Information Society Commission

Ireland's Broadband Future

December 2003

Contents

Foreword

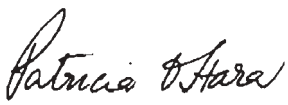
The quantity, quality and geography of broadband access and services are key areas of concern for the Information Society Commission (ISC). The ISC's Broadband Working Group was convened just prior to the publication of *New Connections*, which committed Government to securing widespread broadband infrastructure throughout the state within three years. The Working Group has been following progress since then through engagement with the various interests in broadband provision and has drawn on the considerable expertise and experience within the Group itself. It is clear that, although there have been some positive developments over the past eighteen months, progress in broadband rollout has been relatively limited, and this has caused Ireland's position in international rankings to plummet.

While recognising that 'broadband issues' are being well articulated in many quarters, the Working Group is concerned at what it perceives to be a lack of clarity and understanding about the significance of broadband infrastructure to Ireland's continued growth and competitiveness, and the link between broadband applications and demand. We also believe that there is a need to highlight the huge difficulties experienced by businesses and other users, who are grappling with the everyday reality of inadequate telecommunications infrastructure.

It is our hope that this report will shed light on these issues, and underline once more the importance of a concerted national effort by Government to putting in place the means of achieving widespread broadband access in the short term. We trust that our recommendations will be considered a useful contribution in this regard.

On behalf of the ISC, I would like to thank Sonas Innovation and Peter Bacon & Associates who prepared this report. Working Group member Dee Carri's work on the case studies was invaluable. Our grateful thanks are also due to the ISC secretariat for their unstinting support for our activities, particularly in the final stages of bringing this report to publication. We are much indebted to them.

Finally, I am deeply conscious and very appreciative of the interest and commitment of the members of the Working Group who have given so much of their time and expertise to advancing the broadband issue. I am hopeful that our collective endeavour through the publication of this report will help to transform the communications landscape for all of us.



Dr. Patricia O'Hara
Chairperson

Broadband Working Group
Information Society Commission

Key Messages from the Information Society Commission

(a) Overview of Report

Introduction

The overall aim of this report is to highlight the important issues in relation to the provision and availability of broadband communications infrastructure. There are four objectives:

- Investigate the importance of broadband for Ireland's future economic development
- Analyse broadband availability and take-up in Ireland today
- Show in practical terms how the take up and usage of broadband can develop in Ireland in the medium to long term
- Support recommendations to Government on broadband policy development

The overriding conclusions of this Report are that market failure exists; that the supply market is failing to meet latent demand; that a spatial digital divide exists with adverse consequences for business and for national competitiveness; that the economic and social benefits flowing from ubiquitous availability of broadband are proven to be substantial; and that the risks for Ireland in falling behind – as we are currently doing – are very serious.

The ISC's principal recommendation is that it is time for government to revive and reinvigorate its commitment to the Information Society by putting in place an Action Plan with a set of measures to stimulate the market; by fostering real competition through a shift to platform-led – rather than access-led – investment and incentives; by accelerating provision of infrastructure through driving demand; and by closely monitoring progress.

The Characteristics of Broadband

Broadband services are communications facilities which provide users with high speed and always-on connections to access the internet and transfer data. Broadband services can be delivered on a variety of platforms to end users. The main characteristics of a broadband service are as follows:

- *Speed* - How much information can be transferred over the connection each second.
  We believe that a speed of 256kbps is the minimum level at which a service can be considered to be a 'broadband' service. Most dial-up internet services use a modem which gives a maximum data speed of 56kbps (56,000 bits of information per second) and an average somewhere around 40kbps. Most entry level broadband services offer a download speed **ten** times as fast.
- *Always-On* - The link does not require time or technical skill to make ready. It is as easy to use as turning on a television.
- *Cost* – The service must be available at a reasonable price.

The Importance of Broadband to Growth and Competitiveness

The potential economic impact of broadband in Ireland is substantial. The role of broadband technology in boosting competitiveness and economic activity has been emphasised by many State bodies - including Forfás and the National Competitiveness Council. Evidence from research indicates that the potential productivity improvements from broadband are considerable.

It is estimated that broadband deployment could result in net employment creation in the region of 85,000 jobs in Ireland over the first 10 years of its widespread adoption by business over and above what might otherwise be achieved. A conservative valuation of this employment is €850m per annum.

Research undertaken, principally in the US, has been drawn on to provide indicative estimates of consumer spending on broadband related purchases. These estimates suggest that annual consumer expenditure on broadband services, TV and movies, education, and telemedicine would reach €400 million within a few years. When online shopping and other potential revenue sources are included, consumer expenditure using broadband could be three times this figure - €1.2bn.

A different approach to estimating the value of broadband focuses directly on consumer welfare rather then the products that might be consumed. This approach draws on projections of broadband take-up as set out in Section 4 of the main report. If it is assumed that broadband access will reach 90% of households in 20 years, consumer surplus with a discounted present value of €1.3bn or about 1.2% of Irish GNP is estimated. However, access in areas of low population density may be slower to develop. If take-up in rural areas is only 50% in 20 years, then this estimate could fall by 26% to €0.96bn.

There is obvious potential for the development of new services and new methods of delivery of Government services. In areas such as telemedicine, efficiencies have been researched and measured. It has been estimated that an investment of €18 billion in ICT in medicine delivery in the US would yield savings of greater than €120 billion for the healthcare industry over a six year period[1]. This saving would represent about 1.5% of the estimated US annual expenditure of US$1,300 billion on healthcare. While it is clearly difficult to extrapolate from this, a similar percentage cost saving in Ireland would reduce public expenditure on health, which is currently running at close to €9 billion per annum in total, by close to €150 million in 2004.

However, this cost saving would be only a small part of the potential gains since overall efficiency, quality of service and delivery in rural areas would also improve.

The Evidence of Market Failure

Despite flat-rate narrowband internet access services becoming available in Ireland only relatively recently, more than 90% of businesses and about 40% of Irish homes use the internet today. Given this fact, it is clear that SMEs and residential consumers are likely to be eager users of broadband in the right circumstances.

Similar to many other EU countries, Ireland currently has a variety of network platforms providing broadband services nationally (see Map 01 below).

Fixed-line telephone network - Copper telephone lines can be upgraded to support broadband services – known as digital subscriber line (or DSL) services. DSL services are generally aimed at both small businesses and households. Prices for DSL currently start from around €55 per month. Eircom aims to have 1m lines (out of a total of 1.6m) DSL enabled by the end of 2003.

Wireless networks - These 'wireless' broadband services are generally aimed at business users and are typically available in the centre of large cities. It remains to be seen what impact they will have in Ireland. In Ireland today there are a number of operators providing wireless broadband services to over 5,000 users.

1 "Building a Positive, Competitive Broadband Agenda." www.positivelybroadband.org , ITAA, 2001

Cable TV networks - Cable TV networks can be upgraded to support broadband services via cable modems - with services aimed at households and small businesses. In Ireland the number of cable modem customers is an order of magnitude lower than other countries. For example, in the UK 5% of cable TV households have broadband as against 0.35% of households in Ireland.

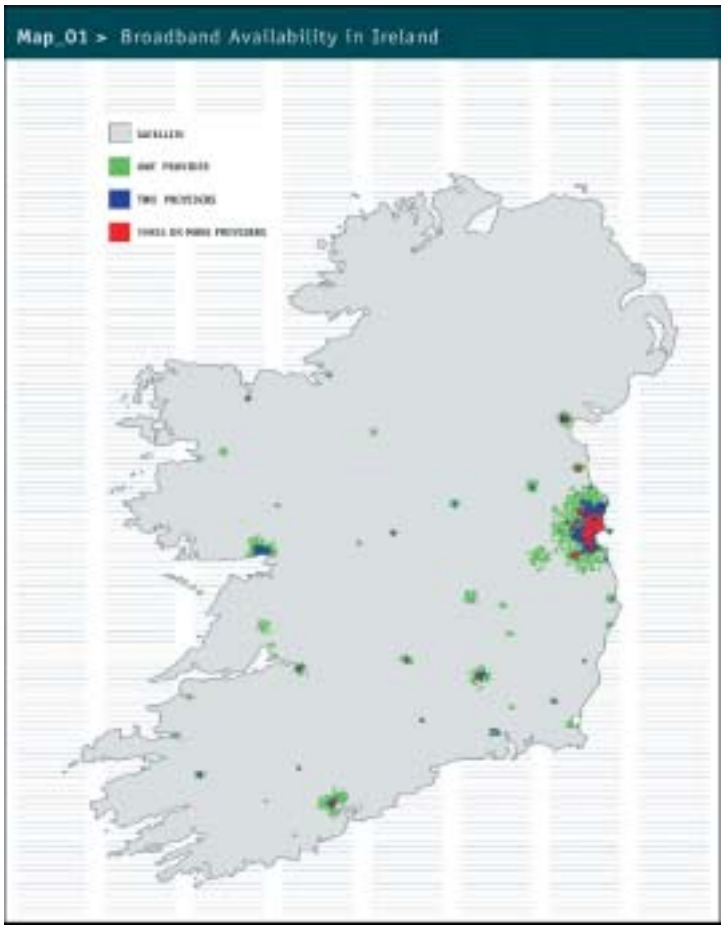
Satellite - A number of providers offer satellite services throughout Europe and into Britain. Ireland is also covered by these services. Satellite services tend to be focused on the higher end of the market. The principal advantage of satellite is that the same choice of services is available in rural areas as in cities.

The telephone network and cable TV networks provide by far the most likely platforms for significant supply of broadband. However, to date in Ireland, very little investment has taken place in cable TV networks.

As a result, the dynamic of network-based competition for broadband is almost completely absent in Ireland. Thus, the imperative on the fixed incumbent to invest in broadband improvement, and to drive consumers to take up DSL services, is significantly reduced.

Broadband availability and choice are also characterised by the fact that:

- service availability follows population density
- large parts of the country do not have access to any terrestrial broadband service and
- choice of service provider is generally very limited



Source: Sonas Innovation

The case studies throughout this report highlight the very real difficulties for businesses and individuals wishing to access broadband services. Among these is the startling fact that, not only is it extremely difficult to access very high speed broadband services, but that, depending on location, the cost can be 20 times higher than the comparative cost in Dublin. The prohibitive cost of leased lines in particular, means that satellite is often the only realistic option. Latency problems experienced with satellite services however, have forced one company to relocate its server to the US and another company experienced delays and costs associated with obtaining planning permission and licences for its satellite dish. This imbalance of access to broadband services, along with price differentiation, puts rural areas at a disadvantage, exacerbates the digital divide, and puts an additional cost burden on Irish companies, affecting adversely their ability to compete internationally, while inhibiting their expansion plans. Such a situation flies in the face of the National Spatial Strategy, as well as acting as a brake on economic development.

The conclusion from the analysis of the potential economic value (Section 2) and potential future take-up of broadband (Sections 4 and 5), is that **current availability of services points to market failure in broadband - so that supply is failing to meet actual and latent demand.**

The supply market, is characterised by significant economies of scale to suppliers as usage increases. These would allow for a fall in prices as the numbers of consumers increase. But these decreases will only arise where demand grows by large amounts. Meanwhile, the private sector is unwilling to supply services and users are excluded due to the high cost of access – a situation known as the 'broadband gap'.

A second market failure arises because the social benefits of broadband access do not accrue to private developers since they cannot be charged for. Many of these social benefits can be described as achieving policy objectives in terms of a more inclusive society that overcomes the current problems of social and regional imbalance.

It is concluded that these market failures are very unlikely to be addressed by the telecommunications industry in the medium term. Ultimately, it falls to Government to try to resolve the situation.

Government Targets

The Government's primary target for the sector is to see the widespread availability of affordable, always-on broadband within three years. Specifically, the aim is to see Ireland within the top decile of OECD countries for broadband connectivity by 2005. The Figures for how Ireland's broadband take-up compares with a number of similar sized EU states are presented in Table Ex.1 below.

Table Ex.1 **Ireland's Broadband Penetration Compared with Other EU Countries**

Country	DSL lines	Other broadband	As a % of population	EU ranking	Growth in the last 6 months
Ireland	5,370	4,100	0.25	14	47%
Belgium	627,970	417,897	10.19	2	19%
Denmark	389,805	168,795	10.44	1	24%
Finland	280,000	63,950	6.64	5	25%
Sweden	591,695	299,685	10	3	36%
EU average			4.65		36%

Source: EU Commission Broadband Access in the EU (as at July 2003)

It is clear that Ireland currently ranks second last in the EU for broadband penetration and that while the rate of growth in the last 6 months is above the EU average it will not lead to Ireland closing the gap on its EU counterparts in the short to medium term.

To assess more accurately the task faced in meeting the Government's target by March 2005, an EU best broadband penetration of 12% by 2005 is projected in the Report. **To achieve this target Ireland will need over 450,000 broadband users - an almost fifty-fold increase from current levels.**

Current circumstances in the sector point strongly to a market failure in the supply of broadband. This holds out the prospect of a significant level of unsatisfied demand in the medium/long term. **Unless this situation is addressed, the Government's target for 2005 will not be achieved.**

Research undertaken in preparing this report has uncovered a number of areas where data deficiencies may inhibit the measurement of the roll-out and the economic impact of ICT and broadband in Ireland. A preliminary set of (consumer, business, and structural) indicators has been identified for Ireland, mainly based on work done in the US. Some of the indicators identified may be usefully compared with those of competitor economies while others would require time series analysis.

A Projection of Broadband Adoption Patterns

Evidence of underlying trends has been used to generate a projection of the number of broadband users in Ireland over 20 years assuming that broadband will be freely available at an economic price.

User behaviour changes as a result of adoption of technology. Users derive more value and need from ICT with maturity of usage. Any new technology will go through a process of adoption over time. There are many other experiences of technology adoption which can be used to predict likely adoption of broadband, including the mobile phone, the VCR, the colour TV, and the CD player. The pattern where technologies form an "S curve" in the early to middle stages of adoption is well accepted by technology interests and by academia.[2]

Broadband had been available in other developed countries for some years before it was introduced in Ireland, so these experiences also inform the projections for adoption in Ireland. The first projection assumes a penetration rate of 90% (or 1.2m) of households is achieved in 2024. This gives the take-up and penetration levels set out in the Table Ex.2 below:

Table Ex.2 **Summary of Adoption Projection**

Year	Number of Connections	Household Penetration (%)
2007	117,000	9%
2012	417,000	32%
2017	951,000	72%
2022	1,200,000	90%

Source: Sonas Innovation

The second projection of household uptake recognises that there are issues related to accessibility in areas of low population density. The assumptions here are that while penetration in towns rises to about 40% in the first 10 years and 90% in the following 10 from a base of 5% in the first year i.e. at the same rate as was assumed for all households in the first calculation, it reaches only 10% of rural households in the first 10 years and 50% after 20 years from a base of 1% in the first year. The resulting take-up and penetration rates are set out in Table Ex.3 below.

2 Frank Bass – Diffusion Model

Table Ex.3 **Summary of Adoption Projection with Rural Adjustment**

Year	Number of Urban Households	Number of Rural Households	Overall Household Penetration (%)
2007	69,000	14,000	7%
2012	246,000	50,000	23%
2017	561,000	110,000	51%
2022	714,000	239,000	72%

Source: Sonas Innovation

A Projection of Broadband Capacity Needs

Developments in a number of key sectors (e.g. education and healthcare) are analysed to show how broadband availability can lead to new ways of performing essential functions. The longer term trends of the evolution of IT and communications technology since the 1980s are also considered. Projections for the likely demand for bandwidth for a typical Irish consumer over the next 20 years are also provided, bearing in mind that the Irish Government has identified, in the *"New Connections"* document, an objective of 5 Mbps to the home in the 2012 – 2017 timeframe.

In Section 4, the evolution of user needs is examined. Analysis of some key application areas illustrate these. Chosen areas are:

Education - Increasingly the educational system will involve technology in its core activities. Broadband can deliver much improved pedagogical results, facilitating access to a wealth of learning resources, fostering "anytime, anywhere" learning, creating digitally literate students, allowing the full integration of ICT into the classroom and ensuring that ICT resources are always available with no time wasted in waiting for internet connection. Broadband allows ICT to be effectively harnessed in the educational environment

Health - Centralised medical records, collaboration between medical teams, ongoing professional updates and learning, remote access to medical results and records, and a consistent view of the patient, whatever part of the system he or she engages with, are all possible. Broadband can mean easier and more efficient access to a higher quality health service.

Communications - Society now expects instant and quality communications. Broadband will allow for a myriad of new uses. Sharing home videos with friends and family via broadband could be one such example.

Teleworking - Broadband can allow for much greater flexibility and productivity. Research in Europe projects that the number of teleworkers will rise from 4.5 million in 2000 to 17.5 million in 2010.[3] As one of the case studies in this Report demonstrates, teleworking enhances the quality of life for people, has a positive effect on the environment by reducing traffic pollution and congestion, and enriches local community life. Effective teleworking depends however on the availability of low-cost high speed communication links such as broadband. In Ireland, poor or costly access to broadband services is inhibiting the potential growth of teleworking. Businesses which have relocated to the country for cost of living or quality of life reasons, find that their workers have to commute to offices in Dublin because of communications problems.

Entertainment - Entertainment uses are often the first to exploit new technology. Gaming has reached a high level of popularity in Ireland, with statistics showing that the country is second only to Japan in the penetration of Playstation devices. Entertainment has already proven to be one of the first application areas to drive broadband take-up.

3 *EU Emergence Project, May 2000*

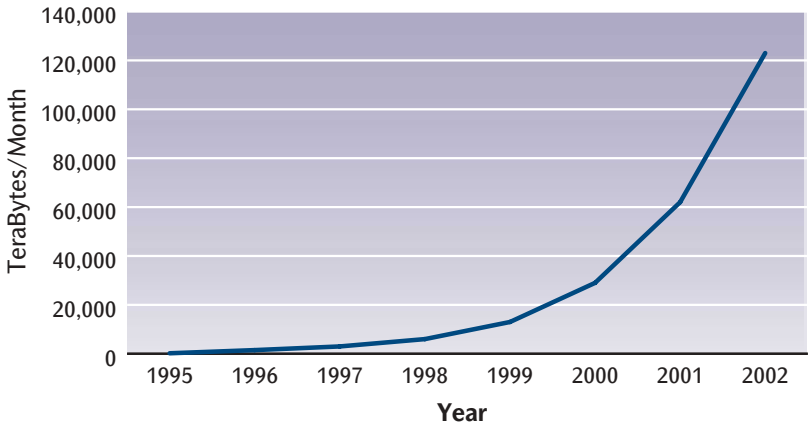
There are a number of recognised broadband trends which underpin the analysis of how much broadband capacity users will need in Ireland. The core trends are as follows:

Increased Broadband Users Drive More Broadband Use - A significant driver behind the amount of broadband consumed is the number of users on the network. As there are more users, there is more utility in interaction between each other.

Increase in Devices on the Internet - The number of devices on the Internet not only reflects the number of users, but also the number of destinations to go to online, and associated services to consumers.

Overall Traffic Trends - Traffic on core Internet backbones has continued to grow over recent years. This traffic is directly related to the amount of broadband each user on the Internet now needs and will require in the future. Research referred to indicates that Internet traffic is likely to double every year. (see Fig.Ex.1)

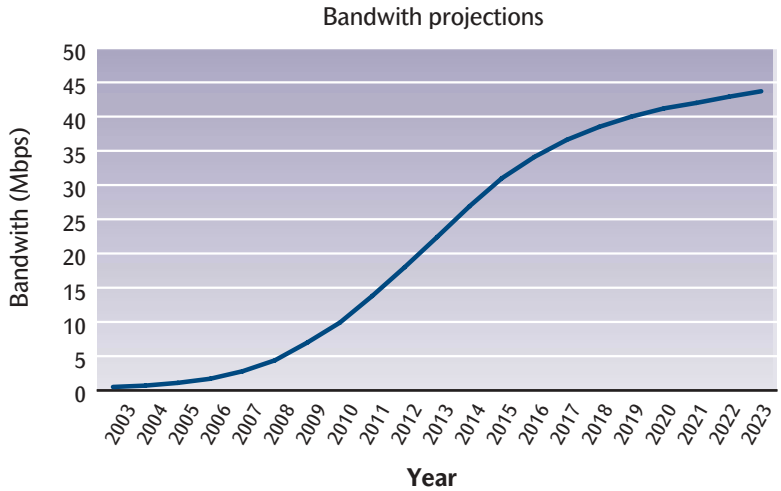
Figure Ex.1 **Traffic on Internet Backbones in the US**
(1 terabyte is the equivalent of the contents of 2,000 CDs)



Source: "Internet traffic growth: Sources and implications", Andrew M. Odlyzko, University of Minnesota, Minneapolis – Draft

Applications Getting 'Fat' - In recent years, the proliferation of multimedia content on the web, along with the file-sharing phenomenon, has driven growth in traffic needs to new levels so that the need for greater bandwith is increasing rapidly (see Fig.Ex.2)

Figure Ex.2 **Projection of bandwidth used by an Irish consumer**



Source: Sonas Innovation

In summary, this graph projects the broadband usage levels set out in the table below

Table Ex.4 **Projection of bandwidth used by an Irish consumer**

Year	Bandwidth Usage
2005	1Mbps
2010	7 Mbps
2015	28 Mbps
2020	40 Mbps

Source: Sonas Innovation

The simple message emerging from this research is that when broadband is made available to users, they have an intrinsic capability to utilise it and to require more.

(b) Key Recommendations to Government

Introduction

This Report reinforces what is already well-known: that ubiquitous access to low-cost broadband services has become an essential tool to ensure Ireland's continued competitiveness. Recognising Ireland's vulnerability as a regional economy, the impact of falling behind is even greater for this country than for others. Apart from the clear economic and social benefits to be reaped from ubiquitous availability of broadband, as amply demonstrated in this report, the consequences of the alternative state of affairs are equally clear. Our recent sluggish performance highlights the risks of Ireland trailing behind developing nations which have the capacity to leapfrog ahead of us. The serious slippage in recent international rankings, while the needs of business and consumers in Ireland are increasing, must give cause for concern. Above all, this Report demonstrates that we are witnessing market failure. This underlines the need for Government action to tackle the situation.

The three main reasons for Government to take a leadership role can be summarised as follows:

- There is a strategic imperative to ensure that Ireland is well positioned in the new, knowledge-based society of the future.
- Market failure clearly exists.
- The Government's strategy for the information society, *New Connections*, set ambitious national objectives and targets for broadband access and take-up, but all the evidence shows that at the present rate of progress these will not be realised. There is, therefore, a need to revitalise and reinvigorate the commitments in *New Connections* with more deliberate and concerted action to ensure that policy targets are met.

National Broadband Strategy – A Government Priority

Broadband connectivity should be treated as a priority basic infrastructure which can deliver very tangible benefits to the economy in the short to medium term.

Recommendation 1:
An Action Plan which specifies clearly what must be done, who should do it, the means by which it will be achieved, and times and targets for completion, should be immediately developed and agreed by Government.

The Action Plan should both specify direct action from the Minister for Communications and set priorities across other key government strategies, policies and programmes e.g. the National Spatial Strategy, the Health Strategy, and planning regulations. Government must ensure that the actions of each of its departments are appropriately aligned to deliver the Plan's priorities.

The Minister for Communications should be given responsibility for delivering a costed, integrated plan in the form of a National Broadband Telecommunications Infrastructure Programme with clear targets and provided with the resources to ensure its implementation. The latter should include:

- **The provision of multi-annual budgets to ensure stability; and**
- **A mandate to ensure appropriate policy direction to ComReg regarding competition enhancement, and to introduce any necessary legislation to enhance ComReg's powers.**

Stimulating Competition between Platforms

Evidence from the Report is illustrated in the map above. There is simply little or no competition outside the major population centres and a failure to invest and develop the market for broadband on the part of the dominant player. Other significant problems include the limited spread of cable network and wireless networks to provide platform competition, high incumbent wholesale prices and inequality between urban and rural areas with respect to basic availability of service, choice of providers and price. The effective monopoly of the incumbent means that it has very considerable market power and, in a profit-driven environment, will seek to maximise returns from its extensive infrastructure. While there is some evidence of roll-out of DSL services in recent months, cover is still extremely limited, wholesale prices are high and consequently retail prices are not sufficiently low to attract widespread take-up. The comparisons with other countries are stark.

There is a need for greater clarity on the extent to which Government and ComReg favour competition based on access (to the incumbent's network) or on platforms/facilities. The emphasis on access-based competition to date is a reflection of the nature of the market in Ireland and, until recently, the limited availability of competing platforms.

In an environment where a much greater variety of broadband delivery technologies are now being deployed or emerging (e.g. FWA (Fixed Wireless Access), WiFi (wireless LAN), powerline communications, 3G mobile, satellite, fibre to the home, etc), consideration must be given to whether the promotion of platform, or facilities-based competition would deliver better choice to customers at more competitive prices.

Recommendation 2:
Government and regulatory policy should shift the focus of incentives and support measures towards a platform-led basis to facilitate the emergence of technology platforms that will deliver investment in broadband infrastructure.

As is evident from the case studies, a leased line is the only option in many areas and is also hugely expensive, particularly outside the population centres.

Recommendation 3:
ComReg should review the pricing structure for leased lines with a view to finding ways of cutting the retail price to consumers.

Recommendations 2 and 3 should have the effect of enhancing the competitive environment and reducing the market power of the current dominant player, while also perhaps forcing the pace of investment and marketing initiatives by the existing market participants.

Government Involvement in Direct Infrastructure Provision

While progress on Phase 1 of the Metropolitan Area Networks (MANs) is welcome, the ISC is concerned about the delay in the establishment of the Managed Service Entity (MSE). There is also much uncertainty about subsequent phases of the MANs programme and the fate of the NDP budget of €152m for regional broadband deployment. Government intervention in the provision of core infrastructure is crucial if the principles of the National Spatial Strategy are to be adhered to. Current market failure is contributing to increasing the digital or spatial divide, is affecting regions' attractiveness as locations for investment; and may ultimately lead to job losses and corporate relocations away from the regions, which would be a catastrophic outcome. On the other hand, the economic and social benefits of fostering broadband access across the country will lead to the regeneration of target areas, enrichment of local communities, improvement in quality of life, and an increase in teleworking with the associated economic benefits of reducing traffic congestion, pollution and rural depopulation.

Recommendation 4:
The establishment of the MSE should be expedited and the position regarding further phases of the MANs programme clarified. There is a need to make a detailed assessment of the current broadband status of the towns originally targeted for rollout under the MANs programme and to adjust and implement further phases of the MANs programme accordingly.

In *Building the Knowledge Society* published in December 2002, the ISC pointed out that a number of state bodies (ESB, CIE and Bord Gas) had made significant investment in 'backbone' of broadband infrastructure (fibre) with NDP support. These networks are currently inactive and thus not delivering value to the bodies themselves, the government or the consumer.

Recommendation 5:
The broadband infrastructure assets of state bodies should be managed by the MSE, when it is established, in order to provide an alternative 'backhaul' from MANs towns to international connections, thereby further stimulating competition.

The focus on the provision of competitively priced 'backhaul' facilities needs to be matched by an emphasis on 'last mile' (ie. connectivity to the customer's premises at reasonable cost) solutions. Pilot trials using a variety of technologies (wireless, satellite, PLC etc) are already underway while other initiatives are currently under consideration for possible funding by the Department of Communications and the CLAR programme.

Recommendation 6:
The usage of further incentives to stimulate the introduction of 'last mile' solutions at reasonable prices to customers, particularly in areas with dispersed populations, is urged. Fast-tracking of the existing plans for pilot trials and an expansion of the programme to find innovative means of local broadband delivery is also recommended.

Demand for Broadband Infrastructure

The Report demonstrates clear evidence of demand and need. It also highlights the likely patterns of usage once business users and consumers become familiar with the technology itself and with its potential uses (applications). Models of user behaviour in adopting other technologies are well-documented as is the particular Irish appetite for embracing new technologies, once their utility is proven (the phenomena of Irish commitment to Playstation usage and PC gaming generally, mobile phone ownership and use of texting are good examples). While the key issue is of course price – new products and services must be accessible at a reasonable cost – it is also abundantly clear that public awareness and understanding of the potential benefits of broadband are lacking.

It has become urgently important to demonstrate what broadband can deliver in terms of cost saving, efficiency, comparative advantage and entertainment. Businesses and consumers alike, locked into one system, may be reluctant to change/upgrade their communications services or providers in the absence of clear, objective information about the benefits of broadband. Currently, virtually the only sources of information about broadband are the advertising campaigns of the telecommunications providers themselves. These do not, by and large, address the wider issues or play a sufficiently educational role. At the moment, they are principally targeted at "early adopters" – those who already understand broadband.

Recommendation 7:
Government should intervene on the demand side to initiate customer-led, customer-focused information campaigns and marketing initiatives designed to increase public awareness and familiarity with the uses and benefits of broadband. Such campaigns could be co-funded by, and operated in partnership with, the private sector.

The campaigns should be targeted at specific sectors – business (especially small businesses and entrepreneurs), healthcare, education, local communities, potential teleworkers etc. They should focus on actual applications and uses, including 'best practice' examples relevant to each sector. Peer-to-peer marketing should be deployed wherever possible.

Recommendation 8:
As a further demand stimulus, larger employers should be encouraged to fund broadband connections at home for their employees. This has already happened in some firms in Ireland and, apart from the benefits of employees' remote access, the potential for the speed-up of literacy and application adoption are obvious.

Government as Demand Stimulus

Recommendation 9:
Government should support the adoption of ICT, thereby stimulating demand for broadband sevices, through:

- **Procuring ICT services in a way which actively promotes competition in the telecommunications market**
- **Putting in place a strategy for the use of ICT in the health services as an enabler of efficiency and effectiveness**
- **Prioritising ICT literacy through setting national targets**
- **Putting in place a strategy to have all schools ICT enabled within three years while ensuring parallel curricular reform**
- **Positioning e-government in such a way as to maximise access and the acquisition of skills for usage, in parallel with an appropriate programme of information and training**
- **Facilitating the community and voluntary sector to engage with, and participate in, information society initiatives;**
- **Recognising and finding ways of addressing security concerns among consumers.**

Need for more Effective Measures of Progress

The lack of adequate measures for monitoring the information society has been highlighted in this report. Data deficiencies may inhibit measurement of the impact of ICT and the case for a rollout of broadband. A preliminary set of (consumer, business, and structural) indicators has been identified for Ireland, mainly based on work done in the US. Some of the indicators identified may be usefully compared with competitor economies while others would require time series analysis.

Recommendation 10:
Data deficiency issues should be addressed as a matter of urgency, to enable effective monitoring of the information society. This requires the development of performance indicators and adequate measures of the impact and outcome of programmes and initiatives.

List of Figures

List of Tables

1 Introduction

Introduction

This report focuses on the potential future take-up and usage of broadband services by consumers in Ireland. It sets out an economic analysis of the importance of widespread take up of broadband and assesses current availability of service.

Aims and Objectives of this Report

The overall aim of this report is to highlight some key issues in relation to the provision and availability of broadband communications infrastructure in Ireland.

Our aims and objectives in this report are to:

- Investigate the importance of broadband for Ireland's future economic development [Section 2]
- Analyse broadband availability and take-up in Ireland today [Section 3]
- Show in practical terms how the take up and usage of broadband can develop in Ireland in the medium to long term [Sections 4 and 5]
- Inform and support recommendations to Government by the Information Society Commission on broadband policy development

The report is structured to meet the objectives listed above and addresses the key themes as a series of questions.

The question addressed in Section 2 is – 'Why Does Broadband Matter?'. The purpose of this section is to address the concern amongst many policy makers and industry players that much of the broadband agenda is built on technology hype. This section examines issues relating to the potential economic impacts of broadband in Ireland. These are covered under three broad headings: the impact on Ireland's productive potential, the impact on consumers, and the impact on Government policy.

The current level of broadband availability and take-up is assessed in Section 3 – 'Where Are We Now?'. While a brief review of narrowband internet services and international broadband capacity is included here, our focus is on national broadband networks and services. We compare the technical capabilities and current roll-out of competing platforms. A brief analysis of the market structure for broadband supply is undertaken and a set of indicators is proposed for more accurately measuring the development of the Information Society. This section concludes by assessing Ireland's current performance against the Government's targets for the sector.

Sections 4 and 5 have a future-based focus and seek to chart how broadband can develop in Ireland in the medium to long term.

Section 4, 'How Many Broadband Users Will There Be?', analyses how changes in user behaviour result from the acquisition of new ICT technologies. It draws on technology adoption patterns for similar types of services and concludes with two projections of the number of broadband users in Ireland over the next 20 years.

Section 5, 'How Much Broadband is Needed?', reviews developments in a number of key sectors (e.g. education, healthcare, and communications) to show how broadband availability can lead to new ways of performing essential functions. Consideration is also given to the longer term trends of the evolution of IT and communications technology since the 1980s. Drawing on international trends for bandwidth usage, a projection is made of the bandwidth to be used by a typical Irish consumer over the next 20 years.

What is Broadband?

Broadband services are communications services which provide users with high speed and always-on connections to access the internet and transfer data. Broadband services can be delivered in a variety of means to end users. Existing telephone and cable TV networks can be upgraded to support these services. New delivery platforms are coming on stream to provide users with the prospect of even greater choice.

There has been much debate about the speed of broadband services. A simple way of considering broadband speeds is to compare them with what is on offer to users who do not have access to broadband. Most dial-up internet services use a modem which gives a maximum data speed of 56kbps (56,000 bits of information per second) and an average somewhere around 40kbps. Most entry level broadband services offer a download speed **ten** times as fast.

The price of broadband services is also an important driver of demand. It will be demonstrated that significant reductions in the retail price of broadband services have been a key factor driving their take-up. For example, today consumers in Ireland can use a broadband service for less than €60 per month. As recently as 18 months ago broadband type services would have cost six times as much.

In technical terms, **'Broadband' is a high speed and always-on communication service.** The two main technical characteristics are as follows:

- Speed – this describes how much information can be transferred over the connection each second. It can vary from 256 kbps to 10 Mbps (10m bits of information per second) and above. We believe that a speed of 256kbps is the minimum level at which a service can be considered to be a 'broadband' service. This threshold is acknowledged by international authorities (for example, see Paltridge, OECD 2001). The actual speed of a broadband service is determined by the needs of the user and the capability of the underlying network.
- 'Always-On' – this means that the link does not require time or technical skill to make ready. It is as easy to use as turning on a television.

High capacity communications connections (technically equivalent to broadband) have been available for many years, following the development of digital technologies in the 1980s. Ireland's national telephone network has been fully digitalised for almost ten years. Today high capacity connections are available to every single business and home in Ireland – in the form of leased lines on the eircom network. The key factor inhibiting take up of these services on a mass scale is their cost - the cheapest 256kbps leased line service currently available from eircom at the time of writing costs over €1900 to connect and €375 per month in rental – excluding VAT. Research from ComReg shows that at these price levels consumers in Ireland will not take up the service in large numbers.[4]

4 "Consumer demand for Broadband in Ireland" ComReg/MRBI, September 2002

In parallel with the digitalisation of networks a number of other developments (such as the development of the internet, falling technology costs, and liberalisation of the telecomms markets) have together contributed to create the circumstances where high capacity communications services can now potentially address a wider market. Today broadband services are available to consumers in Europe at prices which make mass take up possible. For example, in the case study on 'Broadband Availability for Teleworker in Sweden' a 2.5Mbps broadband service was available for €25 per month.

The definition of what is a "reasonable cost" will vary from person to person. However, the ComReg research referred to above concludes that a price of €30/€40 (incl VAT) per month is required to ensure significant take-up in Ireland.

Bringing the various elements together – **Broadband service is a communications service offering a minimum speed of 256kbps and always-on functionality available at a reasonable cost.**

Case Study

Celtic Transcripts

www.celtictranscripts.com

Background:

Healthcare providers have many problems to tackle in the current environment, such as:

- Improving patient care
- Reducing medical errors
- Controlling spiralling costs.

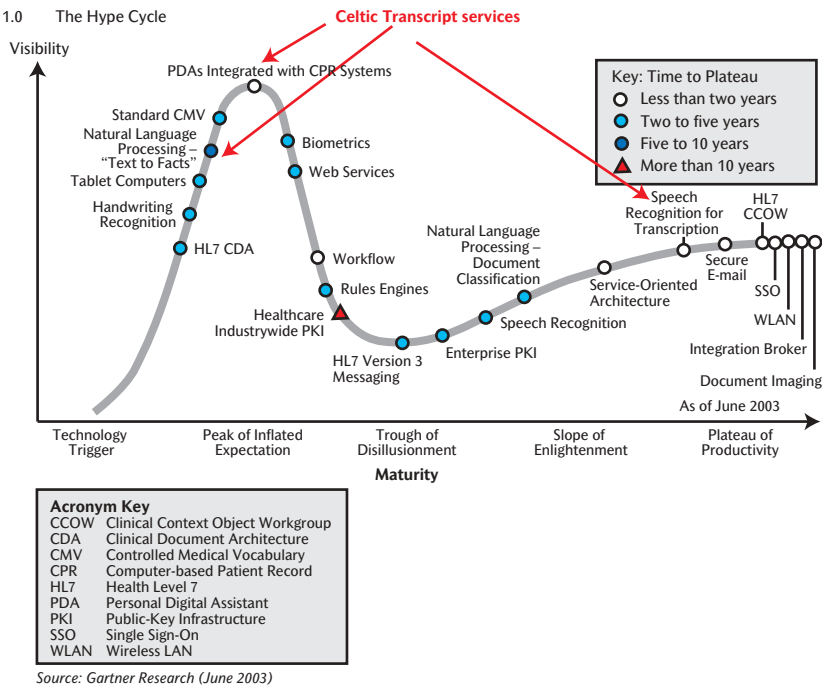
In this environment, IT has a large role to play. Computer based patient record systems, made portable by wireless and mobile personal digital assistants can help physicians and other providers to give better care by facilitating faster and more comprehensive sharing of patient information.

Improved information input technologies, such as natural language processing, and voice and handwriting recognition, will also play a large role.

The US market is the most advanced market for computer-based patient records at this time with Gartner forecasts stating that 'By 2005, speech recognition will become the preferred method of physicians and nurses for entering text data, achieving up to 70% productivity gain'

This is the niche market in which Celtic Transcripts, a Gweedore based company founded in 2002, operates. The diagram below, by leading international IT research company, Gartner, plots the emergence of technologies that are developing with the primary aim of addressing the specific needs of the Healthcare market. The red arrows indicate the technologies that support Celtic Transcripts service offerings. Celtic Transcript is at the forefront of speech and transcription developments.

Fig 1.1 **Gartner Hype Cycle for Healthcare Provider Technologies, 2003**



Source: Gartner Research (June 2003)

Celtic Transcripts

Located at an Údarás business park in Derrybeg, Northwest Donegal, Celtic Transcripts is a high growth company employing 50 knowledge workers who provide the US market with specialist medical transcription services.

The sophisticated technology supports a simple service model:

1. Celtic Transcript provides healthcare practitioners with digital dictaphones and related computer software.
2. The healthcare practitioners use the digital dictaphones to record patient interactions. This information is then uploaded to a secure Celtic Transcripts website.
3. Celtic Transcript staff converts the Dictaphone records to high quality, structured, US regulation compliant medical records, within 24 hours.
4. The documents are returned to the Celtic Transcripts secure website.
5. These records are then available for downloading by the originating practitioner for their own use, or for sharing in other patient management applications, as appropriate.

Key factors in the high adoption rate for this technology are:

– That it requires no behaviour change by the medical practitioners
– The availability of wireless and mobile technologies.

Celtic Transcripts is well placed to exploit the benefits of this lucrative niche market and expansion plans are in place to increase staff numbers up to 200 by 2006, by entering new markets and by extending voice transcription services to other sectors e.g. legal.

Communications is a Critical Success Factor for the survival and growth of Celtic Transcripts

A critical success factor for the achievement of these aggressive growth targets is the availability of competitively priced, reliable, broadband services in Derrybeg, County Donegal.

The company has outgrown its original configuration of 4 ISDN lines and currently uses a 2Mbps Digiweb service that costs €160 per month. This move has resulted in file download improvements – from 11 to 3 hours. Unfortunately there is a downside to this progress. Potential latency problems between the US doctors' broadband connections and the satellite service can occasionally result in lost doctor voice files. In order to avoid this possibility, Celtic Transcripts have deviated from their IT and management plan and moved their server to their US based office. The preferred strategy would be to locate the server in Donegal.

Drivers for further Broadband investment

The need for significant expansion in bandwidth is clear and compelling.

Immediate:

1. A recent sales achievement with a UK media company has created a requirement for the capability to download very large voice narrative files for conversion (up to one gigabyte) on a regular basis.

Future:

2. The combined plans for 800 clients on the books by 2005 and a fourfold increase in staff numbers will translate to a requirement for a minimum 8GB of data transfers each day

The current broadband configuration and support is inadequate to deal with these requirements.

Broadband expansion options available to Celtic Transcripts

Broadband connectivity options for Celtic Transcripts, in the near future are limited and expensive:

1. Purchase a leased line. They have been given an indicative cost of €50,000 per annum for the provision of this service. With negotiation, this might be reduced by 10-15%.
2. Incur the capital cost of the purchase and installation of a satellite and transponder (up to 40 MBPS capacity). Bandwidth would then be purchased separately. This option will incur a significant capital investment although on-going cost of ownership would be reduced.
3. Gweedore (approx 7 miles from Derrybeg) is nominated as a Metropolitan Area Network. The cost of laying fibre to connect to the MAN would incur an indicative cost of €100 per metre.
4. Údarás could undertake the capital cost of building a peer to peer network to service the business park, connect to the MAN, or Eircom service and then charge occupants for bandwidth. This option is attractive only if the service levels on offer meet Celtic Transcripts' business demands.

Options and Price Comparison with organisations with a similar workload, located in Dublin:

1. Leased line. Cost of approx €2k per month.
2. Co-location approx €100 per megabyte per month.
3. Wireless connection 2mbps approx €599 per month, 10mbps approx €2k per month

Note:
Dublin is roughly comparable to the UK and US for these specific services although certain MAN connections in certain US cities will be less expensive.

Conclusions:
High speed broadband communications are much more difficult to access and are up to 20 times more expensive in Derrybeg, creating a considerable competitiveness burden for high tech industry locating in remote rural locations.

2 Why does broadband matter?

Why does broadband matter?

Information technology has become ubiquitous in modern economies, the importance of knowledge as a key wealth creating resource continues to grow, and connectivity creates a whole new dimension for the use and development of technology and knowledge. Opinions differ, and it is clear that there is considerable uncertainty, regarding the ultimate effect of the increased use of information technology on the structure and performance of economic activity.

In this section we set an economic context for the evaluation of communications and broadband policy in Ireland. A number of areas are investigated where economic competitiveness would be affected by the extent of broadband usage and the impact of ICT on economic performance is assessed.

Structural Shift in the Economy

In addition to undergoing a period of rapid growth over the past decade, the Irish economy also underwent considerable structural change. This change was not unique to this period but has been continuing for a number of decades. What was different during the high growth period was not just the pace and clear direction of the change but also that gains in output and employment were far greater than the losses that occurred in sectors from which the economy was changing. Table 2.1 shows the output growth of the various broad sectors of the economy in each 5-year period since 1971. In effect, these numbers can be interpreted as the contribution of each sector of the economy to Ireland's Gross Domestic Product (GDP) growth in each period.

Table 2.1 **Annual Growth in GDP by Sector (%)**

	1971-1999	1985-1990	1990-1995	1995-1999
Agriculture	0.3	0.3	0.3	0.1
Building and Construction	0.3	0.1	0.3	0.6
High-tech Manufacturing	3.1	4.1	2.9	7.4
Traditional Manufacturing	0.7	0.5	0.8	0.7
Market Services	1.9	1.8	2.1	3.5

Source: Slevin (2002)[5]

Table 1.2 shows the changes in manufacturing output in the high growth period comparing activity in traditional industry, food processing and high tech sectors. The potential for the output of high tech sectors where affiliates of foreign owner Multi-National Corporations (MNCs) dominate to be distorted by transfer pricing has been widely commented on and, as a result, any output based data on the Irish economy – including labour productivity – must be handled with caution. However, given that Gross National Product (GNP) – which nets out the impact of MNC profits – grew by 54% in real terms in this

5 *"Is there a New Economy in Ireland?" Slevin, G, Central Bank of Ireland Technical Paper 3/RT/02, 2002*

period, it is clear that the high tech sector provided the source of growth while the traditional and food processing sectors grew only slowly. This is reflected in the second half of this table which shows the output of high tech manufacturing increased from 55.9% of the total to 69.8% in just 5 years.

Table 2.2 **Gross Output by Industrial Sector**

	1995	1996	1997	1998	1999	2000
(€billion)						
Traditional	8.3	8.5	9.0	9.2	9.5	9.9
Food Processing	10.8	10.9	11.0	11.8	12.4	12.9
High Technology	24.2	27.2	33.5	41.2	47.3	52.7
(% of total)						
Traditional	19.1	18.2	16.8	14.7	13.8	13.1
Food Processing	24.9	23.4	20.6	19.0	17.9	17.1
High Technology	55.9	58.4	62.6	66.3	68.4	69.8

Source: National Competitiveness Council (2002)

Further evidence of the growing importance of the high tech sector of the economy is provided in Table 2.3 which shows employment in these main sectors in this period. This shows that while employment in the traditional manufacturing and food processing sectors was almost static, employment in high tech manufacturing grew by almost 30,000 or 26.7%.

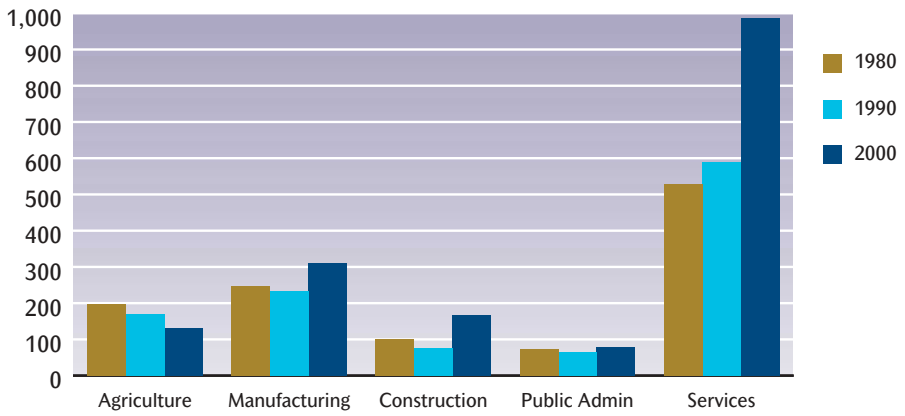
Table 2.3 **Employment by Industry Sector (000s)**

	1995	1996	1997	1998	1999	2000
Traditional	81	81	83	82	83	81
Food Processing	40	41	41	41	42	42
High Technology	105	110	122	126	129	133

Source: National Competitiveness Council (2002)

However, this strong performance in manufacturing needs to be placed in the context of a longer term trend of change in the economy that is shown in Table 2.1. Although employment was rising in high tech manufacturing, the trend for the whole economy has been strongly towards employment creation in services. These two trends have been major elements of the evolution of the Irish economy in recent years.

Figure 2.1 **Numbers Employed by Broad Sector ('000)**



Source: National Competitiveness Council (2002)

When these measures are combined the result is a rapid rise in productivity in the high tech sector with much lower, although generally positive, rises in productivity in the traditional and food processing sectors. This is the case in almost every 5-year period between 1971 and 1999, becoming much more pronounced during the 1990s. A second important point is that services became an increasingly important source of economic growth in the 1990s and this coincided with a rapid increase in service exports.

Imperative to Sustain Productivity Growth

The focus in Ireland has generally been on the importance of broadband in preserving Ireland's **relative productivity** in the face of other economies. This contrasts somewhat with many countries where the focus has been on the role of broadband interconnectivity on improving the **overall productive capacity** of the economy and reflects the importance that is attached to international competitiveness in Ireland. There is good reason to conclude that the Irish focus on the impact of broadband on competitiveness rather than productivity is the correct approach given the extreme openness of the economy, the reliance on fairly mobile capital and the continuing pace of structural change in the Irish economy. In a world of mobile capital and competing locations, even a marginal advantage can lead to a large gain in terms of the location of production i.e. a 'winner takes all' type of situation.

Foundations of Competitiveness

According to Porter (2001) competitiveness must not be analysed as a zero-sum game between economies in which the more competitive nations gain additional market share at the expense of others[6]. Lower wages, which would lead to a gain in competitiveness in terms of the market share view, do not necessarily lead to a gain in welfare and will not ultimately lead to sustainable competitive gain in the absence of gains in the underlying value-adding potential of the economy. Rather, competitiveness is built on productivity where an improvement can lead to an increase in the standard of living in all countries. This has two further implications. First, while macroeconomic balance is required it is not sufficient and microeconomic policies hold the key to developing competitiveness. Second, the crucial role of productivity means that the entire economy matters in determining the standard of living and not just the internationally traded sectors. As a result Porter concludes that competitiveness depends on productivity which is determined by microeconomic performance in two interrelated areas:

1. the sophistication with which companies in the country compete; and
2. the quality of the business environment.

These insights are reflected in many areas of economic policy in Ireland in recent years. MacSharry and White relate the difficulties that were experienced in the 1980s when initiatives to attract foreign investment to Ireland, no matter how consistent internally, were constantly undermined by the adverse macroeconomic imbalances being experienced[7]. By the mid-1990s, these problems were considerably eased and attention could increasingly focus on the microeconomic foundations of the economy. Since then, while the low interest rate environment and the effective devaluation of the currency in the advent of EMU (Economic and Monetary Union) provided a boost to the economy, the boost was to an already booming economy. The policy foundations of this were located in incomes policy, taxation policy, competition policy, re-regulation and a whole range of initiatives in the general area of industrial policy. These interventions are almost wholly concerned with the effective working of markets or with improving market incentives. As such, they are microeconomic, meaning that the key elements of national economic policy in Ireland over the past decade have been microeconomic with macroeconomic policy mostly limited to avoiding excessive exchequer deficits once the decision to join EMU had been made.

Viewed in this light, the principal economic metrics related to the Irish economy over the past decade – high growth, falling and then low unemployment, a strong balance of payments, etc. – are outcomes of an economy that has undergone a competitive improvement and not the result of macroeconomic policy intervention beyond the role of policy in the avoidance of harmful imbalances. This analysis effectively reverses the idea that as the macro economy improves the microeconomic functioning of the economy

6 *"Enhancing the Microeconomic Foundations of Prosperity: the Current Competitiveness Index",* WEF Global Competitiveness Report 2001-2002, *Michael Porter, 2001*

7 *"The Making of the Celtic Tiger", MacSharry, R. and P. White, 2000*

follows and is very much in keeping with Porter's finding that microeconomic conditions in an economy have a causal relationship with the level of GDP and with changes in the level of incomes. As a result, microeconomic reform is at least as important as macroeconomic reform in determining performance and, as economies converge in terms of macroeconomic policy and performance, microeconomic polices probably become the key arena in which governments can affect performance.

Disproportionate Impact of Falling Behind

This characterisation of the Irish economy must not be interpreted as concluding that the challenges have all been met. Not only are there still weakness in the functioning of many markets but a new set of challenges, of which the growing importance of the knowledge economy is among the greatest, need to be met. Furthermore, there are two additional vital issues to be considered.

While it is true that productivity must be seen as the determinant of competitiveness, the fact remains that an economy's sustained competitiveness is determined by its productivity gains relative to its trading partners. Thus, while competitiveness is not a zero-sum game in the aggregate, national competitiveness is still related to market share.

Second, even if a simple relationship between productivity and competitiveness is assumed in terms of causation, this does not imply that the gains from improved competitiveness are similar to those from productivity gains. To see this, assume that all economies in the EU experience a 1% improvement in productivity. Productivity has improved and the standard of living will rise, but relative competitiveness has not changed. Change the assumption so that one country with an open economy experiences a 2% increase in productivity. In this case, the potential is that the standard of living in that country will rise by far in excess of the productivity gain since it has now also had a relative improvement in competitiveness.

For a small open economy such as Ireland, trading on world markets, this means that the welfare gains from improved productivity, if there is an improvement in competitiveness relative to its trading partners, are potentially far greater than the rise in productivity would initially suggest. However, the reverse is also true. A fall in competitiveness such as might be experienced by relatively slow or inadequate access to broadband has implications for the standard of living well in excess of what measures of productivity might suggest.

Regional Imbalances

As the Irish economy has grown in recent years, regional imbalances have become ever more obvious. Unless developed in an optimal manner, broadband could make this situation worse by providing superior access in leading, generally urban regions. Furthermore, research shows that the benefits of connectivity may be difficult to predict since network effects mean that the past can be a poor indicator of the future. **However, if appropriate investment is undertaken, broadband holds the potential to overcome a number of the problems that have been associated with unbalanced regional growth.**

While the magnitude of the potential benefits of a better distribution of economic activity is difficult to assess, it is known that investment in upgraded infrastructure is required if they are to be realised. A number of alternatives are possible including enhanced transport and utility infrastructure in rural areas. The question then is to identify the most cost effective. **The available data show clearly that, where connectivity is important, by far the most cost effective infrastructure is ICT related. Thus, it can be stated with certainty that while broadband infrastructure is expensive and return on investment is strictly long term, it is far less expensive by a factor of 10 and more, in the case of most relevant alternatives, when compared to other infrastructure costs such as roads, water and electricity.** Broadband may eventually diffuse through the economy, even in the absence of state involvement. **Therefore, the real issue is the fact that policy initiatives will speed up the process.**

The problem with including these issues in any assessment of the benefits of broadband is that, although they are important, there are no effective methodologies for the measurement of these dynamic effects. Indeed, instances of the successful application of weights to recognise the different marginal utilities of income in areas with contrasting economic performance are rare, even where the dynamic network effects are not recognised. The result is that the CBA (cost benefit analysis) approach will underestimate the potential benefits of broadband in terms of its long term impact on the spatial distribution of production and households in Ireland.[8]

The idea that there is an optimal spatial distribution for economic activity and household formation in Ireland has been implicitly accepted in both the NDP and the National Spatial Strategy, although the current distribution diverges considerably from this optimal. The argument being made here is that the attainment of this optimal would be made more feasible by the availability of broadband in currently lagging regions. Similar arguments lead to conclusions in relation to the distribution of income that promote the idea that there are economic gains – in excess of the welfare benefits of reducing poverty – that arise from promoting greater social inclusion.

While increasing attention has been paid to achieving regional objectives in Ireland and in Irish economic policy, the evidence of the past decade is that, apart from the important contribution made in this area through the reduction in unemployment, the development of the economy has not improved the distribution of income in the manner that might have been hoped. Just as the leading regions have gained most from growth, the stronger income groups have gained from rising prosperity. However, many of the benefits of balanced regional development and enhanced social inclusion are not marketed. These include issues such as a greater choice of where to live, less lost commuting time, lower congestion in the Dublin region and the welfare gains of participation in economic activity. As a result, their evaluation is very difficult but clearly positive in terms of economic welfare.

The Importance of Broadband

Given the critical importance of maintaining and improving relative productivity, i.e competitiveness, and the demonstrable national and international trends towards information based economies, the importance of widely available broadband connectivity has been identified and integrated into policy objectives at national and EU levels.

Following on from the initial eEurope 2002 Plan, the European Commission has produced an action plan, *eEurope 2005.* The aims of this plan are that by 2005, Europe should have widespread availability of broadband access at competitive prices and a secure information infrastructure to ensure modern online public services and a dynamic e-business environment.

The focus on identifying the impact of broadband in Ireland has correctly been on the impact on competitiveness rather than productivity. Forfás placed the economic role of broadband technology in context:[9]

> The ability to create, distribute and exploit knowledge and information is the main source of competitive advantage, wealth creation and improvements in quality of life … World class broadband telecommunications infrastructure and services are essential to the development of a knowledge-based economy.

This reflects the earlier assessment by the *National Competitiveness Council* that 'broadband services are now key determinants of competitiveness'.[10] Placing a valuation on these benefits requires that some estimate is available of the extent to which broadband will improve competitiveness, the effect that this will have on the level of production in the economy and the impact of this growth on welfare. In other words, to what extent would broadband improve competitiveness and in what way would increased competitiveness translate into increased output and incomes?

8 *It is expected that broadband will promote teleworking and therefore allow for more flexible living and working patterns. This has definite benefits but these are fully included in the consumer surplus approach above. The effects being discussed here arise from externalities that can be harnessed to alter the spatial distribution away from congested areas through enhancing the competitiveness of non-urban areas*

9 *"Broadband Investment in Ireland: Review of Progress and Key Policy Requirements", Forfás, 2002*

10 *"Statement on Telecommunication: a key factor in electronic commerce and competitiveness.", National Competitiveness Council, 1998*

ICT Can Enhance Productivity

Research indicates that technology investment alone does not create increased productivity. The simple insertion of ICT into existing work practices will not deliver the expected increases in productivity but where ICT allows for new ways of working to emerge, major gains can be made[11]. US studies at sectoral levels have concluded that experience was varied with different sectors performing much better than others[12]. Among the best performers were the ICT producing sectors, such as semiconductors and telecoms, which accounted for only 8% of US GDP but 36% of productivity growth between 1993 and 2000.

The research found that although most sectors of the US economy experienced positive productivity growth, the change was concentrated in only six sectors of the economy – semi-conductors, wholesaling, securities, retailing, computer manufacturing and telecoms – and that ICT was only one of several factors that contributed to the growth of productivity in these sectors. Other important factors included capital availability and cost, process innovations, new products and changes in the regulatory environment, as well as the impact of demand in a booming economy. In addition, behind many of these lie further influences such as the motivation to gain efficiencies that is provided by the tightening labour market that was experienced in this period.

Given this finding, follow-up research addressed the question of how ICT affected productivity in these sectors and the conditions under which this positive impact might be maximised[13]. The main finding of this work was that the relationship between ICT and productivity is complex and varied, not only between sectors, but within industries also. In summary, the findings suggest that it is not the nature of the technology that is employed that matters, nor the sectors in which it can be used – although important fundamental influencing factors will be present in some sectors only at a particular point in time – but the way in which the ICT and processes within the industry are managed that is the crucial determinant of the productivity gains that are experienced.

In summary, these findings mean that ICT is only one contributor to performance, albeit an essential ingredient and its payoff will be positive and sustainable only when the investment is tailored to needs. This means that the focus of attention to realise a productivity improvement must not be on the technology but its use. Otherwise, the investment will become just another cost item. This has implications for the development of new applications and services to be delivered as well as the provision of new infrastructure.

Increase in Economic Activity

The economic activities enabled by broadband can increase the value of jobs in Ireland. This has become widely articulated as a key goal of policy. There is a direct and indirect economic impact of this increase, and values for the likely impact will be investigated here.

Research suggests that there may be considerable scope for improvement in Ireland's telecommunications infrastructure with associated improvements in economic competitiveness[14]. In an assessment of the state of development of broadband in Ireland in 1998 and of the potential gains from new infrastructure, Forfás found that investment in broadband would lead to considerable economic gains for Ireland[15]. This report found that there was a large and widening gap between the facilities that were available in Ireland and those provided in a range of other countries, many of which are competitors with Ireland for trade and inward investment. The analysis concluded that a failure to do this would result in job creation in manufacturing and trading firms falling 25,000 short of the targets that had been set for 2010. This shortfall would arise due to the loss of competitiveness in industry and would be only part of the lost opportunities for Ireland. The Forfás work estimated elasticities for the major variables and found that

11 *"Beyond Computation: Information Technology, Organisational Transformation and Business Performance" Journal of Economic Perspectives, Volume 14 (4), Brynjolsson E. and L. Hitt, 2000*

12 *"US Productivity Growth 1995-2000: Understanding the Contribution of Information Technology Relative to Other Factors", McKinsey Global Institute, 2001*

13 *"How IT Enables Productivity Growth", McKinsey & Co., 2002*

14 *"National Investment Priorities for 2000-2006" ESRI Policy Research Series No. 33, March 1999*

15 *"Broadband Telecommunications Investment in Ireland", Forfás, 1998*

broadband investment of £200 million (€254 million) along the lines discussed in the report would increase Irish GDP by $4 billion (€5 billion) per annum and create an additional 35,000 net new jobs by 2010. Furthermore, given the direct contribution that access to enhanced telecommunications can make to economic welfare and its role in promoting more balanced economic development, as recognised in the *National Development Plan 2000-2006,* there would be additional gains through these developments.

The *National Competitiveness Council* (NCC) has argued that broadband access is vital to improving productivity in Ireland and would also contribute significantly to reducing costs in production[16]. Although adoption of new ebusiness technologies by companies in Ireland, including SMEs, is high, the availability of broadband needs to be accelerated from its current growth if the 'always-on' technologies that will be required in the future for these companies to compete are to be available.

Connectivity is a key requirement in promoting the development of the new economy and the fact that ICT may have counted for about 65% of the growth in labour productivity in the US in the late 20th century has been put down in considerable measure to the development of connectivity in this period[17]. The *Brookings Institute* has estimated annual savings from connectivity at over $370 billion for the US in 2005[18]. In other research, over 90% of respondents reported that the gains resulting from increased productivity exceeded the cost of the DSL service[19]. This research also showed that 76% of respondents found improvements in productivity and 70% found improvements in customer relations when broadband services were introduced. Other benefits have also been found as a result of greater use of teleworking including higher employee satisfaction and productivity. This also gives rise to potential savings in terms of travel time and costs and reduced congestion. These have been estimated at $23 billion per annum for the US.

In summary, research indicates that there are positive impacts on productivity and competitiveness as a result of access to broadband and that this level of inter-connectivity is necessary for the productive capability of earlier ICT technologies to be realised due to the time and cost savings that are available in the deployment of these technologies.

Broadband and Employment Creation

The effects on the economy of widely available broadband services are predicted to include increased direct employment and knock-on indirect employment and higher value employment.

Although its relatively low dependence on international trade means that the US is not a good comparator for Ireland, research there indicates some parameters for assessing the extent to which competitiveness gains are important[20]. It has been estimated that a full rapid roll-out of broadband would create in the region of 1.1 million permanent jobs in the US. The same research also showed that there are a number of aspects to the competitiveness issue. Non-access to broadband does not only lead to a competitive loss relative to others but that it will lead to absolute losses as well. This arises since download times on the internet for non-users are increasing considerably by as much as 50% in the past two years as content providers design increasingly complex sites and systems. This means that there is a good reason why businesses, even if relatively sheltered from competition, need access to broadband.

Indirect effects of investment have accounted for an important part of the benefits that have been identified in many CBAs in Ireland, particularly prior to the mid-1990s. However, although the net benefit of these impacts in a full-employment economy will be reduced, they remain particularly important in this project. There are two reasons for this. First, the reduction in unemployment does not mean that the knock-on effects of any investment are reduced, it just means that the net benefits of this are lower. This should be accounted for by using an appropriate shadow price for labour, probably in the region of 90 to 100% of the wage rate unless the impact is felt in a lagging region. Second, an important issue is that

16 *"Statement on Telecommunication, eBusiness and the Information Society" National Competitiveness Council, 2000*

17 *"The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?" Journal of Economic Perspectives, Volume 14 (4), Oliner, S. and D. Sichel, 2000*

18 *"Net Impact Report" in association with the University of California-Berkeley and Momentum Resources Group, Brookings Institute, 2002*

19 *Research undertaken in the US by the Yankee Group published at www.sbc.com*

20 *"Building a Nationwide Broadband Network: Speeding Job Growth." TeleNomic Research, Va., Pociask, B., 2002*

indirect effects of investment in advanced technology are thought to be much greater than for the economy in general. This arises because of its productivity impact in sectors other than ICT where the technologies are used and applied. This raises an important issue. The main effect of broadband will not be an increase in the number of jobs but an increase in the value of the employment that is available. In many respects this equates to the objective of improved competitiveness in the future: it allows for higher value added employment rather than aiming at increased employment. It is important that the opportunity cost of labour that should be used – that is, the shadow wage – should be based on the value of employment in the absence of broadband. This provides an argument that the shadow wage of 'new' employment should be below the wage rate, even in an environment of full employment. The new employment might not be additional jobs, but they are higher value jobs replacing what previously existed.

International research suggests however that the impact of investment in ICT is much more extensive than for the economy in general. Pociask reports that ICT multiplier effects are greater than for investment in general with the multiplier effect of the introduction of Microsoft software being estimated at 6.7. This is extremely high but is indicative of the productivity impacts that are possible. However, the multiplier effect of broadband is likely to be lower because while its potential applications are very wide it is not as fundamental a technology as a basic operating system. It does appear likely that a multiplier in the region of 4 may be appropriate. In other words, 4 indirect jobs would be created for every 1 job created directly in the investment in broadband. Once again, it is worth noting that in the labour market that exists in Ireland, this should not be interpreted as 4 additional jobs, but that additional value equivalent to what would be created through 4 additional jobs will be created indirectly in the economy for every direct job created through enhanced productivity as a result of the availability of broadband. This is a total effect, the net benefits being found by the subtraction of the shadow wage, in this case, the value of the current employment of these people in lower value added activities.

The factors from this research are applied to employment in Ireland and are represented in Table 2.4:

Table 2.4 **Broadband and Employment Creation**

Industry	Employment Growth in US due to Broadband (% p.a.)	Employment in Ireland (000s)	Potential Job Growth in 10 Years
Manufacturing	1.2	215.8	**27,300**
Healthcare	1.1	32.5	**3,800**
Finance & Business	1.5	113.9	**18,300**
Hotels & Restaurants	0.9	46.9	**4,400**
Other Services	0.9	159.9	**15,000**
Wholesale & Retail	1.2	128.6	**16,300**
Total:		697.6	**85,100**

Note: Employment estimates for Ireland are based on the CSO's Quarterly National Household Survey, Seasonally Adjusted Series for February 2003

The table shows net employment creation of just over 85,000 could result in the first 10 years of broadband adoption if Ireland progressed along the lines of the US. In fact, the structure of the Irish economy, in particular its openness means that the potential may be greater. The US economy is effectively limited in productive capacity by the size of the US market with exports playing a relatively small role. However, there is not such a constraint in Ireland since most manufacturing is destined for export to a global market that is effectively unlimited, provided Ireland is competitive. Thus, the potential in manufacturing is probably greater, and subsequent demand would push up employment creation in the supporting service sectors.

However, this approach, while producing some indicative estimates, includes productivity gains only. It is therefore appropriate for the US but not for Ireland. If competitiveness is introduced then the gains could be a lot greater but two important issues arise. The first is that in assessing the gains from competitiveness it is important to remember that the concept has a meaningful interpretation only in relation to some other benchmark. The impact of this is that the gains in competitiveness from broadband

– assuming that our competitors develop broadband at least as quickly as Ireland (which is probable) – are better expressed as the avoidance of losses. In other words, once the gains from productivity are included, if all countries develop broadband at the same rate, there are no further actual gains to be included. However, if one lags the others then redistribution takes place whereby the lagging economy suffers losses that are redistributed as gains to competitors. Furthermore, this will probably not amount to a zero sum and the overall balance will show a loss due to a weak member of the trading system.

The second issue is that the impact of competitiveness on the economy is very volatile with respect to measurement. **Indeed, for a technology such as broadband, even a relatively small deficiency could have a large impact on the competitiveness of the economy.** This is distinct from productivity since it needs to include the impact that international competitiveness has on the underlying structure. As a result, predicting gains on the basis of the existing economy is unlikely to produce reliable estimates.

It is difficult to quantify exactly the differential value of this employment. However, an estimate will be instructive to put the value of this prize, or indeed penalty into context. It could be estimated that should there be a €10,000 differential in annual salary in the value of this employment, then there is a direct value of €851m annually to the economy.

Broadband and Consumer Spending

In this sub section we examine the potential impact of broadband on the standard of living of Irish residents. The approach taken in this report is based on identifying the consumer surplus that would be associated with access to broadband. Consumer surplus is an old idea in economics but can be confusing. Put simply, it can be thought of as a measure of the effect on the standard of living of a consumer from being able to spend income on a product – compared to a situation where the income was available but the product was not. It depends on the observation that if the welfare received by a consumer from a purchase was measured fully by the price of the item bought then there would be no reason for the consumer to undertake the transaction. If the consumer decides to go ahead with the transaction then it can be concluded that the welfare received from the product or service exceeds its price.

Broadband technology will undoubtedly add to the wealth creating potential of the economy, even if this ultimately only amounts to preserving Ireland's relative standing with other countries who invest in the technology, and a lot of attention has focused on this issue in Ireland and abroad. However, it is ultimately the extent to which broadband affects the consumption possibilities of Irish residents that leads to increases in welfare[21].

This is in keeping with Porter's argument that competitiveness based on achieving lower wages where labour productivity does not increase is unsustainable, although the underlying argument is different. The approach adopted in the EU indicates that this point is accepted and considerable emphasis is being placed on the use of broadband technologies in enhancing the quality of life of EU citizens in addition to the competitive gains that the technology offers to producers. This is also more inclusive than a focus that emphasises the impact on productive capacity only.

The economic benefits that would accrue to consumers as a result of household broadband access arise from a number of sources, including:

- **home retail shopping for goods and services;**
- **the ability to access digital entertainment;**
- **reductions in commuting costs and the revenues associated with teleworking;**
- **increased ability to access telephony and communications services;**
- **enhanced community strength;**
- **access to government; and**
- **savings and revenues associated with telemedicine and distance education.**

21 Consumption here is broadly defined and should not be read as relating to expenditure on material goods and services only. An example would be greater choice regarding where to live and still remain part of a particular community through online communication

However, consumers do not perceive the opportunities that are available since they expect a gradual development of the technology rather than the step-change that broadband would induce. Therefore, there may be many new uses in the future that are currently unforeseen that will be stimulated by the advent of broadband. We examine this issue in greater detail in Section 5. This is supportive of the conclusion that the use of broadband, and therefore the benefits that will accrue, will be supply driven and will not arise for as long as investment takes place only in response to observed demand. However, it is also possible to argue that consumer demand will be important in the development of consumer products and that the extent of the benefits that arise will depend not just on the potential that is created through incentivising infrastructure and creating an amenable competitive industry but also on the ability of consumers to adapt and avail of the new opportunities that arise. In a sense this argument reflects the earlier point regarding the productivity effects of ICT where the ability of people to utilise the technologies and adapt systems and structures determined the payoff.

It is unlikely that the prospect of higher speed internet access will be sufficient to encourage consumers to pay for broadband access. As a result, the greater variety of services that will be available on broadband when compared to the alternative technologies provides the key to understanding the potential value of this business to consumers. Research indicates that consumers would be willing to pay for online entertainment services provided they were of the quality of delivery that is promised by broadband access[22]. This work estimated that entertainment services in the US would have market revenue of about €6.6 billion per annum currently. Furthermore, the number of consumers willing to pay for education online was nearly as great although revenue here would be lower at about €3 billion.

Other research in the US has produced a range of values for a number of consumer markets. These estimates are summarised in Table 2.5[23]. As well as indicating potential magnitudes these estimates also provide an indication of the uncertainty that surrounds the commercial potential of broadband. This table also contains derived estimates of the potential of the Irish market[24]. These are based simply on the US estimates rescaled to the smaller size of the Irish market and lower GDP per capita in Ireland in purchasing power parity[25]. They are clearly subject to errors of magnitude.

Since these estimates are derived from a wide variety of sources it is to be expected that there would be considerable variation in underlying methodologies and also the possibility that similar activities could be included under different product categories in different studies. As a result, the rows of this table are not additive in the sense of providing an indication of the potential consumer market. However, some are clearly distinct.

22 "Customers at the Gate: Mounting Demand for Broadband-enabled Services", Sage Research, 2002

23 The work from which these estimates are derived has been undertaken by a wide variety of researchers in commercial organisations and academia. This table is based on a review of this work contained in eMarketer (2002) The Benefits of Broadband. Many of the estimates assume that about 50% of the population will have broadband access within a fairly short period i.e. by 2005/6, although this assumption also varies

24 A €/US$ exchange rate of parity is used in producing the Irish values

25 According to The Economist World in Figures 2003, Irish GDP per capita in 2002 was approximately 75% of the US value when measured in terms of purchasing power parity

Table 2.5 **Annual Broadband Consumer Revenue Estimates**

Product Category	Year	US Value Range (US$ billion)	Rescaled to Ireland (€ million)
Access revenue	2004	7.9 – 31.2	83.5 – 330
IT Equipment	By 2011	110	1,163
Residential Gateways	2006	5 – 24	53 – 254
TV and movies	2005	0.3 – 3.9	3.2 – 41
TV and Movies	2010	5.5	58.1
Continuing education		3.0	31.7
Telemedicine		2.6 – 20	27.5 – 211
Telephony		1.9 – 51	20 – 540
Unified messaging	2005	1.0 – 2.1	10.6 – 22.2
Telecommuting		1.0	10.6
Online gaming	2005	1.2 – 2.8	12.7 – 29.6
Shopping		74.0	782
Streaming	2005	7.5	79.3
Advertising	2005	3.1 – 3.5	32.8 – 37

Source: eMarketer (2002)

Taking mid-point values for Ireland, these estimates suggest that annual consumer expenditure on access to broadband services, TV and movies, education, telemedicine and online gaming would reach €400 million within a few years. When online shopping and other potential revenue sources are included, consumer expenditure using broadband could be 3 times this figure. Forecasts indicate that private consumer expenditure in Ireland in 2003 will be in the region of €63 billion in total[26]. This suggests that consumer expenditure utilising broadband services would be in the region of 2% of total consumer expenditure with a few years i.e. when potential access reaches about 50% of the population. This does not include expenditure on equipment to support operating platforms.

While these extrapolations provide indicative estimates, the fact is that uncertainty over uses that consumers and producers of consumer products will find for broadband makes the prior estimation of the benefits of access particularly difficult from a socio-economic point of view, just as it introduces additional risk for potential investors in the private sector. As a result, while the analysis could try to predict what services consumers will buy, this approach is very speculative. An alternative approach is to concentrate on estimating consumers' willingness to spend in acquiring broadband access for whatever purposes as an indication of the value that may be extracted. The model for the evaluation of consumer benefits therefore concentrates not on the direct impact of broadband on consumers' decisions but on the change in consumer welfare that would result from its availability.

The concept of consumer surplus is discussed in Appendix 2 to the report[27]. The concentration on consumer welfare in general rather than expenditure on individual goods and services may appear at first to be a sharp deviation from the usual approach to economic appraisal as used, for example, in undertaking cost benefit analysis. In fact this is not the case but is a return to the basic methodologies that underlie such procedures and recognises the fact that the nature of the expenditure that will take place is unknown. Importantly, this approach is perhaps more appropriate for a general analysis of the impact because actual instances of investment and consumer expenditure are not being specified but a general development of the integration of a new technology into the economy. Only as specific costs and benefits become clearer in the future would it be valid to implement precise CBA techniques[28].

26 *ESRI (2003) Quarterly Economic Commentary, July*

27 *For a full understanding of the discussion, the appendix should be read in conjunction with this section. However, it can be omitted for brevity*

28 *Research in the US shows that this approach, based explicitly on measuring consumer welfare, may be more appropriate for appraising the benefits to households of broadband access than an alternative that attempts to predict the future uses of the technology. See Crandall, R. and C. Jackson (2001)* The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access, *Criterion Economics. In the analysis, this consumer welfare approach actually found estimates of benefits for the US that were very close to what was obtained by placing valuations on a speculative basket of possible future services that consumers might purchase*

In the case of typical broadband services, consumers either subscribe to the service, or they do not. As the uses of broadband multiply, the value to subscribers, as defined under the consumer surplus approach, rises far above the monthly subscription price. Placing a value on potential consumer surplus requires a number of assumptions regarding the likely rate of consumer penetration and the price that consumers will be willing to pay to be connected. These are detailed in Appendix 2.

The calculation shows that achieving a rate of penetration of 90% in 20 years would give rise to consumer surplus with a present value of €1.3 billion. This is approximately equal to about 1.2% of GNP at present. In other words, the development of broadband along these lines increases economic welfare by approximately 1.2% of GNP as a result of increased consumer surplus.

However, there are issues related to accessibility in areas of low population density that will affect household uptake. To accommodate this it is assumed that penetration in towns rises to about 40% in the first 10 years and 90% in the following 10 years from a base of 5% in the first year, but reaches only 10% of rural households in the first 10 years and 50% after 20 years from a base of 1% in the first year. This lower penetration of rural households reduces the present value of consumer surplus over 20 years to €0.96 billion or 0.9% of current GNP. This estimate is about 26% below the previous estimate based on a total take-up of 90% of all households and arises as a result of the additional costs to be addressed in providing broadband in areas of low population density.

Broadband and Public Services

There is obvious potential for the development of new services and new methods of delivery of Government services. One of the greatest problems with providing projections in this area is that the actual range of potential consumer uses of broadband and the business models that will be used to supply these markets remains very unclear. However, in areas such as telemedicine, efficiencies have been researched and measured.

It has been estimated that an investment of $18 billion in ICT in medicine delivery in the US would yield savings of greater than $120 billion for the healthcare industry over a six year period[29]. This saving would represent about 1.5% of the estimates US annual expenditure on healthcare of US$1,300 billion. While it is clearly difficult to extrapolate from this, a similar percentage cost saving in Ireland would reduce public expenditure on health, which is currently running at close to €9 billion per annum in total, by close to €150 million in 2004. However, this cost saving would be only a small part of the potential gains since overall efficiency, the quality of service and delivery in rural areas would also improve. These represent clear benefits over and above any savings.

Increased efficiencies would accrue to many other areas within Government. Full exploitation of these efficiencies requires a complete deployment of ICT including access to broadband technologies. Increased efficiency would be the first step along transformational change, allowing for increased effectiveness such that the quality of services delivered to citizens would improve.

Conclusions

The Irish economy has seen significant structural change in recent decades. High-tech manufacturing has been the driving force behind Irish economic growth for over 30 years. This trend became much more pronounced during the 1990s. The services sector became an increasingly important source of economic growth in the 1990s and this coincided with a rapid increase in service exports.

29 "Building a Positive, Competitive Broadband Agenda." www.positivelybroadband.org, ITAA, 2001

Competitiveness is a key metric governing Ireland's future economic success. There is a need for every aspect of Government policy to maintain absolute focus on ensuring that relative productivity increases continue. For a small open economy such as Ireland, trading on world markets, this means that the gains from improved productivity, if there is an improvement in competitiveness relative to its trading partners, are potentially far greater than the rise in productivity would initially suggest. However, the reverse is also true. A fall in competitiveness, such as might be experienced by relatively slow or inadequate access to broadband, has implications for the standard of living well in excess of what measures of productivity might suggest.

Productivity growth is the essential requirement for maintaining and improving competitiveness. Research has shown that it is vital that investment at the firm level is accompanied by process innovations and that the technology employed must be appropriate to needs. As such, investment in IT is only one element in achieving productivity growth. This requirement is reflected at national level in the need to ensure that macroeconomic imbalances are avoided, that appropriate microeconomic initiatives are introduced in a range of areas and that the structure of the economy is such that the potential of technological progress can be realised. There is reason to believe that Ireland is in such a situation suggesting that there are potentially large gains but that the potential losses from falling behind are also considerable.

The evidence indicates that the potential productivity improvements from broadband services are considerable. The role of broadband technology in boosting competitiveness and economic activity has been emphasised by many State bodies – including Forfás and the National Competitiveness Council. **It is estimated that broadband could result in net employment creation in the region of 85,000 jobs in Ireland over the first 10 years of its widespread adoption by business over and above what might be created by the economy. A conservative valuation of this employment would be €851m annually – representing a prize or penalty for the Irish economy.**

Consumer expenditure utilising broadband services would be in the region of 2% of total consumer expenditure within a few years. Research undertaken, principally in the US, has been drawn on to provide indicative estimates of consumer spending from broadband related purchases. These estimates suggest that annual consumer expenditure on access to broadband services, TV and movies, education, telemedicine and online gaming would reach €400 million within a few years. When online shopping and other potential revenue sources are included, consumer expenditure using broadband could be 3 times this figure.

If it is assumed that broadband access will reach 90% of households in 20 years and available data for willingness to pay are used, then consumer surplus with a discounted present value of €1.3 billion or about 1.2% of Irish GNP is estimated. However, access in areas of low population density may be slower to develop. If take-up in rural areas is only 50% in 20 years then this estimate could fall by 26% to €0.96 billion or 0.9% of current GNP. There is obvious potential for the development of new services and new methods of delivery of Government services. In areas such as telemedicine, efficiencies have been researched and measured. It has been estimated that an investment of €18 billion in ICT in medicine delivery in the US would yield savings of greater than €120 billion for the healthcare industry over a six year period[30]. This saving would represent about 1.5% of the estimates US annual expenditure on healthcare of US$1,300 billion. While it is clearly difficult to extrapolate from this, a similar percentage cost saving in Ireland would reduce public expenditure on health, which is currently running at close to €9 billion per annum in total, by close to €150 million in 2004.

Cost savings are only a small part of the potential gains since overall efficiency, the quality of service and delivery would also improve. These represent clear benefits over the straightforward cost savings. Increased efficiencies would accrue to many other areas within Government. Full exploitation of these efficiencies requires a complete deployment of ICT including access to broadband technologies. Increased efficiency would be the first step along transformational change, allowing for increased effectiveness such that the quality of services delivered to citizens would improve.

30 *"Building a Positive, Competitive Broadband Agenda." www.positivelybroadband.org , ITAA, 2001*

3 Where are we now?

Where are we now?

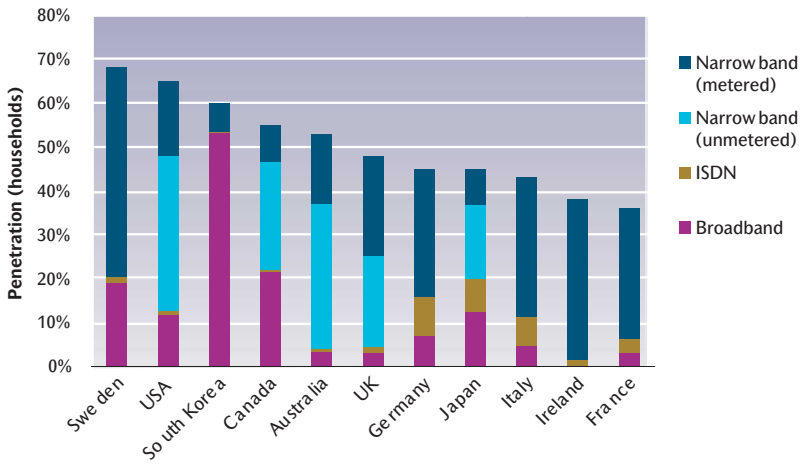
In this section the rate of adoption and the availability of broadband services is assessed. Regarding the future development of broadband availability, potential market failures where the private sector may be unable or unwilling to provide service are explored. This latter review focuses especially on the possible failure of the private sector to deliver services critical to the Government achieving its own targets for the development of this market.

From Narrowband to Broadband

Before fully considering the availability of broadband in Ireland, we will start by focusing briefly on the uptake of basic or narrowband internet services.

Ireland's consumption of gaming, news, mobile telephony, and video entertainment is in the leading group of OECD countries. Despite flat-rate narrowband internet access services only becoming available in Ireland recently, our overall usage of internet access is at a reasonable level. Of the order of 40% of Irish homes use the internet today.[31] This is illustrated in Figure 3.1:

Figure 3.1 **Ireland's Internet Access Market**



Source: Broadband Stakeholder Group (UK) Second Annual Report, November 2002; Analysis

31 *"Consumer TrendWatch" Amarach Consulting for Comreg, February 2003*

Irish consumers also demonstrate a positive attitude towards taking up broadband services. A recent survey found 46% of home users and over 50% of SMEs "fairly" or "very" likely to subscribe to a broadband service.[32] The reasonable conclusion is that Irish SMEs and residential consumers are likely to be eager users of broadband in the right circumstances.

However, making the move from narrowband to broadband requires more than a general interest in usage of new technologies. The presence of a number of other factors is required, including:

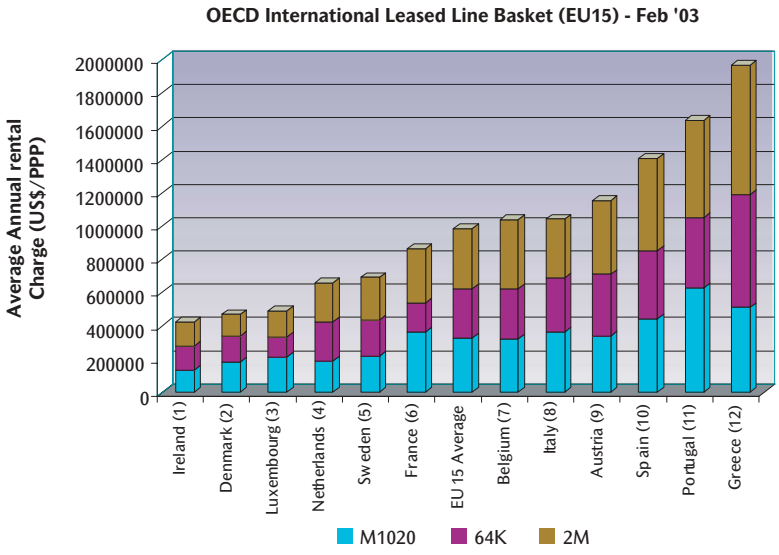
- investment by operators to upgrade networks to broadband capability
- the presence of market or other forces to bring prices to levels that will attract consumers.

Broadband Availability in Ireland

Ireland compares well with other countries regarding availability and pricing of very high capacity international broadband services. In recent years we have seen several major international communications cables established in Ireland by companies such as NTL, Global Crossing, Network 360 (now Hibernia), and Esat BT. All of these cables connect into network nodes in the Dublin area, and there is a high number of competitors who control broadband infrastructure and offer services out of Dublin. The presence of over 10 major carrier hotels or co-location facilities in the Dublin area underlines this point.

The price levels for high capacity international links reflect the impact of competition between the various suppliers. The following chart shows that Ireland is the best in the EU for international broadband pricing:

Figure 3.2 **Ireland's International Broadband Standing**



Source: Comreg

However, investigation of broadband services available outside of the large international nodes in Dublin tells a very different story. This is confirmed by the appraisal of national availability levels in the following pages. It is also backed up by the views of a range of experts and users who made contributions to this study.

32 Consumer Demand for Broadband in Ireland, ComReg/MRBI September 2002

Case Study

Business Disadvantaged in County Clare

Bealtaine Ltd. is a localisation company with a difference – the vast majority of people working on any of its projects at a given time are teleworking (working in a location remote from the office, and connected using ICT). The company, based in Scariff, Co. Clare, has a full time staff of only seven yet it makes use of a network of over 500 expert translators from all around the world.

Example projects include a recent win, valued at €750,000, to translate and publish documents for the Department of Foreign Affairs arising from the Irish Presidency of the European Union. Turnaround target from document receipt to publication on the Presidency website is only 2 hours.

Their outsourced model adds scale to the business, such that people assigned to projects can be grown from 7 to 70 rapidly.

However, Bealtaine's Directors Nana Luke and Martina Minogue are concerned that the lack of affordable broadband will hurt the company's competitiveness: "It will be necessary for us to have broadband to be successful in the future".

The company finds it has a very limited set of broadband options. The cost of narrowband internet access is currently running at €250 per month.

This is now becoming a critical issue for their business, "Large emails can take hours to download slowing down work in the office. This is a central part of our business", says Nana Luke.

The issue is only likely to become more acute for the business, as its directors note: "File sizes are getting bigger, and applications such as online conferencing are becoming commonplace".

Having a broadband service would have a huge impact on Bealtaine's operations. Receipt of and responses to customer emails, which often contain large files, would be accelerated. Management of teams of international teleworkers would become much more efficient.

Recently, Bealtaine were considering getting a new software package from Canada which would have allowed them to communicate with and manage their teams more effectively. This system would support on-line team meetings with video conferencing. However, the Company could not run the demonstration because their download speed was too slow.

Bealtaine are actively looking at upgrading their service. Satellite is one option. They have received a quote for a 2Mbps satellite connection which would cost €699 per month on top of an installation fee. They are concerned that availability of better broadband at more competitive cost to competitors in other countries will negatively impact their business.

Conclusions

- Narrowband internet access imposes very high costs and restricts some important business communications activity.
- Bealtaine's rural location places them at a disadvantage for the availability of broadband services.

Which Platforms Are Providing Broadband Services?

The following paragraphs compare the different platforms or networks currently providing broadband services in Ireland.

1. **Fixed-line telephone network**
   Traditional telephone lines can be upgraded to support broadband services – known as digital subscriber line (or DSL) services. DSL services are generally available to any phone user within 3km of the local exchange. However, due to the poor condition of some telephone lines, not all consumers living within the 3km range will be able to receive service.

DSL services are generally aimed at both small businesses and households and in Ireland currently offer services from 512kbps up to 2Mbps. Prices for DSL currently start from around €55 per month, in addition to connection fees and charges for modems. Eircom recently announced a special offer for new connections based on a free modem and free connection.

In Ireland, eircom owns the national fixed network and has been upgrading exchanges to support DSL services over the last two years. Eircom aims to have 1m lines (out of a total of 1.6m) DSL enabled by end 2003. Other operators can provide DSL services to end users over the eircom network and a number of companies currently provide services in this manner. Figures from ComReg show that that there are now over 7,000 DSL broadband users in Ireland[33].

Throughout the EU, the network of the incumbent fixed-line telephone operator is the primary means of delivering high speed services. Today the EU has over 11m DSL lines in operation. This represents 6% of the total telephone lines in the EU. In Ireland DSL lines account for less than 0.7% of the national total.

2. Wireless Networks

Developments in technology have allowed new high capacity services carried over radio signals to emerge. These 'wireless' broadband services are generally aimed at business users and are typically available in the centre of large cities. These services have had a considerable impact in some countries but have not achieved mass availability or take-up. It remains to be seen what impact they will have in Ireland in the medium to long term.

In Ireland there are a number of operators providing wireless broadband services to over 5,000 users. Key players include Leap, Irish Broadband and Digiweb.

Prices are generally similar to those pertaining to DSL services. However, in recent months some prices for wireless broadband have been positioned at a discount. For example, Irish Broadband offers a 512Kbps service for residential users for €30 (incl VAT) per month.

Standards are emerging which may allow much higher speed services over wireless.[34] New interactive uses of radio frequencies allowing for 'intelligent' radio devices may allow for more efficient use of the scarce spectrum resource and faster lower cost services.

ComReg has been to the fore in seeking to license new operators for wireless broadband and a recent competition for local licences received 128 applications.[35] Government funding has also been provided for a number of pilot programmes for innovative wireless services.

3. Cable TV Networks

There are almost 500,000 homes connected to cable TV in Ireland. This is amongst the higher penetration levels in the EU. Cable TV networks can be upgraded to support broadband services via cable modems – with services aimed at households and small businesses.

In the EU, almost 4m cable TV customers have been upgraded to broadband services. In many countries (e.g. the UK, Belgium, Denmark, Sweden, Netherlands and Austria) the number of cable modem customers is around the same or greater than the number of DSL users. Cable modem services provide by far the strongest competition to DSL services.

In Ireland there are far fewer cable modem customers compared with, for example, the UK where there are 1 million cable modem users (5% of households)[36]. There are around 3,000 cable modem users in Ireland (0.35% of households) today.

Significant capital expenditure is required to upgrade most cable TV infrastructure to broadband functionality. To date in Ireland, very little improvement of cable infrastructure has been completed. This lack of investment is due to a variety of factors but its impact is clear.

The dynamic of network-based competition for broadband, which drives take-up in many EU States, is almost completely absent in Ireland. As a result, the imperative on the fixed incumbent to invest in broadband upgrades, and to drive consumers to take up DSL services, is significantly reduced.

33 *ComReg Quarterly Key Data, September 2003*

34 *Source: Intel announcement wireless 802.16 standard may allow for 70Mbps access with a range of 30 miles, April 2003*

35 *ComReg statement of 16 September, 2003 (PR 160903)*

36 *Broadband Stakeholders Group, Second Annual Report and Strategic Recommendations, November 2002*

4. **Satellite**
   Broadcast Satellite service providers have about 280,000 TV customers in Ireland. Interactive satellite services have also advanced to allow providers to deliver broadband services. Currently, a number of providers offer services throughout Europe and into Britain. Ireland is also covered by these services. Satellite services tend to be focused on the higher end of the market.

   The principal advantage of satellite as a means of delivering services is that it does not need any local network. This means that the same choice of services are available in rural areas as in cities. Currently customer numbers are less than 1,000.

   It is important to note that there are some technical questions regarding whether Satellite will have the capacity to provide a mass market service. Satellite broadband services typically serve businesses users.

5. **Fibre**
   Fibre networks are in use in Ireland for highly trafficked links. These include international trunk links and national backbones. Local fibre links are typically only in place to business parks, large businesses and high density city centre locations.

   Fibre will typically be deployed for links of speeds between 2 Mbps and 10 Gbps (one Gbps = one thousand Mbps). Fibre (or its copper hybrid, VDSL) is not available to the mass market in Ireland today. This type of network almost exclusively serves large businesses.

Where is Broadband Available?

Table 3.1 lists the cities and towns where broadband services are available in Ireland. The main providers for each service are identified.

Table 3.1 **Locations of current broadband availability**

Service provided via	Main providers	Location Available
DSL on eircom's network	Eircom Resellers of eircom wholesale services	Dublin, Cork, Limerick, Galway, Drogheda, Dundalk, Monaghan, Wicklow, Arklow, Greystones, Portlaoise, Naas, Lexilip, Celbridge, Maynooth, Carlow, Athy, Waterford, Wexford, Enniscorthy, Gorey, New Ross, Kilkenny, Clonmel, Mallow, Bandon, Macroom, Killarney, Tralee, Listowel, Shannon, Ennis, Newmarket, Westport, Castlebar, Ballina, Athlone, Mullingar, Sligo, Letterkenny, Carrick-on-Shannon, Navan, Ashbourne
DSL via Local Loop Unbundling of eircom exchanges	Esat BT	Centre of Dublin, centre of Cork, Limerick, Galway, Greystones, Wicklow, Arlow, Kilkenny, Gorey, Enniscorthy, Waterford, Mallow, Tralee, Killarney, Thurles, Clonmel, Navan, Drogheda, Athlone, Mullingar, Ballinalsoe, Ballina, Sligo
Cable modems on cable TV networks	NTL Chorus	Tallaght, Lucan, Kilkenny, Clonmel, Thurles
Broadband wireless	Leap Irish Broadband Digiweb	Centre of Dublin, Cork, Limerick, Dundalk and Drogheda
Satellite	Digiweb Aramiska	Nationwide

Source: Sonas Innovation

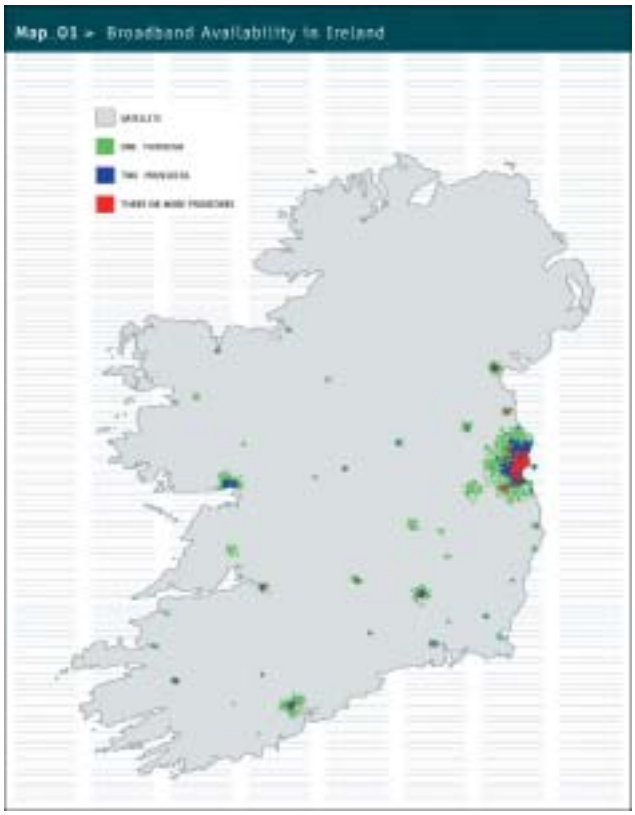
This information is also represented on a map (see overleaf). In the map the network information is overlaid to give an illustration of areas where consumers have a choice of providers. Satellite services are available in all parts of Ireland. The choice of terrestrial broadband providers (i.e. DSL, cable modem, or wireless) is represented in green for one provider, blue for two and red where three providers offer service in a geographic area.

The Department of Communications, Marine and Natural Resources has also partially funded local authorities to build communications infrastructure in regional locations in Ireland. The Regional Broadband Programme aims to establish broadband service availability to many urban areas within Ireland through the construction of carrier-neutral, open access Metropolitan Area Networks (MAN). These projects will consist of metropolitan fibre optic cable and ducts with co-location space available on an open-access basis.[37]

Nineteen towns have been selected to date as part of this programme: Athlone, Ballina, Carlow, Carrick-on-Shannon, Clonmel, Cork City, Digital Hub/Liberties area in Dublin, Dungarvan, Galway City, Gweedore, Kilkenny, Letterkenny, Limerick City, Manorhamilton, Mullingar, Portlaoise, Roscommon, Tullamore, Waterford City, Wexford.

A competitive process is currently underway to select the entity that will manage these networks on behalf of the State. Issues such as interconnection of each MAN, and reach of the network to a high proportion of the areas served are to be resolved.

Once in place, these networks could potentially provide resources to further competition in the supply of Broadband in Ireland.



Source: Sonas Innovation

Market Structure and Market Failure

Clear conclusions about broadband availability and choice can be drawn from the preceding table and map:

- service availability closely follows population density
- large parts of the country do not have access to any terrestrial broadband service
- choice of service provider is, in most areas, very limited.

37 "Broadband Newsletter" Department of Communications, Marine and Natural Resources, February 2003

The preceding analysis of the market for supply of broadband in Ireland leads on to consideration of whether there is evidence of market failure and what role, if any, the State should take in addressing this situation.

The arguments presented in Section 2 show that the development of broadband in Ireland will provide a more competitive environment for business and will provide enhanced welfare for consumers. The following Sections (4 and 5) show that take-up and usage of broadband in the future should be significant. Given this, it is reasonable to ask why the State should be involved in developing a broadband policy, particularly since this is likely to involve public expenditure. The widely accepted conclusion is that, ultimately, the development and delivery of broadband services and content is a matter for the private sector.

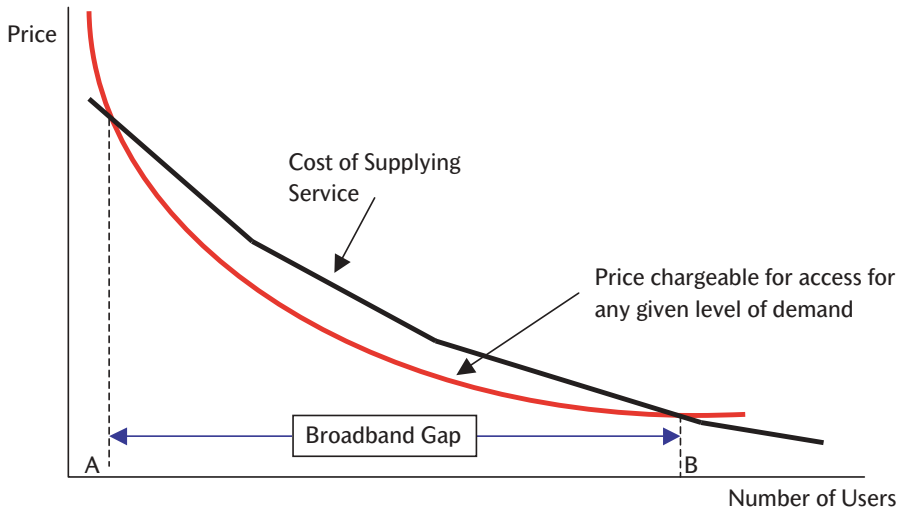
However, while the industry will be dominated by private commercial firms, although they will operate in a regulated environment for the foreseeable future, this does not mean that an economic role for the public sector is negated. Rather, closer examination shows that, as a result of some important market failures, a rationale for state intervention can be identified. This is required in order to deliver on the Government's own targets for broadband availability and access. It seems clear that the market is unlikely to take the steps necessary to achieve those targets.

Two quite separate sources of market failure can be identified that need to be addressed if investment in broadband provision is to be adequate.

The first arises from the existence of considerable economies of scale to service providers that mean that the price of access to the broadband infrastructure can fall considerably as take-up increases. This is a desirable situation but the economies of scale may be so large that the infrastructure approximates the characteristics of a public good and the growth may not come about. However, users may not perceive the full potential uses of broadband until they have started to use it. In other words, access costs need to fall first to stimulate uptake, but will not do so until uptake is sufficient to allow for the economies of scale to arise.

The relationship between price and the growth of usage of broadband would lead to a sub-optimal equilibrium that would inhibit growth. This is illustrated in Figure 3.3:

Figure 3.3 **Price and Cost of Access to Broadband**



Source: Based on Forfás (2002)

This figure shows that the cost of providing access to each user falls considerably as the number of users increases but, over a certain level of demand, the price at which suppliers would be willing to supply services is too high for potential customers. This leads to a broadband gap where, essentially, the private sector is unwilling to invest to supply services and the sector does not grow. Below output level A, larger firms for whom broadband access is mandatory, would be willing to pay the high prices implied by output A, but their number is limited. Small commercial users and domestic consumers are excluded due to the high cost of access.

At output level B and above, the cost to the supplier and therefore the price at which the service is supplied, is at or below the price level required to stimulate demand, and growth occurs. Indeed, there is the possibility of considerable profit for suppliers who can attain sufficient economies of scale to force down costs to these levels. The problem, however, is that there are clearly high risks involved in creating the infrastructure required to bring about this situation. The existence of the broadband gap means that an equilibrium is reached so that the supplier charges a high price that is sufficient to cover costs but that limits demand to output A.

The development of the Irish industry to date suggests that this may be an appropriate analysis since it explains why charges are high and take-up is low even in areas where the technology is available, but there has been little evidence of new market entrants emerging.

In Ireland, a number of factors have conspired to limit the amount of investment in existing networks. Late liberalisation of the telecomms sector (in December 1998) followed by the impact of the rapid contraction in the communications industry gave Ireland a narrow window during which major investment could realistically take place. The impact of these two factors is seen particularly in the very limited roll-out of cable modem services nationally.

This minimal availability of cable modem services has had a significant negative impact on the availability and pricing of DSL services:

- late launch of DSL – broadband services via DSL became available in Ireland in May 2002, some 3 years behind other OECD countries
- high price levels – up until very recently prices for DSL services were at exceptionally high levels. Even given recent reductions, they are still well above those available in many other EU countries.

The second market failure arises due to social benefits that will arise but will not accrue to private developers since they cannot be charged for. Many of these social benefits can be described in terms of a more inclusive society that overcomes the current problems of social and regional imbalance. Overcoming the imbalance that has emerged has been given prominence in Irish economic policy in recent years in under the regional and social inclusion programmes contained in the *National Development Plan* and in the *National Spatial Strategy*, but there is a widespread acceptance that the general thrust of Irish economic development over the past decade has tended to magnify rather than reduce the imbalances that exist. The development of broadband access in Ireland to date has further promoted these undesirable trends. **This means that while a more rapid roll-out of access to broadband may be required from the point of view of maintaining Ireland's international competitiveness, from the point of view of maximising the national benefits of having access to these technologies, a different regional and social structure of the roll-out is required.** However, above output level B costs will increase due to the need to provide access in areas of lower population density.

We conclude that this analysis provides a rationale for public intervention in developing broadband. The role of Government is addressed in the following pages.

Government Targets For Broadband Roll-Out

The Government's overall objectives for the development of broadband telecommunications infrastructure are set out in the 'New Connections' document, published in March 2002. In terms of specific targets regarding availability of services, the report (in Section 1.3) states that:

> *Government wants to see the widespread availability of open-access, affordable, always-on broadband infrastructure and services for businesses and citizens throughout the State within three years, on the basis of utilisation of a range of existing technologies and broadband speeds appropriate to specific categories of service and customers. We wish to see Ireland within the top decile of OECD countries for broadband connectivity within three years.*

The New Connections document also sets a target for household usage of broadband at 5Mb in the 2012/2017 timeframe. We analyse this target in detail in Section 5.

As the key target of Government is based on reaching a particular comparative position internationally, we believe the best approach here is to compare our broadband take-up with that of other EU and OECD countries.

South Korea is the world leader in broadband take-up. Penetration is projected to reach 12m users by the end of 2003 – representing 25% of the population.[38] DSL accounts for 55% of the total supply market, with cable modems holding 34%. Currently, over 200,000 customers have availed of new very high capacity 20 Mbps DSL services.[39] Table 3.2 provides figures for how Ireland's broadband take-up compares against a number of other EU states.

Table 3.2 **Ireland's Broadband Penetration Compared with Other EU Countries**

Country	DSL lines	Other broadband	As a % of population	EU ranking	Growth in the last 6 months
Ireland	5370	4100	0.25	14	47%
Austria	207 850	330 000	6.62	6	32%
Belgium	627 970	417 897	10.19	2	19%
Denmark	389 805	168 795	10.44	1	24%
Finland	280 000	63 950	6.64	5	25%
Sweden	591 695	299 685	10	3	36%
EU average			4.65		36%

Source: EU Commission Broadband Access in the EU (as at July 2003)

The following points should be noted from this table and an analysis of related data:

- **Ireland currently ranks second last in the EU for broadband penetration**
- **While we have enjoyed a large growth rate over the last 6 to 12 months, this must be judged against the very low level from which we were at recently – e.g. 1300 connections in July 2002**
- **The rate of growth in connectivity levels in the last 6 months is above the EU average but will not lead to Ireland closing the gap on its EU counterparts in the short to medium term**
- **For Ireland to reach the current (July 2003) EU average penetration level, we would need to grow our broadband numbers to over 175,000 – or by 1760%**
- **For Ireland to reach the current (July 2003) EU best penetration level, broadband numbers would need to rise to over 375,000 – or a forty fold increase.**

38 *Point Topic (April 2003)*
39 *Dotecon (October 2003)*

However, it must be acknowledged that the level of broadband penetration throughout the EU and internationally is likely to grow rapidly over the next few years. To assess more accurately the task that Ireland faces in meeting the Government's target by March 2005, we have projected broadband penetration in the EU over the next two years. Using the figures in the table above as a base, we use a very conservative growth rate of 10% for all countries. The result is that the EU best for broadband penetration is around 12%.

To achieve the Government's target, we estimate that Ireland will need over 450,000 broadband users in 2005 and will need to grow its user numbers almost fifty-fold from current levels.

As set out above, the current circumstances in the communications sector point strongly to a market failure in the supply of broadband. Given the potential for user uptake (see Sections 4 and 5), this holds out the prospect of a significant level of unsatisfied demand in the medium/long term. Unless this situation is addressed the Government's target for 2005 will not be achieved. **Our conclusion is that a clear imperative exists for the State taking a direct role in the communications sector.** In Section 5 of this report a number of recommendations for appropriate action by the Government will be proposed.

Monitoring the Information Society

The research undertaken in preparing this report has uncovered a number of areas where data deficiencies may inhibit the measurement of the roll-out and economic impact of ICT and broadband in Ireland. As a result, it is important that the impact of this technology and, indeed, the development of the information economy in general is monitored. Among the areas where information is deficient are:

- The potential uptake and usage of broadband by consumers;
- The likely price of access and the structure of service supply to consumers;
- The likely investment response of the private sector to initiatives by the public sector;
- Rate of adoption by industry and producers;
- Willingness of suppliers to pay for access and price elasticities;
- Metrics regarding the impact of broadband on competitiveness and economic measures such as employment, productivity, investment, regional location of production and entrepreneurship.

In the context of developing broadband, it is clearly important that the response of the sector to policy interventions is monitored and that there is good information on the development of the sector and its economic contribution. While accepting that some of the deficiencies will only be addressed as the development progresses, lack of data inevitably inhibits economic valuation.

One way that is being developed to get around this is to develop indicators of developments in the economy. One example is the new economy index for US states[40]. This approach surveys 21 indicators that are deemed to be related to the growth of the information economy. These are divided into 5 categories:

1. Knowledge jobs:

2. Globalisation:

3. Economic dynamism and competition:

4. The transformation to a digital economy:

5. Technological innovation capacity:

Even a cursory glance at this list indicates that the focus is much wider than just technology and its application. The clear message is that policy to develop IT and its application in the economy should not be seen as a separate area to be ring-fenced in terms of policy creation and delivery but as part of the overall strategy for the enhancement of the wealth creation capacity of the economy into the future.

40 *Atkinson, R. (2002)* The 2002 State New Economy Index

A set of indicators has been identified for Ireland, mainly based on work done in the US. The list is summarised in Table 3.3. Some of the indicators identified may be usefully compared with competitor economies – these are identified as comparison indicators in this table – while others would require time series analysis and are identified as trend indicators. They can be used as a guide to the role of policy and to where deficiencies may exist, and to the response of the economy following intervention.

Table 3.3 **Indicators for Assessing Ireland's Progress of the New Economy**

Description of Indicator	Comparison	Trend
Consumer Indicators		
Access to computer and to Internet (% of households)	✔	
Potential household broadband access (% of households)	✔	✔
Actual broadband uptake (number, % of households)	✔	✔
Access to broadband in Dublin and outside Dublin		✔
Adoption of new technologies	✔	
Online purchases by households (value)		✔
Use of online financial services e.g. banking online		✔
Flexible work patterns e.g. part-time or self-employment	✔	✔
Computer literacy (% of population with computer skills)	✔	✔
Education (schools with internet, pupils per computer)	✔	✔
Access/Use of e-Health services	✔	✔
Use of e-Government services	✔	✔
Business Indicators		
Corporate investment in R&D		✔
Business to business e-procurement (% of purchases)	✔	✔
Business to consumer transactions (value)		✔
Business to consumer transactions (% of total sales)	✔	
Businesses with an intranet (by size of business)	✔	✔
Trends in business inventories (as % of GDP)		✔
Number of registered trademarks		✔
Venture capital to high tech sector (value)		✔
Percentage of business with outsourcing relationships	✔	✔
Inward FDI in high tech sectors (value)		✔
Structural Indicators		
Investment in the ICT sector (% of total)	✔	✔
Internet hosts per 1,000 inhabitants	✔	
Share of output from high tech MNCs		✔
Share of output from SMEs in high tech sector		✔
Employment in high tech MNCs (number, %)		✔
Employment in SMEs in high tech sector (number, %)		✔
Value added by high tech sector as % of total		✔
Employment by enterprise size	✔	✔
Number of enterprises by size		✔
Number and proportion of Science and Technology graduates	✔	✔
Change in VAT registration per annum		✔
Employment by skill level	✔	✔
Relative Manual/non-Manual earnings	✔	✔
Government R&D expenditure	✔	✔
Online availability of government services	✔	

This list should be treated as preliminary and further research would be required to finalise the indicators in advance of evaluation. In addition, decisions would be required in respect of the relative importance of individual measures to assist appraisal.

As a preliminary measure, Table 3.4 provides values and commentary based on the work of the National Competitiveness Council[41]. The ranking provided refers to the value achieved by Ireland relative to other OECD economies for which a comparable measure was available.

41 *The main source is National Competitiveness Council (2002)* Annual Competitiveness Report 2002

Table 3.4 **Ireland's New Economy Relative to Other OECD Countries**

Indicator	Value	Rank
Number of PCs per 100 population	39.1	6th of 16
Number of internet users per 1,000 population	289.5.	12th of 16
Broadband penetration per 100 population	0.01	15th of 16
ISDN subscribers, % change 1998-99	196.6	1st of 8
Mobile telephones per 1,000 population	753.5	5th of 16
Compound annual growth of mobiles 1995-2001	61.5	6th of 16
Internet hosts per 10,000 population	33.7	9th of 16
Business to consumer transactions (US$ per 1,000 population)	20	3rd of 9
Business to business transactions (US$ per 1,000 population)	360	8th of 9
% of SMEs connected to internet	58	3rd of 10
DSL as proportion of total lines	0.06	10th of 10
ICT expenditure as % of GDP	5.7	11th of 16
ICT employment as % of total	4.6	6th of 14
Telecom investment 1995-1999	101.5	1st of 10
% of population aged 25-34 with 3rd level education	29	8th of 13
Science and Engineering as % of total degrees awarded	26.9	5th of 15
New science and technology PhDs per 1,000 population	0.61	6th of 12
FDI inflow (% of GDP in 2000)	21.7	1st of 16
Venture capital as % of GNP (1999)	1.5	4th of 10
Share of foreign affiliates in manufacturing R&D (1997)	58.5	11th of 12
High tech investment as % of total (2001)	81	1st of 7
Patent applications per million population	87.6	10th of 12
Expenditure on R&D as % of GDP (1997-2000)	1.39	11th of 16
Labour productivity (% change 1996-2001)	26.2	1st of 12
GDP per person employed in manufacturing 2001 (US$ 000s)	70.5	3rd of 16
GDP per person employed in services 2001 (US$ 000s)	55.7	5th of 16
Total export growth 2001 (%)	12.1	5th of 16
Export services growth 2001 (%)	8.3	7th of 16

These indicators provide a mixed picture of Ireland's progress in the development of the information society relative to other countries. As has been widely discussed, performance in this period in respect of aggregate measures of output, investment and productivity was very good in Ireland. On core IT measures such as access to and use of technology it generally achieves a mid-table outcome indicating that there are deficiencies. The lowest positions are with respect to usage of broadband and high speed lines. Some supporting requirements such as education levels and R&D in technology also display weaknesses. Further analysis indicates that this research weakness is particularly noticeable in indigenous firms.

These findings are supported by research and international comparisons carried out by IMD[42]. This research ranks Ireland as the 11th most competitive economy – among countries with populations below 20 million – down from 9th in 2002 and 5th in 2000. The greatest weaknesses are identified in the area of infrastructure where Ireland is ranked 18th of the 29 small countries. This weakness is seen across all areas of infrastructure apart from education with Ireland ranked 18th for technology infrastructure and 17th for scientific infrastructure. **Most notably, Ireland was placed in last place, i.e. ranked 29th, for the availability, speed and cost of internet access.**

The overall conclusion from this area of research is that although there have been improvements in Ireland's performance compared with some years ago, Ireland still lags developments in other OECD countries in the development of the information society. Provision of infrastructure is a major weakness but cost of access to technology and supporting areas such as R&D and scientific education are also inhibiting progress and competitiveness.

42 *"World Competitiveness Yearbook 2003". IMD, 2003*

Conclusions

Ireland currently has a variety of network platforms providing broadband services nationally. Of these, the fixed telephone network and cable TV networks provide the most likely platforms for significant supply of broadband. To date in Ireland, very little investment has taken place in cable TV networks. As a result the dynamic of network-based competition for broadband, which drives take-up, is almost completely absent in Ireland. Thus, the imperative on the fixed incumbent to invest in broadband upgrades, and to drive consumers to take up DSL services, is significantly reduced. It is clear that:

- service availability follows population density
- large parts of the country do not have access to any terrestrial broadband service
- choice of service provider is generally very limited
- SMEs and residential customers are likely to be eager users of broadband in the right circumstances
- Ireland compares well regarding availability and pricing of very high capacity international broadband services.

Current levels of supply point to evidence of a market failure in broadband – where supply is failing to meet a latent demand. The supply market, as evidenced by the step change seen in price levels and take-up elsewhere, is characterised by significant economies of scale to suppliers as usage increases. These would allow for significant price decreases. However, these decreases will only arise where demand grows by large amounts.

A second market failure arises due to social benefits that will arise but will not accrue to private developers since they cannot be charged for. Many of these social benefits can be described in terms of a more inclusive society that overcomes the current problems of social and regional imbalance.

These market failures are very unlikely to be addressed by the market in the short to medium term. Ultimately, it falls to Government to try to resolve the situation.

The Government's target for the sector is to see the widespread availability of affordable, always-on broadband within three years. Specifically, the objective is that Ireland be within the top decile of OECD countries for broadband connectivity within three years. Based on an analysis of comparative data for a number of EU states, the following conclusions are drawn:

- Ireland currently ranks second last in the EU for broadband penetration
- While Ireland has enjoyed a rate of growth of broadband users rate over the last 12 months, this must be judged against the very low base level
- The growth rate in the last 6 months is above the EU average but will not lead to Ireland closing the gap on its EU counterparts in the short to medium term.

To assess more accurately the task faced in meeting the Government's target by March 2005, an EU best broadband penetration of 12% by 2005 is projected. To achieve this target Ireland will need over 450,000 broadband users – an almost fifty-fold increase from current levels.

As set out above, the current circumstances in the broadband sector point strongly to a market failure in the supply of broadband. This holds out the prospect of a significant level of unsatisfied demand in the medium/long term. Unless this situation is addressed the Government's target for 2005 will not be achieved.

The research undertaken in preparing this report has uncovered a number of areas where data deficiencies may inhibit the measurement of the roll-out and economic impact of ICT and broadband in Ireland. As a result, it is important that the impact of this technology and, indeed, the development of the information economy in general is monitored.

A set of indicators has been identified for Ireland, mainly based on work done in the US. Some of the indicators identified may be usefully compared with competitor economies – these are identified as comparison indicators in this table – while others would require time series analysis and are identified as trend indicators. They can be used as a guide to the role of policy and to where deficiencies may exist, and to the response of the economy following intervention. The indicators should be treated as preliminary and further research would be required to finalise them in advance of evaluation.

The overall conclusion from this area of research is that although there have been improvements in Ireland's performance compared with some years ago, Ireland still lags developments in other OECD countries in the development of the information society.

Case Study

Broadband Critical to new IT Business

www.missioncritical.ie

Introduction

Highly publicised virus attacks, increased legislation, the general political environment and a lack of the range of technical skills necessary to secure an organisations IT infrastructure have all contributed to the creation of a new market for outsourced cyber security services. The Network Security Domain is predicted to grow at a CAGR of 17%, reaching a global value of $46.5bn by 2006 (Datamonitor).

A segment of this market is focussed on providing security services. Organisations playing in this market are called Managed Security Service Providers (MSSP).

MSSP services are defined as:

Outsourcing of remote management and monitoring of security devices, including firewalls, intrusion detection systems and gateway antivirus systems.

Managed Security Services can include:
- Managed firewall
- Managed intrusion detection
- Managed anti-virus
- Security incident response

The market for these services in Europe is huge, growing at 19.3% CAGR with a forecast value of €2.8bn by 2006 in Europe.

The main market for MSSP services is small and medium enterprises (SME). They cite cost, availability, lack of in-house skills, reliability, security and quality of service as the main reasons for outsourcing these tasks.

Mission Critical
Mission Critical is a Dunshaughlin based, Irish owned MSSP and security software development company that commenced business in April 2001. It has grown very quickly and currently employs five highly skilled, knowledge-intensive workers and one administration worker.

Quality of life factors, such as commute times, together with the requirement to rapidly access client companies located in M50 area around Dublin were major determinants in choosing Dunshaughlin as a headquarters for the business.

Mission Critical provides general MSSP services and secure e-mail services. On the product development side of the business, Mission Critical has developed an anti-spam product. This product is deployed as part of its MSSP services and it is also available for sale to organisations who do not wish to outsource security services. Clients are based all over Ireland and the UK.

Mission Critical has aggressive plans for growth and has identified both local and European export markets as providing opportunities for expansion in the next two years. Key to this plan is the availability of reliable, cost effective broadband services.

John Thewlis of Mission Critical explains that his company is a new age technology company whose very existence is dependent on broadband and broadband related activities.

Critical Success Factor
One of the critical success factors identified by Mission Critical for their business growth is to remain cost competitive. This is essential in a market where existing players such as ISPs are beginning to offer MSSP services in competition to pure play MSSP companies, with both size and cost of communications service advantages. This market segment is set to become fiercely competitive.

Technical Architecture
The technical architecture that supports Mission Criticals business is sophisticated, technically advanced and *entirely dependent on broadband communications.*

Servers are based as follows:

1 – located in Dunshaughlin Business Park.
2 – located in Data Electronics at Ballycoolin Industrial Park
1 – located in London (redundant server)

Monitoring of the servers takes place at 60 second intervals from Dunshaughlin. In the event of a problem, the services are automatically switched to the next available server. SMS and Email notifications are automatically triggered to support staff in the event of a system or service problem.

Communications Configuration
A wireless VPN is in place, encompassing all of the servers, running over a satellite link sourced from UK Company, Amariska. The VPN provides secure access for authorised personnel to work at any Mission Critical location. The satellite dish is located in Dunshaughlin, providing bi-directional services of 1024k download and 256k upload capacity. Two 256k ISDN lines provide automatic failover recovery (10 seconds) in the unlikely event of satellite failure.

The cost of the satellite is €599 per month (excl VAT).

This configuration provides clients with the re-assurance that service level commitments of 99.9% availability can be met.

Communication options and consequences
Establishing communications between Dunshaughlin and the other locations was difficult because:

- There was no availability of broadband services in Dunshaughlin Business Park.
- Planning permission was required for the satellite dish which measures 1.3 metres. It is mounted on the side of the building.
- A license was required for the use of the satellite dish.

There were no other viable options available that would meet Mission Criticals needs:

- The cost of a leased line was 'out of order' (John Thewlis, Mission Critical)
- A previous ISDN configuration utilised at an earlier start-up office in Kells was too expensive, often costing over €2,000 per month. For this reason, ISDN was dismissed as an option.

Conclusions
Mission Critical demonstrates that Ireland has talented, highly skilled workers available and capable of entry into emerging technology sectors such as the Network Security Domain.

However, their passage from start up is greatly hindered by lack of choice, lack of real competition and, once established, by the cost of broadband services.

Ireland's ability to exploit the opportunities available in the Network Security Domain will be dependent, not solely on the availability of a talented, highly skilled workforce, but also on the availability and provision of (internationally) competitively priced broadband services.

4 How many Broadband users will there be?

How many Broadband users will there be?

Given that Internet use is at a relatively early stage of development in Ireland, the social and economic importance of Government targets for broadband is sometimes questioned. Broadband demand is apparent in early-adopting, highly technology literate parts of Irish society. However to date in the mainstream, demand has not emerged. This section will build evidence of underlying trends to generate a projection of the number of broadband users in Ireland over 20 years. It adopts the perspective of the consumer, and generates projections for the growth of demand should supply be unconstrained. This projection can be adapted and used as an ongoing template for consensus between stakeholders.

The methodology adopted consisted of the following steps:

1. Analysis of the factors underlying adoption
2. Research of adoption drivers
3. Comparison with international experience
4. Consultation with the industry

The consultation with industry included the following players:

Telecom Operators	(EsatBT, Eircom)
Telecom Equipment Manufacturers	(ST Microelectronics, Aware)
User Device Manufacturers	(Intel, Cypress Technologies)
Application Developers	(Enteraktion, Microsoft)
Visionaries	(Vint Cerf, Reed Hundt, Alistair Glass)

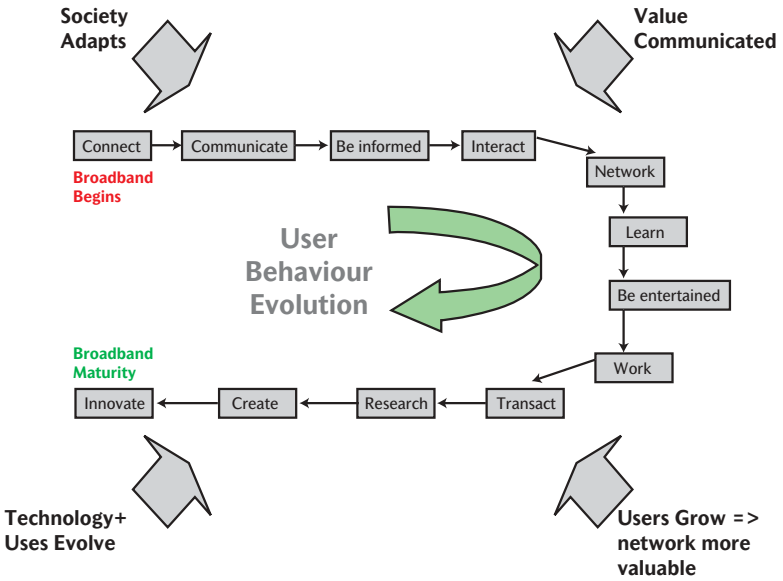
Factors Driving ICT Adoption in Society

At the heart of the question as to how pervasive would broadband be in society, is the extent to which user behaviour changes as a result of adoption of technology. Users derive more value and need from ICT with maturity of usage. There are network effects driving the adoption of any technology in society.

The following figure illustrates the factors driving this change for consumers from broadband beginnings to maturity:

As can be seen from Figure 4.1, use of ICT in the home is an evolutionary process. Users become more accustomed to the technology and can put it to more effective uses with familiarity. An ICT and broadband user will have higher communications requirements over time, and will become more dependent on broadband. The value of each of these activities becomes higher as more people are connected to the network.

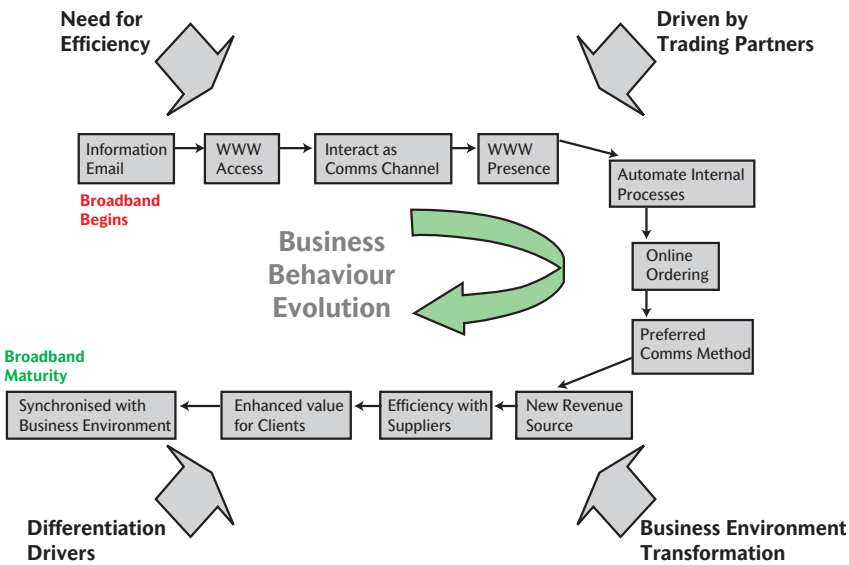
Figure 4.1 **Consumer Behaviour Influenced by Technological and Society Change**



Source: Sonas Innovation

There are similar drivers for the business user as can be seen from the following figure:

Figure 4.2 **Business Behaviour Influenced by Technological and Economy Change**



Source: Sonas Innovation

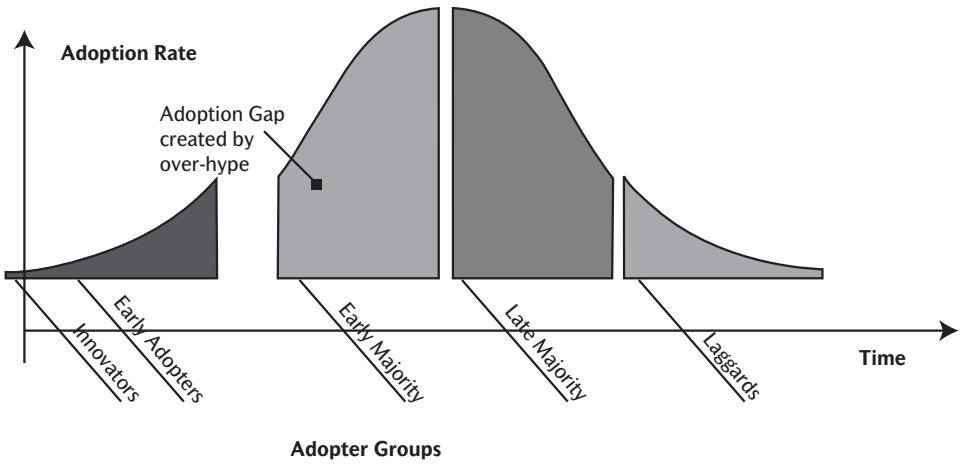
An evolutionary pattern for broadband adoption exists for the business user. Again, it is driven by the utility which can be gained from the system as the business's capabilities increase, and the environment itself becomes more pervasive to broadband.

This "network effect" is described by Metcalfe's Law, which describes how the value of the network is equivalent to the square of the number of people using the network. This effect drives accelerated uptake of ICTs in society as increasing numbers of people adopt.

Adoption Patterns

Any new technology introduced in a society will go through a process of adoption over time. Those segments, or groupings of people, more disposed to adopt and use the technology adopt earlier. These segments are sometimes referred to as 'Innovators', 'Early Adopters', 'Early majority', 'Late Majority' and 'Laggards'. The rate at which a technology is adopted is plotted over time in Figure 4.3 – Technology Adoption Curve.

Figure 4.3 **Technology Adoption Curve**



Source: Kotler et al

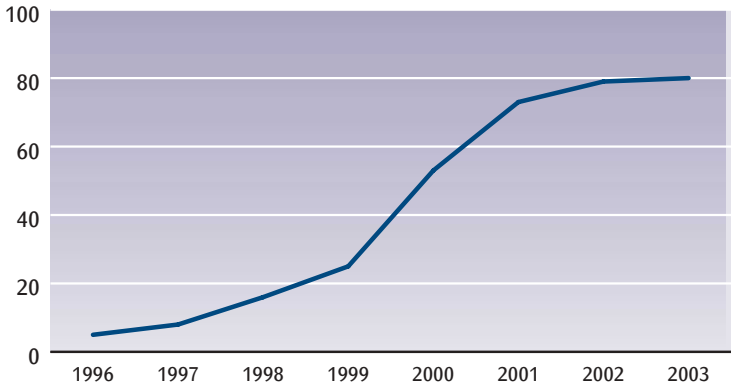
Similarly with characteristics of adoption of other technologies, consumers' perception of broadband as a technology of value will drive its adoption successively through the segments of the society who are most disposed to deriving these benefits. The fundamentals behind this approach will later be utilised to determine the total numbers of broadband users for Ireland. The adoption gap indicated in the figure (above) also highlights the phenomenon of over-hyping of technologies. During the adoption gap, the extent to which the technology will become fully adopted in society is questioned.

There are many other experiences of technology adoption which can inform likely adoption of broadband. Devices including the mobile phone, the video cassette recorder, the colour television, the compact disc player and the personal computer have all undergone a process of adoption over time. The pattern where technologies form an "S curve" in the early to middle stages of adoption, as benefits of a technology are dispersed throughout segments of a society, is well accepted by technology business and by academia.[43]

Broadband and mobile communications have some similar characteristics in terms of potential for "personal" experiences and communications utility. The adoption of mobile phones by users in Ireland, as seen in the next illustration was rapid.

43 *Frank Bass – Diffusion Model*

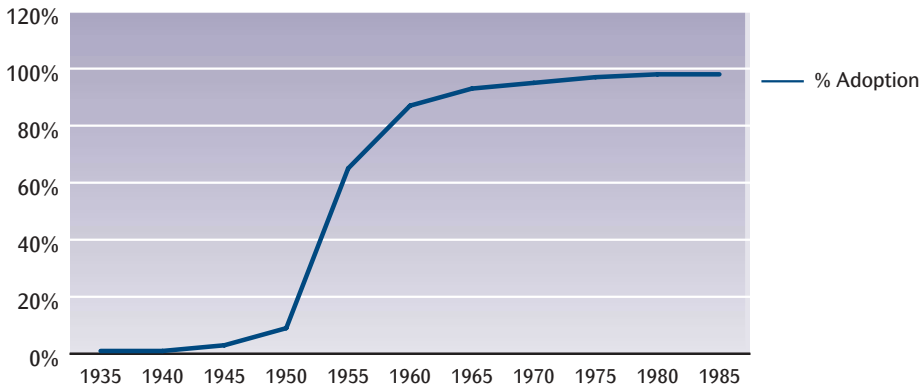
Figure 4.4 **Number of Mobile Phone Subscribers per 100 inhabitants**



Source: Comreg Quarterly Data Reports

There is evidence to suggest that entertainment in the home will be transformed by broadband technologies in the next twenty years. The consumer of the future will demand an interactive entertainment experience. As such, adoption of colour TV may have similar characteristics to the adoption of broadband. The following illustrates the percentage adoption of colour TV in households in the US:

Figure 4.5 **Adoption of Television by Users (in the US)**



Source: Nielsen Media Research-NTI, Jan. each year

Experience elsewhere of the rate and extent of broadband adoption therefore informs projections for likely adoption in Ireland. As broadband has been available for some time in other developed countries, there is considerable evidence on which to draw. Two comments from US sources illustrate the experience there: The US Federal Communications Commission states, in relation to broadband growth rates, "At this pace, consumers are adopting current broadband technologies at a faster pace than CD players, cell phones, colour TVs and VCRs."[44]

Research by McKinsey shows that "At the current pace of growth, broadband will achieve 25 percent penetration in the United States within six years of its commercial launch. PCs reached this level in 15 years, mobile telephones in 13, and the World Wide Web in seven."[45]

44 *UNDERSTANDING BROADBAND DEMAND – Review of Critical Issues" Office of Technology Policy U.S. Department of Commerce, September 2002*

45 *"Making sense of Broadband", McKinsey Quarterly, June 2003*

There are a number of other drivers which may impact on broadband provision and take up

- Plant Renewal – It is likely that the economics of plant renewal for communications operators will become a key driver in the promotion of broadband in the medium to long term. This was previously experienced at the time of the roll-out of digital exchanges in Ireland in the 1980s, when the previous generation of mechanical switches became expensive to operate and maintain. A consensus view is that all communications (including phone and cable TV) equipment being purchased in 5 years will be broadband ready. Older plant and equipment will become too expensive, and upgrades will happen to control costs.
- Generation X – Demographic factors may have the effect of driving broadband, given the widespread use of broadband-related technology by youth. Research in the US shows that 90% of children between the ages of five and seventeen now use computers proficiently.[46] These young users will mature and accelerate the mainstream demand for broadband. This effect will accelerate the arrival at a "Tipping point" (i.e. where there are sufficient broadband users to form a critical mass of users in a society – generally reckoned at 35%).
- New Broadband Technologies – While the current generation of Internet technologies are more closely aligned with the personal computer, the next generation, involving broadband communications links and an array of broadband enabled devices in the home, are generally expected to have different uses and benefits, and will follow a more accelerated adoption path. ST Microelectronics plan that there will be a number of devices in the home which will be networked together to a broadband pipe. Intel's product roadmap sees the low cost of broadband-enabling devices driving high speed connectivity capability to multiple digital devices in the home. Eircom sees this as an area of opportunity in that such devices will be able to rival the utility of mobile devices.

Projection for Broadband Adoption in Ireland

This section concludes by drawing together the various strands presented in this Section and the Model for Estimating Consumer Surplus (see Section 2). Two scenarios for broadband take up are presented.

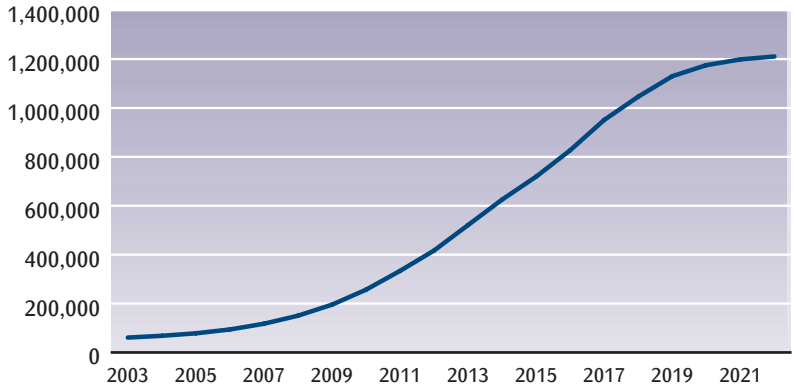
This analysis is a demand-side analysis. It is based on the evolution of demand without reference to the actual or projected supply conditions in the market. While this is a projection for the future, the speed at which adoption will happen will obviously be significantly influenced by market conditions and Government policy. A key value which this adoption path may bring is a consensus view between all stakeholders on the timeframe over which we can accurately target progress towards broadband objectives.

The first projection assumes a penetration rate of 90% of households is achieved indicating 1.2 million active broadband household connections in 2024. It is also necessary to set out an appropriate profile of connections for the period. We assume a 5% connection rate in the first year of operation (2004), equivalent to just over 60,000 connections. To achieve 90% household penetration in 20 years would require constant annual growth of almost 17.1% per annum for the full period. However, this assumption of a constant rate of growth appears unlikely and it is more likely that after a slow start the rate of growth would accelerate before slowing as it approaches its steady level of penetration.

This approach is in keeping with the Kotler adoption curve referred to above and the example product life-cycles presented. Eventually, lower prices, due to economies of scale, and the availability of richer content attracts the mass market. Then as the technology matures and the market approaches saturation the annual rate of growth falls towards a steady state. The number of connected households in each year under this approach is shown in Figure 4.6 on the next page. This approach is further described in Appendix 2 of this report.

46 *"Understanding Broadband Demand: Broadband & Business Productivity", US Technology Administration, March 2002*

Figure 4.6 **Number of Broadband Connections (000s)**



Source: Sonas Innovation

In summary, this graph projects the household take up and penetration levels set out in the table below:

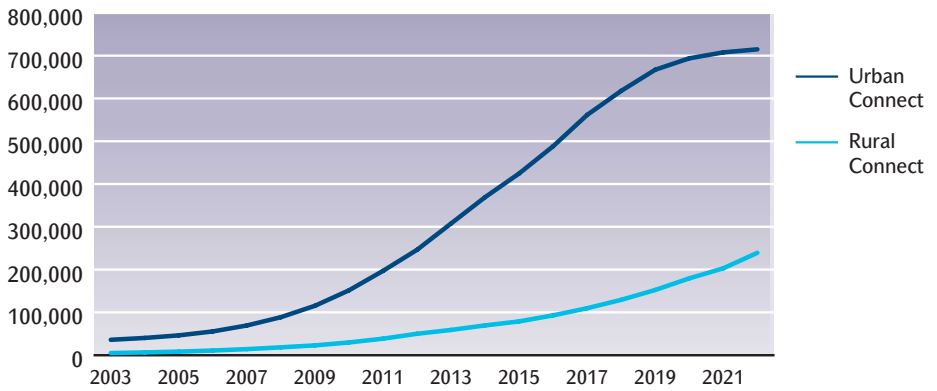
Table 4.1 **Summary of Adoption Projection**

Year	Number of connections	Household Penetration (%)
2007	117,000	9%
2012	417,000	32%
2017	951,000	72%
2022	1,200,000	90%

Source: Sonas Innovation

The second projection of household uptake recognises that there are issues related to accessibility in areas of low population density. The assumptions here are that while penetration in towns rises to about 40% in the first 10 years and 90% in the following 10 from a base of 5% in the first year i.e. at the same rate as was assumed for all households in the first calculation, it reaches only 10% of rural households in the first 10 years and 50% after 20 years from a base of 1% in the first year. This gives the number of household connections as shown in Figure 4.7:

Figure 4.7 **Number of Broadband Connections (000s) – With rural population adjustment**



In summary, this graph projects the household take up and penetration levels set out in the table below:

Table 4.2 **Summary of Adoption Projection with Rural Adjustment**

Year	Number of urban households	Number of Rural Households	Overall Household Penetration (%)
2007	69,000	14,000	7%
2012	246,000	50,000	23%
2017	561,000	110,000	51%
2022	714,000	239,000	72%

Conclusions

At the heart of the question as to how pervasive would broadband be in society, is the extent to which user behaviour changes as a result of adoption of technology. Users derive more value from ICT with maturity of usage. Two figures are presented which illustrate the factors driving this change for consumers and businesses from broadband beginnings to maturity.

Any new technology introduced in a society will go through a process of adoption over time. There are many other experiences of technology adoption which can inform likely adoption of broadband. Devices including the mobile phone, the colour TV, and the PC have all undergone a process of adoption over time and provide parallels for broadband adoption. Other important demographic factors will also contribute to driving demand and adoption as will the emergence of new technologies and plant renewal.

5 How Much Broadband is Needed?

How Much Broadband is Needed?

The Government has identified, in the "New Connections" document, an objective of 5 Mbps to the home in the 2012 – 2017 timeframe as the target broadband service. It is important to confirm that demand for this level of bandwidth exists or is likely to develop.

In this section the short and medium term broadband capacity requirements for residential/SME users are identified. This question is approached from the perspective of how demand could evolve should broadband be freely available at an economic price.

A projection is developed that can be adapted and used as an ongoing template for consensus between stakeholders.

The methodology adopted consisted of the following steps:

1. Analysis of Broadband application trends in key sectors (e.g. education and health)
2. Assessment of broadband usage trends
3. Consideration of the evolution of technology

Key Application Areas

In the previous Section, the evolution of user needs was examined, describing the time it takes to initiate use of a technology, experiment with it, adapt its capabilities to benefit specific uses, discover new ways to do current tasks, and employ the technology to enable completely new uses. Analysis of some key application areas will further illustrate this. Chosen areas are:

1. Education
2. Health
3. Communications
4. Teleworking
5. Entertainment

Education

On the 20th June 2000, the European Commission formally integrated e-learning into its global plan for 2000-2003 entitled eEurope. Romano Prodi, president of the European Commission, said

> *eEurope is a road map to modernise our economy. At the same time, through its e-learning component, it offers everyone, but particularly young people, the skills and tools they need to succeed in the new knowledge-based economy.*

Mr Prodi was setting the scene for a paradigm shift in educational delivery, recognising a major change in the industrial world to information and knowledge based economic prosperity.

eLearning forecast from international research organisation Gartner:
'By the end of 2005, except for Web infrastructure, email and search, e-learning will be the most-used application on the Web (0.7 probability)'.

There is a growing body of evidence available that demonstrates this sea change in education delivery methodologies around the globe.

A. At the infrastructure level:

- PC shipments to the US education market grew 5.8% in 2002, outpacing the professional market, with the under 12th grade segment accounting for more than half of total education sales. Furthermore, notebook sales far exceeded growth rates (37%) of deskbased sales growth (1%).
- Growth of wireless access has accelerated in many countries. This has provided the platform for the 'anywhere anytime' vision for education to be realised.

  By using wireless LAN, schools can avoid costly physical infrastructure changes while enjoying the flexibility to deploy technology where and when it is needed within the school building. Mobile laboratories are relatively inexpensive compared with the cost of installing cable, dealing with safety issues relating to trailing cables and removing the necessity to provide both space and furniture for desktop PCs. As the student-to-computer ratio decreases, classrooms are running out of space for desktop PCs.

  In the wireless environment, teachers can bring mobile PCs and a wireless access point to their classrooms on a trolley. With the wireless-connected mobile PC trolley, teachers can instantly turn any classroom into a temporary computer lab. The increased flexibility eliminates the need for students to move from one classroom to another, easing scheduling requirements for computer use. Wireless computers are also used to supplement classroom desktops. This allows teachers greater flexibility in placing workstations around the room.

  Some countries are beginning to explore other possibilities for wireless technologies. In Africa, for example, the World Bank's World.Link suggests that "wireless Internet connectivity and e-learning offer not just improved education but community-development opportunities."
- Home PC penetration rates have continued to rise steadily, providing further opportunities for students to access the web and to supplement traditional learning methodologies.
- As the cost of connectivity decreases, and high speed bandwidth availability increases, hosted e-learning solutions are emerging as a solid delivery alternative to single school delivery solutions. The hosted e-learning environment offers the advantages of low ramp-up time and centralised support – both tasks that challenge most schools.

B. At the investment level:

- *China:* The Chinese Ministry of Education enacted a policy to require computer and Internet usage as part of the curriculum for students above the age of 12. At the university level, by mid-2001, nearly 250,000 students took courses from 38 online universities. Beijing University has launched an Internet education portal that it projects will service 1 million students!
- *Latin America:* in early 2001, an Inter-American Development Bank (World Bank and G8 Nations) grant was established to supplement the costs of developing e-learning programs.

- *US:* The Henrico County Public Schools (HCPS), Virginia, is a system of 65 schools (kindergarten through grade 12) with student enrollment of approx 43,000. In a bold move intended to change paradigms in secondary school instruction, the school commenced a project in 2001 that has resulted in the implementation of 20 wireless LANs and 23,000 laptops for students who do not have home internet access. (http://www.henrico.k12.va.us/iBook/) See attachment.
- *US:* The government of Maine, signed contracts worth $37.2m to provide every seventh and eight grade student and teacher in the state with an iBook.
- *US:* Michigan committed $10m in seed money to assist in funding a program to provide wireless computing devices, including PCs and PDAs, to every student in the state during a four year period.
- *France:* The French government launched an investment programme operated by the *Landes Department* designed to match investment in hardware with learning materials.
- A school in Singapore delivered curricula via the internet, with support through email and phones, during the recent SARS outbreak that mandated school closure for a number of months. They had their educational service in place within two days of the school closure.
- As part of its development program for educational technologies, Italy has made available equipment and training activities for teachers, combined with distance-learning initiatives run by the national TV broadcasting company and the use of structural funds.
- The Swedish ITIS initiative provides in-service training, a multimedia computer and an email address for more than 60,000 teachers.
- In the UK, the 'Excellence in Cities' programme is putting in place 80 city learning centres in major city schools to provide pupils and adults in the community with connectivity, infrastructure, content and training.

C. At the Application level:

- eLearning applications have become consistently more sophisticated, attracting significant investment by technology, educational and content development companies.
- Apart from the 'traditional' digitised text books, more advanced e-learning applications now include technologies such as collaboration, interactivity, modelling, simulations, virtual reality interfaces and gaming – all techniques that, when applied appropriately, can deliver "learning through experience."
- Further evidence of the arrival of the e-learning age is a recent survey concluding that online learning designers will be among the Top 10 positions most in demand among Global 1000 enterprises by 2005.

Case Study

Brannoxtown National School, Naas, Co Kildare

History

Brannoxtown National School was established in 1885 as a Baptist School. It closed for some time in the 1900s. It was taken over by the state in 1927, and re-opened as a Catholic National School. It began as a one teacher school and remained so until the 1970s. It became a three teacher school in the 1990s and continues to cater for the needs of the growing local community.

Brannoxtown is a very small village that doesn't have a shop or a pub. As the only public building, it provides accommodation for local community activities in after school hours.

Enrolment in 2003

84 pupils

Teachers: 4 plus a shared learning support teacher

Number of Classrooms:

Four

1 located in the original schoolhouse building

3 located in temporary buildings in the school grounds

Number of PCs:

11 – of mixed breed, age and configuration

8 of these PCs have been donated by friends of the school when they became obsolete.

Laptops:

1 One provided by the Department of Education for connection to the school projector.

Communications configuration:

2 x PSTN lines

1 – for the school telephone

1 – connecting a PC via modem to the internet

1 mobile phone

Purchased to avoid situations that necessitated children being left unsupervised in classrooms

Unfortunately, the mobile phone does not have coverage in the temporary buildings – only the old school!

Challenges:

In discussion with Miriam Nolan, Principal of Brannoxtown NS about ICT usage in the school, she said:

'The new curriculum is geared to guide children to knowledge, not to hand it to them – in this context access to the external world and the internet could be a valuable resource and asset to national school children.

The teachers would like to make use of the internet to access shared teacher support resources, such as schemes of work, policies and special activity ideas that are available on the INTO website.

For the children we would like them to gain access to the web for project work and also resources on websites such as www.scoilnet.ie.

In Brannoxtown NS we should ideally provide Internet access in every room with two PCs available to the senior classes for collaborative work.

The reality however is somewhat different and there are many challenges to be overcome to inorder to realise this vision. The major challenges for us, at Brannoxtown NS, are:

- **Training for teachers:** There is no ICT training provided for teachers. We are training on our own time and at our own expense. This is the reason that Brannoxtown NS does not have a website. As yet, none of us has attended a website creation training course.
- **Support for ICT in the school:** There is an ICT facilitator located in Kildare who visited us for one hour in the last academic year. Unfortunately he works only during school hours and we do not have the possibility of sending children home while he visits.
- **Network:** We have 11 PCs but only one very slow internet connection. Because the original building is very old and the temporary classrooms are separate temporary buildings, cabling the other classrooms may be very expensive so we may just purchase another telephone line and connect another PC.
- **Supervision:** When a child or children are using the PC they require extra supervision. We don't have any special protective software installed on the PCs at this time.
- **Maintenance** is a big issue in a national school where tiny fingers will break equipment. It can take weeks to have equipment repaired if it breaks.
- **Funding** is always a challenge. Some funds are available from the Department of Education but it cannot be used for repair and maintenance or software purchases.
- **Access time for children** is, by necessity, extremely limited.'

Conclusions:
The Brannoxtown NS ICT experience is representative of many schools around Ireland, providing a bleak picture of eLearning and communications reality.

The provision of a Wireless LAN, some modern PCs (the existing PCs may be so old that they will not connect) and high speed internet access in Brannoxtown NS would become both a school and a community resource.

In an ideal world, the school would also receive secure email and security services from a reliable Managed Security Service Provider (MSSP), releasing untrained teachers from the burden of security and technical problems.

Compared to many of their counterparts in other OECD countries, Irish children face a real risk of being left behind as regards IT literacy. This has major implications for Ireland's future human resource capital.

Health

The distributed nature of the health service is such that there are multiple service locations and organisations, all of which rely on data regarding the patient for treatment. Creating a unified view of the patient, which would be accessible where appropriate from any health organisation would facilitate a higher quality, more efficient service.

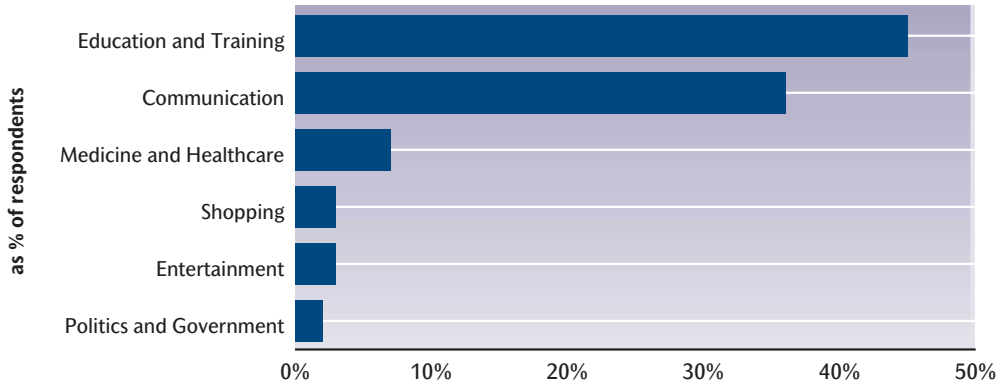
Access to broadband technologies could empower Irish health practitioners with relevant and timely information in whichever organisation they work. Section 2 provides estimates for the savings which could result from investment in ICT in this sector. Centralised medical records, collaboration between medical teams, ongoing professional updates and learning, remote access to medical results and records, and a consistent view of the patient whatever part of the system he or she engages with are all possible. Broadband would mean easier and more efficient access to a higher quality health service.

Communications

Communications effectiveness is increased significantly by adoption of technology. Usage of mobile technology in Ireland has reached very high levels of usage (80% of population adopting within 6 years). It is likely that the popularity of using ICT to aid communications will increase once broadband is accessible in the home.

Society now expects instant, and quality communications. Broadband will allow for a myriad of new uses. Sharing home videos with friends and family via broadband is just one such example. Other applications as yet unimagined will arise if the infrastructure and connectivity of broadband are available.

Figure 5.1 **Forecast of Internet Purpose in 2011**



Source: SBC Communications, 2001

Teleworking

Broadband technology can allow for much greater flexibility and productivity.[47] Research from the US shows that the most significant driver for consumer broadband adoption has been teleworking. Research in Europe projects that the number of teleworkers will rise from 4.5 million in 2000 to 17.5 million in 2010.[48] The positive impacts of broadband-enabled teleworking would include:

- Protect the environment – reduce traffic/congestion
- Improve work-life balance – allowing for family-friendly working arrangements
- Build on the country's reputation as a digital island
- Encourage rural sustainability and enabling rural development

Entertainment

The use of broadband infrastructure to distribute entertainment services has already taken hold in Ireland. The penetration of Playstation devices in Ireland is second only to Japan. The creation of an interactive 3-D video experience for the consumer is underway and will drive the need for broadband in the home. Entertainment has already proven to be one of the first application areas to drive broadband take-up in South Korea, where broadband usage is significantly higher than in the US or the UK.

Standards which have been established for transmission of video signals (MP4) require a 6 Mbps stream to accommodate one High Definition Television (HDTV) channel. It is generally accepted in the industry that for any entertainment use, that four such channels in operation at any time would require a 24 Mbps pipe into the home.[49] File-swapping is an application increasing exponentially in usage as illustrated in Figure 5.4 – Application driven network growth. The projected increase in devices requiring file–sharing will stimulate demand for far greater bandwidth in the home.

47 *In-Stat/MDR, June 2002*

48 *EU Emergence Project, May 2000*

49 *From consultation with consumer technology company*

Table 5.1 **Internet Usage as % of Internet Users**

Application	South Korea	US	UK
Audio-video	73.9%	23.8%	29.5%
Games	54.1%	5.8%	4.1%
File transfers	39.2%	22.8%	21.4%

Research by In-Stat MDR concludes: "The forecasts of devices and revenues for home networking products only begin to capture the value impact that moving from standalone devices to networked appliances will have. The overall impact is well beyond the number of adapter cards or wireless LAN connections in TVs and stereos, as the move will help reshape the market for digital entertainment in the next decade…"[50]

Broadband Usage Trends

There are a number of trends which inform analysis of how much bandwidth broadband users will need in Ireland. The core trends relied upon are described here.

Once it is made accessible and usage begins, the amount of broadband consumed grows at significant rates. Research into the levels of broadband usage in other countries where broadband has been available for some years (e.g. Korea or Japan) shows that the amount of broadband in use is markedly larger than those in less mature markets (e.g. Italy).

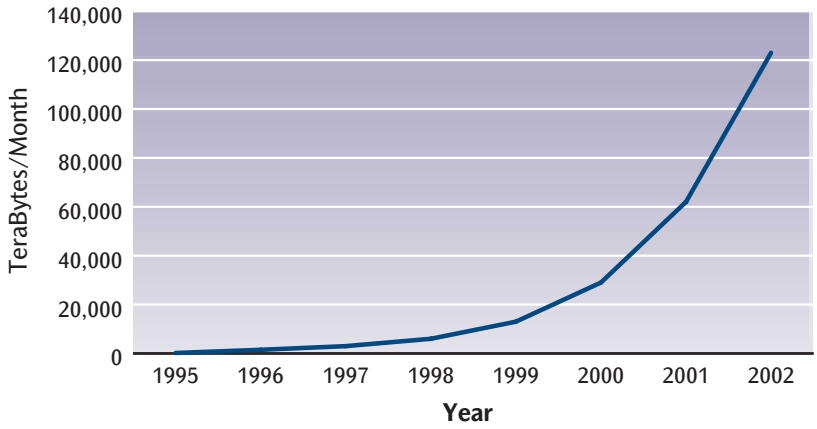
Increased Broadband Users Drive More Broadband Use – A significant driver behind the amount of broadband consumed is the number of users on the broadband network. As there are more users, there is more utility in interaction between each other. The utility of the network grows exponentially with the number of users (known as Metcalfe's Law). A historical analogy is the increased value of fax machines as there were more users to send faxes to.

Research shows that the number of broadband users is increasing rapidly. In a report published by Nielsen//Netratings in May 2003, it was reported that over one quarter of Europe's online population is now using broadband. Furthermore, it was noted that in the 13 months from April 2002 to April 2003, the number of European surfers using high-speed services grew by 136%. In some countries the growth rate was higher, with the UK experiencing the largest increase at 235% during this period. 28% of European Internet users are now connected to high speed services, a growth of 14% from April last year. In the US 35% of the population surf the web using a broadband connection, but this figure is dwarfed by some of the Asia Pacific markets, with 82% of Hong Kong's Internet population connected to a broadband service.

50 *In-Stat MDR "The Top Ten Drivers of the Converged Home Network", April 2003*

Overall Traffic Trends – Traffic on core Internet backbones has continued to grow over recent years. This traffic is directly related to the amount of broadband each user on the Internet now needs and will require in the future. Research referred to indicates that Internet traffic is likely to double every year. Figure 5.3 illustrates its growth:

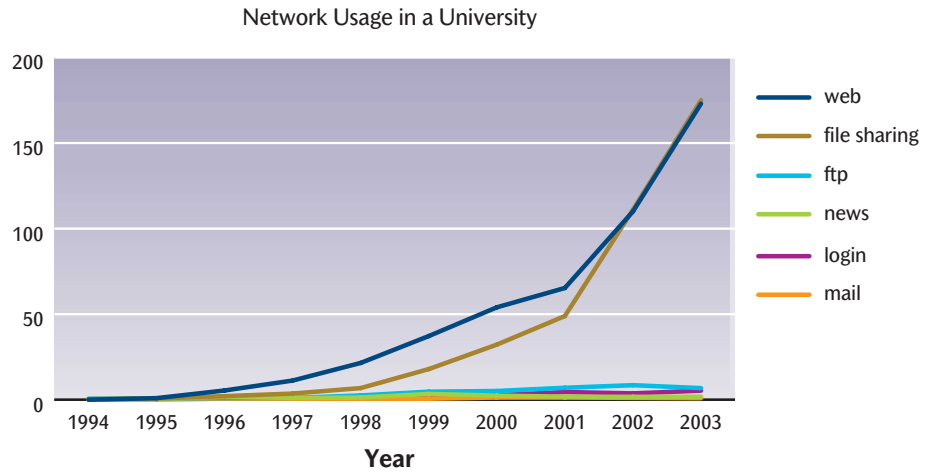
Figure 5.2 **Traffic on Internet Backbones in the US**
(1 terabyte is the equivalent of the contents of 2,000 CDs)



Source: "Internet traffic growth: Sources and implications", Andrew M. Odlyzko, University of Minnesota, Minneapolis – Draft

Applications Getting 'Fat' – There is little data available on usage of applications generally on the Internet. However, a representative sample of network traffic in a university in the US is captured in Figure 5.3. Users in a university will generally have relatively good access to broadband facilities. This environment will reflect usage in other such unconstrained environments (e.g. broadband at home). These statistics show that there have been huge increases in the amount of data intensive web and file-sharing activity.

Figure 5.3 **Application driven network growth**



Source: University of Waterloo Statistics

Evolution of Technology

Technology develops at a remarkably constant speed. The evolution of computing (based on silicon technology) has increased according to Moore's Law – the doubling of ICT capability every two years. The utility and adoption of this technology happens in waves, as functionality increases and costs reach affordable levels such that a critical mass is reached.

Today there is evidence of emerging needs for networked devices arising from the dramatic changes in the consumer electronics industry. There is blurring at the functionality boundaries between consumer devices, which will all require networking for interoperability. Mobile communications devices have digital cameras included. Gaming consoles have video play and record capability. Video cameras connect to the HiFi and TV devices. Personal computer capability is becoming included in communications hubs for the home as a central resource for all digital devices. As this level of networking increases, the demand for broadband will grow.

Our technical analysis of Internet/broadband technologies shows that there will be a "third wave" of applications brought about by broadband. Current communications by computers/other devices have been restrained by the lack of bandwidth/broadband for network intensive applications.

First wave (1985 – 1995) – Email
Internet connected stand alone applications on specific computers.
The organisation is real and local.
The network is subservient to the computer.

Second wave (1995 – 2005) – Web
Applications and services are accessible by anyone using web *(e.g. WWW).*
Organisation, data and application are location specific.
Computers become dependent on networks.
First wave of web services and concept of virtual organisation as an overlay to multiple physical locations.

Third wave (2005 – 2015) – Networked Applications
Data and application uncoupled from specific locations or machines *(can be accessed and directed from many locations).*
The computer is subservient to the network.
Data and application exist in "cyberspace" *(i.e. completely in the network and are not bound to any specific machine or location).*
Virtual organisation using virtual data and virtual applications[51].

This primarily follows from research which has been conducted by CANARIE, a Canadian research organisation.

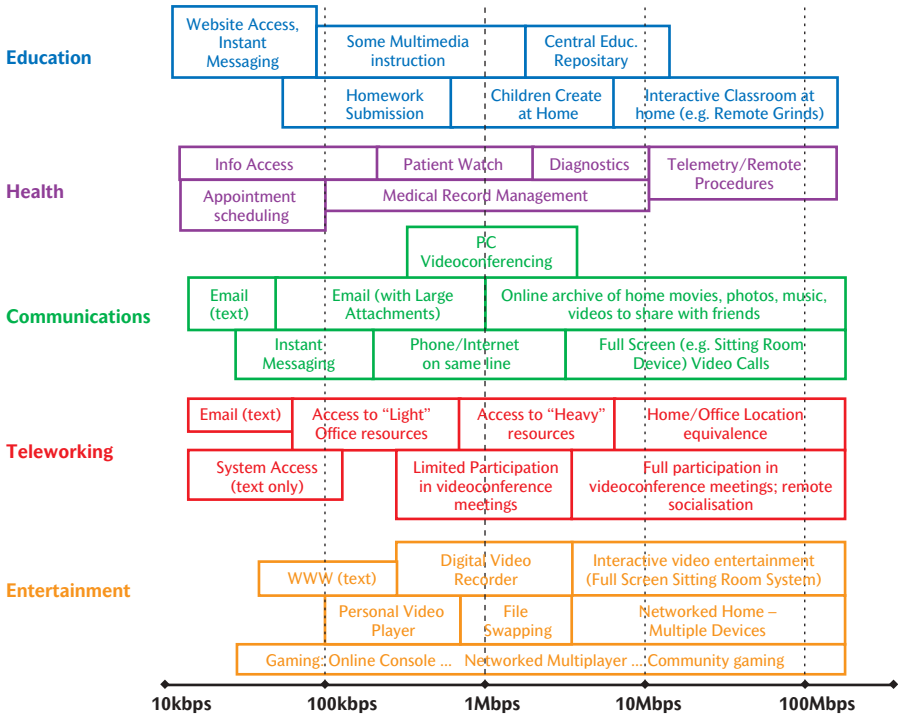
The emergence of this third wave is also borne out by discussions with the technology companies who are investing today for tomorrow's market. Industry players developing applications and ICT devices are currently designing and building for 1Gbps connectivity capability to the end user. The incremental cost of hardware with very high speed broadband capability is small, so devices are now having this technology included. Intel has become a significant promoter of broadband and is investing in wireless as an alternative medium for broadband provision. Technology providers to the communications operators are planning for the interactive digital home and SME customer base.

In our view, the evolution of technology leads to a requirement for more and more broadband. In each of the application areas identified above (e.g. health or education), the more users become familiar with, and gain utility from, broadband, the more information is required to serve that need. Similarly, the more the users are capable of utilising ICT and broadband, the more feasible it is to provide services over broadband. The network effects of more users accelerate adoption once a critical mass is attained.

51 *Adapted from CANARIE "The Third Wave". http://www.canarie.ca*

Some examples of applications and their corresponding broadband demand are illustrated in Figure 5.4.

Figure 5.4 **Evolution of Broadband Uses**

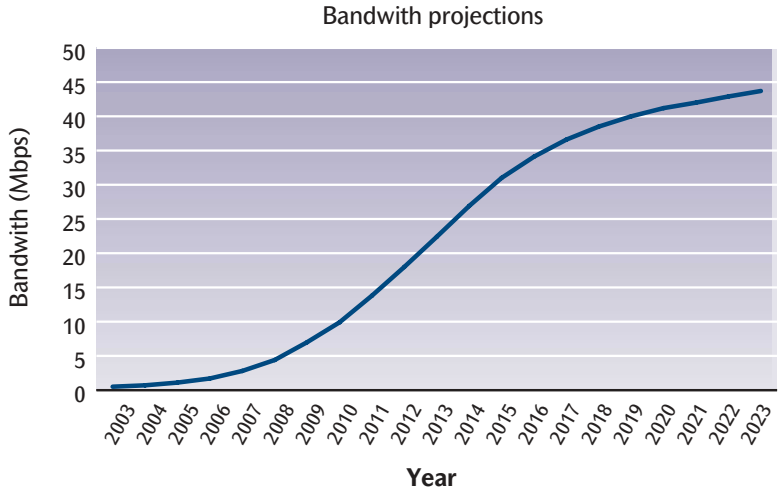


Source: Sonas Innovation

Broadband Usage Projection

A projection of the amount of broadband needed may be made based on the technology adoption methodology used in Section 4. Using this methodology, the demand of a consumer who uses a standard broadband offering today can be estimated for the future. As emphasised throughout this Section, the user will adopt applications over time which will require more broadband. The standard DSL/Cable Modem service today at 512kbps is taken as the starting point. Trends already experienced in other markets and with other technology adoptions underpin this projection.

Figure 5.5 **Projection of bandwidth used by an Irish consumer**



Source: Sonas Innovation

The assumptions underlying the above projections include:

- Growth rates are below 60% – less than the 100% CAGR proven intrinsic to internet backbone traffic since 1995.
- Growth of broadband usage is conservative relative to higher growth evidenced in usage of a broadband local link in a relatively unconstrained environment– (see Figure 5.3 – Application driven network growth)

This trend also fits with interviews of network technology companies and application developers who see 50 Mbps to the home/SME as the direction the market has adopted. The case study below from Sweden, shows that other more advanced markets are already providing 10 Mbps broadband.

The following case study is an example of how in other countries, 'fat' broadband is becoming a common offering at an affordable price. Asia is leading the way with 10 Mbps available for €20 a month in Japan. Even closer to home in Sweden, users are already needing more advanced broadband than is available in Ireland.

Case Study

Broadband Availability for Swedish Teleworker

Introduction

It is estimated that the teleworking population of Western Europe will grow from approximately 12.3 million at the end of 2001, to just over 19.5 million by the end of 2006.

The drivers for the growth in Teleworking are twofold:

- **Attraction and retention of valuable, skilled employees**
  The ability to offer the teleworking option may make the difference between losing or retaining valuable staff who are attempting to obtain balance between their business and personal lives.
- **Environment and infrastructure drivers:**
  Individuals and Businesses face increasing cost and time penalties with regard to traffic congestion, pollution and fuel economy.

Gartner Dataquest considers the top teleworking nations in Europe to be Germany, the United Kingdom, Finland, Sweden, the Netherlands and Denmark. Together, these six nations account for just more than 70 percent of all the teleworkers in Western Europe.

These countries have a number of contributing factors in common:

- strong liberalisation of telecommunications infrastructure
- high computer literacy
- growing internet penetration rates
- Real buy-in and investment in the concept of flexible working.

Application and usage trends

Up to quite recently, Teleworkers connected to enterprise applications to access or download information, to enter transactions or for email communication. By 2003, with high speed bandwidth becoming affordable advanced bandwidth hungry applications such as collaborative teleworking, Webinars, distance learning, voice communications and video links have become possible and are becoming more widely adopted.

Background

Gatorhole Technologies is a subsidiary of **Gatorhole AB**. Gatorhole Technologies provides services within network programming, design, implementation, operation and support. Gatorhole Technologies delivers solutions using a unique combination of advanced network know-how and traditional software development skills. Gatorhole was founded in 1999 and currently has offices in Stockholm, Sweden.

Ragnar Lone, an employee of Gatorhole, works as a computer games developer. Ragnar works from home for around 2 hours each day, where he has a 2.5Mbps ADSL connection.

For work purposes he uses email and logs into clients' mainframe computers to carry out network checks. He can also use his DSL connection to test network-based games.

During his leisure time he likes to watch movies on-line. The DSL connection supports all this activity.

For his home service he pays approx €25 per month. Currently, he has a choice of 5 different providers.

He also has the option of a higher capacity service (8Mbps) which would cost approx €43 per month.

A company called Bredbandsbolaget (www.bredband.com) is pioneering very high capacity services in some urban parts of Sweden. They provide a 10Mbps connection to homes via a fibre connection (which can be scaled up to 100Mbps). This supports a video on demand service so people can watch a whole range of movies through their computer. The company offers a choice of 1000 movies and had over 80,000 customers at the end of 2002.

Conclusions:
Low cost, highspeed broadband connections are life enhancing. They enable quicker response times and therefore improved service levels, enhanced lifestyles and they are kind to the environment.

The simple message emerging from this research is that when broadband is made available to users, they have an intrinsic capability to utilise it and require more.

One of our key aims in this report is to focus debate and policy actions on the needs of end users. We believe that adopting the projection methodology used in this Section may provide a concrete way to measure Ireland's progress against other countries and, in particular, against the Government's targets for the sector. We return to this point in the following Section (Recommendations).

Conclusions

There are compelling factors which point to an increase in the demand for broadband capacity:

- Development of use in specific application areas
- Quantifiable broadband trends
- Technology evolution
- Industry views

A key conclusion is that the utility derived from broadband occurs more significantly at higher speeds, and where the user has a high level of familiarity with it. Based on the various trends and factors referred to above it is expected that an average Irish broadband user will require up to 28Mbps by 2015 which is very much in line with the Government's target of 5Mbps by 2012. If anything the Government's target could be considered conservative.

Case Study

NZ school sees digital literacy as an essential life skill

Introduction
St Cuthberts Junior school is an independent girls school in Auckland, New Zealand. The school has 1,360 students, from entry level Year 1 (5 year olds) to final Year 13 (18 year olds).

Consideration of how new technologies could be used as part of the education process, led, in 2000, to the school beginning a trial using laptops. The trial followed a lot of analysis of the principles underlying the use of IT in education and a detailed consideration of the learning environment.

It is intended that all students will have an Apple iBook in the junior school. However, it is a requirement that the children must have one at year 6.

The thinking is that younger children need to learn how to read and write first!

Liz Battersby, Head of the Junior School is convinced of the importance of ICT in education, "We believe that digital literacy is an essential life skill. Traditionally girls were not moving into jobs in the technology sector. We want students to be well prepared for careers in these sectors".

The extent to which ICT has now become important to the learning process in the school is highlighted by the high usage of the laptops. The laptop is used for about 70% of class time to supplement traditional learning methods.

iBook laptops are in use both in the school and at home. High speed broadband connections are available and inexpensive in NewZealand, making this a reasonably priced strategy.

The school has established its own high speed wireless network which allows students to log on and use their laptops at any point in the school campus. This supports the concept of "anywhere anytime learning". The School's aims in this regard are to develop

(i) Genuine integration of ICT into the curriculum

(ii) Digitally literate students, and

(iii) ICT resources always available – no wait time.

Each class has their own section on the school's website (www.stcuthberts.school.nz)

Parent's Perspective
Niamh emigrated to New Zealand in 1984. Niamh has three children, Sinead (12), Conall (10) and Cormac (6). Sinead attends St Cuthbert's School.

Niamh's comments:
Sinead has been attending St Cuthbert's College for almost a year. I was most interested in St Cuthbert's for a number of reasons. It is close to our home, it has the highest academic record of any school in New Zealand in external exams and, of course, it is committed to digital literacy.

It is a requirement for all children attending the school at Year 7 that they have a laptop.

Laptop supply and cost
The school organises the supply of the laptop together with associated parts, printer and warranty. There are two methods of obtaining the PC, either by purchasing it outright or by a lease arrangement. I opted for the purchase outright option as over time it provided the best value for money. I was assured by the ICT people at St Cuthbert's that it was capable of being upgraded if required and additional memory could be installed. I was also assured that the school was committed to using the laptop for the following six years of Sinead's education at St Cuthbert's.

To give you some idea of cost, the purchase outright option was approximately NZ$4,000 (€ 2,000). The lease to buy arrangements involved consecutive monthly payments of approximately $140 (€ 70). At home we have two other computers available for family use. One is Windows XP and the other is a basic computer which is a number of years of old but which is dedicated to Word and games. One of our at-home computers has access to the Internet. We subscribe to Jetstream which is a high speed internet link. This costs $80 per month (€40). We get internet access through Ihug. This costs approximately $25 per month (€12.50 per month) for unlimited usage.

Training & Support
Initially Sinead received training on how to use her laptop in the year preceding her entry to St Cuthbert's. She had reasonable skills using Word prior to this. That certainly helped. We have had a number of challenges and difficulties in respect of the laptop, which is an Apple iBook. I wasn't used to an Apple environment and that meant when Sinead had difficulties, they had to be referred to the school's iBook clinic. The difficulties she experienced were minor and had I had some training on Apple, I think I could have saved some time and a little bit of heartbreak along the way. *We have had no bad experiences with connectivity to broadband services, even though we moved house, temporarily, during the year.*

The clinic is run by dedicated technicians who are "techno geeks". They assume a high level of knowledge among parents. Our household has a reasonable level of knowledge, but not high. Therefore obtaining sensible and practical information has presented its challenges.

Value of ICT for Schools
I think it is excellent for the girls to become very familiar with technology which will become part of their everyday lives. As Sinead is in year 7, I don't think that she is obtaining the full use of her PC at this stage. Her use of it will increase over the years to come. From what I can gather, the school is pushing hard to make the classroom a paperless environment. I think this is a very good thing for a number of reasons. The school however, is also committed to basic writing skills which I think is essential.

I have some doubts about the "toy" aspect of the laptop. I think that there are a number of distracting elements (access to movies, photos etc.) which means that homework is not completed in a timely way. I accept this is a matter of discipline but nevertheless it is difficult to monitor the use of the PC all of the time.

In terms of improper use of the internet, I have installed various programmes which prevent inappropriate sites being accessed, so I have no particular concern in this area.

I don't think there is any loss of traditional literary skills with an increase in computer skills. In fact, it might be that there is more awareness of those, given the use of spell checkers and grammar checks which are available.

There has been some spin-off for the other children in my family. Both are looking forward to the day when they have their own laptops. They see the convenience in being able to carry a computer around - and, of course there are the games.

All up, I am very happy with the use of ICT as an integral part in Sinead's education. In fact, I would regard it as essential. **Reasonably priced, high speed broadband is, of course, the enabler that makes all of this use of ICT a reality.**

Student's Perspective

Background
Sinead is 12 years of age and in year 7 at St Cuthbert's school.

Sinead was introduced to computers on entry to school (aged 5). Her primary school has a computer suite and all children are required to attend at least 2 computer classes a week. There are sufficient computers for all of the students. On joining St Cuthbert's College, Sinead was required to have an Apple iBook.

As part of this project, Sinead was asked a number of questions and her responses are set out below:

Q. Do you and your friends like using the laptop and why?

A. Yes, I do like using the PC. It helps me to complete my work more quickly. For example, I can access the internet through my laptop. This saves time, as I do not need to visit the library to obtain reference books like I used to before. In addition, I am able to exchange information at school with other students through the network. I find it very useful that I can prepare and save my homework so that I can then check it in school before I give it to my teacher. The laptop is also a lot of fun. I have some games on it but I am not allowed to play those at school.

Q. Do they break down and what happens if they do?

A. They don't often break down. However, if they do, St Cuthbert's School has an iBook clinic. There are specially trained technicians who sort out most of the problems. If the school is unable to fix the problem, the iBook is sent to Apple. My iBook is covered by a warranty and it provides cover for all damage (except for intentional damage).

If my laptop has to be sent away to be fixed, the school has a number of "loaners". I am not sure how many there are, but there are plenty available if there is a problem. The school provides loaners free of charge.

Q. Was it difficult to get used to the laptop?

A. No, it was very easy to get used to. Prior to joining St Cuthbert's, I attended classes during each of my holidays in the preceding year. At those classes I was given lessons so that by the time I joined St Cuthbert's I was of a similar standard to my classmates.

Q. Did you have to learn to type?

A. Yes, it is compulsory. I received a total of 10 lessons in term 1, and 8 lessons in term 2. My typing speed is currently 45 words per minute (touch typing). I am getting faster. I'd like to be able to type at 60 – 80 words a minute.

Q. What do you use the laptop for in school and at home?

A. In school I use the laptop for a number of things. Sometimes I record my homework on my laptop. I have an actual physical diary for this, and the school prefers I use the physical diary so that it is easily checked by parents. However, I use my laptop for most classes except for maths and information communication technology. At home, I use it for homework, projects and research. I find it very useful for storing my old homework.. I can access it very easily. I like not having to carry around a number of different exercise books which are easily lost.

Q. Does it help with your homework/class work on line if you need to revise?

A. Yes, the laptop does help with my homework and class work online. I am able to revise some of my work through the network. For example, my French homework is on the school's server. I can access this and make sure that I am doing the right work by the required timeframe.

Q. In what way do you think it is better than "old fashioned learning"?

A. I am not sure because I haven't done any old fashioned learning. Our teachers tell us that it will be much easier for us at University if we have good research skills. I know of some St Cuthbert's students keep their laptops and use them for taking lecture notes. Our teachers say that we must be experts on computers by the time we leave school because we are in a computer world. The teachers say that being able to use a computer will be taken for granted, just like using a telephone.

Q. Are you still required to write homework on paper?

A. Yes, but only for maths and some oral language requirements, art and music.

Q. Do you use the Laptop outside school?

A. Yes I do. As well as for homework, I enjoy using the Movies, Tunes, Chat and Internet Explorer for fun.

Q. Do your brothers Conall (aged 10) and Cormac (aged 6) use the laptop at home sometimes, and if they do, what do they use it for?

A. I am not allowed to let Conall and Cormac use the laptop. Sometimes though, they play games with me on the laptop. The laptop costs a lot of money and if Conall and Cormac use it and break it, I will get into trouble. In our house we have two other computers. Once has access to the internet and the other has Word and games on it. Conall uses the computer (Windows XP) for his research. Cormac uses both computers for games.

Q. Are there any rules that you have to obey when you use the laptop?

A. Yes, there are a lot of rules about using the laptop. I had to sign an agreement with the school which had a lot of rules. Most of the rules meant that I had to agree not to play games or access porn sites on the internet. If I break them I could be asked to leave the school.

Conclusions:
The availability of reasonably priced high speed broadband access provides the foundation building block for e-learning, both in the school environment and in the home.

Appendices

Appendix 1 – Productivity Analysis

These data are shown in Table A1 and have been interpreted by many as one of the main reasons for the growth of the economy in this period

Table A1 **Change in Productivity (% per annum)**

	1995	1996	1997	1998	1999	2000
Traditional	6.3	2.1	3.5	3.3	3.0	6.7
Food Processing	6.3	–1.1	0.9	7.0	2.7	4.0
High technology	11.6	6.9	11.0	19.2	11.8	8.4

Slevin (2002) analyses the important role of productivity growth in determining the performance of the economy in various periods. She shows that total hours worked in high-tech sectors in Ireland in the period 1997-2001 grew by 6.2% per annum while average annual output growth was 17.6%. This means that average labour productivity (ALP) growth was 11.4% per annum in this sector. However, the picture is very different in the traditional manufacturing sector. Here, average hours worked did not grow while output grew by 1.6% per annum indicating ALP growth of only 1.6% per annum. A similar picture emerges when data on total productivity growth (TLP) are examined. Table 2 shows TLP figures for the same years and sectors as in Table A2. They show the key role played by productivity growth in the performance of the Irish economy.

Table A2 **Annual TLP Growth by Sector (%)**

	1971-1999	1985-1990	1990-1995	1995-1999
Agriculture	0.7	0.4	0.4	0.3
Building and Construction	3.6	4.5	3.0	6.3
High-tech Manufacturing	2.5	3.5	2.1	5.7
Traditional Manufacturing	0.8	0.5	0.7	0.6
Market Services	0.7	1.1	0.5	0.3
Total Economy	4.9	6.0	3.8	7.0

Source: Based on Slevin (2002) Appendix 4, Table 5

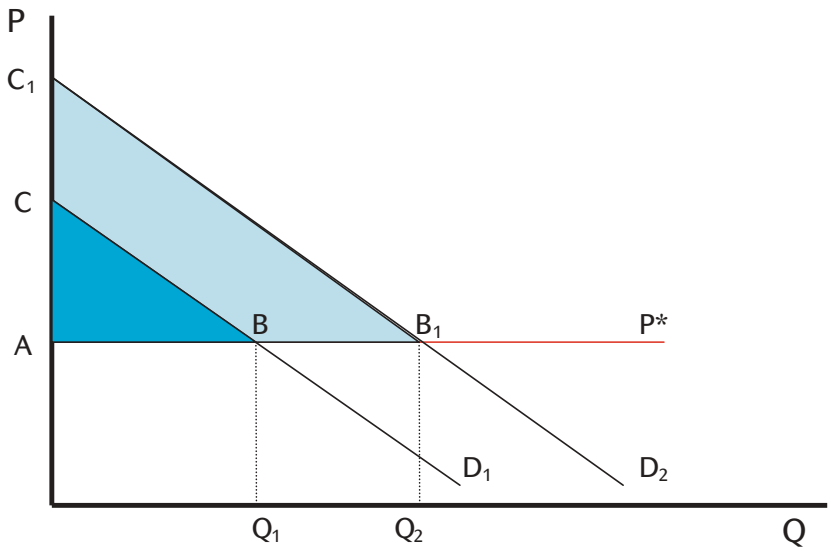
While many of the general trends already observed can still be seen in this table there are some important differences. The out performance of the high tech sector is not as noticeable, although the relatively poorer performance of the traditional sector remains. The explanation for this is the very large expansion that has occurred in capital intensity in the high tech sector. A similar feature is also present in the services sector where TLP is not as high as might be expected given the rapid growth of recent years. In this case, the productivity figures are not so useful over longer periods since the activities that comprise the service sectors have changed considerably. As a result, there has been rapid growth in new sectors many of which are capital intensive while other sectors such as personal services have grown, but find it difficult to achieve labour productivity gains.

Appendix 2 – Model for Estimating Consumer Surplus

Identifying Consumer Surplus

Any new marketed product or product improvement has the potential to create benefits for consumers as well as producers. Consumers may gain because they are able to purchase a new or improved product that was previously unavailable. They consume it up to the point at which the marginal value of the product to them is equal to its price. However, the price at which the good is available is the marginal valuation of the marginal consumer, in other words, the lowest valuation placed on the good by any consumer that is equal to or above the minimum price that producers are willing to accept. This, assuming a downward sloping demand curve, is less than all previous consumers. Thus, consumers receive welfare from consumption in excess of their evaluation of the welfare of holding on to their money. While this analysis has been criticised on many occasions, it does comply with the observed result that economic well-being rises as economic activity increases. The benefit of growth in demand and consumption is then approximated by the change in the consumer surplus. The argument is illustrated in Figure A1.

Figure A1 **Consumer Surplus**



With demand curve D_1, the quantity consumed is Q_1, price is P* and consumer surplus is the shaded triangle ABC. When consumption rises as a result of the availability of supply to Q_2, indicated by the shift of the demand curve to D_2, then the area of the triangle increases to AB_1C_1[52]. The difference between the before and after measurements of consumer surplus – the area BB_1C_1C – measures the net benefits to consumers of the new technology. A similar type of analysis could be undertaken in relation to the benefits to producers.

Data Requirements and Assumptions

Providing a valuation of the addition to consumers' welfare arising from the availability of broadband requires a number of pieces of information:

1. The nature of the demand curve and its elasticity
2. The period over which the evaluation takes place
3. Projections of the population
4. The rate of growth of penetration of the new technologies in this period
5. An estimate of the price of access

52 For simplicity of exposition, it is assumed in this analysis that economies of scale mean that the new technology can be provided at the same price as the old technology. In fact, this assumption need not be used in the appraisal of broadband benefits since almost all demand will be additional

We also give full consideration to the factors identified in Section 4 (How Many Broadband Users Will There Be?).

It is common in appraisal to assume that the demand curve for a product is linear. Data from a survey of consumer demand for broadband may be used to construct a demand curve for access and suggests that this assumption is reasonable in the case of broadband[53]. It is worth noting that this may provide demand estimates that are somewhat on the low side since, as has been argued above, growth is likely to be supply driven with demand evolving as consumers realise the potential benefits and uses of access. The survey results are shown in Table 3. From these data it is also possible to project total revenue.

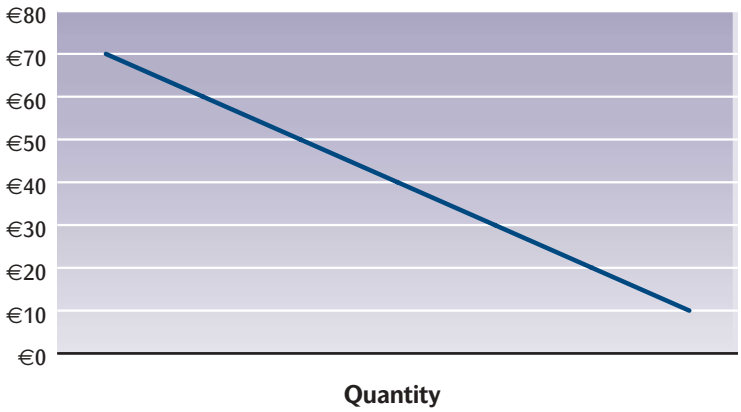
Table A3 **Household Demand for Broadband (% of respondents)**

Monthly Fee	€70	€60	€50	€40	€30	€20	€10
Extremely likely	2	3	8	15	26	38	55
Very likely	3	6	8	11	11	13	7
Fairly likely	14	12	14	13	15	10	6
Fairly unlikely	12	13	11	9	5	3	2
Not very likely	16	17	14	11	7	4	3
Not at all likely	45	40	34	30	25	21	17
Don't know	8	10	10	12	11	10	11

Source: MRBI and ODTR (2002)

If it is assumed that the first three answers at each price level indicate demand while the bottom three indicate that there will not be demand, and that the 'Don't Knows' are even distributed, then these data provide the simple demand curve shown in Figure A2.

Figure A2 **Household Demand Curve for Broadband Access**



Regarding elasticity, Crandall and Jackson assumed elasticity of demand equal to –1 in the US. While this assumption at first appears arbitrary, it may not actually be a bad assumption to start with since, in an oligopolistic market, this represents demand where the supplier is experiencing marginal revenue equal to zero. This industry is subject to very large economies of scale such that the marginal cost facing suppliers at large volumes will approach zero. This is another way of saying that the main costs are in the capital and fixed costs and that, once connected, an additional user does not place great costs on the producer. In this situation, the profit maximising condition requires that the price will fall until demand rises to a level where marginal revenue approaches zero also[54]. This is the argument that costs for consumers will be lower when volume is high (but volume will not rise until prices fall). In summary, the assumption of elasticity equal to –1 appears valid.

53 Consumer Demand for Broadband: Survey Findings. *MRBI and ODTR, September 2002*

54 *This does not mean that price approaches zero at this equilibrium*

The period for the evaluation should be a sufficient period for the technology to reach an equilibrium level of penetration. The development of broadband requires high up-front investment in infrastructure with fairly low subsequent running costs. However, unlike in the case of a road, the life of the infrastructure is limited due to the pace of technological development in this area. Adopting a timeframe of 20 years appears appropriate since the timeframe must be a balance between a sufficiently long enough period for broadband to achieve penetration rates comparable with existing communications technologies, such as telephones or television, but sufficiently concise to recognise adequately that the speed of the technology cycle has increased and there is the possibility that broadband could be superseded if a longer timeframe was adopted. It is also in keeping with the recommendations of the Department of Finance regarding investment in infrastructure projects[55]. However, although the infrastructure may still be used beyond this date, a final residual value should not be added in. Technological improvements mean that it is likely to be obsolete from the point of view of adding to the competitiveness or welfare of society.

The fact that benefits will arise over a period while costs are mostly up-front means that the flow of returns must be discounted. Furthermore, it is essential that all opportunities costs are incorporated. In practice, this is very difficult but the problem is lessened if there is a general alternative use for funds that can be assumed in all CBAs and if a margin of error is built into the results. In Ireland, it has become commonplace to adopt repayment of the national debt as the alternative use of funds. Thus, the opportunity cost of the funds is the interest that could be saved on the national debt. This is usually taken to be 5% per annum of the funds involved. This value is then used as an appropriate discount rate to use – although it is debatable whether this is as appropriate going forward as it was in the past – and is in keeping with Government recommendations[56].

Some assumption regarding the likely uptake of broadband usage – the degree of penetration – is also required. Currently, there are in the region of 1.1 million colour television licences in Ireland. On the basis of the available data this would suggest a household penetration rate of about 90% over 20 years for a mature technology and this is used in deriving the first estimate below of potential net benefits to consumers. However, there are difficulties with trying to identify potential penetration rates for broadband by extrapolating from existing technologies. For example, it is currently estimated that adult internet usage is 40% with only 26% using the medium at home. However, growth rates have slowed. The problem with using a metric such as this as a basis for predicting broadband penetration over 20 years is that the existing internet has proven to be an inadequate medium – the fate of the stock market dotcoms illustrate this disappointment – and customers have not embraced it as a result. The potential is that broadband will overcome this deficiency. A good example of this is provided by the life cycle of mobile phones. When introduced using the original analogue technology with bulky handsets penetration was low. However, the introduction of digital technology facilitated new features such as text messages, pictures, greater security and reliability and network competition to control prices. This was allied with neater handsets and penetration and usage grew to levels that could not have been extrapolated from the analogue experience. In addition, the network effects discussed below mean that there is potential for further unpredictable development.

It can be argued that both mobile phones and broadcast television are unsuitable comparators since the development of broadband will be primarily based on cabling. However, as emphasised in Section 4, this argument fails to distinguish adequately between the technology employed in the medium and the utility of the medium. Penetration is based on utility: customers are unconcerned to a large extent as to the technology involved. The only issue then is with regard to the relative costs involved in the different technologies. The growth in the popularity of cable television services in recent years when mature broadcast technologies are available suggests that this is not a simple relationship and that businesses have been very innovative in developing ways to recover sunk costs. However, there is an issue here in relation to the relative penetration of broadband in urban and rural areas to the extent that beyond a certain level the potential growth of the medium could be restricted due to the need to access areas of low population density.

55 *CSF Evaluation Unit (1999)* Proposed Working Rules for Cost Benefit Analysis

56 *Department of Finance (1994)* Guidelines for the Appraisal and Management of Capital Expenditure Proposals in the Public Sector

The estimates produced by Crandall and Jackson of the potential economic benefit of widespread diffusion of broadband internet in the US were based on broadband becoming as widely used in 20 years time as the telephone service is now. However, if broadband is only adopted by 50% of households, they estimate the potential consumer benefit to be closer to $100 billion. This means that the level of benefits is very sensitive to the level of adoption with a non-linear relationship. To reflect this, a second calculation is undertaken based on dividing the market between urban and rural households and assuming that penetration in rural areas will be both lower and slower than in towns[57]. The results of Census 2002 indicate that 59.6% of the population lived in towns in 2002 compared to 58.1% at the last census in 1996. The results of the Census in relation to households are not yet available but, in the absence of data, it is assumed that household size is the same in rural and urban areas. This means that the number of urban households is estimated at 717,570 with 486,400 rural households. Furthermore, it is likely that the urbanisation that has been ongoing will continue partly as a result of the factors that have been driving the process to date and due to the impact of the National Spatial Strategy with its emphasis on identifying leading development centres to promote regional growth. Combining the projected rate of population growth and a continuation of urbanisation trends means that the number of urban households will have risen to 854,160 in 20 years time while the number of rural households will have fallen slightly to 478,400. This forms the basis of the second estimate below of potential net benefits to consumers.

Population change is likely over this period implying growth in the potential market. A range of projections are contained in the CSO's *Population and Labour Force Projection 2001-2031* on the basis of alternative assumptions regarding migration and fertility rates utilising data from the 1996 Census. The available results of the 2002 Census suggest that the high assumptions are more appropriate given recent trends, but the projection of these over the full 20 year period could be problematic. This means that a projection based on moderate fertility and high immigration would appear to be most appropriate[58]. Alternative assumptions would clearly affect the future population and demand for broadband. If it is further assumed that household formation and household size remains constant at 3.25 over the period, then population and household growth will be as given in Table 4.

Table A4 **Projections of Population and Households in Ireland 2002-21**

	Population	Households	Annual % change in preceding period
2002	3,917,203	1,203,976	1.10
2006	4,068,329	1,250,383	0.95
2011	4,178,461	1,284,232	0.67
2016	4,269,074	1,312,081	0.43
2021	4,335,656	1,332,545	0.31

Source: Derived from CSO Census 2002: Principal Demographic Results and CSO Population and Labour Force Projections 2001-2031. *The assumptions used here are equivalent to the CSO's M1F3 projection.*

These projections indicate that the number of households in Ireland will increase by 128,569 in the period 2002-2021. This is equal to 10.7% growth over the 2002 figure. This is clearly a much slower rate of increase than has been the case for the past few years.

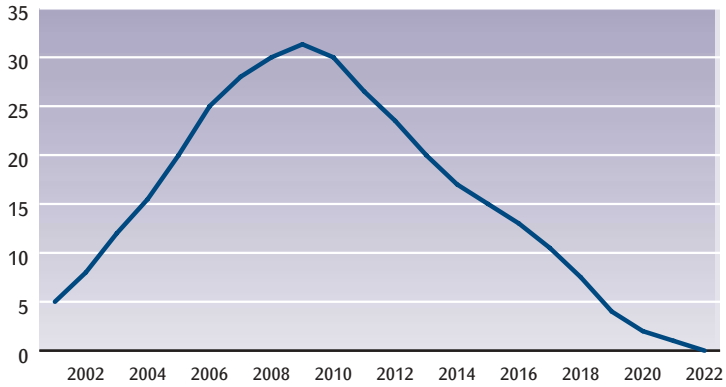
Estimates of Consumer Surplus

The first estimate of consumer surplus assumes that a penetration rate of 90% of households is achieved indicating 1.2 million active broadband household connections in 2024. It is also necessary to set out an appropriate profile of connections for the period. Assume a 5% connection rate in the first year of operation (2004), equivalent to just over 60,000 connections. To achieve 90% household penetration in 20 years would require constant annual growth of almost 17.1% per annum for the full period. However, this assumption of a constant rate of growth appears unlikely and it is more likely that after a slow start the rate of growth would accelerate before slowing as it approaches its steady level of penetration. Annual growth under this scenario is shown in Figure A3.

57 *Urban areas are identified as 'Towns' as defined in CSO (2003)* Census 2002 Volume 1 – Population Classified by Area

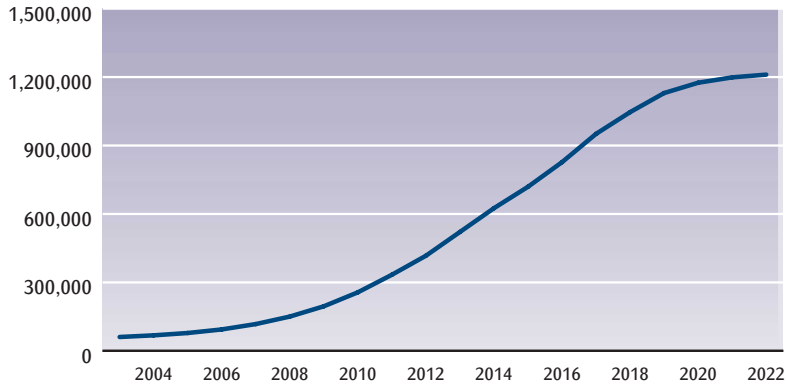
58 *The moderate CSO projection under the M1F3 assumptions forecasts a population growth rate of 1.12% per annum in the period 1996-01. The actual rate in the period 1996-02 was just below this at 1.10% per annum*

Figure A3 **Assumed Broadband Annual Growth Life-Cycle (%)**



This approach is in keeping with a typical product life-cycle where early adopters are attracted to the new technology but the numbers are limited. Eventually, lower prices, due to economies of scale, and the availability of richer content attracts the mass market. Then as the technology matures and the market approaches saturation the annual rate of growth falls towards a steady state. The number of connected households in each year under this approach is shown in Figure A4.

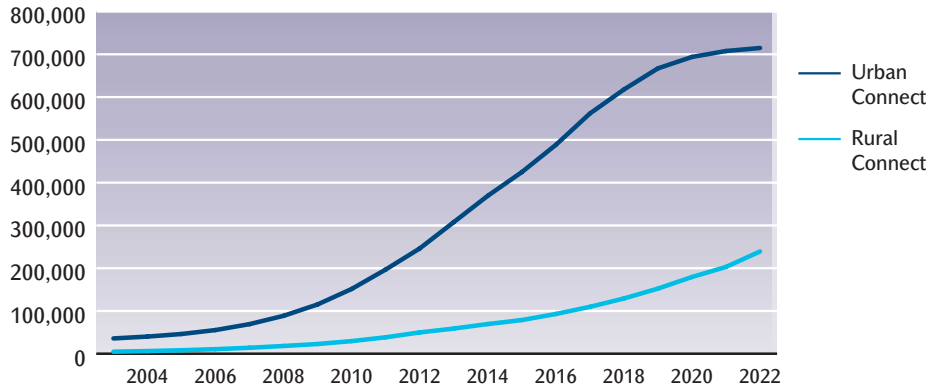
Figure A4 **Number of Broadband Connections**



Applying these market growth projections based on the population projections, and assuming access cost of €40 per month as discussed above, this indicates an industry with the potential to generate revenues of about €30 million in the first year rising to over €100 million by 2010. As discussed, consumer surplus at 50% of revenues would appear to be a realistic assumption. This means that, applying a real social discount factor of 5% per annum to the stream of returns indicates aggregate consumer surplus over the period up to 2024 with a present value of €1.3 billion. This is approximately equal to about 1.2% of GNP at present. In other words, the development of broadband along these lines increases economic welfare by approximately 1.2% of GNP as a result of increased consumer surplus.

The second projection of household uptake recognises that there are issue related to accessibility in areas of low population density. The assumptions here are that while penetration in towns rises to about 40% in the first 10 years and 90% in the following 10 from a base of 5% in the first year i.e. at the same rate as was assumed for all households in the first calculation, it reaches only 10% of rural households in the first 10 years and 50% after 20 years from a base of 1% in the first year. This gives the number of household connections as shown in Figure A5.

Figure A5 **Number of Broadband Connections (000s)**



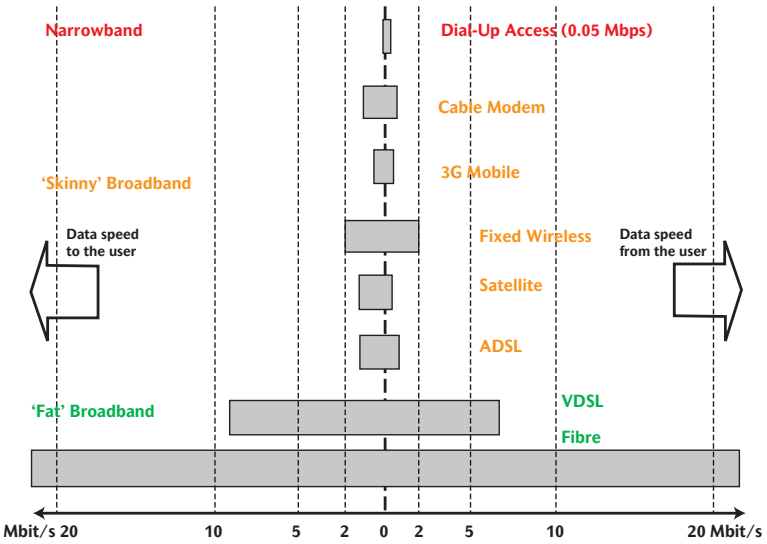
This lower penetration of rural households has an effect on the projected present value of the consumer surplus that arises. The calculation shows a present value of €0.96 billion or 0.9% of current GNP. This estimate is about 26% below the previous estimate based on a total take-up of 90% of all households and arises as a result of the additional costs to be addressed in providing broadband in areas of low population density.

Appendix 3 – Speed of Broadband Media and Services

Most 'skinny' broadband services do not allow for the same speed of information transfer both to and from the user. The following chart further represents communications services':

- Range of speeds
- Two-way communications abilities

Figure A6 **Broadband Media & Speeds to End User**



Source: Sonas Innovation

Legend

— Narrowband
— 'Skinny' Broadband
— 'Fat' Broadband

The two-way flow of information (both to and from the user) is more fully enabled with 'fat' broadband. This becomes important when the user and his/her digital environment becomes a more significant contributor to the communications flow as opposed to being more in 'receive mode only'.

Appendix 4 – Sonas Acknowledgments

Sonas Innovation would like to thank the following people for their time and cooperation in making valuable contributions to the project and the production of this report:

Stephen Banable, ComReg
Liz Battersby, St Cuthbert's School
Keith Bohanna , Product Inform
Ed Brophy, NTL
Derek Buchanan, Champion Sports
Joe Butler, Intel
Michael Byrne, Netsource
Vint Cerf, MCI
Paul Conway, ComReg
Enda Cronelly, Daughters of Charity
Frank Cronin, Setanta
Christine Eckersly, Southern Health Board
Brian Fitzsimmons, ESB Telecom
Adrian Devitt, Forfás
George Doherty, ESB Telecom
Tim Duggan, Department of Finance
Peter Evans, Esat BT
Sean Foley, Cypress Technologies
Alistair Glass, Science Foundation Ireland
Prof Jane Grimson, TCD
Donal Hanrahan, Aurora
Gary Healy, ComReg
Paula Hicks , TCD
Brian Higton, Cygnet Solutions Ltd,
John Horan, Chorus
Richard Horton, ComReg
Matt Kemp, NTL
Ragnar Lone, Gatorhole
Kathy Lester, AAMC, Maryland, USA
Mick Lohan, Southeast Software
Doug Reed, McKinsey (ex FCC)
Nana Luke, Bealtaine
Tom McFadden, Portmarnock N.S.
Orla Sheridan, Microsoft
Brian Moran, Chorus
Dr Phil Nolan, Eircom
Michael Norman, Esat BT
Niall O'Donnchú, Dept of Communications, Marine & Natural Resources
Ciaran O'Donoghue, Conemara West
Ursula O'Sullivan, SHB
Jonathon Parkinson, ComReg
Colm Piercy, Digiweb
Shane Quinlan, Forfás
David Martin, Eircom

John Quist, Eircom
Phil Rink, AAMC, Maryland, USA
Ann Ryan, St Marks Primary School
Eddie Sadlier, Tymon Bawn Community Centre
Chuck Shafer, AAMC, Maryland, USA
John Sharkey, Stiefel
Ciara Sommers, Temple Street Hospital
John Thewlis, Mission Critical
Eric Tompkins, ComReg
Brendan Tuohy, Dept of Communications, Marine & Natural Resources
Marcus Tzannes, Aware.com
Richie Walsh, Saint Mark's School
Tom Walsh, EnterAktion
Laura Wren, Atanaskovic Hartnell,
Joe Macri, Microsoft
Alan Leahy, Hoki
Siobhan Masterson, IBEC
Patrick Vankwikelberge, ST Microelectronics
Carlo Ottaviani,, ST Microelectronics

We would like to pay a special thanks to the members of the Telecommunications Working Group of the Information Society Commission, under the Chair of Dr Patricia O'Hara, and to Aedan Hall and Tony Downes, in the Department of An Taoiseach, for their guidance and support throughout the project.

Sonas Innovation would like to recognise the work of Iarla Flynn as co-author on this report. Inputs by Ben Hurley on telecommunications technology and design input by Philip Lynch of Pixel Soup are appreciated.

Appendix 5 – Bibliography

Amárach Consulting for Comreg (February 2003) *"Consumer TrendWatch"*

Atkinson, R. (2002) *"The 2002 State New Economy Index"*

Bass, Dr. Frank M. (1999) *"Diffusion Theory in Marketing: A Historical Perspective"* (Paper at La Londe Conference)

Broadband Expert Group (May 2002) *"Nederland Breedbandland – Recommendations to the Cabinet"*

Brookings Institute in association with the University of California-Berkeley and Momentum Resources Group (2002) *"Net Impact Report"*

Brynjolsson, E. and Hitt, L., Journal of Economic Perspectives, Volume 14 (4) (2000) *"Beyond Computation: Information Technology, Organisational Transformation and Business Performance"*

ComReg (September 2003) *"The Irish Communications Market Quarterly Review, Key Data Report"*

ComReg/MRBI (September 2002) *"Consumer demand for Broadband in Ireland"*

Crandell and Jackson (July 2001) *"The $500 Billion Opportunity: The Potential Economic Benefit of Widespread Diffusion of Broadband Internet Access"*

DeLong, B (June 2001) *"A Historical Perspective on the New Economy"* (Paper presented to New Economy Conference, Montreal)

Department of Communications Marine and Natural Resources (February 2003) *"Broadband Newsletter"*

Dotecon and Criterion Economics (October 2003) *"Competition in broadband provision and its implications for regulatory policy"* (A report for the Brussels Round Table)

eMarketer (2002) *"South Korea – A Case Study"*

ESRI (July 2003) *"Quarterly Economic Commentary"*

ESRI Policy Research Series No. 33 (March 1999) *"National Investment Priorities for 2000-2006"*

European Union (May 2000) *"EU Emergence Project"*

Forfás (2002) *"Broadband Investment in Ireland: Review of Progress and Key Policy Requirements"*,

Forfás, (1998) *"Broadband Telecommunications Investment in Ireland"*

Gartner Dataquest (July 2002) *"The Payoff of Ubiquitous Broadband Deployment"*

IMD (2003) *"World Competitiveness Yearbook 2003"*.

In-Stat MDR (April 2003) *"The Top Ten Drivers of the Converged Home Network"*

MacSharry, R. and White, P. (2000) *"The Making of the Celtic Tiger"*

McKinsey & Co. (2002) *"How IT Enables Productivity Growth"*

McKinsey Global Institute (2001) *"US Productivity Growth 1995-2000: Understanding the Contribution of Information Technology Relative to Other Factors"*

McKinsey Quarterly (June 2003) *"Making sense of Broadband"*

National Competitiveness Council (2002) *"Annual Competitiveness Report"*

National Competitiveness Council (2000) *"Statement on Telecommunication, eBusiness and the Information Society"*

National Competitiveness Council (1998) *"Statement on Telecommunication: a key factor in electronic commerce and competitiveness"*

Office of Technology Policy U.S. Department of Commerce (March 2002) *"Understanding Broadband Demand: Broadband And Business Productivity"*

Office of Technology Policy U.S. Department of Commerce (September 2002) *"Understanding Broadband Demand – Review Of Critical Issues"*

Oliner, S. and D. Sichel, Journal of Economic Perspectives, Volume 14 (4), (2000) *"The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?"*

Pociask, B. (2002) *"Building a Nationwide Broadband Network: Speeding Job Growth."* TeleNomic Research, Va.

Point Topic (April 2003) *"Korea Broadband Overview" (http://www.point-topic.com/content/operatorSource/profiles/South+Korea/South+Korea+broadband+overview+0310.htm&comp_id=612)*

Porter, Michael WEF Global Competitiveness Report 2001-2002 (2001) *"Enhancing the Microeconomic Foundations of Prosperity: the Current Competitiveness Index"*

President's Council of Advisors on Science and Technology (December 2002) *"Building out Broadband"*

Sage Research (2002) *"Customers at the Gate: Mounting Demand for Broadband-enabled Services"*

Slevin, G. Central Bank of Ireland Technical Paper 3/RT/02, 2002 *"Is there a New Economy in Ireland?"*

The Work Foundation (May 2003) *"Time to go Home"*

UK Broadband Stakeholders Group (November 2002) *"Second Annual Report and Strategic Recommendations"*

www.canarie.ca *"The Third Wave"*

www.positivelybroadband.org ITAA (2001) *"Building a Positive, Competitive Broadband Agenda"*

Appendix 6 – Membership of the Information Society Commission

Chairman
Dr Danny O'Hare

Members
Ms Inez Bailey, National Adult Literacy Agency
Mr Michael Byrne, Ennis Information Age Services
Ms Dee Carri, Torque Management
Rev Dr Eamon Conway, Mary Immaculate College of Education – University of Limerick
Dr Chris Coughlan, Hewlett Packard
Ms Claire Cunningham, Aura Internet Services Ltd
Mr Joe Horan, South Dublin County Council
Ms Karen Hynes, Chambers of Commerce of Ireland
Mr Robert Johnston, JLS Technology
Mr Brian Lennon, St Oliver's Community College
Ms Clodagh O'Donnell, IBM
Dr Patricia O'Hara, Western Development Commission
Ms Marion O'Neill, Kilkenny Information Age Town
Ms Kathryn Raleigh, IBEC
Mr Colm Reilly, PA Consulting
Mr Peter Ryan, Department of the Taoiseach
Mr Jerry Shanahan, ICTU/Amicus
Mr Charles Stanley-Smith, Piercom
Mr Donal Toolan, Forum of People with Disabilities

Communications Director
Mike Neary *(mike.neary@t.gov.ie)*

Secretariat Contacts
Edel Cooke *(edel.cooke@t.gov.ie)*
Tony Downes *(anthony.downes@t.gov.ie)*
Aedan Hall *(aedan.hall@t.gov.ie)*
Brian McAufield, Secretary *(brian.mcaufield@t.gov.ie)*

Appendix 7 – Members of Broadband Working Group

Chair

Dr Patricia O'Hara, Western Development Commission

Members

Mr Rory Ardagh, Leap Broadband
Ms Dee Carri, Torque Management
Mr Adrian Devitt, Forfás
Mr Martin Fraser, Department of the Taoiseach*
Ms Karen Hynes, Chambers of Commerce of Ireland
Ms Fiona Murphy, CMS Peripherals
Mr Niall O'Donnchú, Department of Communications, Marine and Natural Resources
Ms Kathryn Raleigh, IBEC

* Replaced Mr Deaglán Ó Briain, February 2003

Information Society Commission

Information Society Commission
Department of the Taoiseach
Government Buildings
Upper Merrion Street
Dublin 2

Tel: +353 1 619 4344
Fax: +353 1 619 4340

Email: info@isc.ie
www.isc.ie