariffs: 3 minute local call (peak & off–peak)
- Fixed to mobile network prices
- Average price of ICT hardware
- Price of leased lines

**3) Diffusion of ICT and usage of ICT–services**

- Installed PCs per 100 inhabitants
- Diffusion of Internet access technologies by transmission speed
- Households with Internet access
- Internet users (at home/at work/both)
- Percentage of employees using e–commerce–enabling technology
- Access to PCs/Internet broken down by socio–economic variables
- Purpose of online activities from home
- Diffusion of cellular mobile phones
- New mobile subscribers added
- Monthly usage of cellular mobile phones
- Cellular mobile subscribers as a percentage of total telephone subscribers
- ISDN subscribers
- Internet use by businesses
- Enterprises providing Internet services
- Average time spent online
- Number of Web sites
- Internet penetration by enterprise size class
- Businesses with Web sites
- Internet purchases and sales (amount of e–commerce)
- Percentage of individuals using and ordering goods and services over the internet
- Cable TV subscribers

**4) Expenditures for ICT and ICT–services**

- Trade in ICT goods
- ICT expenditures (as a percentage of GDP)
- Telecommunications investment
- Telecommunications revenue per inhabitant
- Packaged software markets
- Mobile telecommunications expenditures
- ICT intensity (=ICT expenditures as a percentage of GDP)

## 6 DATA COLLECTION REQUESTS

This section briefly outlines our first set of data collection requests from European and national agencies. Our initial enquiries suggest that most of what we require is not available at the European level, though we will re-approach the relevant agencies in WP2. Our list of requirements is set out in Annex 1 to this report. This list of indicators will have to be circulated to national statistical agencies and telecommunications regulators. The request seeks to assess whether data for each of these indicators are collected at various territorial levels: NUTS 0, NUTS 1, NUTS 2 and NUTS 3. This list may be amended in the light of partner discussions at our meeting in early November.

## 7 PRELIMINARY POLICY DIRECTIONS

The review of territorial patterns of telecommunication networks and services in this report suggests that there are broad territorial disparities in provision and demand. We have not been able in this report to consider differences at the regional or finer spatial scale due to the complete absence of such data in the main European data sources, but we have pointed to a number of previous studies that suggest that similar or greater disparities exist at the inter-regional and intra-regional scales at least in some countries (see, for example, ASPECT, 2001). The data presented in this report also suggests that an element of 'catch up' is occurring in at least some technologies. For example, in the case of mature technologies such as fixed telephone and some newer technologies, notably cellular mobile, the rate of growth in candidate countries outstrips that of member states. A key question, however – one which the data available does not allow us to answer here – is whether the gap is closing in respect of more advanced technologies. Evidence from earlier studies suggests that, in liberalised markets, the roll-out of new technologies generally occurs in densely populated and economically more advanced territories. We therefore concentrate on advanced technologies and particularly on broadband in this section of the report. We conclude the section, however, by pointing out that there is also a case for making more effective use of existing technologies.

This section briefly outlines some of the policy options through which to address territorial disparities. It must be stressed that these options represent preliminary thoughts and further discussion will be required within the ESPON 1.2.2 partnership to refine, elaborate and expand policy options. Preliminary suggestions include:

- Further liberalisation of telecommunications markets to stimulate competition and investment.
- Amending the Universal Service Directive to take into account more advanced technologies than are currently considered.
- Direct investment by (national, regional or local) government in advanced infrastructures, e.g., through network ownership
- Direct or indirect financial support to carriers

- Aggregating broadband demand, which in turn may stimulate supply through market mechanisms.

We can only give brief consideration to these options here and it is likely that some combination will be necessary in practice if territorial coverage is to become more equal.

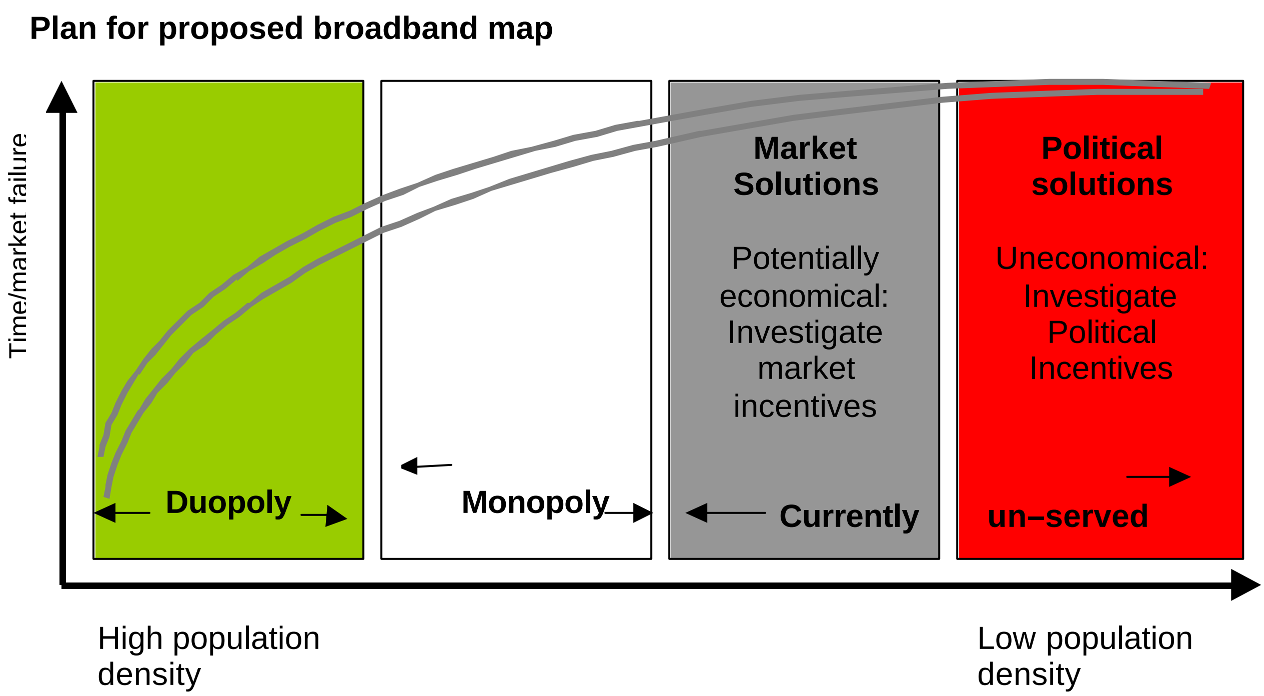
First is the further liberalisation of telecommunications markets. This appears to be the favoured option of influential organisations such as OECD who argue that introducing greater competition is the key way in which to ensure wider territorial coverage. OECD (2002a) argues that:

"government policies should continue to emphasise the role of competition in stimulating broadband development and diffusion and should avoid direct intervention in the broadband market which risks distorting market mechanisms. Government's role should be to facilitate such development and only intervene in areas where it has become clear that there will be no private infrastructure investment" (p3).

Evidence of liberalisation to date in the UK, which was the most rapidly liberalised market in Europe, suggests that the market will not necessarily provide in all areas. Liberalisation has led to major advances in rolling out infrastructure in *urban areas*, particularly in London and other major cities where demand from business is high. Less urbanised areas, however, lag behind. The end to BT's monopoly brought an influx of new telecommunications providers to the UK market and has produced fierce competition. This competition, however, has mainly been experienced by the corporate sector. In geographical terms it has largely been limited to urban areas. In short, the evidence of almost twenty years of telecommunications liberalisation in the UK is that major telecommunications providers have little interest in extending advanced networks to (or rather breaking out advanced networks in) rural areas except where subsidised by the public purse. Even with public subsidy there is no guarantee that they are prepared to invest in some areas (Richardson, 2002).

The evidence suggests that liberalisation is effective in ensuring roll-out where there is a commercial market. Recent work by the Broadband Stakeholder Group for the UK e-envoy suggests that there may be some places which will never be commercially viable for broadband investment and that it is not just a question of time lag rather that there is no guarantee that certain areas will ever be served without intervention (Computing, 2002). A recent report by the Swedish government makes similar claims (Swedish Ministry of Industry, Employment and Communications, cited in OECD, 2002a). The UK Broadband Stakeholders Group are in the process of developing a model (see figure 23) that would gauge whether particular areas are likely to be commercially viable. It is anticipated that the model will be mapped on to territories shortly. Depending on how robust this model turns out to be it may be replicable across other parts of Europe.

*Figure 23: Model for considering the prospects for commercially viable broadband roll-out.*




Source: UK Broadband Stakeholder Group (Computing, 2002)

The second policy option is amending the Universal Service Directive (USD)to take into account more advanced technologies than are currently considered. The USD lays down minimum requirements for EU Member States. Member States can go beyond this minimum with certain provisos regarding competition distortion. The goal of the USD is ensure availability of certain minimum services to citizens at affordable levels regardless of geographical location. The USD, however, relates only to a quite basic level of service. The most important provision in the context of the present report is that users should be provided on request with a connection to the public telephone network at a fixed location, at an affordable price. This requirement, however, does not cover the provision of higher bandwidth let alone broadband:

"..a single narrowband network connection…and does not extend to the Integrated Services Digital Network (ISDN) which provides two or more connections capable of being used simultaneously….Connections to the public telephone network at a fixed location should be capable of supporting speech and data communications at rates sufficient for access to online services such as those provided via the public Internet (OJEC, 2002, L108/52, para 8)".

The USD could be extended to cover some more advanced services. It could also be extended to embrace more service providers – at present it is generally limited in application to the former monopoly provider. The USD suggests that in a rapidly evolving market there is the need for periodic reviews of what should be covered. The arguments against extending the scope of the Directive include the view that this could lead to one technology being favoured ahead of others, thus distorting competition. A more crucial argument might be that the huge cost of upgrading infrastructure in places where there is not necessarily significant demand for services could inhibit the overall deployment of advanced networks.

Third, government (national, regional or local) could directly intervene to construct and own broadband networks to ensure greater equality of supply across territories. In the current political environment and under the existing regulatory regime, such action would clearly have to be justified by governments. Examples of this approach can be found in Sweden (as well as in several parts of the US). The purpose is both to stimulate broadband services and to bring broadband to communities which might not otherwise receive them, at least in the medium term. This approach has been criticised by OECD on several grounds including competition grounds and that it potentially excludes alternative technologies (see OECD, 2002a).

Fourth, investing public money in telecommunication providers – either as a subsidy or as part of a public-private partnership to invest in broadband ahead of demand. There are examples of this in the US and Canada. Closer to home, and on a smaller scale, local and regional authorities have recently adopted this approach. A longer standing example of this approach, but relating to an earlier technology – ISDN – occurred in the rural Highlands and Islands of Scotland. Here the regional authority added public money to private spend by the (then) monopoly provider BT to create an ISDN enabled network. This approach appears to have been reasonably successful (see Gillespie et al, 2001). In the longer term, however, unless such investment stimulates demand which is sufficiently large to overcome remoteness and low population density, further rounds of public investment in newer technologies (for example, broadband) will be required.

Finally, a number of attempts are now underway to aggregate broadband demand on a territorial basis. This is seen as particularly appropriate in regions which telecommunication providers perceive to be not commercially viable. In such regions the public sector is often the largest customer. It is argued that by bringing demand from various public agencies together a better offer can be obtained from providers. If successful the private sector (or at least some parts of it, e.g., SMEs) can then utilise the technology. Public sector demand aggregation, however, requires the construction of institutional structures sufficiently robust and flexible to ensure co-operation. This is not always easy.

This policy section has concentrated on ways of enhancing networks and services in territories where the market appears not to be working. It is worth noting, however, that regions and localities can also take action to get the most out of existing technologies. This will require painstaking work, often at the micro-level. Results achieved at this level can be worthwhile, but are less likely to be politically visible than will the securing of large-scale investment in new advanced infrastructure.

A final point to note is this. In line with the thrust of ESPON this section (and indeed the report as a whole) has concentrated on infrastructure and services. It is clear, however, that these can only form one element of an information society regional policy. A number of other elements will be required in order to create the enabling environment within which investment in telecommunications networks and services necessarily leads to greater economic, social and territorial development benefits.

# 8 NEXT STEPS

A meeting will take place between ESPON 1.2.2 partners in Brussels on November 8 and 9. Discussions will take place regarding any amendments to the proposed work plan. Several of the partners will also attend the first Trans Partner Meeting in Luxembourg. Views expressed by partners at our Brussels meeting and any relevant information from Luxembourg will be taken into account when considering the detail of the future direction of the project. We envisage, however, that WP2 will go ahead in line with the revised proposal. WP2 will involve three sub-workpackages: interviews with European level agencies; a set of case studies of leading telecommunications operators with a view to uncovering territorial patterns of telecommunications investment; and the analysis and mapping of data gathered through those stages.

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## APPENDIX 1

| Indicators | NUTS 0 | NUTS 1 | NUTS 2 | NUTS 3 |
|---|---|---|---|---|
| **<u>1) Development of telecommunications–infrastructure</u>**<br>• Internet host density<br>• Network growth: New Internet hosts added<br>• Estimated number of ISPs<br>• Number of secure servers<br>• Number of (telephone) access lines per 100 inhabitants<br>• Percentage of capacity used of main telephone lines<br>• Digitisation of fixed telecommunication networks<br>• Faults per 100 main lines per year<br>• Percentage of households with a telephone<br>• Deployment of fibre optic cable<br>• Number of public Internet access points<br>• Investments in communication networks by telecommunication operators<br>• Competition in fixed network infrastructure<br>• Competition among different networks for Internet access<br>• Competition in cellular mobile infrastructure<br>• Broadband penetration rates<br>• Network growth: New telephone lines added | | | | |
| **<u>2) Prices of telecommunications services</u>**<br>• Internet access costs (peak, off–peak, low–band, broad–band etc.)<br>• Monthly ISP charge (for 20 hours of usage)<br>• Composite basket of residential telephone charges<br>• Composite basket of business telephone charges<br>• Fixed telephone call charges<br>• Fixed telephone rental charges<br>• Telephone tariffs: local call<br>• Basket of consumer mobile phone charges<br>• Basket of business mobile phone charges<br>• Cellular tariffs: 3 minute local call (peak & off–peak)<br>• Fixed to mobile network prices<br>• Average price of ICT hardware<br>• Price of leased lines | | | | |

| | | | | |
|---|---|---|---|---|
| **3) Diffusion of ICT and usage of ICT–services**<br>• Installed PCs per 100 inhabitants<br>• Diffusion of Internet access technologies by transmission speed<br>• Households with Internet access<br>• Internet users (at home/at work/both)<br>• Percentage of employees using e–commerce–enabling technology<br>• Access to PCs/Internet broken down by socio –economic variables<br>• Purpose of online activities from home<br>• Diffusion of cellular mobile phones<br>• New mobile subscribers added<br>• Monthly usage of cellular mobile phones<br>• Cellular mobile subscribers as a percentage of total telephone subscribers<br>• ISDN subscribers<br>• Internet use by businesses<br>• Enterprises providing Internet services<br>• Average time spent online<br>• Number of Web sites<br>• Internet penetration by enterprise size class<br>• Businesses with Web sites<br>• Internet purchases and sales (amount of e–commerce)<br>• Percentage of individuals using and ordering goods and services over the internet<br>• Cable TV subscribers | | | | |
| **4) Expenditures for ICT and ICT–services**<br>• Trade in ICT goods<br>• ICT expenditures (as a percentage of GDP)<br>• Telecommunications investment<br>• Telecommunications revenue per inhabitant<br>• Packaged software markets<br>• Mobile telecommunications expenditures<br>• ICT intensity (=ICT expenditures as a percentage of GDP) | | | | |