Report On Information Technology Infrastructure

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Information Technology Infrastructure

Executive Summary

This report by **NWLabs**, with mapping input from **Compass Informatics**, to the Department of the Environment and Local Government deals with Information Technology Infrastructure as an input to a National Spatial Strategy.

The report outlines global changes that are taking place in the nature of telecommunications and their importance in the context of the emerging Information Society. Key technologies that are fundamental to the provision of advanced telecommunications based services are identified. Changes resulting from the process of deregulation in the Irish telecommunications marketplace and their impact on information technology are noted.

These changes are on-going and the character of Irish telecommunications is changing on a daily basis. The report identifies the broader trends and the implications of what this means in the context of spatial planning.

The report concludes that:

- Telecommunications infrastructure will continue to remain the most important component of national infrastructure provision for the immediate future.

- The range of technical options or possibilities available means that every part of the country could be equipped or serviced with an appropriate telecommunications infrastructure within the short to medium term.

- The de-regulation process will deliver competitive telecommunications access mainly in urban areas. Industry based in predominantly rural areas will not benefit from this process to the same extent. As a result the "digital divide" will widen between urban and rural areas.

- Local groups or communities need to address the provision of alternative infrastructures in these rural areas.

Infrastructure

- It is apparent that nearly all the larger towns and urban areas have access to an appropriate infrastructure at this moment. The coverage of smaller towns and rural areas is extremely erratic and these areas are in danger of being by-passed or of under participating in the impending information society unless this situation changes.

- Other interim infrastructure solutions (e.g. FWPMA/FWA) have the potential to deliver services into neglected areas at this moment. These can provide an alternative to the incumbent network and accelerate the deployment of broadband. Nevertheless these solutions may not result in significant end-user cost reductions if alternative and competing network infrastructure is not available to these new service providers.

- The physical typology or location of the national backbone network is not a significant factor. Bandwidth capacities in the national backbone networks are not considered to be an issue. It is expected that on-going innovation in network technology will continue to increase these capacities where suitable optic fibre cable exists.

- Investment in network upgrades and in network technology is likely to continue to be demand related. This means that where demand is weak or dispersed as in rural areas, demand may not materialise to justify investment.

Competitive supply

- The speed with which an appropriate telecommunications infrastructure covering all the country can be achieved is more dependent on nontechnical issues than technical solutions. The stimulation of local or alternative network infrastructures and the creation of competition at the level of local network supply is a key issue.

- Major progress is being achieved by the ODTR in de-regulating the telecommunications industry. De-regulation may however result in a more pronounced imbalance in the supply of competitively priced services for end-users in certain areas of the country.

- Unless competing networks evolve it is unlikely that dramatic reductions in the cost of leased circuits of bandwidth will materialise or network resilience issues will be addressed throughout all the country. This will have a knock-through impact on the possibility of locating "e-commerce" type companies in many areas of the country. It will also impact on the speed of roll-out of advanced services to residences and SMEs in these areas.

- Local authorities or planning regions need to address this local telecommunications infrastructural issue. Solutions could range from the requirement to install optic fibre capacity in new roads infrastructure or the creation of a national or regional "carriers carrier" which would lease interconnect capacity to individual operators.

- The speed of roll-out of alternative local networks is also a cause for concern. It is apparent that local planning bottlenecks exist. Planning permission for masts and other facilities needed locally should be prioritised. The future telecommunications access needs of business parks, new housing estates or communities should be addressed as part of local government planning.

Demand Stimulation

- Clusters of multinational software companies have successfully developed in Dublin, Galway, Limerick and Cork. Such clusters are likely to be sustained due to the attractiveness of these four locations. In turn these locations are also likely to be the primary locations of new software firms created by former employees of these multinationals. However due to the continued preference of e-business based businesses for Dublin locations for reasons of telecommunications infrastructural costs, the view is that ecommerce and related businesses, will concentrate in Dublin. The establishment of the "Digital District" in Dublin will further add to this concentration.

- The provision of low cost bandwidth and dark fibre to Galway, Limerick and Cork would encourage greater e-commerce activity in these locations, building on established software clusters.

- In parallel with providing physical infrastructure other initiatives are required to increase Internet awareness, improve IT literacy skills and NSS - Information Technology Infrastructure generally stimulate accessibility in a broader context. In turn these initiatives will also help stimulate local demand for better and cheaper infrastructure and meaningful e-services that utilises this infrastructure.

- Some of these initiatives are already underway and these should encourage general widespread awareness and take-up throughout the country.

However they will have limited success in locating new companies who are intensive users of telecommunications into many areas of the country. The viability of these companies is determined by the cost of telecommunications access.

- The barrier to the growth of e-commerce providing firms outside of Dublin is primarily structural rather than educational. Barriers comprise the cost of telecommunications, availability of dark fibre, low level of IT support services outside of the main cities and hence investment and funding credibility for new ventures. This situation is likely to continue until ecommerce "flag-ship" projects are established by IDA Ireland in say the BMW region.

- Specific educational initiatives are less important than the emergence of relevance and meaningful IT services/applications which are needed in the day-to-day work and home environment.

- Access, content, literacy, pedagogy and community may not be enough to ameliorate the "digital divide" in Ireland. Giving people access to technology is important, but it’s just one of many issues that need to be considered. Schools, libraries, and community centres are taking that first step in getting wired, but they must also consider the needs of the learners, the teachers, and the communities that support them.

Legislation & Regulation

- The Telecommunications (Infrastructure) Bill should be progressed to assist the roll out of infrastructure nation-wide, particularly FWPMA/FWA, UMTS and DTT.

- Consideration needs to be given to empowering the local authorities to streamline processes and assist the infrastructure roll out. As the current regulatory framework was created for an era of state owned utilities.

- The ODTR should consider licensing MMDS for the provision of interactive services and allow FWPMA/FWA operators to engage in secondary allocations of unused spectrum. This should result in earlier competitive service provision in rural areas.

- Central co-ordination of assets suitable for collocation, which are owned by the state and its agencies, e.g. masts, rooftops and way-leaves.

1 Introduction

The Government has mandated the Department of the Environment & Local Government to prepare a National Spatial Strategy (NSS). The document *"The Scope and Delivery of the National Spatial Strategy"* sets out the Objectives, Challenges and Issues that the NSS will address. This study on *Information Technology Infrastructure* is one component of an assemblage of key data sets necessary to allow an analysis of current trends and spatial development patterns in Ireland in the context of the NSS.

The Objectives of the Study on Information Technology Infrastructure are:

- To comprehensively map and report on the distribution and capacity of the various advanced telecommunications systems and their penetration into Ireland in spatial terms.
- To map and report on the current distribution of e-commerce enterprises in Ireland by town, county and region, including the identification of clustering, with the scale of the enterprises outlined in terms of turnover, employment levels and skills profile.
- To examine, in particular, the national backbone and broadband access communications networks (including ISDN, ADSL and fibre optic cabling etc.) and identify their current strengths and weaknesses, as a support to regional and national development of E-commerce.
- To examine the position of different areas in terms of benefiting from the theoretical potential of the information society.
- To identify any opportunities for the development of E-Commerce, with particular reference to areas currently not on the existing proposed systems, including use of non network systems such as remote satellite link ups.
- To identify any danger of disadvantaging areas, through concentration of investment in information technology infrastructure.
- To identify any educational needs or other supports necessary to facilitate the development of E-Commerce as a source of employment in the regions.

The report is divided into the following sections:

- Section 2: overviews how telecommunications developments are enabling the emergence of the Information Society.
- Section 3: deals with the telecommunications infrastructure in the context of how it can be deployed or configured to support e-business.
- Section 4: addresses non-technical issues that will impact on the roll-out, nature and use of the telecommunications infrastructure.
- Section 5: deals with available and planned infrastructure throughout the country.

- Section 6: deals with perceived demand for telecommunications and ebusiness services whether from business or residential customers and assesses the educational needs together with the distribution of e-commerce firms.
- Section 7: highlights the policy implications of the findings of the report.

A glossary of terms and a list of references are appended to the report.

2 Information Society Developments

This section overviews the broader Information Society trends. Telecommunications developments are enabling the emergence of the Information Society. Telecommunications is only one aspect of these broader developments. However it is the key platform on which all the developments which are underway at this moment will be built.

Section 3 following will deal with specific telecommunications technologies developments and trends that will impact on the nature and roll-out of this infrastructure nationally.

2.1 Introduction

Until 1998 Eircom (formally Telecom Eireann) had a monopoly in the provision of fixed telecommunications infrastructure. This infrastructure consisted primarily of copper wire, optic fibre and some radio transmission links. Eircom essentially provided the public switched telephone network (PSTN)[1], the network of interconnections between telephone subscribers, operated for public use.

Since then a number of other licensed operators (OLOs) have started to provide infrastructure and services in the Irish market and a further number are planning to launch services in the immediate future. Nearly all the new telecommunication operators are Dublin based, with Chorus (the former Irish MultiChannel) located in Limerick being the major exception to this trend.

On the 30th November 1998, the Director of Telecommunications Regulation awarded 29 new telecommunications licences.

Currently 44 licensed operators have commenced services, and a further 32 licences have been issued.

Liberalisation of the use of non-telecommunications networks means that other access platforms, such as cable television and broadcast networks, can now offer and deliver telecommunications related services.

In the context of spatial planning, mapping these planned and existing networks will indicate how different areas of the country are serviced from a telecommunications perspective. Nevertheless this will not indicate what potential demand exists in the areas served or how technology developments will evolve which will impact on the level of services that can be delivered to users whether residential or business.

1. A glossary of terms is provided in Appendix 1

2.2 Communications trends

Advances in physical telecommunication networks have progressed from copper based to satellite and mobile. Copper wires have gone from supporting plain voice telephony, through ISDN towards ADSL technology capable of delivering high speed data and video content to the household. In turn telecommunication switches have progressed from being subscriber to bandwidth based. Cable TV has progressed from one way TV and radio re-broadcast towards supporting interactive voice, video and data. Fixed antenna wireless access (FWPMA/FWA)[2] has gone from an analogue narrow band technology to a broadband digital technology capable of delivering fibre equivalent services to businesses and capable of supporting a host of residential services.

This trend is set to continue due to developments in semiconductor devices, the need for more bandwidth that is being fuelled by the explosion in the use of the Internet, falling hardware prices and increased competition as a result of the deregulation of the national telecommunications infrastructure.

The *Internet*, the need for greater *access* and *mobility* combined with the emergence of the phenomenon of *convergence* are driving these infrastructural developments.

2.3 Convergence

Convergence of media types is in progress as media production, transmission and storage move from analogue to digital and in end user equipment whether PCs or TVs. Convergence in distribution chains is also occurring, as the previously separate broadcasting, computing and telecommunications industries work ever more closely together in delivering the same product or content to end-users.

Convergence is understood as:

- the ability of different network platforms to carry essentially similar kinds of services, and
- the merging together of consumer devices such as the telephone, television and personal computer.

This industry convergence is a key to facilitating a range of entertainment and e-commerce type applications. However to date most convergence has occurred at the tele-communications network level with few examples of convergence at the level of end-user devices.

2. Fixed wireless access also known as wireless local loop (WLL)

Digital technology is the key building block underpinning convergence. The sectors that are converging are at the forefront in the adoption of digital technology in creating, processing and transmitting content. Computer technology now plays a key role in content creation and production in the media industries. Digitally created content can be used in different environments and delivered on different network infrastructures. The networks handling such content are oblivious to the nature of the source material, whether image, sound or text.

The convergence trend is a recent phenomenon and how this will impact on society and economic activity is as yet poorly understood. There is a consensus that convergence will radically transform the current approach to delivery and use of information. However it is not clear how much these developments will change existing business practices and over what time-scales. Current indications are that developments will become more user rather than technology driven.

2.4 Access

Access in relation to tele-communications infrastructure development, particularly the increase in network capacity and the need for greater access capability to the home is the priority. This access factor is becoming more complicated with the increasing choice and complexity in the supply structure as new networks and suppliers emerge. Access is no longer a gradual upgrading of access lines from simple copper pairs to ISDN, bringing fibre steadily closer to the home and business. Telecommunications access now reflects competing technologies and infrastructure and is regulated at a national and EU level to ensure competition.

2.5 Mobility

Mobility has become a key component of the telecommunications environment. Although the primary application for mobility is, and will remain, basic voice transmission, value-added services are becoming more important. Mobile has gone from 1st generation analogue to second generation GSM with a natural migration path from GPRS[3] and EDGE towards 3rd generation UMTS. The licensing of UMTS is identified by the ODTR[4] as a major task for this year. Mobility is normally equated with the digital cellular network, but it also occurs in the fixed network depending on the local network intelligence. The emergence of the global satellite communications services and cellular systems enabling broadband multi-media mobile applications further blur the distinction between networks, services, operators and countries. This is particularly important in the context of globalisation and services that are provided for corporate customers.

3. These technologies are explained later in Section 3.
4. Office of the Director of Telecommunications Regulation

2.6 The Internet

The main driver of these trends over recent years has been the Internet. This has created a demand for easy and widespread access to digital information and forced a shift in the concept of networking. The Internet has benefited from the widespread adoption of a networking Internet protocol, IP, and the emergence of "browser" software which allows relatively easy search and retrieval techniques.

The need for simple e-mail and file transfer facilities drove the early adoption of the Internet. This in turn led to the wide spread use of the World Wide Web (WWW) and to the development of the purchase and sale of goods and services over the Internet. The emergence of such activity termed "e-commerce" is now a core driver that is expected to radically transform commercial and trading relationships in the early years of the 21st. Century.

In parallel computer equipment prices have substantially lowered. From 1995 to 1999, the prices of computing power fell by 10% annually. The next generation Internet connections, largely considered by computer experts to be a few years away, are expected to achieve speeds as high as 22 megabits per second, roughly ten times faster than most current broadband services.

2.7 Conclusions

This overview of the facilitating technologies illustrates their role as the engine of change. Technology is continuously developing and the rate of change is accelerating. However technology development itself is not as important as the development of innovative applications and services which are based on these technologies.

In an Irish context the issue is the rate of deployment of the facilitating technologies at the origination, transmission and receiving levels and the rate of emergence of new innovative services and products which will produce the dramatic changes that we expect as part of the emerging e-economy. The immediate concern in the context of spatial planning is:

- The speed of roll-out of the existing and planned telecommunications networks,
- The coverage and capacity of these networks, in relation to the location of users whether business or residential,
- The emergence of competition nationally, and
- The extent of local demand.

3 Telecommunications Infrastructural Trends

This section overviews telecommunications infrastructure in the context of how it can be deployed or configured to support e-business. The aim is to overview some of the developments or bottlenecks to providing an adequate infrastructure. Section 4 will address emerging telecommunications market structures and barriers to development.

3.1 Introduction

"Digital Divide" refers to individuals, firms or areas who have or have not access to the appropriate information and communications technologies needed to access the Internet or engage in e-commerce.

Among the objectives of this study is the need to comprehensively map and report on the distribution and capacity of the various advanced telecommunications systems and to examine, in particular, the national backbone and broadband access communications networks. By doing this we should be able to identify the capacity of the infrastructure to support e-business and establish whether a "digital divide" exists in certain areas of the country. Ideally the "spatial plan" should be able to make recommendations to ameliorate this "digital divide" in the future.

Technology advances and the emergence of different types of networks are now blurring the boundaries of what could be considered broadband or narrow band. Networks that were previously considered narrow band in certain instances or conditions can now be used for broadband communications.

Narrowband communications are generally viewed as communication speeds of up to 64,000 bits per second (64Kbit/s).

The minimum speed normally associated with broadband is 2 million bits per second (2Mbit/s).

Bandwidth is significant because the greater the capacity of the facility, the greater the opportunities for usage and business application. *Broadband* technologies allow for the transmission of voice, data and video signals over the one medium. The Internet has been born of the possibility of transmitting data over telephone lines, for example, with the use of a modem. The expansion of bandwidth capacity is effectively catapulting the world of communications into a whole new realm, that of the Information Age and the e-economy.

The following sections outline the emerging infrastructural options and the types of services (broadband or narrow band) that these could be used to deliver. These options demonstrate that infrastructure can be no longer viewed as one particular solution or approach, but is rather a mixture of technologies or infrastructure(s) which collectively provide a communications transport layer throughout the country.

3.2 Networks

Fixed Networks

The main all pervasive network is the Public Switched Telecommunications Network (**PSTN**). The PSTN is the main telecommunications access used by firms and residential users through out the country. The Universal Service Provider (USP) Eircom provides the connections to the PSTN. Users access the PSTN through local exchanges or in some cases remote subscriber units (RSUs) which are connected to the local exchange. In turn these local exchanges are interconnected using a **backbone network**.

"Wireless in the local loop" (WLL), also known as **FWPMA** (Fixed Wireless Point to Multipoint Access) or **FWA** (Fixed Wireless Access), uses radio communications to connect customers' premises to an operator's network (radio and/or fibre). From a user perspective, it differs from mobile telephony through the use of fixed antenna at the customer premises, hence it is a fixed rather than a mobile service. FWPMA licences have been issued by the ODTR for both broadband and narrow band transmission rates. The broadband licences are aimed at larger businesses in the main population centres and narrow band at the smaller business and residential markets.

FWPMA provides a less expensive alternative to connecting local customers than would be the case with copper wire or optic fibre.

The licences are particularly well suited to the needs of medium to large users of telecommunications services and will allow for the high-speed transmission of large volumes of information including voice, video and data.

Operators could rapidly deploy services in areas where they do not provide services at present, hence increasing local competition.

The technology could also be used to augment the local infrastructure in response to increased local demand.

Broadband access will enable services such as PABX connection, high speed 'always-on' Internet access, multimedia and fast file transfer.

FWPMA/FWA allows the introduction of broadband and narrow band access to areas that are not particularly well serviced by traditional fixed line telecommunications networks.

This technology is particularly relevant in the context of the NSS in that it can be rapidly deployed into areas where appropriate services do not exist. It can also be used to provide an alternative to the incumbents local loop network in certain areas.

FWPMA operators have to "back-haul" traffic from remote users through fixed line infrastructure. The cost of leasing circuits or optic fibre from another operator may severally impact on the economics of service provision.

Nevertheless FWPMA/FWA is a relatively untried technology in Europe, that requires line of sight between the transmission and receive points, has transmission distance limitations and its viability can depend on the density of customers within a transmission cell. The growth of FWPMA/FWA in Europe is partly being driven by delays in both unbundling of the local loop and in the roll out of DSL based services. In reality most FWPMA/FWA deployment will be used to develop local markets which could eventually be serviced using other fixed line communications as volume develops.

Cable TV networks offer another type of infrastructure for telecommunications services delivery. Certain cable television (CATV) operators have started upgrading their networks to facilitate the provision of interactive TV, voice and data services. Cable modems can be used to send and receive high-speed data transmission over the cable TV network.

This has a bearing on potential communications access throughout the country, nevertheless it is restricted to those areas of the country that are cabled, that is the major towns and cities. In less populated areas, MMDS[5] and/or deflector type services for the provision of video services are available but these are not licensed to provide interactive services.

The ODTR estimates that there are 615,000 cable and MMDS subscribers nationally and that a further 1 million households could avail of these services through existing infrastructure.

In the context of the NSS the impact of these networks may have a limited relevance to the needs of the local business community, as their primary focus to date is the residential market.

Broadcast infrastructures

Digital terrestrial television (**DTT**) is scheduled for launch, once the necessary legislation is in place. This is essentially a broadcast and one-way transmission technology that will deliver broadcast broadband services to the users premises. Users would require a return path through the PSTN to specific service providers.

The relevance of this technology to the NSS depends on how the service is regulated and the extent, through legislation/regulation, that it can be used for data transmission, particularly business services. Once digital television legislation is introduced in Ireland, it is proposed to dispose of 72% of RTE's transmission infrastructure to the private sector.

5. MMDS Microwave Multipoint Distribution System

Satellite systems are ideal for broadcast services. Digital satellite TV transmissions are available and the Department of Public Enterprise is making available funding for a number of **VSAT** (very small aperture terminals) trials of satellite Internet access. VSAT is considered appropriate for both rural and remote areas.

There is no spatial dimension to VSAT coverage in that all areas of the country can be covered. However deployment will impact on the market for CATV video services and possibly on the market for ADSL (see below) type services. Using the PSTN for the terrestrial link normally provides interactivity in these systems, but latency is a major issue.

Mobile networks

GSM is normally limited to 9.6 Kbit/s transmission speeds.

GPRS offers up to five times GSM speeds.

The next step up from GPRS is EDGE (Enhanced Data GSM Environment) evolving towards UMTS or 3rd generation (3G) services.

The current mobile networks are the Eircell and ESAT Digifone networks. The Meteor network, the third licensed operator, is currently being developed and service roll out is scheduled for early 2001. These networks have limited data transmission potential, irrespective of WAP[6] technology. The existing networks cover, for all practical purposes, almost 100 percent of the county. Because of this ubiquitous coverage, mobile networks have little or no impact from a spatial planning perspective.

UMTS[7], 3rd generation mobile, will be licensed by the ODTR next year. This will allow transmission speeds of up to 2Mbit/s in certain instances. Local availability will impact on the ability of firms to provide or access UMTS enabled services in certain areas of the country. Generally UMTS will deliver the range of services that we currently expect from fixed line communications. However, it will necessitate a doubling in the number of base stations and masts as higher bandwidth and data transmission requirements will result in smaller cells.

GPRS[8] is a wireless technology that is a stage between GSM and UMTS. It allows users to log into a data network for example and is 'an always on' service. WAP type services at present being developed for GSM systems are more feasible using GPRS technology and will eventually use UMTS when it becomes available.

TETRA, a national digital terrestrial trunked radio licence award is in progress. This will be used by the emergency services and by firms to manage vehicle fleets and for communications on large construction sites and as such has limited relevance to the NSS.

6. Wireless Access Protocol
7. UMTS Universal Mobile Telecommunications Service
8. GPRS General Packet Radio Services

3.3 Access technologies

Integrated Services Digital Network (**ISDN**) has been available in Ireland since the mid-nineties. However, until recently the take-up rate was low. Essentially ISDN converts the signal at the users premises to a digital format before it is transmitted through the PSTN to the local exchange or access point. It is not universally available throughout the country due to the technical limitations of some local exchanges.

ISDN defines a standard interface for the transmission of two 64Kbit/s channels together with a signalling channel. This is known as "Basic Rate" ISDN. Eircom's "hi-speed" connections, as presently marketed, are effectively "basic rate" ISDN.

A higher capacity "Primary Rate" ISDN also exists consisting of 30 by 64Kbit/s channels together with a 64 kbit/s signalling channel. This is effectively 2Mbit/s (broadband) transmission.

ISDN is delivered over the existing copper line to the customer.

Digital Subscriber line (**DSL**) technology is a modern technology that uses existing twisted-pair telephone lines to transport highbandwidth data, such as multimedia and video, to service subscribers. **xDSL** is drawing significant attention from operators and service providers because it promises to deliver high-bandwidth data rates to dispersed locations with relatively small changes to the existing infrastructure.

From an NSS perspective, (x)DSL will be limited in the immediate future to those exchanges that can support ISDN. The effectiveness of DSL is dependent upon line conditions such as the length of the copper wire and becomes less effective the greater the distance from the telephone exchange.

Eircom are presently assessing what parts of the network can support DSL. As noted above DSL has strict limitations on the distance between the users premises and the local exchange, as a result large numbers of rural inhabitants will be outside the range of potential DSL services.

Cable TV modems can also provide high-speed Internet access over a shared cable television line. Cable modems have greater downstream (from the Internet into the home) bandwidth capability than other access devices such as DSL. However this bandwidth is shared among all users on each network node, and will therefore vary, perhaps dramatically, as more users in a neighbourhood 'node' get on-line at the same time. Reduction in node sizes will become crucial.

From an NSS perspective cable modems will only be relevant to those areas where NTL and Chorus (formerly Irish Multichannel) are upgrading their cable television networks, primarily in the cities. Exceptions to this are in Dungarvan, Co Waterford where CaseyVision has deployed cable modems on its cable TV network and in Kilkenny and Clonmel where the Suir Nore cable network is being upgraded. Generally, it would appear that these cable modem areas would overlap with the same areas where DSL will be initially rolled out!

Network technologies

Until recently most of the provincial telecommunications network was **PDH** (Plesiochronous Digital Hierarchy), built predominately to support voice traffic and not as cost effective, suitable or flexible for data transmission. By the end of 2000, Eircom will have connected all of its core exchanges and some RSUs[9] to an **SDH** (Synchronous Digital Hierarchy) based trunk network.

SDH technology is needed in the network between the customer and the core network otherwise access to broadband is restricted. It is more cost effective to use an SDH network to provide data connectivity rather than use a PDH network. PDH can carry data only at the expense of voice traffic.

DWDM (optical switching) technology enables fibre transmission capacity to be increased by a factor of 32. Most of Eircom's broadband backbone network uses DWDM technology. The trend to increasing capacity using DWDM technology is set to continue.

For example Nortel expects to ship in volume DWDM equipment capable of deriving one hundred and sixty, 40Gbps wavelengths on a single fibre pair by this time next year, an increase from their current volume shipments of thirty-two, 10Gbps wavelengths.

From an NSS perspective this means that national backbone network capacity should not remain a major concern. How this capacity is broken out or re-sold to other operators will remain an issue, as it will impact on the viability of regionally hosted services.

3.4 Conclusions

This section has overviewed technology developments in the context of telecommunications infrastructure. It can be seen that there are a number of infrastructural options and different means of delivering advanced telecommunications based services to users. Table 3.4.1 below compares some of these infrastructural options. Some of these infrastructure platforms compete, for example, cabled TV areas with xDSL services delivered over the PSTN. Broadband FWPMA/FWA will compete with the incumbent through providing an alternative to the local loop. Others infrastructure platforms are complementary, for example using narrow band FWPMA/FWA technology or VSAT solutions to deliver services into areas where the PSTN is inadequate.

Table 3.4.1: Telecommunications platforms suitability

Platforms	Advantage	Disadvantage
Broadband FWPMA/FWA	• Fast deployment • Available bit-rate	• Reach & line of sight
UMTS	• Mobility	• Geographical coverage • Availability of handsets

9. Remote subscriber units

Table 3.4.1: Telecommunications platforms suitability *(continued)*

Platforms	Advantage	Disadvantage
Satellite	• Coverage	• Latency
Fibre	• High Speed	• Cost & time of installation
ADSL	• Use of deployed copper pairs Permanent connection	• Distance related limitations • Collocation & local loop requirements
MMDS	• Low cost equipment • Fast deployment	• Reach & line-of-sight • Not licensed for interactivity
Cable TV	• Use of deployed cable • Permanent Connection	• Subscriber bandwidth sharing • Designed for residential one way video distribution

From a spatial planning perspective:

- The physical typology or location of the national backbone network is not a significant factor. The perception is that upgrades in network technology (e.g. DWDM) combined with building new networks will provide ample bandwidth capacity.
- Other interim infrastructure solutions (e.g. FWPMA/FWA) have the potential to rapidly deploy services into areas poorly serviced at this moment and to provide both an alternative to the local loop and rapid deployment of broadband services. Nevertheless these solutions may not result in significant end-user cost reductions if alternative and competing network infrastructure is not available to these new infrastructure providers.
- The range of technical options or possibilities means that potentially every part of the country could be equipped or serviced with an appropriate telecommunications infrastructure within the short to medium term.

In reality the possibility of equipping all areas of the country will depend more on non-technical issues, such as local demand, than on technical solutions. Investment in network upgrades and in network technology will continue to be demand related. The speed of rollout of alternative infrastructures will also be demand related.

The emergence of competition at the level of local network supply will stimulate this demand through the provision of cheaper end-user access. This becomes more apparent when we look at the nature of the built infrastructure in Section 5.

Ubiquitous cheap access is only one aspect in a range of factors that will stimulate widespread broadband take-up and use. The emergence of relevant and meaningful services (content) is critical, as are appropriate educational and awareness initiatives. These will all help to stimulate demand and help to overcome social inclusion problems.

4 Market Development Aspects

The previous section outlined technical developments in telecommunications infrastructure provision. This section addresses non-technical issues that will impact on the roll-out, nature and use of such infrastructure. The main issues revolve around competition in the supply of infrastructure and related to this "cost of use" (demand-side) from the perspective of users whether companies or residential.

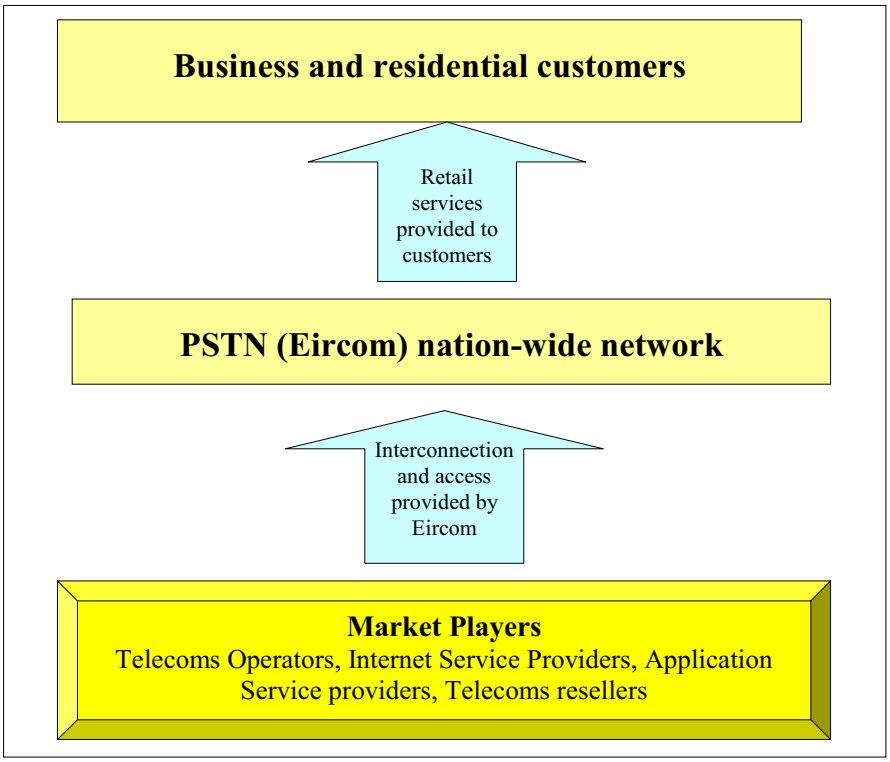
4.1 Emerging market structures

Since deregulation in 1998, the telecommunications market in Ireland has been transformed and the pace of change continues at a rapid rate. New telecommunications infrastructure providers, new delivery platforms, technology advances and new forms of operators are contributing to this process.

Some telecommunication operators in this market do not own any physical networks, but rather lease capacity from other providers that they then re-sell to their own customers. Irrespective of this the PSTN, the ubiquitous nation-wide network operated by Eircom, will remain the channel through which nearly all connections will be made. New operators, with the exception of FWPMA/FWA and cable TV operators, do not build local loop networks so they must interconnect through the PSTN as part of providing services to their customers.

The diagram below illustrates a view of this market relationship.

Figure 4.1.1: Market overview



As a result nearly all telecommunications service provision routes through Eircom's network. Exceptions may occur where a customer uses an Other Licensed Operator (OLO) to communicate with other customers of the OLO or through the use of alternative access platforms, with local loop elements, such as FWPMA/FWA and cable TV.

The significance of this is that irrespective of what new telecommunications infrastructure or services appear on the scene, the PSTN will remain the predominant local access for the vast majority of customers whether business or residential for the foreseeable future.

The table below illustrates how some technologies/infrastructures are suitable for delivery of specific services to market segments. These market segments are based on the historic activity of both Eircom and cable TV companies together with the market positioning of broadcasters and of advanced telecommunication services such as ISDN, FWPMA/FWA and ADSL. The PSTN has the potential to deliver the range of services, however other platforms such as cable TV, fixed wireless access, broadcast and satellite networks, will in the future deliver some of these services.

Table 4.1.2: Relationship between platforms and markets

	Markets				
Platforms	Residential	SOHO	SMEs	Large Businesses	Services
PSTN					Voice & data
ISDN					Voice & hispeed data
ADSL					Voice, high speed data & video
CATV (twoway)					Video, voice & high speed data
Narrowband FWPMA/ FWA					Mainly data services
Broadband FWPMA/ FWA					High speed data
DTT					Voice & oneway data
Satellite					Voice, video

4.2 Telecommunications deregulation and competition

Telecommunications (de)-regulation is focussed on managing the transition from a market dominated by a former state-owned monopoly towards a competitive market. Ireland is moving rapidly to becoming one of the more liberalised telecommunication markets in the EU. This process is in its infancy and is a direct consequence of the establishment of the National Regulatory Authority, the Office of the Director of Telecommunications Regulation (ODTR).

By September 2000, some 44 General licences were issued by the ODTR of which 25 had commenced operations.

Much progress has been made with a sizeable number of new players entering the market. Competition is growing significantly and this is being reflected in reduction in tariffs for end-users. As the dominant supplier, Eircom is now privatised, however pending the unbundling of the local loop and the provision of competing services from cable TV, FWPMA/FWA or DTT platforms, consumers whether residential or business will not reap all the benefits of deregulation.

The ODTR estimates that Eircom (September 2000) accounts for 85% of the fixed line market and that Eircell accounts for 60% of the mobile communications market.

At present the degree of competition in Irish tele-communication services is less than that in the US and other parts of Europe. Eircom still controls the vast majority of revenues. As a result, the average end-user in Ireland is only beginning to see the benefit of lower costs and few have yet experienced the wider choice associated with a competitive marketplace. Section 5 will highlight areas of the country where competitive service provision has yet to appear.

It is expected that, in line with more liberated markets, as competing infrastructure and services are rolled out, access costs will drop and services supplied will improve. The experience to date would indicate that access costs are indeed reducing, although not as rapidly as in our trading countries, and that the main beneficiaries are large businesses in urban locations, particularly the greater Dublin area.

The Eircom monopoly has effectively been replaced by a duopoly, Eircom and the BT owned ESAT, both refusing to provide dark fibre as an alternative to circuit leasing. It may be at least another two years before significant competition develops in the market. The real possibility exists that in rural and remote areas competition will still not emerge and local users will have to survive with a second rate and costly telecoms service. There is a real possibility that these areas will be part of the "digital divide" that does not have an appropriate infrastructure necessary to access broadband services.

The ODTR is presently progressing through an ambitious workload and addressing issues such as interconnection charges, number portability, facilities sharing and unbundling of the local loop. Resolution of these issues will contribute to greater competition and transparency in service prevision.

4.2.1 Local Loop Unbundling

Local Loop Unbundling (**LLU**) refers to the physical link between the household or business premises and the local exchange. It would be inconceivable that every telecom operator would install physical wires or links to each individual user or business. Unbundling the local loop is particularly relevant for users and small businesses who are located in areas which are not directly serviced by competing networks. At issue here is the possibility of third parties offering services to local businesses and residents through the Eircom network.

In the interest of competitive service provision different approaches to "unbundling" the local loop are pursued by telecommunications regulators.

Under "*full physical unbundling*" the incumbent opens up its local infrastructure by providing leased copper pair links to new operators. These would then install their own equipment at the local exchange, "collocating" with Eircom. The new operator would then attach its own broadband equipment to one end of the loop and provide matching equipment at the customer's end.

In this manner the new operator would share the physical operation of the local loop and offer an alternative range of services, from simple voice telephony to advanced broadband services. Under "*Line Sharing*" the incumbent provides the telephone service, while the new operator offers high speed data services (broadband) over the same lines using their own high speed ADSL modems. The new operator installs a DSL Access Muliplexer (DSLAM) at the local exchange.

Under this approach a user can continue to use the incumbent's telephone service and use another operator to provide broadband type services. With "bitstream access" the incumbent installs all equipment within the local loop. The new operator would then be responsible for routing traffic from the local exchange to other destinations. Generally the new operator connects to the broadband digital bit stream circuit provided at the local exchange and then takes the data onto its own network.

Universal Service Provider (USP) In May 1999, Eircom was designated the "universal service provider" of certain designated services, independent of geographical location. These services include:

- Connections to the PSTN and access to telecommunications services,
- Provision of payphones,
- Provision of directories and directory enquiry services.

In an Irish context the local loop between the local exchange and the users premises will be unbundled. The backbone network will still remain under control of the incumbent (Eircom). This means that advanced services can be offered from the local exchange to the customers' premises by an OLO[10]. However the interconnection or re-routing of this traffic will depend on whether the OLO has their own independent network or is depending on the national backbone network for certain of the links.

There are a number of other issues that can impact on the viability of OLO local service provision. For example the *routing* principles for calls terminating on Eircom's network are different to those for calls originating on Eircom's network. For calls terminating on Eircom's network, Eircom tandem interconnect nodes will accept Eircom national termination traffic destined for all geographic number ranges.

Where an OLO interconnects with the Eircom tandem exchange for the local call area in which the relevant call is initiated, this will be routed up the Eircom network to a tertiary node which is capable of delivering Eircom call origination traffic for all geographic number ranges. The result of this routing up the network instead of across the network, from a tandem node to another tandem node, as is the case for traffic terminating on the Eircom network, is that extra distance related routing charges might be incurred by the OLO.

Transit rates apply to calls handed over to the Eircom network from an originating OLO's network for termination in networks other than the Eircom network.

The availability of *collocation* facilities at exchanges and network access services provided by the incumbent operator is an essential part of the process of unbundling the local loop. Eircom currently offers collocation to Internet Service Providers (ISPs) Points of Presence (PoPs) when the PoP is owned by Eircom and leased to the ISP. However, Eircom does not currently offer collocation

10.OLO Other Licensed Operator

interconnection services of any form to interconnecting operators. Obviously unbundling the local loop should speed the competitive roll-out of advanced services (e.g. ADSL) to end-users. However where an operator has to interconnect using Eircom's or Esat's backbone networks, additional costs (transit) will arise which may retard this roll-out in different areas of the country.

4.3 Other infrastructural aspects

All barriers to the creation of a competitive telecommunications supply-side will not disappear through de-regulation activities alone. Local planning and road opening permits still remain a major impediment to the roll-out of an appropriate telecommunications infrastructure. Local planning has emerged as a major issue that urgently needs to be addressed or resolved. Opposition to planning applications for masts in the past has curtailed the operations of mobile operators and it would appear that new entrants such as the FWPMA/FWA operators are now facing similar installation problems.

It is apparent that a bottleneck exists in the area of local planning and road opening approval for construction of infrastructure, whether laying cable or erecting transmission masts. Method of streamlining planning approvals, road opening permits and of ensuring a standard "county" approach to infrastructure installation regulation in this area needs to be urgently addressed.

New infrastructural operators find it difficult to get a consistent approach to "way-leave" approvals and road opening permits from local authorities and from state bodies such as Ducas. Not all problems are related to local authority regulations. It is apparent that established operators will not readily allow the use of their existing transmission sites, e.g. collocation of transmission equipment on existing masts by new entrants, who may be developing competitive services. The passage of the Telecommunications Infrastructure Bill[11], designed to address these issues, appears to be faltering. In addition there is the absence of a co-ordinated strategy for access to rooftops and to the transmission masts of state bodies and departments.

Before telecommunication liberalisation the local authorities, in the major centres, could just about cope with five or six utilities - telecoms, water, gas, electricity, roads etc. After liberalisation a significant number of telecoms utilities were added, all entitled to equal treatment. Consideration now needs to be given to empowering the local authorities to streamline processes and assist the infrastructure roll out.

11. Telecommunications (Infrastructure) Bill, 1999

Current issues include, 3 months notice to open roads for duct laying and/or for customer connections, location of public pay phone boxes of new operators, and capacity of roads and bridges for additional ducts e.g. some canal bridges in Dublin cannot carry any more ducts. The provisions in the Road Traffic Act '61 are not considered adequate and questions are raised about the ability of the proposed Telecommunications (Infrastructure) Bill to improve matters.

Each county seems to adopt a different approach to road opening permits, planning permission and the conditions imposing for duct laying, hence infrastructure installation costs can vary between counties and installation delays become commonplace.

Local authorities need to deal with telecommunications infrastructure like any other infrastructure such as roads, water and sewage. In this context insisting that network ducting is laid alongside new roads or as part of road improvement schemes or in new housing developments, would be a start. Such ducting should be made available to OLOs at cost to encourage the emergence of low cost telecommunications networks.

4.4 Other development issues

This report concentrates on the telecommunications aspect of IT infrastructure on the basis that the emerging information society is facilitated through telecommunications developments. The ability of users whether individual or corporate to access this infrastructure is of paramount importance in the context of spatial planning. Availability, ease and cost of use of this infrastructure will influence the extent of widespread access.

Resilience and lack of competition by Service Providers within the BMW Region is causing difficulty according to a recent report on the National Plan. Polarisation in favour of urban areas is the most likely trend, according to the report.[12]

However providing physical access alone will not automatically result in universal adoption of these technologies throughout Irish society. This aspect is dealt with in considerable detail in the Information Society Commission's report on "IT Access for All"[13].

In this document the need to increase awareness of new technology and the understanding of the opportunities that it offers is seen as a factor which determines access. The need to increase IT literacy skills, provide access through local access points, undertake community based initiatives, provide government services on-line, launch awareness campaigns are seen as equally necessary to promote wider access.

12. Will the National Development Plan bridge the widening economic Gap between East and West? Special Programmes Manager, Donegal County Council, September 2000
13. IT Access for All. Report of the Information Society Commission. March 2000

4.5 Conclusions

- The importance of deregulation cannot be overstated. It has already delivered reduced tariffs to end-users. Nevertheless it may produce an even greater imbalance in the supply of competitively priced services for endusers. For example there may be a reduced incentive for Eircom to upgrade local exchanges to SDH switching technology if OLOs will reap the benefits.
- Likewise many local areas, particularly in the BMW region, will not have enough market demand to stimulate the provision of competitively priced services by OLOs. The expectation that a range of platforms and competing suppliers will result in a competitively priced access infrastructure for all users may not materialise. Thus it is conceivable that in certain circumstances deregulation could result in a further widening of the gap in telecommunications service provision in many parts of the country.
- Local planning issues remain a major impediment to the rollout of an appropriate telecoms infrastructure. Planning permission for transmission masts and other facilities needed locally needs to be prioritised.
- A co-ordinated approach is required towards the utilisation of building rooftops, transmission towers, canals and other infrastructure in public ownership and suitable for telecommunications infrastructure. New housing estates, roads etc. should have network ducting as a planning requirement. This should be treated like insisting on sewage, roads and electricity, as part of the planning approval process and should be made available at cost to infrastructure providers.
- In parallel with providing physical infrastructure other initiatives are required to increase telecommunication and IT awareness, improve IT literacy skills and generally stimulate accessibility in a broader context. In turn these initiatives will also help stimulate local demand for better and cheaper infrastructure and meaningful services that utilises this infrastructure.

5 Telecommunications infrastructure

This section deals with available and planned infrastructure throughout the country.

Until 1998 the fixed telecoms market was covered by a single large monopoly provider, Eircom, but now this market has been opened to competition from other licensed operators (OLOs) such as Chorus Communications, C&W, ESAT, MCIWorldcom, NTL, GTS, Stentor and others.

Of these new operators few will actually build infrastructure. Many of these will rent, resell or purchase capacity from other providers. These factors all contribute to the new dynamism and increased complexity of the Irish telecoms marketplace. It also means that for commercial reasons factual details on development and plans are increasingly difficult to ascertain from individual operators.

The following sections profile a number of these players concentrating on operators who are building networks that will deliver telecommunications services covering significant parts of the country. Other operators exist, however not all of these are building significant networks which would be important in the context of spatial planning.

5.1 Fixed Line Telecommunications

The main network operators are Eircom and ESAT.

Eircom as the "incumbent" controls the national network and will remain the main provider of telecommunications especially in rural and remote areas for the foreseeable future. Major investment has been made over the past decade to modernise the network and continuous investment is required to ensure that all areas of the country have equal access to comparable infrastructure.

In the context of broadband access available network technologies such as PDH or SDH has a major bearing on the use of the network for local business. Figure 5.1.1 displays the fibre access nodes provided by Eircom. The figure includes some planned SDH nodes that will be implemented before the end of 2001. The Dublin located nodes have not been displayed.

The map illustrates how the majority of optic fibre nodes throughout the country use PDH technology which is less suited for the provision of advanced data services such as ISDN or ADSL.

Eircom has in excess of 1,000 exchanges and RSUs around the country, of these 120 exchanges are covered by the planned roll out of SDH. Because of their concentration in the urban areas and larger towns this covers some 60% of all fixed lines.

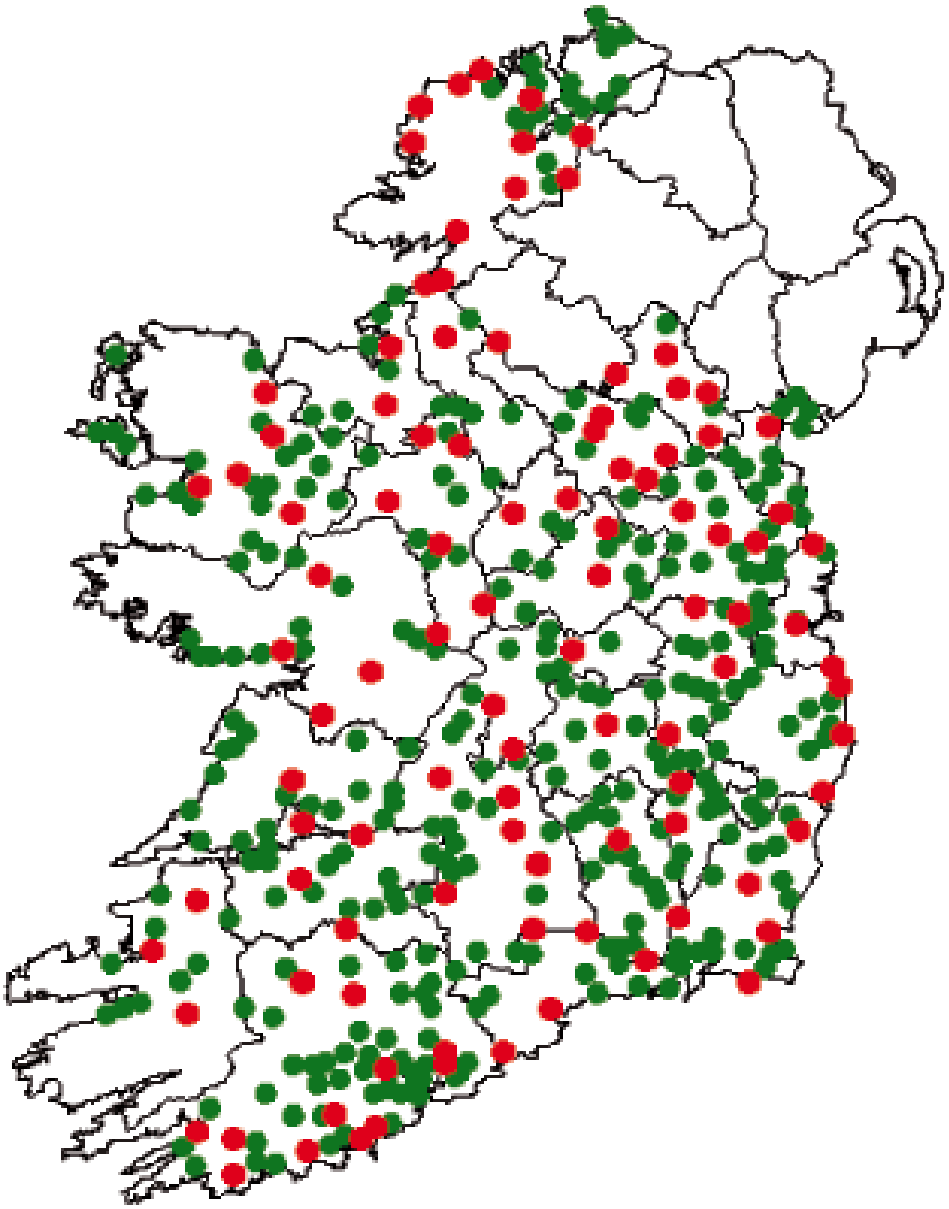
Some 277 exchanges are connected with fibre using PDH technology, these have limited flexibility in offering advanced data services.

The remaining exchanges and RSUs are not directly connected to the optic fibre network. These are connected using copper, coaxial and microwave links. Until these are upgraded local firms and users are disadvantaged in their ability to participate fully in the emerging e-economy. It is expected that some of the areas covered by these exchanges will benefit in the short term from the deployment of FWPMA/FWA infrastructure.

Interconnection capacity between the nodes is important in the context of regional service provision and demand. Figure 5.1.2 illustrates Eircom's existing and planned interconnection of SDH nodes. Nearly all links shown are STM-16 links operating at 2.5Gbit/s. Fibre counts on many of these routes will be increased in the immediate future and a greater number of the main regional routes will use DWDM technology that can increase capacity, currently by a factor of 32.

By the end of 2001, Eircom will have connected all of its core telephone exchanges and some remote subscriber units (RSUs) to an SDH-based trunk network.

Figure 5.1.1: Coverage of Optic Fibre nodes

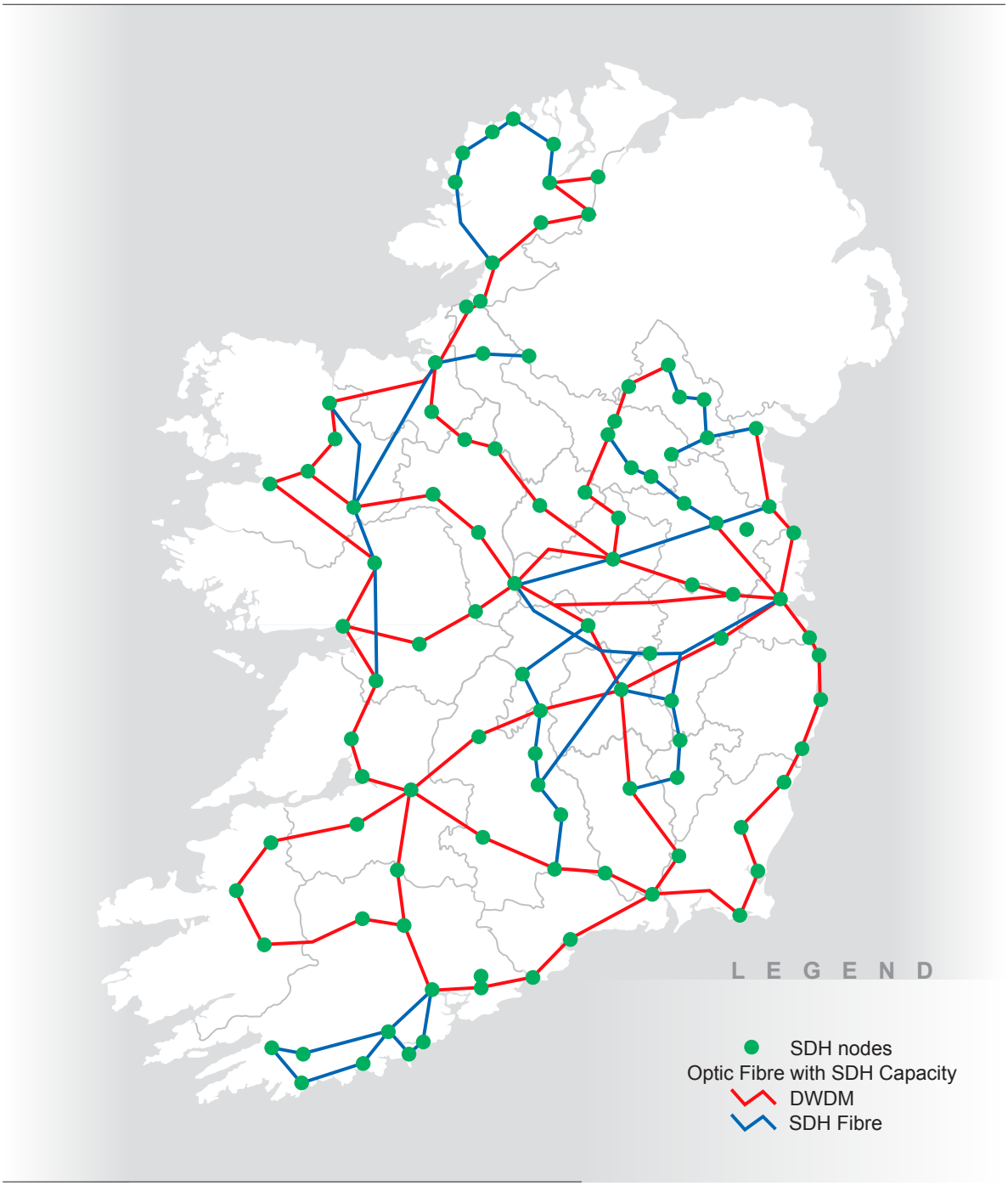


Since the late 1980s Irish telecommunications infrastructure has benefited from EU Structural Funds support, including the EIOP. The present EIOP projects include the development of a 75 km fibre optical backbone in Donegal with INTERREG fund support and the upgrade of the Suir Nore Relays cable TV system. Such European regional development support is also to be provided for the deployment of a fibre optical backbone along the west coast from Sligo to west Cork. The map has included the proposed Donegal ring and the planned interconnection between Castlebar, Westport, Tuam and Galway.

It is expected that a series of additional projects will be supported in the BMW and SE regions, in addition to 'in-fill' projects in the Dublin region, under the call for projects for Structural Funding that is being undertaken by the Department of Public Enterprise at present[14].

14. Structural Funds for the Development of e-Commerce and Communications Infrastructures and Services in Ireland. Competition announced in July 2000.

Figure 5.1.2: Broadband Network



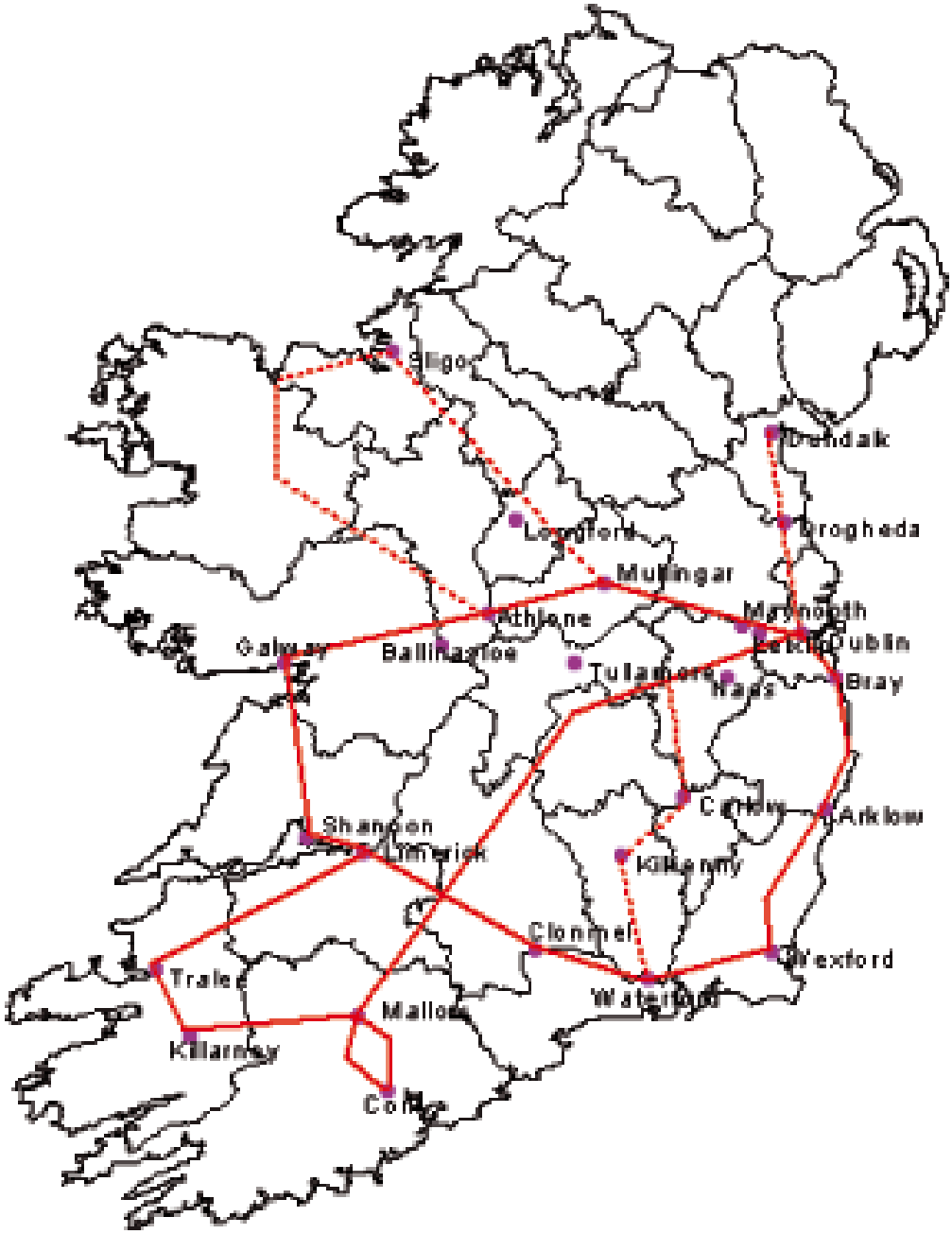
The ESAT network is the other main national network. ESAT has been building a fixed line backbone network along the CIE rail network linking the main cities and towns throughout the country. However for most users local access still means access through the Eircom local loop network.

In addition to this, ESAT has deployed optic cable in industrial estates in Dublin, Cork, Galway, Shannon, Waterford and the National Technology Park in Limerick. Figure 5.1.3 illustrates the ESAT network where it can be seen that the focus is on the cities and larger urban areas.

NTL has constructed a network linking Dublin to Belfast. A number of other networks are being built. For example the ESB Dublin to Shannon diverse network. The OCEAN backbone from Dublin to Galway and the Ocean/Chorus network from Galway to Cork.

It would appear that areas, primarily the cities and major towns, that are already reasonable well favoured with telecommunications facilities are being targeted by the additional alternative carriers and suppliers. Competition in these areas will result in lower tariffs and a greater and more rapid uptake of Information Society developments.

Figure 5.1.3: ESAT Network



FWPMA (Wireless local loop)

Narrow band and Broadband FWPMA licences have been issued to:

- Eircom
- ESAT
- Chorus (Irish Multichannel):

A Broadband licence has been issued to Formus Communications Ireland. It is proposed by the ODTR to issue three further FWA licences during the first quarter of 2001, two broadband and one narrow band licence.

These alternative wireless local loop infrastructures (FWPMA/FWA) will provide access to both the business and residential sectors. FWPMA access can be rapidly deployed to customers by line of sight from the nearest transmit antenna. These networks are currently being deployed and the licensees are not prepared, for commercial reasons, to disclose their individual planned coverage and roll-out programmes. Currently, Chorus and ESAT are conducting technical trials and Formus Communications has commenced providing service to 20 companies. Each broadband licence holder is required to have a minimum of 15 base stations in 15 counties within three years.

Nevertheless the early deployment of FWPMA/FWA should have significant impact on local access to telecommunications. FWPMA/FWA will be used for local access that is then interconnected to the national Eircom backbone or to a network node provided by an OLO. Deployment will provide alternative localloop facilities as part of national network access.

OLOs who are deploying services will have to interconnect to Eircom's network unless there is local access to an alternative supplier. As a result it is not immediately apparent that competitive service provision will arise in areas that have not already access to an alternative network or infrastructure. What will likely happen is that when an alternative supplier targets an underdeveloped area, Eircom will respond competitively by upgrading its local facilities in the area.

Cable and MMDS

The Cable and MMDS sector is controlled by NTL and Chorus (Irish Multichannel), both of whom are currently upgrading their cable networks in Dublin, Limerick and Cork for the provision of Internet access, voice services and Digital television.

NTL controls the earlier Cablelink networks. Chorus in addition to its cable and MMDS operations also controls CMI and Suir Nore Relays cable and MMDS networks. Chorus is installing an optic fibre network linking Galway to Cork. This will enhance the microwave backbone network which links its MMDS transmitters.

In all probability the use of cable modems to access and deliver Internet type services will only occur in the major urban areas in the medium term. The urban areas that will have access to modern cable systems will also have access to SDH systems and thus will be able to access ADSL broadband services, when they are rolled out.

DTT

The plan is to spin off Digico, the transmission network business unit, from RTE to run the national digital terrestrial television (DTT) network. The DTT network will be built using the transmission sites presently used by the existing analogue network, but will require a significant number of additional transmission sites and masts. DTT is relevant in the context of spatial planning provided that it is licensed to carry significant data business services.

In addition to terrestrial digital TV trials by RTE, both NTL and Chorus have conducted Digital MMDS trials. Both NTL and Chorus have announced digital TV roll out plans which are not dependent on the roll out of digital services by either RTE or TV3. Currently Southcoast Community Television, a Cork based TV deflector operator, is undertaking a trial of local digital TV transmission.

Satellite transmission services

Of immediate interest is the use of VSAT to provide broadband access to remote communities. The Department of Public Enterprise is presently conducting a call for VSAT based broadband infrastructure pilot projects. The aim is to stimulate developments in this area. Trial applications for industry, educational institutes, public services are expected. Broadband access capacity of 2 Mbit/s or higher is envisaged.

Satellite TV operators, such as BskyB, could offer high speed Internet using satellite as the forward path and the phone line as the return channel.

Essentially broadband services will be delivered through by-passing the national backbone and local loop infrastructure. This will prove that a latent demand exists in areas not presently covered by adequate infrastructure.

GPRS

Eircell is scheduled to commence trials of GPRS with corporate customers shortly and to roll out the service over the next few years. GPRS allows users to log into a data network, such as a company LAN or an Internet service provider.

5.2 Overview of the coverage

On the basis of the plans identified nearly all towns and urban areas with populations in excess of 5,000 have access, or will in the immediate future, to an SDH fibre node. Approximately half of the towns between 3,000 and 5,000 population have access. Only a third of towns between 1,500 and 3,000 population have access and the coverage of towns below 1,500 population is extremely erratic. The ESAT coverage is concentrated around the larger towns and cities and with one exception does not provide SDH access where Eircom is providing similar technology.

As a result the main conurbations and larger towns have access to an SDH node or network. These areas account for some 60% of all fixed access lines. They also tend to be the areas where cable modems and ADSL will be installed and where it is likely that FWPMA/FWA broadband services will also be offered. Nevertheless some of these larger towns will only benefit from competitive access if there is competition at the level of network supply.

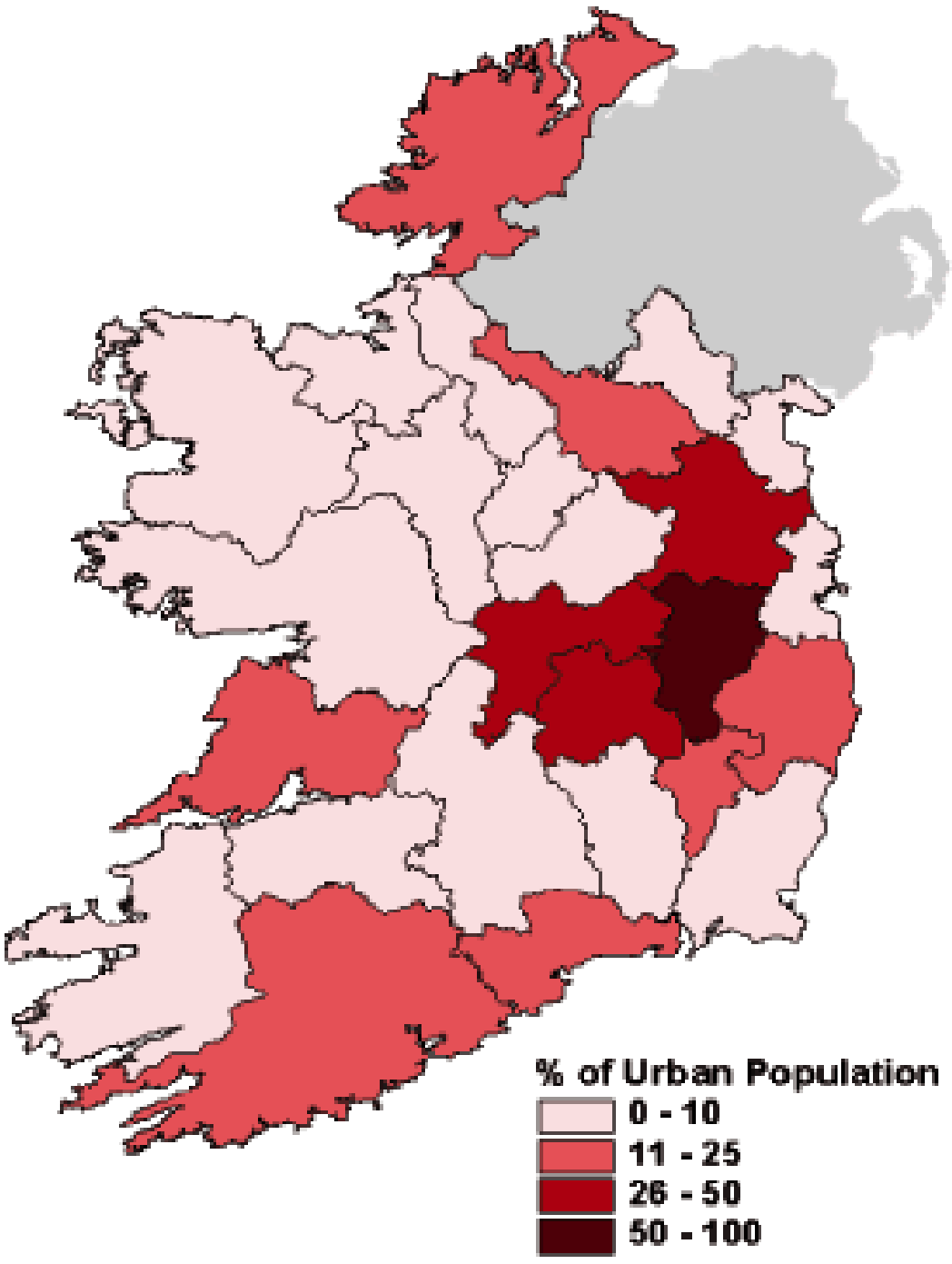
Equally as important as access to SDH type networks is the availability of alternative network suppliers. In the Dublin area and to a lesser extent in Cork, Galway, Limerick, Sligo and Waterford users have a wider choice of network supplier. Alternative network supply, in addition to the provision of network resilience for service providers, leads to a reduction in access costs for individual users and companies as a result of reductions in the costs of leased circuits. It also means that innovative or advanced services are provided to users more rapidly than in other areas.

In contrast to the telecommunications infrastructure situation in the larger towns, smaller towns and rural areas are poorly serviced. This situation is not as critical when the location of PDF fibre nodes are taken into account. However until these are upgraded to SDH technology, the ability to deliver the new emerging services will be severely constrained.

Even with 100% coverage of all nodes, access to advanced services such as ADSL, will not be feasible in most rural areas of the country. Distance from the nearest exchange will be the limiting factor. As a result rural areas will need delivery platforms other than copper wire to access advanced services in the short-term e.g. FWPMA/FWA and satellite.

The two exhibits, figures 5.2.1 and 5.2.2 illustrate this problem. These exhibits show the existing and planned SDH node coverage of urban areas on a county by county basis. Dublin is not included in the analysis. Figure 5.2.1 illustrates the percentage of the urban population outside of SDH coverage in each county. Some 70% of the urban population of Kildare is not covered. Whereas coverage of the urban populations in the western counties is relatively better. This reflects the spatial distribution of population in that the larger urban towns in the west are, or will be, covered.

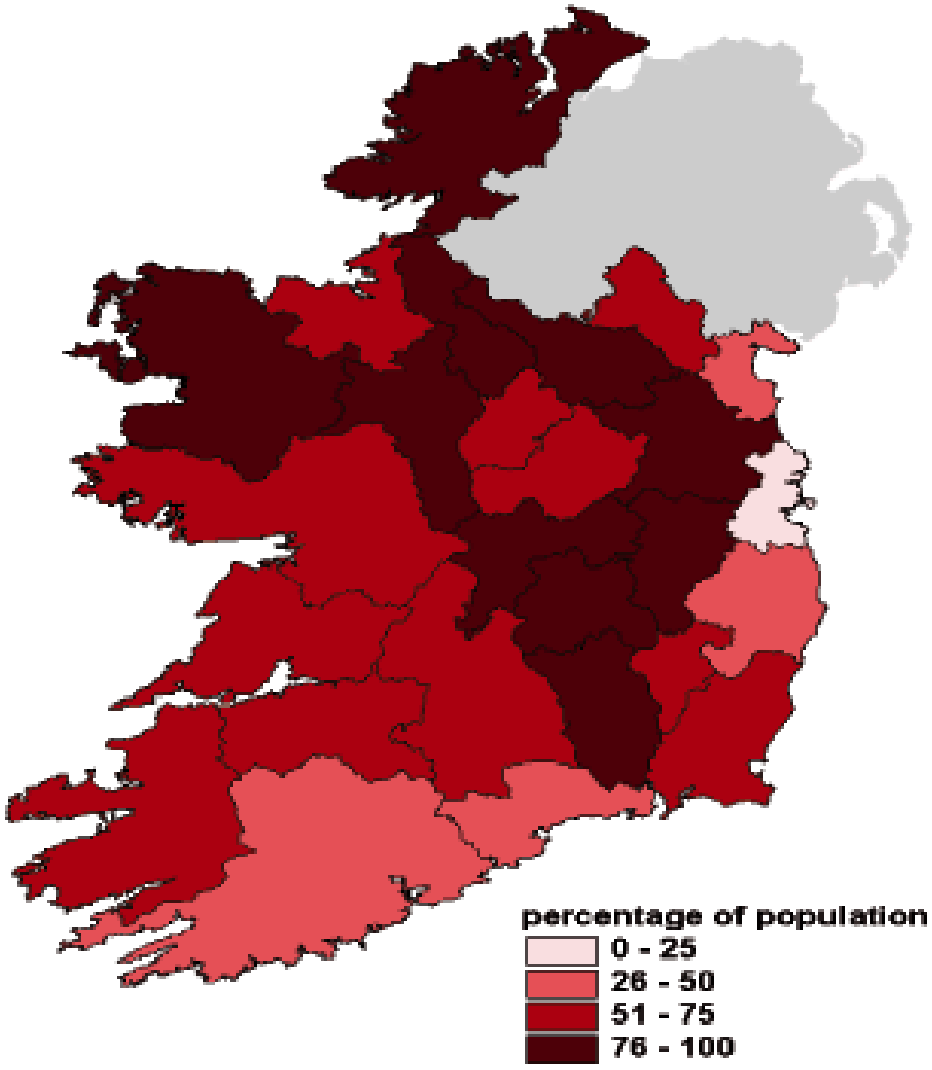
Figure 5.2.1: Percentage Population outside SDH coverage



In contrast figure 5.2.2 shows the percentage population coverage for each county as a whole. In this it is apparent that counties with large rural populations are poorly serviced.

This level of analysis does not depict the full picture. For example Galway City as an SDH area, effects the performance of the county as a whole. Likewise in Donegal, equipped with a relatively good penetration of SDH exchanges, a large percentage of the population does not reside in close proximity to these exchanges.

Figure 5.2.2: County SDH coverage



5.3 Conclusions

- It is apparent that the main towns and urban areas are being equipped with an appropriate infrastructure for access to advanced services. In certain urban areas alternative platforms (cable modems) will also be available.
- For many areas (including most urban areas) choice of network interconnection will remain limited. This will militate against any significant reduction in the cost of leased lines or circuits and retard the speed of roll-out of advanced services. Network resilience issues will remain. Advantages to be gained through the deployment of FWPMA/FWA type solutions may not result in corresponding reductions in access costs. However FWPMA/FWA will result in the earlier deployment of advanced service capabilities in certain areas.
- The situation for smaller towns and rural areas is bleaker. Few of these areas will have access to networks that will support the delivery of broadband type services. Such areas will depend on alternative platforms such as satellite or DTT for these services. MMDS is only licensed in Ireland for one way video distribution. This is in contrast to the US which has licensed bi-directional MMDS services. (MMDS spectrum is unavailable in the majority of EU member states as it is reserved mainly for military purposes.)
- Narrow band FWPMA will provide some limited solutions in areas where the terrain and rural settlement pattern is suitable. Rural based businesses, that need access to advanced and competitively priced telecommunications infrastructure outside of these areas, will continue to be disadvantaged.

6 Demand for telecommunications services

The earlier sections outline available networking technologies and the rate that these are being deployed throughout the country. This section deals with perceived demand for telecommunications services whether from business or residential customers. The aim is to initiate a debate on the type of telecommunications infrastructure that is required nationally. What is appropriate access, what network capacities are required in the context of the NSS? Should we build our telecommunications infrastructure around the needs of a few "e-commerce" related companies or is the goal to address the wider "eeconomy" needs whether business or residential?

6.1 E-economy

The "*e-economy*" derives from both the convergence of computing and telecommunications, especially broadband, in that the new telecommunications capacity enables improvements to the digitally facilitated exchange of goods, services, information and knowledge. The Internet and its associated technologies allow information to be packaged, distributed, accessed and consumed without spatial or temporal limitations.

E-commerce related activity is but one element of the *e-economy* and refers to the marketing and selling of goods and products, and in certain instances when the goods are in digital form, delivering them to the customer electronically. According to Forrester Research (Oct.,'00), e-commerce will account for 8.6% of world-wide sales of goods and services by 2004.

E-commerce provides opportunities for suppliers to become closer to their customers, to understand their needs and to provides goods and services personalised to them. Alternatively customers can by-pass established distribution chains and deal directly with manufacturers - sometimes called "disintermediation".

However the main impact of the *e-economy* will be much wider and farreaching than the mere marketing of products and processing related payments. Revolutionary change is beginning to occur in methods of work and work practices, organisational structures, marketing strategies and the broader business paradigms that have served economies for the past two centuries. These impacts are as yet poorly understood, but a look at the rapid change in the Internet related industry alone over the past two years is indicative of what has yet to come.

In 1999 the Government published "*Implementing the Information Society in Ireland: An Action Plan*", this and other more recent publications have stressed the opportunities for Ireland in embracing the Information Society. The success to date of attracting and growing the new companies who are at the forefront of this revolution is indicative of what can be achieved. Yet this success is not uniform throughout the country.

Many regions and areas cannot participate either as consumers or producers in the new developments through lack of appropriate telecommunications based infrastructure and/or through the absence of the necessary skills. At the same time the areas that have an appropriate telecommunications infrastructure and which are successful, mostly in the greater Dublin area, are facing other impediments in the form of roads infrastructure, housing costs, electricity capacity and skills shortages.

In the new economy a consumer may also be a provider - a residential user may also be a tele-worker for a geographically dispersed organisation. The challenge from the spatial planning perspective is to ensure that physical location is not a constraint to participation in the new economy and that bottlenecks relating to telecommunications infrastructure are rapidly ameliorated.

There are significant economies of scale to be realised in e-business for reasons of lower market entry costs, lower transaction costs, lower input prices, lower inventories and reduced time to market. Manufacturers and distributors face the challenge (and or opportunity) to find a niche in the new (e-business) economy.

The "ASPs" (Application Service Providers), data and collocation centres who are flooding into Dublin due in part to Government initiatives such as Global Crossing and MediaLabs Europe, have already found their market niche in the new economy. The NSS should not be over concerned with this type of company, as the clustering of these is likely to be confined to the greater Dublin area. Rather it should focus on the telecommunications requirements of the more traditional companies who are dispersed throughout the country and who will be challenged to find their new niche in the near future.

6.2 Overview of telecommunication service provision

It is difficult at times to differentiate between promotional statements and real plans that reflect the reality of what is happening on the ground. For example Eircom has been undertaking ADSL trials for some three years and NTL (or Cablelink then) announced the roll-out of high speed cable modems some two years ago. Two or three years later we still do not have firm schedules for the launch of these services. Likewise there are questions about the speed of rollout of DTT in the absence of enabling legislation.

Irrespective of the roll-out of advanced services it is apparent that the main urban areas and nearly all towns with in excess of 5,000 population have access to SDH type local exchanges, which will be necessary for advanced data type services delivered through traditional fixed line infrastructure. Only 40% of exchanges in towns with populations between 1,500 and 5,000 are SDH enabled. A limited number of towns below 1,500 population have access to these facilities.

It is likely that only the cities Dublin, Cork, Limerick and Waterford will have access to interactive cable services over the next three years.

Competitive service provision will generally only materialise in the major urban centres and towns of over 5000 population.

6.3 Delivery aspects

Typical business applications of telecommunications include service hosting, remote working, information research, video-on-demand, video-conferencing, document transfer, education and training and the range of applications which are increasingly referred to as e-business. Typical residential services realisable through broadband and Internet technologies include shopping on-line, music and video downloading, personal banking and Internet telephony.

How these applications will develop in the future and what medium will be used to deliver the service to individual firms or end users is a matter of conjecture. Nevertheless in the context of spatial planning we can postulate that all business related applications will be delivered in the short-term using mostly fixed line telecommunications augmented in certain instances with FWPMA/FWA links.

A limited number of VSAT applications will also emerge targeted at disparate and remote users (for example some remote holiday villages and offshore islands). VSAT applications will in the main help to develop certain market segments that will eventually be serviced using the traditional telecommunications infrastructure.

The residential market place will be more complex with different options for service delivery. ADSL over the local loop, cable modems in a number of urban centres, DTT and satellite digital TV. The main point to note is that where ADSL services can be delivered from a local exchange similar services can be provided for local business. In addition to this, local exchanges that can deliver ADSL can also deliver ISDN type services to business without severe distance restrictions.

In the medium to longer term (at minimum 3 years), UMTS should start making an impact as a complementary and alternative delivery mechanism, initially at the high end of the market due to likely high cost of service and handsets.

6.4 Demand Aspects

6.4.1 Business demand

Not all companies or businesses will use or have the same demand for telecommunications services.

ASPs typically provide software and related services for companies.

An ASP manages and delivers the software application in a data centre and delivers it to the client company on an interactive basis using telecommunications.

SMEs are the main market for ASP solutions.

Companies whose primary business is the provision of telecommunications enabled services will be *intensive users* and totally dependant on advanced telecommunications. For example, Application Service Providers (ASPs), Colocation services, Internet Service Providers (ISPs), Web Hosting services, Data Centres and certain Call Centres. Companies whose very existence is as a result of advanced telecommunications. New ventures in the ASP area are being announced on a regular basis and by 2003, it is projected that 30% of enterprise application software will be sourced in Europe through an ASP model[15].

Intensive users need access to cheap bandwidth. This is the main determinant of location. Termination of Global Crossing at CityWest and Clonshaugh providing cheap international bandwidth, together with the termination point of the NTL submarine cable are the main reason for the location of ASPs, collocation centres and other intensive users in these areas of Dublin.

The emergence of the CityWest/Clonshaugh type of development does not necessarily indicate a broader need for similar telecommunications infrastructure throughout all parts of the country. Indeed the provision of similar low-cost bandwidth structures elsewhere may not result in similar developments for reasons of attractiveness to network operators, skills availability, electricity supply and the historic trend of software related businesses locating in Dublin.

Typical users will be companies who produce and distribute products which can be facilitated using Internet type applications. These companies can be providers and users of advanced telecommunication services.

Generally e-commerce type companies do not host their own web-site, this is usually performed by a web hosting operation, which can be located anywhere in the world. Selling physical goods in contrast to software or digital music requires order fulfilment and distribution logistics similar to any mail order operation, these activities can also be out-sourced.

It is also envisaged that the use by SMEs of ASPs to provide for example, software, accounting services, customer relationship services, will start to emerge. Smaller companies find it increasingly more attractive to outsource their IT requirements for reasons of costs, skills requirements etc. For this type of application companies will need interactive broadband access from their premises.

15. The Application Service Provider Industry, Summary Report, Enterprise Ireland, March 2000.

Passive users are companies who are primary producers and sub-supply to other companies who do the final retail and distribution. Developments in outsourcing and e-business uptake will gradually move these companies to more intensive use of telecommunications

Certain companies will for the immediate future have limited requirement for ASP and collocation type services. Even today many small companies still do not use any form of IT technology (PCs) in their day to day operations.

Irrespective of this it is expected that home users (residences) where they use telecommunications to access digital entertainment or other services will need access at minimum speeds of 2Mbit/s.

This means that for planning purposes we can assume that all users throughout the country will require broadband access in the near future.

6.4.2 Residential demand

Residential demand will revolve around entertainment services, web surfing, shopping and educational services. As pointed out above the delivery options will be more complex, involving a range of platform options from satellite, DTT, ADSL, cable modems, fixed wireless and so forth.

The main demand on bandwidth will relate to video on demand, video streaming, and possibly home surveillance systems. Generally most requirements will be primarily one way, downloading services. Hence the additional possibility of satellite broadcast with a PSTN connection providing the interaction and requesting the programme content.

A 2Mbit Internet connection only delivers 37 simultaneous (low quality) 56k video streams.

Even a Gigabit connection only transmits 250 high quality MPEG-2 streams (at 4.5Mbps) or 667 at 1.5Mbps, MPEG-1.

Streaming video Internet bandwidth is becoming an issue as web sites become moresophisticated.

Plans already in train envisage video streaming using DSLAMs/ADSL at rates of 4 Mbit/s to selected households.

This planned development means that we can start dimensioning what is required nationally irrespective of whether the target groups are business or residential users.

Bandwidth aspects

The exhibit in the previous chapter outlines bandwidth between exchanges. Generally bandwidth between exchanges is not a major problem. There are a number of reasons for this. DWDM technology is being applied in some of the major routes. The national backbone is not being unbundled from Eircom, so that where other licensed operators avail of the local loop to offer services to local users, they will have to use Eircom's networks for interconnecting. Alternatively they can provide the links themselves or source the dark fibre or circuits elsewhere. The main immediate bottleneck revolves around the type of exchange and RSUs in the local area. If these exchanges do not have SDH equipment, this means severe limitations on the type of services that can be offered at the local level. ADSL type service provision is not feasible. Data accessed on a PDH node must be brought back on the PDH network to an SDH hub, i.e. old leased line technology.

Assume 1

- Households and businesses require 4Mbit/s links
- 30% penetration of house-holds
- Blocks of 600 simultaneous users at a local SDH exchange will require a 2.5 Gbit/s connection.

Assume 2

- Usage is not simultaneous and the ratio is 12 to 1
- The 2.5 Gbit/s link to the local exchange can now support some 7000 users!

Another aspect is that the provision of additional bandwidth in a short timescale is only feasible using SDH technology. Telecoms lead times on the provision of additional bandwidth on a PDH network can be typically six weeks, however on an SDH network, lead times could be hours as it's just a matter of reprogramming the switch.

The rate at which Eircom upgrades local exchanges and RSUs to SDH technology will be important. With LLU there may be a hesitancy to do this in many areas, if the main beneficiary are OLOs offering competitive local ASP type services.

As a norm we should assume that typical users whether business or residential will require telecommunications access at rates of 2Mbit/s or greater. The proposed delivery of entertainment to household using 4Mbit/s may mean that the capacity required is closer to this figure than the 2Mbit/s links.

Sweden is considering a nation-wide broadband network comprising a 'carriers-carrier' backbone provided by the national electricity grid and local area networks.

The concept involves the national electricity grid leasing dark fibre on commercial terms to towns and local municipalities. In turn the towns and local municipalities would be assisted through central government funding to construct the local area networks.

Access costs of the local area networks in unprofitable low-density areas could also be subsidised centrally.

(Communications International, April 2000)

Obviously there will be variations in demand depending on socio-economic profile and size of company and type of business sector. For example the early indications from initial ADSL roll-out in the UK that higher income and professionals will subscribe to these services in contrast to the lower income profile of users of Satellite and pay-per-view TV services.

6.5 Factors that effect demand

For residential users and small businesses, the most significant costs for engaging in electronic commerce or Internet use are the prices of local communications access[16]. This appears to be the main determinant of the rate of up-take of the Internet and its related services. The OECD document "Local Access Pricing and E-Commerce"[17] concludes that the key to greater tariff innovation to support electronic commerce is to increase competition.

Costs of leased lines or circuits are indicators of competitiveness. For example the cost of international leased circuits has dropped dramatically over the past three months and Ireland is now the second most competitive destination in Europe. This reflects in part the roll-out of the Global Crossing high-speed link.[18] So from an international connectivity perspective, Ireland has become extremely competitive as a location for internationally focussed e-commerce or other types of Internet based activity.

Annual rental of a 64k circuit:
Dublin = £1,878
Sligo = £3,452
(Eircom quote - Oct. 2000)

The cost of leased circuits on the national market is not as competitive. Substantial price reductions would have to take place before the situation here is comparable to the Scandinavian countries.

Continuous downward price movement in other countries means that this relative position to other countries may not improve significantly. Approximately 37,000 circuits are leased nationally mostly to end-users. The Internet and increased data transmission requirements are driving demand and this is also reflected in the need for leased lines and interconnect circuits amongst the OLOs.

16. See OECD Internet Access Price Comparison
17. OECD DSTI/ICCP/TISP(2000)1/Final
18. ODTR 00/71 The Irish Telecommunications Market - Quarterly Review, Sept 2000

Unlike the international situation the lack of competing national network suppliers means that a competitive market place in circuit supply does not exist nationally. As a result it can cost three times as much to lease a circuit nationally as a connection between Dublin and say Munich or New York. This has knock through implications for the location of e-commerce type operations outside of Dublin.

Secondary allocation of fixed wireless spectrum

Where an FWPMA/FWA narrowband services provider is not providing a service or using their spectrum allocation in a particular area, a scheme or mechanism could be introduced so that a local organisation/ operator can lease this unused capacity from the national licensee.

FCC proposed Secondary Market Rules for Spectrum, November 2000

In addition to this the two main infrastructural providers do not lease dark fibre to other operators. So FWPMA/FWA and ADSL service providers will have to have their own optic fibre or lease operational circuits from either Eircom or ESAT in order to "back-haul" user traffic in most locations throughout the country. Higher costs for service supply and delays in supplying interconnections will result. Thus the benefits of increased competition at the local level may not be universally evident throughout the country.

A possible solution to this problem is to encourage the emergence of a national and/or regional wholesale tele-communications operator purely serving OLOs, a "carriers carrier". Such a carrier would not compete with other operators in the supply of end-user tele-communications services. Rather the approach would be to lease "dark fibre" or network capacity to other operators in order to encourage more competition on the network supply side of this market.

"Carrier's carriers" are emerging in the Dublin area. Incentives such as Structural Funding assistance are required to encourage the emergence of such carriers. They are needed in the Dublin region to bridge infrastructure gaps and to bring increased competition into the BMW and SE regions through the provision of alternative network infrastructure, in the form of dark fibre and circuit provision.

Infrastructure of State agencies and departments have been used by OLOs as part of their rollout strategy e.g. Garda transmission masts by Digifone and CIE rail network by Esat Telecom. Coilte provides mast sites for Eircell, Digifone and others. Space on ESB and RTE transmission masts have been made available to OLOs. However, such State infrastructure usage is being arranged on an ad-hoc basis rather than being centrally co-ordinated resulting in some exclusive arrangements and under utilisation of some assets.

6.6 Education

The need to prioritise human resource development is addressed under the National Development Plan and the need to invest in education and skills development as a major source of productivity growth is recognised in other government publications.[19]

Over recent years, considerable funding has been made available to the regional Institutes of Technology resulting in a considerable increase in the number of computer labs and IT related courses. In parallel, computer and Internet training companies have emerged in most towns and the ECDL (European Computer Driving Licence) has been extensively promoted by such training companies, vocational educational colleges and by state agencies such as Fas and the Information Society Commission. Information Society nation-wide awareness campaigns have been undertaken by IBEC, ISME and other organisations through support from the Information Society Commission. IT competence and awareness development is now common place in a range of sectoral educational initiatives.

These investments and initiatives will all contribute to the general uptake of ecommerce type development. However, for regions other than Dublin, increasing specific IT educational support does not appear to deliver a matching number of IT related jobs. For example the BMW region has throughout the last decade been a net exporter of IT qualified graduates to other regions. This situation will undoubtedly continue with regard to specific e-commerce company development until these areas of the country have access to telecommunications infrastructure at a cost comparable to areas such as Dublin.

The barrier to the growth of e-commerce providing firms outside of Dublin is mainly structural rather than educational. Barriers comprise the cost of telecommunications, low level of IT support services outside of the main cities and hence investment and funding credibility for new ventures. This situation is likely to continue until e-commerce "flag-ship" projects are established by IDA Ireland in say the BMW region[20].

For general IT use, whether small businesses or residential users, stimulation of and focussing demand at the local level, through increased delivery of administrative, business support, community services, educational, health and other services, would appear to be part of the wider solution. Content and relevance of these services/applications will influence the nature and extent of emerging demand and use.

19. See for example: Forfas - Enterprise 2010
20. Background research to this study did not identify educational levels as being a barrier to the development of e-commerce.)

For example the e-government "Reach" project will deliver a range of services for residential users. The extension of this project to include application forms for agricultural related schemes will mean that this service is also relevant to the day-to-day requirements of farmers. The Revenue Online Services (ROS) is another example of an application where SMEs can file or interrogate their VAT and PAYE data electronically. As meaningful and relevant services become available, use will be stimulated. These and similar services should become part of the "way-of-life" or "way-to-do-business". If these services are not relevant, self explanatory or intuitive by design, education by itself will not increase use or take-up.

The digital divide may seem like an intangible concept to some, but studies have begun to articulate it in no uncertain terms. It is considered one of the most important civil rights issues facing our modern information economy. As telecommunications increasingly entwines itself with educational, social, financial, and employment opportunities, those communities lacking access will find themselves falling further behind the rest of society. The Internet has the potential to empower its users with new skills, new perspectives, new freedoms, even new voices; those groups who remain sequestered from the technology will be further segregated into the periphery of public life.

Access, content, literacy, pedagogy and community may not be enough to complete the entire digital divide puzzle, but they go a long way in providing us a picture of what's at stake. Giving people access to technology is important, but it's just one of many issues that need to be considered. Schools, libraries, and community centres are taking that first step in getting wired, but they must also consider the needs of the learners, the teachers, and the communities that support them.

6.7 e-Commerce

E-commerce is an application that is facilitated through the telecommunications and IT infrastructure. It is a way of doing business that is as yet understood poorly and means different concepts to different organisations, businesses or individuals. It can range from simple e-mail ordering to the use of formalised structured documents as in EDI. It is particularly well suited to digitised products or goods that can be delivered and paid for electronically, software, travel and music for example. It is less well suited to goods that require physical distribution, where customers need to see and feel or taste before purchasing. Nevertheless elements of e-commerce or in some cases e-business can be incorporated into most manufacturing and services related activities, for example ordering and paying for a theatre or customising and ordering your new computer from dell.com.

Cisco Systems, the US company behind much of the telecoms hardware that carries traffic across the Internet, envisages a five-stage Internet evolution for any business. Stage one involves using e-mail as a quick, low cost alternative to telephone or post. Stage two is creating a website to act as a permanent shop window for the business and a gateway for new customers. The next step - ecommerce - is to turn virtual visitors into sales by upgrading the website to take orders and process payment. This is not to be confused with e-business (stage four), whereby areas such as procurement, inventory management, marketing, supplier relationships and staff benefits are handled by Internet technology. The fifth stage "the ecosystem" - using the Internet as a spine to integrate processes and logistics across a business. Few companies have progressed this far according to Cisco.

Across Europe the majority of businesses are still somewhere between the first two stages and there is strong evidence that smaller companies are some way behind that. This analysis is considered equally applicable to Ireland. However, this low take up level is not considered to be due to educational issues but to cost, internal company systems and business model issues. However, it is predicted that by 2010 over 20% of sales by Irish companies will be conducted by e-commerce.[21]

Mapping and reporting on the current distribution of e-commerce enterprises in the county is not feasible at this moment in time due to the fact that:

- e-commerce can not be defined in any tangible manner and different organisations understand e-commerce to mean different things, (many companies appear to equate e-commerce with the provision of a website)
- the Chambers of Commerce SME E-business survey 2000[22] identified 70% of SMEs with Internet access, half of which had their own websites, but most companies used the Internet for e-mail, sourcing information and PR type activities. Few undertake e-commerce in any meaningful sense.
- Most companies have heard of and are aware of the importance of ecommerce, few know how to implement e-commerce applications and fewer still have implemented any.
- E-commerce is only beginning to emerge nationally. It is estimated that it will be another 2 to 3 years, before widespread application and use will become commonplace.

The e-commerce initiative of the Department of Public Enterprise provided funding to 8 projects outside of Dublin out of a total of 25 projects, three in the BMW region and five in the S&E region.

21. Business 2010, AIB
22. Survey conducted by MRC and presented at the Chambers of Commerce of Ireland National E-Business Conference - 14 March 2000.

The most recent survey from the Information Society Commission shows that Irish business has a high rate of technology adoption and familiarity with new technologies. Ninety-six percent of Irish companies have access to the Internet while 77% of Irish businesses have a web site. This finding, according to the Minister for Science, Technology and Commerce, indicates the movement from e-commerce awareness to adoption. However, the Minister is of the view that small and medium sized enterprises still lag behind and has made funding available to City and County Enterprise Boards to promote e-commerce[23]over the remainder of this year and during next year.

Enterprise Ireland is proposing to develop a number of 'webworks' in various centres throughout the country. These would comprise buildings to house clusters of web based businesses within a supportive environment.

Clusters of multinational software companies have successfully developed in Dublin, Galway, Limerick and Cork. Major IT hardware multinationals (Gateway 2000, Dell and Apple) are located in three of these locations and Galway, the fourth location, is the former location of the Digital Equipment Corporation plant. This cluster relationship between multinational hardware and software firms is likely to be sustained due to the attractiveness of these four locations. In turn these locations are also likely to be the primary locations of new software firms created by former employees of multinationals. Such software formations or 'spin outs' have historically proved highly attractive to venture capital funds and investment banks.

Due to the continued preference of e-business based businesses for Dublin locations for reasons of telecommunications infrastructure and costs, the broad view is that e-commerce and related businesses will result in a greater concentration in Dublin. The location of the US MediaLabs and proposals for "digital districts" in central Dublin will mean that other emerging intensive telecommunications using sectors such as the multi-media content industry will also concentrate in the Dublin region.

However, the provision of low cost bandwidth from a number of OLOs to Galway, Limerick and Cork would encourage greater e-commerce activity in these locations due to the established software clusters.

Ireland's strengths are in software and silicone development. The economics of launching an e-commerce business in Ireland are unattractive as there are not enough local consumers to allow the business to grow to a significant size, with some noteable exceptions.

23. Empower.ie, a national e-commerce fast-track initiative by the City and County Enterprise Boards

6.8 Other demand stimulation supports

Section 4.4 has stressed the need for supports to stimulate demand and uptake of IT&T based applications. The work of the Information Society Commission has in particular addressed initiatives and strategies necessary for the successful development of the Information Society in Ireland.

Government departments and agencies such as Forfas and Enterprise Ireland are actively implementing supports for e-commerce and e-business type developments. IDA Ireland has been particularly successful in locating internationally traded IT based services in Ireland. In turn these enterprises have attracted other IT enterprises and created clusters, particularly in the area of data and call centres.

The dispersal of these new service based industries is not uniform throughout the country. Dublin is at present a net beneficiary. This is a direct result of the development of an internationally competitive telecommunications infrastructure in the greater Dublin region.

For regions, other than Dublin, increasing educational support does not appear to provide a satisfactory solution in its own right. For example the BMW region has throughout the last decade been a net exporter of IT qualified graduates to other regions. This situation will undoubtedly continue until these areas of the country have access to infrastructures at a cost comparable to areas such as Dublin.

Elsewhere in this report the argument is advanced that the appropriate technological platforms exist to deliver services into all areas of the country. The present use of Structural Funds should go someway to ensure that this is attainable, notwithstanding the present weak demand for services in these areas. The challenge is becoming one of ensuring competitive supply so that access costs to these infrastructures is not disadvantageous for local users or new industries.

Choice
- Competition not sufficient
- Regulation & Government Intervention

Quality
- USO limited to Basic telephony
- Electricity for data networks

Price
- Free conveyance with payment for content
- Mobile charges/interconnection
- Transparency of pricing
- Access to networks

Nevertheless IT&T infrastructure is only one aspect of spatial planning, it requires corresponding improvements in other infrastructural supports, for example, roads, education health and general "quality of life" services. These new communications technologies can reduce the economic constraints associated with geographic location, provide new opportunities for diversification of employment and eventually lead to more stable and balanced communities, more demand for and better quality of life services.

Stimulation of and focussing demand at the local level, through increased delivery of administrative, business support, community services, educational, health and other services, would appear to be part of the solution. Content and relevance of these services/applications will influence the nature and extent of emerging demand.

6.9 Conclusions

The main conclusions are that:

- Clusters of multinational software companies have successfully developed in Dublin, Galway, Limerick and Cork. Such clusters are likely to be sustained due to the attractiveness of these four locations. In turn these locations are also likely to be the primary locations of new software firms created by former employees of these multinationals. However due to the continued preference of e-business type businesses for Dublin locations for reasons of telecommunications infrastructural costs, the broad view is that e-commerce and related businesses, will result in a greater concentration in Dublin. The establishment of a "Digital District" in Dublin will further add to this concentration.
- Irrespective of the deregulation process that is underway, competitive supply outside of Dublin may not deliver dramatic reductions in the cost of leased circuits. This will have a knock-through impact on the possibility of locating "e-commerce" related companies in areas outside of Dublin. This will not have the same impact on the residential market, as access costs for home customers tend to be set nationally. Nevertheless it will impact on the speed of roll-out of advanced services to residences and SMEs in many parts of the country.
- The provision of low cost bandwidth to Galway, Limerick and Cork will encourage greater e-commerce activity in these locations and build on established local software expertise.
- Local authorities need to consider the provision of alternative networks or backbone infrastructures in their respective areas to ensure parity with the greater Dublin area and cities. The creation of a national or regional "carriers carrier" is one solution. A scheme to allow "secondary" allocation of fixed wireless spectrum may help in certain circumstances to provide broadband services to areas of low population. Provision of adequate network ducting as part of road construction or repairing is another option. A further option is the co-ordination of transmission site facilities at State owned assets to ensure maximum usage of these for telecommunication services and thereby maximise the return on these assets through a reduction in the digital divide.

- Demand stimulation needs to mirror the provision of appropriate infrastructure. A range of initiatives is underway which should raise IT literacy skills. Relevant services and applications need to be provided. Other infrastructural supports will also influence local take-up and use.
- The barrier to the growth of e-commerce providing firms outside of Dublin is primarily structural rather than educational. Barriers comprise the cost of telecommunications, low level of IT support services outside of the main cities and hence investment and funding credibility for new ventures. This situation is likely to continue until e-commerce "flag-ship" projects are established by IDA Ireland in say the BMW region.
- Specific educational initiatives are less important than the emergence of relevance and meaningful IT services/applications which are needed in the day-to-day work and home environment.
- Access, content, literacy, pedagogy and community may not be enough to complete the entire digital divide puzzle, but they go a long way in providing us a picture of what's at stake. Giving people access to technology is important, but it's just one of many issues that need to be considered. Schools, libraries, and community centres are taking that first step in getting wired, but they must also consider the needs of the learners, the teachers, and the communities that support them.

7 Overall Conclusions

- Telecommunications infrastructure will continue to remain the most important component of national infrastructure for the early part of the 21st Century. Available telecommunications infrastructure will determine who can access the Internet and engage in e-commerce and participate in the emerging Information Society. Its availability and the cost of access for local users will determine the extent of a "digital divide" in different parts of the country.
- Fixed telecommunications, especially local access to modern network technologies at the local level i.e. the PSTN will remain of paramount importance for most of this decade. The importance of the PSTN should decrease as UMTS technology is implemented and grows in popularity. When this becomes widespread, issues such as unbundling the local loop will be irrelevant, the issue will then become one of ensuring that individual users are unbundled in their choice of platform or service provider.

Infrastructure

- There are a number of infrastructural options and different means of delivering advanced telecommunications based services to users. Some of these infrastructures will compete, for example, cabled TV areas with xDSL services delivered over the PSTN. Others are complementary, for example using FWPMA/FWA technology or VSAT solutions to deliver services into areas where the PSTN is inadequate. This range of technical options or possibilities means that potentially every part of the country could be equipped or serviced with an appropriate telecommunications infrastructure within the short to medium term.
- It is apparent that nearly all the larger towns and urban areas have access to an appropriate infrastructure at this moment. The coverage of smaller towns and rural areas is extremely erratic and these areas are in danger of being by-passed or under participating in the emerging Information Society unless this situation changes.
- Other interim infrastructure solutions (e.g. FWPMA/FWA) have the potential to rapidly deploy services into areas poorly serviced at this moment. Equally the appearance of VSAT and DTT technologies will provide some of the service requirements in these areas. Nevertheless these solutions may not result in significant end-user cost reductions if alternative network infrastructure is not available to these new service providers.

- The physical typology or location of the backbone network is not a significant factor. Bandwidth capacities in the backbone networks are not considered to be an issue. It is expected that on-going innovation in network technology will continue to increase these capacities where suitable optic fibre cable exists. The expectation is that upgrades in network technology (e.g. DWDM) combined with building new networks and upgrading of cable TV networks will provide ample bandwidth capacity into the foreseeable future.
- Investment in network upgrades and in network technology is likely to continue to be demand related. This means that where demand is weak or dispersed as in rural areas, demand may not materialise to justify investment.

Competitive supply

- The speed with which an appropriate telecommunications infrastructure covering all the country can be achieved is more dependent on nontechnical issues than technical solutions. These issues revolve around the stimulation of local or alternative network infrastructures and the creation of competition at the level of local network supply to facilitate a speedier roll-out of alternative service suppliers and thus enabling cost competitive access for all end-users.
- Major progress is being achieved by the ODTR in de-regulating the telecommunications industry. The importance of the deregulation process cannot be overstated. It has already delivered reduced tariffs to end-users. Nevertheless it may produce an even greater imbalance in the supply of competitively priced services for end-users in certain areas of the country. For example there may be a reduced incentive for Eircom to upgrade all local exchanges and RSUs to SDH switching technology if other operators will reap the benefits.
- Likewise many local areas will not have enough market demand to stimulate the provision of competitively priced services by other licensed operators. The expectation that a range of platforms and competing suppliers will result in a competitively priced access infrastructure for all users may not materialise. Thus it is conceivable that deregulation could result in a further widening of the gap in telecommunications service provision in certain parts of the country.
- Unless competing networks evolve it is unlikely that dramatic reductions in the cost of leased circuits of bandwidth will materialise or network resilience issues will be addressed throughout all the country. This will have a knock-through impact on the possibility of locating "e-commerce" related companies in many areas of the country. It will impact on the speed of roll-out of advanced services to residences and SMEs in many parts of the country.

- Local authorities or planning regions need to address this local telecommunications infrastructural issue. Solutions could range from the requirement to install optic fibre capacity in new roads infrastructure or the creation of a "carriers carrier" which would lease interconnect capacity to individual operators.
- The speed of roll-out of alternative local networks is a cause for concern. It is apparent that local planning bottlenecks exist. Planning permission for transmission masts and other facilities needed locally should be prioritised. The future telecommunications access needs of new housing estates or communities should be addressed as part of local government planning.

Demand Stimulation

- Clusters of multinational software companies have successfully developed in Dublin, Galway, Limerick and Cork. Such clusters are likely to be sustained due to the attractiveness of these four locations. In turn these locations are also likely to be the primary locations of new software firms created by former employees of these multinationals. However due to the continued preference of e-business based businesses for Dublin locations for reasons of telecommunications infrastructure costs, the view is that e-commerce and related businesses, will further concentrate activity in Dublin. Establishment of a "Digital District" in Dublin will add to this concentration.
- The provision of low cost bandwidth or dark fibre to Galway, Limerick and Cork would encourage greater e-commerce activity in these locations. This will build on locally established software expertise.
- In parallel with providing physical infrastructure other initiatives are required to increase telecommunications and IT awareness, improve IT literacy skills and generally stimulate accessibility in a broader context. In turn these initiatives will also help stimulate local demand for better and cheaper infrastructure and the provision of meaningful services that utilises this infrastructure.
- The barrier to the growth of e-commerce providing firms outside of Dublin is primarily structural rather than educational. Barriers comprise the cost of telecommunications, availability of dark fibre, low level of IT support services outside of the main cities and hence investment and funding credibility for new ventures. This situation is likely to continue until ecommerce "flag-ship" projects are established by IDA Ireland in say the BMW region.
- Specific educational initiatives are less important than the emergence of relevance and meaningful IT services/applications which are needed in the day-to-day work and home environment.

- Access, content, literacy, pedagogy and community may not be enough to complete the entire digital divide puzzle, but they go a long way in providing us a picture of what's at stake. Giving people access to technology is important, but it's just one of many issues that need to be considered. Schools, libraries, and community centres are taking that first step in getting wired, but they must also consider the needs of the learners, the teachers, and the communities that support them.

Legislation & Regulation

- The Telecommunications (Infrastructure) Bill should be prioritised to assist the roll out of infrastructure nationwide, particularly FWPMA/FWA, UMTS and DTT.
- Consideration needs to be given to empowering the local authorities to streamline processes and assist the infrastructure roll out. As the current regulatory framework was created for an era of state owned utilities.
- The ODTR should consider licensing MMDS for the provision of interactive services and allow FWPMA/FWA operators to engage in secondary allocations of unused spectrum. This should result in earlier competitive service provision in rural areas.
- Central co-ordination of assets owned by the state and its agencies e.g. masts, rooftops and way leaves, suitable for collocation.

Appendix 1: Glossary of Terms

ASP	Application Service Provider. ASPs provide "pay-as-you-go" software services to other companies. Instead of investing in computers, software and specialist personnel, increasingly a growing number of companies will outsource their IT requirements to ASPs. ASPs are only one element of a broader trend that sees all computing moving to a networked environment. From an NSS perspective first class and competitive telecommunications access will determine the rate of adoption of these services by indigenous industry. Bandwidth costs will determine the location of specific ASP providing enterprises.
ADSL	Asymmetric Digital Subscriber Line. ADSL and DSL technologies enable broadband service delivery form the local exchange to the customers' premises.
Bandwidth	The transmission capacity of a given facility, in terms of how much data the facility can transmit in a fixed amount of time; expressed in bits per second (bps)
Broadband	A term for communication channels which offer a greater and faster capacity (i.e. a higher bandwidth) than traditional systems e.g. fibre optic and FWPMA/FWA
CDMA	Code-division multiple access.
Collocation	The sharing between communication operators of the use of physical infrastructure e.g. local exchange buildings and network ducts
CPE	Customer premises equipment
DSL	Digital Subscriber Line, see ADSL above.
DSLAM	Digital Subscriber Line Access Multiplexer. Used where a customer needs access to DSL or ADSL enabled services.
DTT	Digital Terrestrial Television.
DWDM	Optical switching technology.
ECDL	European Computer Driving Licence
EDGE	Enhanced Data rate for GSM Evolution. Mobile data communications.
EDI	Electronic Data Interchange
EIOP	Economic Infrastructural Operational Programme. Part of the EU's Structural Funds.
FWA	Fixed Wireless Access (also known as FWPMA)

FWPMA	Fixed Wireless Point to Multipoint Access. Also known as FWA (Fixed Wireless Access) or WLL (Wireless Local Loop). The technology provided a fixed connection over the air without the need for wires or cables.
GPRS	General Packet Radio Services. Mobile data communications technology which is a step between GSM, EDGE and eventually UMTS.
GSM	Global System for Mobile. The universal mobile technology presently used by Eircell and Esat Digifone.
INTERREG	Joint Interreg Programme for Ireland and Northern Ireland 1994-1999 ISDN Integrated Services Digital Network. Eircom's "hi-speed" is an example of ISDN. Exchanges that can provide ISDN should also be able to provide DSL or ADSL type services.
ISP	Internet Service Provider.
LLU	Local Loop Unbundling. Allows operators other than the incumbent (Eircom) to offer services through the connection between the customers' premises and the local exchange. In practice how this is implemented will impact on the roll-out of advanced services nationally. Nevertheless if the local exchange is not SDH enabled there are limitations on what can be offered.
Local Loop	The line from a telephone customer's premises, usually cooper, to the telephone company's local exchange.
MMDS	Microwave Multipoint Distribution System. MMDS systems are used to deliver TV services in many parts of the country.
ODTR	Office of the Director of Telecommunications Regulation.
OLO	Other Licensed Operator.
PABX	The customers internal telephone exchange.
PDH	Plesiochronous Digital Hierarchy. A version of a network technology which is more suited to voice communications and not as versatile or suitable for data transmission as SDH technology.
PSTN	Public switched telephone network. The PSTN links all homes and customers throughout the country.
RSU	Remote Subscriber Unit. Many customers access their local telephone exchange through an RSU.

SDH	Synchronous Digital Hierarchy. Necessary for the cost effective provision of advanced services from the local exchange. The location of SDH enabled exchanges effectively predetermines which areas can access advanced data (ISDN or ADSL) services.
SME	Small and medium sized enterprises
SOHO	Small office/Home office
UMTS	Universal Mobile Telecommunications Service. The third generation mobile communications system which will be licensed next year by the ODTR. UMTS will offer broadband type mobile communications and stimulate the widespread emergence of virtual networks etc. Nevertheless the increasing demand for bandwidth from residential users and companies will mean that fixed line communications will still be needed for the foreseeable future.
USO	Universal Service Obligation. Services that must be provided by the Universal Service Provider.
USP	Universal Service Provider. Eircom is the Universal Service Provider.
VSAT	Very Small Aperture Satellite Terminals.
WLL	A radio local loop generally for the provision of broadband services in competition with the copper wire local loop of the incumbent operator. See FWPMA above.

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John Doherty	IDA Ireland
Fachtna Mylod	NTL
Eric Tomkins	Office of the Director of Telecommunications Regulation
Patricia Byrne	Shannon Development
John Reilly	Sligo County Enterprise Board
Lisa McAlister	Western Development Commission

NWLabs has recently completed a study for the Information Society Commission on "Telecommunications Infrastructure and Regulation". This included a series of interviews with telecommunications operators, government departments and agencies and industry representatives. Many of the conclusions in this study have contributed to the findings in this document.