

Introduction

Throughout the world, the effects of advanced communications technologies on all aspects of living are bringing about a new era. Many countries have recognised the importance of telecoms to future economic development and job creation. They are, therefore, investing substantially in telecoms and are actively creating supportive regulatory and fiscal environments to encourage the required commercial investment. Ireland gained a significant competitive advantage from the strategic investment made by the government in our telecoms infrastructure in the late 1970s and early 1980s, enhancing the country's attractiveness as a location for inward investment and improving the international competitiveness of Irish based companies. Now, however, again there is a real danger of Ireland falling behind. Compared to a number of other countries with which we compete for investment a gap is emerging in terms of the capacity, price and availability of advanced communications services, and this gap is widening.

Because of the increasing importance of telecommunications for the development of the enterprise sector Forfás has, in recent years undertaken work in the area in consultation with government departments, the development agencies, Telecom Eireann and businesses. Forfás has published two reports: Telecommunications in Ireland¹ and Telecommunications and Enterprise: Building and Investing for the Future². The later report argued very strongly for immediate investment in broadband infrastructure in advance of demand. In the Forfás report 'Shaping Our Future: A Strategy for Enterprise in Ireland in the 21st Century' published in May 1996 particular attention was drawn to the potential of telecommunications policy in Ireland as a key instrument of economic development and competitiveness.

While Telecom Eireann has played a significant part in attracting and promoting many tele-based jobs in Ireland in recent years, in conjunction with the development agencies, accelerated investment in broadband telecoms infrastructure is now even more urgently required if Ireland is to provide advanced telecoms services at the advanced level and at the competitive prices already available in competing countries. This investment must be put in place in advance of demand and before similar investment by other countries. Such investment is essential if employment-generating projects are not to be lost. Investment projects in manufacturing and international services will be attracted to those countries that already have advanced services in place. In addition, the development of Irish-owned companies will be curtailed if competitors in other countries have access to more advanced and lower cost services.

The attached report completed by Analysys for Forfás builds on previous work completed. It sets out the specific level of telecoms investment required to close the gap that is emerging between Ireland and other countries, and describes the market conditions necessary to ensure that this investment takes place. It concludes that a IR£50 million investment in ATM³ broadband switches to provide high bandwidth communications to enterprises in the local access network in 22 high-density enterprise areas across the country is required over the next two years, while a further £150 million investment in fibre in the local access network is required over the next five years to provide broadband services to meet the needs of the enterprise sector. This is a rate of investment one and a half to two times greater than is planned according to current indications. The most effective way to achieve an accelerated increase in investment in broadband infrastructure is through a pro-competitive regulatory framework, encouraging competition and policies aimed at accelerating both investment in and use of broadband services, and proactively

¹ A report on infrastructure and services available, planned and required by Irish industry in the period 1994-1999 (1994).

² A report on the importance of telecoms for the future of Ireland's industrial development (1996).

³ ATM is a broadband switching technology which allows voice, data, audio, video and other kinds of telecommunications traffic to be carried on the same network.

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promoting Ireland as an attractive location to providers of broadband infrastructure and services.

The potential for private sector investment is indicated by the investment undertaken since 1 July 1997, when the market to build telecoms networks for delivery of services other than basic voice telephony was de-regulated and opened to infrastructural provision other than Telecom Eireann. Already a range of new investors have entered the market to increase the total level of infrastructure and services - some in joint ventures with State agencies such as ESB and CIE.

The establishment of the Office of the Director of Telecommunications Regulation in July 1997 provides an important first step in creating the required regulatory framework. There is a strong case for extending the powers of the Director beyond licensing to include promoting competition, guarding against anti-competitive practices in the market and protecting the interests of business customers. In addition, full competition in the Irish telecoms market, including voice telephony, must be developed as quickly as possible. Without this, businesses in Ireland will be at a disadvantage compared to businesses elsewhere in reaping the benefits which deregulation of telecom markets brings in terms of increased quality and services and lower prices.

The focus of this Report by Forfás Broadband Telecommunications Investment in Ireland is on the actions necessary to secure increased investment in the broadband infrastructure necessary to enable business firms in Ireland to compete successfully in an environment where digital information and communication is a key determinant of success. Early decisions on these actions are essential to reap the benefits in terms of increased national economic output and job creation that will follow.

Tom Toner
Chairman
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Forfás Foreword

Advanced Communications and Competitive Advantage

The impact of advances in telecoms and information and communications technology (ICT) on economic growth and employment creation are increasingly evident both in the way businesses serve their customers and communicate with each other, and in the way people work. Ireland gained strong competitive advantage from the substantial strategic investment made to upgrade its telecoms network in the late 1970s and 1980s. Since then, however, the pace of technological change has increased, resulting in businesses requiring significantly higher quality and capacity telecoms services.

Faced with global competition, the strategic use of ICT is critical to the ability of international companies to gain and sustain competitive advantage. Their ability to optimise the use of ICT will be hampered, however, by a lack of widely available broadband telecoms at low cost, high quality and high capacity. The attached Analysys report assesses the required levels of investment in broadband in Ireland and the conditions required to ensure that the investment takes place. In this Foreword, Forfás sets out its views on the required response in Ireland.

Advanced Services and the Need for Broadband

The term 'broadband' refers to the capacity of the infrastructure needed to provide high-speed transmission of large volumes of information, including voice, video and data. The higher the unit of telecoms capacity the greater the speed, efficiency and quality of transmission and the lower the unit cost of transmission. The operations of many businesses are increasingly dependent on the availability of broadband services, thus driving the demand for broadband networks offering capacity of 2Mbit/s and higher. For example:

- increasing dependence on the Internet, whose importance as a business tool is becoming more significant - this drives a requirement for high-speed access to the Internet;
- linking computers in different locations around the world for corporate networking, collaborative working and intranets⁴, so that people separated by vast geographical distance can work together on joint projects as easily as if they shared the same building;
- facilities for the high-speed exchange of large volume files between subsidiaries;
- 'instant' access to commercial databases around the world;
- videoconferencing and business TV services are increasing in importance for international business communications.

The Availability of Broadband in Ireland

Although high-capacity broadband lines are inherently cheaper to provide than multiple lower-capacity links, only leased lines of up to 2Mbit/s are available in Ireland. Higher-capacity lines are obtained by leasing multiples of 2Mbit/s, a

⁴ Intranets are private networks which use the same protocols and user interface as the Internet.

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prohibitively expensive way to achieve higher bandwidths⁵. Customers for high-capacity lines are, therefore, unable to benefit from the potential economies of scale that arise from the use of a single high-capacity line, rather than a number of lower-capacity lines. For example, a business requiring capacity of 34Mbit/s is required to rent seventeen 2Mbit/s links.

The situation is very different in other countries. For example, in Sweden and the UK, leased lines are available at up to 34Mbit/s. In the USA, high-speed lines at a range of speeds, including 45Mbit/s and 155Mbit/s, are available from long-distance and regional operators.

This gap in the provision of broadband services between Ireland and other countries is widening with the introduction of new broadband services in other countries. Action is required to reverse this trend. Over the period to 2001, demand for broadband is likely to be concentrated in seven sectors in Ireland - financial services, manufacturing, education, entertainment and publishing, software development and customisation, public services and healthcare - and two cross-sectoral applications - call centres and Internet service provision. It is estimated that over this period there are likely to be at least 600 plants and offices, mainly in high-density enterprise areas, requiring broadband telecoms services, both nationally and internationally, for a range of applications.

The levels of investment in telecoms planned or already underway by alternative operators in Ireland is significant. Telecom Eireann is rolling out a large and significant infrastructure investment programme. Other investors are becoming increasingly active as EU promoted de-regulation takes effect. For example, Esat Telecom and WorldCom (formerly TCL Telecom) are constructing fibre backbone networks - the high-capacity communications links between exchanges - in Dublin, while Esat Telecom, with CIE, is rolling out a fibre backbone across the country, with international connection through a new submarine cable to the UK. British Telecom, with the ESB, is also constructing a fibre backbone network which will provide international communications. Telenor Ireland has been awarded a licence for the provision of Vsat satellite technology that can support broadband applications.

However, if the new products, services and competitive advantages which the revolution in information and technology services offers are to be fully exploited in Ireland, low-cost broadband access services need to be made available to the wider business sector across the country over the short to medium term. These broadband services must not be confined just to a limited number of businesses with larger telecoms requirements which justify dedicated fibre access to these backbones. Based on current market indications, the consultants concluded that it may only be in three to four years time in the case of ATM and only over a longer period in respect of the deployment of fibre that the full benefits of the broadband telecoms services will be widely available to businesses. This contrasts with the position of competitor businesses in other countries that will reap the benefits of broadband services in the short term. The current approach which can be broadly described as waiting for demand to materialise is, therefore, not sensible from an economic development point of view.

Required Investment in Broadband

The pace of change in the information and communications technology requirements of the business sector is such that it is virtually certain that the infrastructure needed to meet these requirements in future years will need to be significantly greater in quality and capacity than what is available at present. Over the next two to three years the major infrastructure bottleneck that requires to be addressed is not the

⁵ One reason for this pricing strategy is the likelihood of 'selling-on' if high-capacity lines (34Mbit/s or higher) are obtainable at lower rates. Competitors leasing high capacity could 'split' their lines, then offer 2Mbit/s links at lower rates to their customers. This competition would inevitably force the leading operator's prices down.

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backbone network, but rather the local access network. This is the telephone line - still primarily copper - that connects a business to Telecom Eireann's backbone network, which is completely fibre. In the future, the connection may be to the backbones being built by Esat Telecom in partnership with CIE, and by BT with the ESB.

Asynchronous transfer mode (ATM)⁶ broadband switches in high-density enterprise areas across the country are required to allow high-capacity broadband connection to fibre backbones. The rapid deployment of ATM and fibre to the business sector as a whole are essential to meet the future telecoms needs of businesses in Ireland.

The cost of the required investment over the short term is estimated at £200 million, as set out below⁷:

- **Rapid deployment of broadband switches in 22 high-density enterprise areas⁸:** installation of multi-service broadband switches and connection of businesses to them, using either copper or fibre. The consultants note that this needs to be done over the next two years. The cost of this deployment programme is estimated at over £50 million. This is a first step in the deployment of broadband for the business sector and is a cost-effective approach to meeting the broadband requirements of the businesses in each area;
- **Deployment of fibre to businesses:** deployment of fibre to meet the majority of requirements of small and medium-sized enterprises, in particular to those businesses requiring 2Mbit/s access or faster. The cost of this deployment programme is estimated at £150 million over five years, including the required broadband switches. This would address deficiencies in the local access network and enable it to be upgraded to meet the future needs of the business sector.

Broadband should also be provided to small businesses and the residential sector through the deployment of a combination of ADSL technology on the copper telephone network and cable modems on the cable television network, at an estimated cost of up to £300 million over the next ten years⁹.

Future Telecoms Policy to Promote Investment

It is required that Telecom Eireann negotiate highly competitive prices in many instances with firms that have high-capacity telecom requirements. The ability and willingness of Telecom Eireann to do so has been significant in winning many high-employment projects for Ireland that would otherwise have located elsewhere. The company has also made progress in recent years in reducing prices and improving the level of service to customers in the face of increasing competition which is both in place and in prospect. This process of improvement is embedded as part of Telecom Eireann's approach to increasing competition. However, it remains the case that in general, businesses in Ireland that use high-capacity broadband telecoms incur an extra cost burden compared with similar businesses in other countries.

Strong and fair competition in the telecoms market is by far the most effective way to achieve a reduction in these costs and a level of service comparable with that available to firms in other countries. It is, therefore, essential that such competition

⁶ ATM is a broadband switching technology which allows voice, data, audio, video and other kinds of telecoms traffic to be carried on the same network.

⁷ Information Society Ireland: Strategy for Action (1996)

⁸ The 22 high-density enterprise areas were identified using the Forfás Employment and Economy Expenditures surveys. The 22 areas include eight in Dublin, four in Cork and two each in Athlone, Galway, Limerick, Sligo and Waterford.

⁹ ADSL (asymmetric digital subscriber loop) gives speeds of up to 6Mbit/s over a standard telephone line. Cable modems allow high-speed digital communications (up to 10Mbit/s) over cable television networks.

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develops as quickly as possible. In particular, a more market-oriented approach to the provision and financing of broadband networks is required if Ireland is to progress towards the ideal of widespread and affordable access to these networks.

In order to encourage the required levels of investment, Ireland needs to convince investors that it is serious about developing a competitive liberalised market. Shortening the derogation on voice telephony that Ireland has obtained to 2000, compared with 1 January 1998 for most other EU countries, would partly achieve this aim. An early sell-off of Cablelink to a company that would compete strongly with Telecom Eireann using the Cablelink infrastructure and invest significantly in its development, would also be of considerable benefit.

Analysys concludes that strong effective telecoms competition would have the effect of:

- lowering the price of high-capacity, high-quality broadband telecoms services, in particular of 2Mbit/s links;
- inducing operators to offer higher bandwidths to match competitors' offerings;
- inducing users to switch to higher bandwidth links due to lower prices.

The development of the role of telecoms in maintaining economic competitiveness and job creation requires that future telecoms strategy in respect of the business sector needs to encompass three main elements: developing an **effectively regulated** telecoms market, encouraging **investment** in broadband, and encouraging the **use** of broadband by the business sector.

Effective Regulation

The primary driving force in achieving the required investment in telecoms will be the private sector. However, the required investment by the private sector will, in turn, require the creation of a genuinely competitive telecoms market. Implementing a pro-competitive regulatory framework is paramount in securing the conditions that will encourage operators to make the required investment. This requires, above all, establishing a comprehensive, consistent and transparent regulatory framework within which all telecoms service providers can fully develop the market opportunities in broadband services. This should be the key policy objective.

The objective is to prevent anti-competitive practices in the telecommunications sector and to promote fair and competitive practices in the functioning of the telecommunications market. This can best be achieved by sector-specific rules to deal with specific issues such as interconnection charges, operating in tandem with general competition law. The Competition Authority would have an overall role in respect of the telecommunications sector, as part of its role to ensure the application of general competition law across the economy. Co-operation and co-ordination between the Office of the Director of Telecommunications Regulation and the Competition Authority is therefore essential. The Telecommunications (Miscellaneous Provisions) Act, 1996, establishing the Office of the Director of Telecommunications Regulation in Ireland, forms a good base from which to build a strong pro-competitive regulatory framework and regulatory environment conducive to increasing competition and investment. However, the provisions of the 1996 Act must be built on as a matter of urgency. In particular, the following amendments are required:

- **Overall Objectives:** The overall objectives of the Director of Telecommunications Regulation should be set out more explicitly in the Act (or in a policy statement by the Minister for Public Enterprise). These should serve as a set of guiding principles for the work of the Director;

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- **Overriding Responsibility:** The overriding responsibility of the Director should be to develop a competitive, liberalised telecom market as an instrument of national economic and social policy;
- **Public Interest Responsibility:** The Director should have a public interest responsibility to look after the interests of the different categories of consumer;
- **Interconnection:** Forfás has been strongly advocating that the Director should have responsibility for effective regulation of the terms for connecting calls between customers of different network operators, known as the terms of interconnection. Any effective regulation has to ensure that interconnection is available at a cost-related price, on fair terms, and within a reasonable time frame. Following the adoption in Ireland of the EU Interconnection Directive at the end of January 1998, a priority should be attached by the Director to examining the prices currently charged for interconnection in Ireland which seem very high when compared to those charged in the United Kingdom. Action is needed to determine how cost related these charges are and to reduce them if their current high levels cannot be shown to be consistent with the costs experienced by an efficient operator;
- **Prices:** The Director should have responsibility for the regulation and monitoring of prices for telecoms services and should be asked to review the 1996 Price Cap Order early in 1998;
- **Fines for Non-Compliance:** The Director should have adequate legal powers of enforcement. Sanctions for non-compliance with the Act should be more than commensurate with any benefit gained from non-compliance and should represent a significant proportion of an operator's revenues so as to be a deterrent for non-compliance.
- **Numbering:** A number portability facility requires to be established by 1 January 2000 (the date for liberalisation of basic voice services in Ireland) rather than the current deadline of 1 January 2003, in order not to further delay the development of a fully competitive market.

In all other respects, telecommunications services should be subject to the provisions of the Competition Acts.

Promoting Investment In Broadband

On the basis of current market indications, the investment required in broadband to drive new project and employment opportunities will only take place over three to four years in the case of the required investment in ATM switches and only over a longer period in respect of the deployment of fibre in the local access network. In addition, private sector investors will focus early investment in areas that offer the prospect of high returns. Thus, although implementing a pro-competitive regulatory framework is of paramount importance, there is an in-built possibility of market failure in the delivery of broadband services if operators wait until demand has materialised. In this context, incentives such as Structural Funds could be provided in certain circumstances to accelerate the required investment in broadband in high-density enterprise areas, in particular in regions where it might otherwise happen too slowly or not at all. From an economic and regional development perspective, it is highly desirable to encourage the rapid roll-out of broadband across the country rather than in a limited number of core locations as is likely to be provided by the market over the short to medium term.

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Licences for the provision and operation of ATM switches in specific enterprise areas could be offered by **public** tender and a subsidy of up to 50% provided from Structural Funds to accelerate the required investment.

While small in many ways, the configuration and growth potential of the Irish market offers good opportunities for telecom operators providing high-level services at competitive prices. Such investment should be pro-actively promoted by the appointment of a marketing expert located within the development agencies or the Department of Public Enterprise. The expert, in conjunction with the development agencies and other interested bodies, would work closely with telecoms service providers and would assess how existing networks can be fully developed, in particular with respect to the local access network. The marketing expert would identify potential investors or joint venture partners for Irish organisations and actively promote and market Ireland for broadband investment to overseas telecoms operators.

Promoting the Use of Broadband

A prime obstacle to the development of the market for broadband services is the overall lack of market awareness of the range of potential broadband service applications and how they can be exploited. The development agencies and telecoms operators should actively promote the potential growth opportunities offered by broadband telecoms for businesses. The objective should be to foster demand for broadband by promoting projects that demonstrate the potential benefits to companies. The negotiating guidelines applied by the development agencies in deciding on financial and advisory support for projects should reflect such a new orientation and priority in project assessment.

Consequences of Inaction

The continuation of the high growth in employment and national income achieved in recent years is premised in 'Shaping Our Future: A Strategy for Enterprise in Ireland in the 21st Century' (1996) and similar reports on Ireland achieving a high standard of broadband telecoms, comparable with that of advanced competitor countries. If, however, the gap between the broadband telecoms infrastructure and services available in Ireland compared to other countries continues to widen, both Irish and overseas companies will change their investment decisions. The disadvantages of uncompetitive communications in terms of availability and capacity will begin to outweigh the other advantages which Ireland offers, while also increasing regional disparities.

Analysys estimates that if the gap in broadband investment between Ireland and other countries remains, job creation in manufacturing and internationally trading firms could fall short by 25,000 over the period to 2010 relative to the employment potential estimated in 'Shaping Our Future: A Strategy for Enterprise in Ireland in the 21st Century'.

Conclusions

- To maintain and develop Ireland's overall competitiveness, especially in the increasingly important telecoms-based industries, a strategic investment programme for the provision of broadband to high-density enterprise areas requires to be speedily implemented;
- The most important and urgent requirement in accelerating investment in broadband is the establishment of a fully competitive telecoms market in Ireland. If potential investors in broadband are to have confidence in the Irish market, the solid foundations laid down in the Telecommunications

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(Miscellaneous Provisions) Act, 1996, establishing the Office of the Director of Telecommunications Regulation require to be built upon and expanded on the lines set out in this report;

- In order to encourage the required levels of investment in broadband, competition for basic voice telephony services needs to be introduced as quickly as possible, in advance of derogation to the year 2000;
- An early sell-off of Cablelink to a company that would invest significantly in its development for the provision of broadband and compete strongly with Telecom Eireann using the Cablelink infrastructure would be of considerable benefit;
- In order to prevent a gap emerging between the broadband infrastructure available in core and peripheral areas, in particular in the regions as a result of the market failing to deliver broadband services, or delivering services too slowly, the use of Structural Funds to accelerate the required investment requires to be considered;
- As part of an active marketing approach to stimulating demand for broadband services, the criteria used by the development agencies in evaluating projects for financial and other support should be changed where necessary to reflect the increasing importance of broadband -related services in achieving competitive advantage. Such guidelines should provide extra assistance on the capital cost of broadband telecoms to businesses that are information intensive or require high-capacity telecoms, as part of a business development plan;
- A telecoms marketing expert should be appointed to encourage investment in broadband telecoms by telecom operators providing high-level services at competitive prices, in particular in the local access network. An important function of the marketing expert would be to pro-actively promote Ireland as a location for such investment in the international telecoms market.

Forfás
January 1998

Executive Summary

The impact of broadband communications on the enterprise sector and upon people both at work and at home is a crucial issue in developed and developing nations worldwide. There is considerable political interest in the potential of broadband communications, with politicians of all parties and nations envisaging a bright future of instant access to information in any format, most notably video, and looking towards an Information Society where all citizens have access to sophisticated communications services.

Ireland has benefited in the past from having world-class telecommunications. However, Ireland must now look to invest in broadband communications, since such investment is critical to Ireland's long-term competitiveness. The objectives of this study were therefore to:

- identify the broadband communications services required by businesses and how these requirements are likely to develop over the period to 2001;
- quantify the level of investment required to put Ireland at the leading edge of European broadband telecoms infrastructure deployment;
- quantify the benefits of undertaking this investment in broadband infrastructure;
- identify a number of possible approaches which could be used to stimulate the required investment.

Demand from Businesses

Broadband communications will form an increasingly important part of business activity in the near future. In common with businesses in other countries, businesses operating in Ireland will require Internet/intranet access, video services, collaborative working services, file transfer and database access. The bandwidth requirements of companies will increase from the range of 14kbit/s to 2Mbit/s seen today to access speeds of 100Mbit/s by 2010. These high access speeds will particularly be required by call centres, software development companies and those involved in the creation of multimedia content.

Investment Required

The potential market for broadband communications services in Ireland in the short term (until 2001) was estimated, together with the cost of providing services which will meet that demand using Asynchronous Transfer Mode (ATM) technology. The cost of provision of this type of service was estimated to be between IR£47 million and IR£65 million. This is consistent with the Information Society Steering Committee's report estimates of the cost of providing advanced communications services in 22 designated broadband service areas. Analysys supports the approach proposed in the Information Society report of providing broadband switches in each of the 22 designated areas, since we believe this is more 'future-proof' than simply having a small number of ATM switches in the main cities.

Analysys's findings also validate estimates in the Information Society report that the cost of making optical fibre access available to most business customers in Ireland will be in the region of IR£150 million in the period 1998 to 2002. This approach is being followed in other countries such as the UK and is a good method of future-proofing against high levels of demand for broadband services.

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Potential Benefits

Forfas believes that more than 100,000 net new jobs could be created in the Irish economy by 2010 in two key sectors: in manufacturing and in internationally-traded services. However, these two sectors make intensive use of communications and information services and meeting this employment target will therefore be contingent upon providing an appropriate environment to attract organisations in these sectors. A vital element of this environment will be the availability of world class telecommunications services and infrastructure. Failure to provide world-class telecommunications and broadband services will cause investment to be diverted to countries which provide the required level of telecoms services at the right price.

There is already a gap between the level of broadband services available in Ireland and other countries, as the following examples illustrate:

- it is only possible to obtain digital leased lines in Ireland at speeds above 2Mbit/s when they are priced as multiples of 2Mbit/s, which makes a prohibitively expensive solution. Operators in several other European countries have a much more flexible approach to providing high speed leased lines, making it cheaper for their customers to purchase capacity;
- many countries such as the UK, France, Sweden and the USA have been offering commercial ATM services for some time. As yet such services are unavailable in Ireland.

If the broadband communications gap is allowed to grow over time, the potential for new job creation may not be achieved. Based on an Analysys economic model a conservative estimate of the likely shortfall in jobs is 25,000 net jobs by 2010 in the manufacturing and internationally-traded services sectors alone. The knock-on effects of this shortfall on the Irish economy could be considerable: GDP could be 5% lower and exports up to 10% lower than the potential achievable if the level of telecoms infrastructure and services in Ireland is not comparable with the best available in competitor nations.

Possible Approaches

The pro-active approach to the development of broadband infrastructure in Ireland should be seen as a strategic investment. A number of options are available to the Irish Government to ensure that the communications gap with competitor nations is closed. The most powerful of these is to liberalise the telecoms market and encourage a range of companies to offer the required infrastructure and services. The Government's most important contribution towards encouraging competition would be to set a credible, consistent and transparent regulatory framework. There are currently several areas of concern regarding the implementation of liberalisation of the telecoms sector in Ireland. The Telecommunications (Miscellaneous Provisions) Act 1996 established an independent regulator for the telecoms sector, but it requires to be strengthened in a number of key areas. The new legislation should include:

- a statement of the exercise of all the functions of the Director of Telecommunications Regulation in promoting competition and representing the interest of the telecoms customers;
- proposals for the transfer of power for price regulation and for determining the price cap from the Minister to the Director;
- proposals for strengthening the enforcement powers of the regulator.

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It is also recommended that a number portability facility should be established by 1 January 2000 rather than the current deadline of 1 January 2003, in order not to further delay the development of a fully competitive market. In addition to liberalisation of the telecoms sector, there are a number of alternative means by which the Government can encourage investment in broadband communications infrastructure and services, such as grants, subsidies, tax incentives and credit guarantees. Demand for broadband services could be stimulated through subsidies for use of these services, and through using broadband services to assist in the communication between government departments and private organisations.

Analysys's view is that broadband investment can best be promoted by fostering demand, in order to strengthen market signals. However, it is clear that these incentives are only likely to succeed in stimulating the development of broadband services if there is a likelihood of commercial viability in the long term. Discussions between Analysys and potential investors have confirmed that the absolute pre-requisite for investment in broadband is a genuinely competitive telecoms market.

Based on the investment plans of a number of alternative operators in the Irish market, such as ESAT with CIE, ESB with BT and TCL/WorldCom it is likely that there will be competitive broadband provision in a number of the 22 high density enterprise areas across the country over the next one/two years. However, the broadband requirements of other enterprise areas, particularly those outside Dublin may not be met as quickly by the market. In the event of such non-provision of broadband communications the use of EU Structural Funds could be considered as a supplement to the competitive market.

The role of organisations such as RTE and Cablelink in providing broadband communications to address the bottleneck in the local access network should also be examined. Cable television networks can potentially be used as broadband infrastructure. The launch of Digital Terrestrial Television services will also provide opportunities for new broadband services to be offered. However, the structure and ownership of these organisations will need to be considered carefully and any action regarding the ownership and structure of these organisations should be targeted at stimulating the provision of broadband communications.

Finally, if the Irish Government wishes to attract investment in broadband communications to Ireland, it needs to review the monopoly Telecom Eireann has on providing basic voice telephony services to 1 January 2000. This restriction sends very strong negative signals to potential investors, as well as probably making some broadband investments uneconomic by not allowing infrastructure costs to be shared between broadband and basic voice services.

Chapter 1. Introduction

The objective of this study was to develop some of the ideas originally raised in Forfas' report *Shaping our Future: A Strategy for Enterprise in Ireland in the 21st Century*. This report, published in 1996, advocated that investment in broadband telecommunications in advance of demand should be a priority. It stressed that such investment is critical to Ireland's long-term competitiveness, to stimulating the development of enterprise in general and to attracting inward investment in particular, including the development of Ireland as a European centre for information services. This is regarded as essential to the development of an Information Society in Ireland which makes effective use of modern communications and computer technologies to enhance the living standards and quality of life of its inhabitants.

Analysys would like to thank Cable & Wireless Ireland, the Department of Public Enterprise, Esat Digifone, Esat Telecom, European Commission DG IV, European Commission DG XVI, Forfas, Norcontel and Telecom Eireann for their co-operation in carrying out this study.

1.1 Background

In the late 1970s Ireland's telecoms infrastructure was at breaking point. The mainly electromechanical systems (with some manual exchanges still in existence in rural areas) had significant reliability problems and the level of service delivered to customers was very poor. New customers frequently waited periods of years for a telephone. This situation was judged to be intolerable and a threat to the development of Ireland's economy. A period of significant Government investment through the Post Office/Telecom Eireann followed and the old electromechanical equipment was replaced with modern electronic switching. Significant effort was put into reducing waiting lists. The resulting improvements were dramatic and made a significant contribution to Ireland's rapid economic growth in the 1980s.

Since that time, communications technologies and services have been enhanced in terms of price, quality and functionality by the widespread introduction of digital technologies. These developments have been accompanied by rapid and substantial increases in the use of telecoms by businesses, and in their dependency on those services. As a result, many large multinational organisations seeking to invest in the European Union (EU) now demand telecoms facilities which are comparable to those in the most advanced economies. A Member State will not attract investment from such organisations unless the telecoms infrastructure and services available in that Member State are on a par with the best in the world in terms of quality and price.

Over recent years, Ireland has benefited greatly from inward investment and has many attractions for potential investors, not least its highly-educated population and the use of English as a first language. Over the past few years, Telecom Eireann has worked closely with development agencies in putting together competitive pricing packages for telecoms services for inward investors, particularly in key growth sectors such as call centres.

However, Ireland's telecoms infrastructure and the price competitiveness of some of the services available is lagging behind that of many other European countries and this is a potential disincentive to investors. Ireland is now set to lose ground to competitor nations as broadband infrastructure investment based on ATM technology gets underway in some of these countries¹⁰. The financial centres of London, Frankfurt, Paris and Stockholm have already licensed competing infrastructure providers, to ensure their competitiveness with the other major financial centres

¹⁰ ATM is a broadband switching technology which allows voice, data, audio video and other kinds of telecommunications traffic to be carried on the same network.

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worldwide. The financial centre in Dublin will need to match the telecoms capability of these cities if it is to continue to attract investment. If the gap in terms of service availability and price between the broadband communications available in Ireland and other countries broadens, it will have an adverse effect on the investment decisions of Irish as well as overseas companies, as the disadvantages of relatively poor communications begin to outweigh the inherent advantages which Ireland offers.

Forfas has advocated that Ireland should invest substantially in advanced broadband infrastructure and advanced telecoms services, and that this investment should be made before, rather than after, other European countries, to enable Ireland to establish a telecoms - and therefore a business - advantage¹¹. The fact that the Irish Government also subscribes to this point of view is also made clear by the following extract from the application submitted by the Government to the European Commission for a derogation on certain aspects of telecoms liberalisation:

"In view of the importance of telecommunications to the Irish economy, it is the Irish Government's objective to achieve a telecommunications sector for Ireland which is in the top quartile of the OECD countries by reference to standard sectoral indicators, notably penetration, service range, price competitiveness, quality and availability as soon as possible¹²."

Although this statement does not explicitly mention broadband communications, it would be impossible to achieve the objective of being in the top quartile of OECD countries without widespread availability of broadband telecoms services. Forfas therefore believes that considerations of national competitiveness, output and employment make a strong strategic case for short-term intensive investment in broadband communications infrastructure.

1.2 Objectives and Approach

The objectives of this study are to:

- identify the broadband communications services required by businesses and how these requirements are likely to develop in the period to 2001;
- quantify the level of investment required to put Ireland at the leading edge of European broadband telecoms infrastructure deployment;
- quantify the benefits of undertaking this investment in broadband infrastructure;
- identify a number of possible approaches which could be used to stimulate the required investment.

¹¹ Telecommunications and Enterprise: Building and Investing for our future; Forfás 1996

¹² Submission by Ireland to the European Commission: Transition Period in Relation to the Implementation of Full Liberalisation of the Telecommunications Market in Ireland (May 1996).

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The study is divided into two major areas:

Making the case for broadband investment

We examined the nature and distribution of Irish business generated estimates of the likely demand for broadband investment services from 1997 to 2001, based on Analysys' familiarity with, and knowledge of, the communications requirements of business. Our findings are summarised in Section 2.1.

In Section 2.2 we consider the infrastructure investment required to satisfy this demand. This analysis was undertaken for two different scenarios, which describe differing progress of infrastructure liberalisation in Ireland between 1997 and 1999. This section also examines Norcontel's proposals for the development of telecoms infrastructure as set out in the report of the Information Society Steering Committee (1996) to extend the benefits of broadband communications to all levels of Irish business and society by 2010.

We examined the benefits of competitive broadband communications services on employment in Ireland and on the Irish economy. The conclusions of this stage of the study are provided in Section 2.3.

Finally, we compared the current broadband infrastructure in Ireland to that available in Sweden, the UK and the USA, as well as in Singapore and Malaysia, in order to establish Ireland's relative position (Section 2.4).

Methods of securing Investment

Having described the case for broadband investment, we examined the merits of a number of different approaches which could be taken to ensure the availability of the required investment so that Ireland has sufficient provision of broadband infrastructure into the next millennium. As part of this process, Analysys interviewed interested parties, who gave their views on the possibilities for stimulating broadband investment. This work is described in Chapter 3.

Chapter 2. The Costs and Benefits of Broadband

2.1 The Requirement for Broadband Services

Before considering the factors which are giving rise to a growing need for broadband communications, it is important to define which types of services fall into this category. The distinction between narrowband and broadband services as delivered to the end user is generally drawn on the basis of the total capacity of the connection provided to the end user. The minimum speed of connection generally categorised as broadband is 2Mbit/s, and this is the definition used in this report. However, it should be noted that this definition will tend to vary over time: as higher-speed services are introduced, so the minimum bandwidth at which services are categorised as broadband tends to increase.

The potential uses of broadband communications services span a wide range of different applications. Broadband can be used to provide both high-speed data access right up to the desktop, supporting real-time video and other advanced capabilities, and the aggregation of many channels of narrowband data, brought together to form a single high-speed data stream. There are valuable opportunities for growth in both of these areas, arising both from changes in user requirements (in the first instance) and emerging opportunities in the telecoms sector itself (in the second instance).

2.1.1 Identifying Sources of Demand for Broadband Services

Over the next five years, take-up of broadband access across Europe will be limited almost exclusively to larger corporate and telecommunications-dependent customers for a number of reasons. Perhaps the most important is that standard principles of market economics will encourage operators to focus initially on those segments of the market which have the lowest price elasticity. Large corporate users of communications services recognise that broadband services constitute a vital component of the information systems which underpin the operation of their companies, and they are thus willing to pay a significant premium for high-quality broadband access.

Another factor which will constrain the roll-out of broadband services to a wide market is the nature of the underlying infrastructure costs. The substantial economies of scale and scope which are offered by broadband technology when deployed on a network backbone (the high-capacity national and international links which carry bulk traffic) ensure that the cost per user is low. However, as the network 'fans out' towards the user premises, the degree of infrastructure sharing is much lower and such economies no longer apply. There is therefore a strong incentive for operators of broadband infrastructure to focus on areas of concentrated demand, such as financial districts, where a large number of high-spending customers can be addressed via a compact Metropolitan Area Network (MAN) infrastructure. This effect has given rise to the current wave of construction of fibre MANs by new entrants in many of Europe's major cities, including London, Paris, Frankfurt and Stockholm. Indeed, since infrastructure competition was introduced in July 1997, competitive infrastructure is being constructed in Dublin.

At the application level, there are a multitude of changes taking place which are giving rise to increased demand for communications services of all types. While there are many reasons for these changes, three drivers of growth can be identified which apply across the spectrum of business users:

- Growth in wide area links to interconnect Local Area Networks (LANs). Organisations with more than one site require their LANs on each site to be connected, to make it more straightforward to share information across many

sites. Take-up of local area networking is now slowing as the market becomes saturated, but the degree of interconnection of these networks using public wide area services is rapidly increasing both in terms of the number of links and the quantity of traffic per link;

- Growth in supply of bulk capacity to new entrants. The provision of high-speed access to mobile operators, providers of independent MANs, managed network service providers, Internet service providers and other new entrants is proving a major source of demand for broadband services, particularly in highly liberalised EU Member States such as Sweden and the UK. Fostering the growth of new entrants requires the availability of high-speed broadband services to provide connectivity on a national and international basis;
- Increasing integration of services and a rise in provision of generic bandwidth is leading to the formation of multi-service broadband networks. In the past, different physical networks have been used to support different types of service, for example telephony on the PSTN, data services on dedicated packet-switched networks, and LAN interconnect on leased lines. However, there is now an increasing trend towards provision of a single access service which is capable of handling traffic of many different types: in the future, all corporate communications services may be supported by a single ATM connection.

2.1.2 Broadband Applications and their Development

This section examines some of the more important business applications for broadband communications in the next five to ten years:

- Internet access
- corporate networking (LAN interconnection/intranet)
- video services (videotelephony/business TV services)
- collaborative working
- file transfer between organisations
- database access
- networked library and archive services.

For each, we provide a description of the application and its potential use to business customers. We have also indicated how the bandwidth requirements of these services can be expected to develop in the medium and long term.

Internet Access

The Internet is a worldwide network of computers which allows sharing of information on a global basis. The network - originally developed to facilitate the sharing of information between academic institutions - has grown phenomenally in recent years as it has gained acceptance in the world of business as a useful tool for communication with other organisations (email and file transfer). In addition, the potential of the World Wide Web (a graphical interface to information on the Internet) as a mechanism for marketing and selling is now being recognised. Once outstanding problems relating to secure electronic commerce are resolved, there will be enormous growth in traffic as the Internet becomes a global marketplace.

Access to the Internet requires an organisation to connect to an Internet Service Provider (ISP). The mechanism used by an organisation to communicate with the ISP will vary according to the amount of Internet traffic it generates:

- Organisations which generate low traffic volumes usually connect to their ISP using a modem over a standard telephone line. This allows communication of up to 56kbit/s (although slower speeds of between 9.6kbit/s and 28.8kbit/s are usually used);

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- Organisations with higher traffic requirements have the option of switched connection via basic rate ISDN (which allows communication of up to 144kbit/s) or using digital leased lines (64kbit/s or 2Mbit/s).

As the Internet develops as a commercial medium (including voice and video communications), the requirements of organisations for high-speed access to the Internet will grow. Even smaller organisations will require high-speed access as they adopt video communication.

| <i>Current Bandwidth</i> | <i>Bandwidth in 2001</i> | <i>Bandwidth in 2010</i> |
|--------------------------|--------------------------|--------------------------|
| 9.6kbit/s to 2Mbit/s | 64kbit/s to 34Mbit/s | 2Mbit/s to 100Mbit/s+ |

Corporate Networking (LAN Interconnection/Intranet)

Corporate networking is probably the most important business data application at present (in terms of traffic volumes) and is likely to remain so for the foreseeable future. The growth in the use of personal computers and workstations in business since the 1980s has created a need to share information electronically between employees within an organisation. Initially this was achieved by creating LANs on individual sites, but this was insufficient to meet the needs of organisations with multiple sites which wished to build a corporate network to share information and resources across the organisation as a whole.

Interconnection of LANs can be achieved using leased lines or over switched services such as ISDN or frame relay. The bandwidth requirements of organisations vary according to the size and geographical diversity of the sites being served, the amount of interaction between sites and the content of the networks.

The traffic on corporate networks covers the full range of communications applications and most carry both voice and data traffic. In recent years, the proportion of traffic accounted for by data has grown as LAN interconnection and other data communications have become more significant. This trend will continue as video communication within organisations becomes widespread. Videotelephony and videoconferencing are already used by larger companies as a means of enhancing communications within and between their organisations. In the future, desktop videoconferencing will become commonplace, as the cost of bandwidth and terminal equipment falls.

An important recent development in corporate communications is the growth in take-up of intranets. Intranets provide corporate communications with the 'look and feel' of Internet access, using a 'browser' user interface to access resources on the corporate network. The power of this approach is that users can use a single means (the browser) to access information and services on the corporate network, in the same way as they can access information and services outside the organisation on the Internet.

Bandwidth requirements for communications between corporate networks are shown below:

| <i>Current Bandwidth</i> | <i>Bandwidth in 2001</i> | <i>Bandwidth in 2010</i> |
|--------------------------|--------------------------|--------------------------|
| 64kbit/s to 2Mbit/s | 64kbit/s to 34Mbit/s | 2Mbit/s to 100Mbit/s+ |

Video Services (Videotelephony/Business TV Services)

It is anticipated that video services, such as videotelephony and videoconferencing, will become prevalent as the cost of bandwidth falls. At present, the use of these services is mainly limited to larger organisations and some specialist smaller organisations. However, the availability of cheaper terminal equipment and PCs capable of processing video, in conjunction with cheaper bandwidth, means that cost will no longer be a deterrent to the take-up of video communications for smaller companies, and it will become commonplace for those engaged in business to communicate by this means. Video communications will not bring about the end of business travel: face-to-face meetings will still form an important part of business activity. However, there is considerable scope for saving both time and travelling costs.

Call centres providing software support are another area where there could be enormous demand for bandwidth. Each call centre can employ hundreds of people handling telephone calls from around the world. In the future, it is likely that a large proportion of the enquiries will be video calls, which allow call centre employees to access callers' computer screens and thus sort their problems out much more quickly.

Finally, business TV services (subscription TV channels offering specialist business information), which are currently only available in the major financial centres such as London and Frankfurt, will also become more widely available as the cost of service access falls.

The bandwidth required for these services currently ranges between 144kbit/s and 2Mbit/s. It is not likely that the bandwidth for each video call or business TV channel will rise above 2Mbit/s. However, requirements for handling simultaneous calls and channels will increase, so that the overall effect will be a large increase in the bandwidth required on a typical business site.

| <i>Current Bandwidth</i> | <i>Bandwidth in 2001</i> | <i>Bandwidth in 2010</i> |
|--------------------------|--------------------------|--------------------------|
| 144kbit/s to 2Mbit/s | 2Mbit/s to 34Mbit/s | 100Mbit/s+ |

Collaborative Working

Working collaboratively is an essential part of most businesses, whether with people from other parts of an organisation or with people in different organisations:

- Key personnel in large corporations may be located on different sites or even in different countries. Allowing these people to work together as if they were in adjoining offices can be a source of competitive advantage to the organisation and is attractive to staff, as it allows them to live where they want and reduces the burdens of travel.
- People working from home frequently need to work with others in order to develop ideas and discuss documents. Collaborative working makes it possible for these people to interact as if both parties were on the same site, all parties accrue the benefits of teleworking.

In the past, solutions to enable collaborative working have involved frequent meetings, exchanging files copied on to disks or slow file transfer mechanisms. However, these solutions can introduce problems of version control for documents and files, with multiple versions of files in existence at different sites. Networked collaborative working allows users on different sites (and possibly from different organisations) to work together on the same files, eliminating many of the problems

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previously experienced in multi-site working. Currently, staff can share applications such as spreadsheets, documents or large Computer-Aided Design (CAD) files.

All participants in a collaborative working session must be able to view the screen and allocate control of the file amongst themselves. The bandwidth required to achieve this can be quite low, although the quality of the shared video image and the immediacy of response improve with higher bandwidth. It is already possible to share applications at relatively low bandwidth across the Internet using collaborative working packages such as Microsoft's NetMeeting. For sophisticated CAD tools, the bandwidth required for collaboration is likely to be higher, although bandwidth requirements in excess of 2Mbit/s are not envisaged. However, as there will certainly be an increase in the number of people in an organisation collaborating in this way, the bandwidth requirements for collaborative working will become substantial in the future.

| <i>Current Bandwidth</i> | <i>Bandwidth in 2001</i> | <i>Bandwidth in 2010</i> |
|--------------------------|--------------------------|--------------------------|
| 28.8kbit/s to 2Mbit/s | 64kbit/s to 8Mbit/s | 2Mbit/s to 34Mbit/s+ |

File Transfer (Between Organisations)

Almost all forms of data communication could be described as file transfer, but the specific form of file transfer under consideration here is the once-off delivery of very large files from one point to another. Examples include transfer of medical images such as CAT scans and X-rays, satellite images for weather forecasting or earth observation, and the distribution of software.

The transfer of such files is heavily constrained by the bandwidth available. In order for the process to be useful, it is necessary to be able to transfer a complete file within a reasonable time from it being requested. As file sizes increase the time needed to transfer them also increases: for example images with a resolution of 1000 X 1000 pixels can currently be transferred easily at 64kbit/s, but for larger, high-resolution images the time needed to transfer the image using even 2Mbit/s links can be prohibitive.

Distribution of software documentation has already moved away from paper manuals to online help facilities which accompany the software on CD-ROM. The next development in this area is likely to be the distribution of both software and documentation to the customer by direct electronic means, thus eliminating the need to manufacture and distribute disks. However, the distribution of a major new piece of software - for example a new version of Microsoft Windows - is a colossal operation and, if this were to be done electronically, the bandwidth required from the distribution centre would be enormous. We estimate that Microsoft would have required well in excess of 1000 2Mbit/s links to attempt to meet the demand seen for Windows 95 in the first few weeks after its release. Clearly, if the maximum link available is 2Mbit/s, as it is currently in Ireland, then from both a price and a management point of view it will be more attractive to launch a major software package from another country with more appropriate broadband capabilities.

In addition to software companies, back office support business is a major growth area for Ireland. This also requires transfers of large computer files between the front and back offices of organisations, and such transfers can require capacities many times in excess of 2Mbit/s. Clearly, if communications are only available at maximum speeds of 2Mbit/s, then the cost of that communication will be high, because the cost of providing bandwidth rises much more slowly than the bandwidth itself, as discussed in Section 3.2. Such increased costs are likely to make Ireland a less attractive location for back office operations.

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Transfer of large files is almost exclusively handled at 2Mbit/s at the moment. However, the delay introduced by transmission at this speed could inhibit the use of images for many applications. It is likely that organisations will use higher transmission speeds installed for other purposes, such as video communications, to overcome this potential problem.

| <i>Current Bandwidth</i> | <i>Bandwidth in 2001</i> | <i>Bandwidth in 2010</i> |
|--------------------------|--------------------------|--------------------------|
| 144kbit/s to 2Mbit/s | 2Mbit/s to 8Mbit/s | 2Mbit/s to 100Mbit/s+ |

Database Access, and Networked Library and Archive Services

It is widely recognised that access to information is essential to the success of a company. Companies need to retrieve information both from within their organisation and from outside sources. The usual sources of information are databases and libraries.

There are currently a small number of service providers which allow access to a database of information on subscription, via direct dial-up or over the Internet. These service providers mostly provide specialist information on single sectors, such as finance, publishing and electronics. In the future, there is likely to be strong growth in the provision of such services, as the possibility of transactions being conducted entirely over the Internet becomes a reality. In addition, various national and other public libraries are investigating the possibility of putting all the material they hold online. This would give access via the Internet to huge volumes of published information and change the way in which research and similar activities are conducted.

These developments are likely to encourage corporate research and information gathering. The bandwidth involved would not be very high initially but, as libraries and databases begin to offer more graphical, image and video information, the bandwidth requirements of customers will rise.

| <i>Current Bandwidth</i> | <i>Bandwidth in 2001</i> | <i>Bandwidth in 2010</i> |
|--------------------------|--------------------------|--------------------------|
| 9.6kbit/s to 64kbit/s | 64kbit/s to 8Mbit/s | 2Mbit/s to 34Mbit/s |

Conclusions

The preceding material demonstrates that businesses will spearhead the take-up of broadband in Ireland and will use an increasing range of telecoms applications in the course of their activities. It is also clear that the bandwidth requirements of business customers will increase dramatically, driven by the increased use of video services.

2.1.3 Applications of Broadband Services by Sector

Based on the premise that early growth in demand for broadband services will be found among large corporate users, seven sectors were identified as representing the majority of market potential in Ireland:

- finance
- manufacturing
- education
- entertainment and publishing
- software development and customisation
- public services
- healthcare.

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In addition to these seven sectors, two cross-sector applications were also identified as particularly significant potential sources of demand for broadband in Ireland:

- **the provision of call centres:** Ireland has a good track record of attracting call centres by exploiting the advantages conferred by its use of English as a first language and its young and well-educated population;
- **the provision of Internet services:** Ireland is experiencing rapid growth in Internet subscriptions, albeit from a small base. At the time of writing, the major Internet service providers had a combined customer base approaching 50,000.

Exhibit 2.1 summarises the communications needs of organisations in each of seven sectors and two cross-sector applications, identifies which of these needs can be met by narrowband access and which will require broadband access, and highlights the characteristics of target sites for broadband access until 2001 in Ireland.

2.1.4 Estimation of the Potential Market for Broadband Connections

The sector-specific considerations described in Exhibit 2.1 were used to determine the size of site for each sector which would indicate a potential broadband customer. In general, it was determined that sites of more than 200 staff would consider that broadband communications were desirable in the short to medium term. For this reason, the number of employees was used as a proxy for demand for broadband communication services. However, the software development and customisation sector was an exception, as it was determined that site sizes of more than 50 persons will require broadband communications in the short or medium term.

EXHIBIT 2.1: Business Sector Telecoms Requirements [Source: Analysis]

| Sector | Applications with narrowband access | Applications requiring broadband access | Target for broadband access |
|--------------------------------------|---|---|---|
| Finance | Interconnection of branch offices of banks, building societies and insurance companies for transaction processing, access to customer information databases etc. Also interconnection of Automatic Teller Machines, and telephone banking | Clearing and financial processing applications, corporate networking (voice, intranet, etc.) for large sites, LAN interconnect, newsfeeds and business television services. | Head offices of banks, building societies, data processing centres, major branches (mainly Dublin based). |
| Manufacturing | EDI, corporate networking for small sites, low-speed (basic rate ISDN) videotelephony, telephony, fax, email. | LAN interconnect and corporate networking (voice, intranet, etc.) for large sites, interconnection of Computer Aided Design systems. | Major design, manufacturing and administrative facilities for international companies. |
| Education | Networking for school, adult education centres and other smaller establishments (telephony, email, internet access, information services). | File transfer to support joint research, networked library and archiving services, remote lectures etc, high-speed access to the internet and of intranet services for the academic community, campus network and LAN interconnect. | Universities, regional technical colleges. |
| Entertainment and publishing | Low-speed internet access for small offices and provision of basic communication services (telephony, fax, email). | Electronic distribution of documents to remote printing facilities and between offices. Access to video and still image libraries. Distribution of broadcast content to remote transmitters. LAN interconnect for large sites. | Studios, editing facilities, libraries and archives, major transmitter stations. |
| Software development & customisation | Email, collaborative working, internet access, file transfer, LAN interconnection. | Distribution of software, networked software libraries, LAN interconnection, collaborative working, video support. | Major software companies developing and customising software in Ireland. |
| Public services | Basic networking services for smaller | Wide area networking for custom | Major administrative |

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| | | | |
|----------------------------|---|---|---|
| | regional offices, to support custom applications as well as telephony, fax, email. | applications to support benefits payments and administrative functions, virtual private networking (voice, intranet, fax, email, etc.) for large sites, LAN interconnect. | centres, large benefits offices, computer centres. |
| Healthcare | Low-volume access to databases of patient records by surgeries and smaller medical centres, administrative support for purchasing and finance, general communications services (voice, email, fax, intranet). | bulk to databases of patient records. Support of custom managerial, administrative and financial functions. Distribution and archiving of medical imaging. Intranet-based information services, LAN interconnect. | Large hospitals and health centres, administrative centres (health boards). |
| Internet service provision | access services to link end users to ISP PoPs. | High-speed interconnection of points of presence and interconnection of different ISP networks. | ISP hubs and large points of presence. |
| Call centres | None | Provision of bulk telephony capacity and custom applications for operator and network support. | Large call centres (30 or more lines). |

Information from the Central Statistics Office, the Department of Education, the Department of Health, Eurostat, Forfas and other sources of information on Irish business were used to estimate the number of such establishments which currently exist in Ireland. Analysys then estimated the number of such sites in 1998 and 2001, based on the latest data available and on trends observed in Ireland and other countries. The results of this analysis are shown in Exhibit 2.2, which indicates that the major opportunities lie in software development and customisation, call centres, healthcare, education and finance. The growth in potential broadband sites represents growth in the number of sites meeting the size criteria for each sector. The majority of these sites were centred around the four main cities - Dublin, Cork, Limerick and Galway.

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EXHIBIT 2.2: Estimates of the Total Potential Market for Broadband Services in Ireland

| Sector | Notes | CAGR ¹³ | Number of Sites | | |
|--|---|--------------------|-----------------|------------|------------|
| | | | 1996 | 1998 | 2001 |
| Finance | Bank and insurance companies' head offices and major sites | 8% | 34 | 40 | 50 |
| Manufacturing | Large facilities with CAD/CAM etc. (international companies) | 5% | 194 | 214 | 248 |
| Education | Universities, Regional Technical Colleges, Institutes of Technology etc | - | 60 | 60 | 60 |
| Entertainment and publishing | Broadcast content distribution etc. | 5% | 10 | 11 | 14 |
| Software development and customisation | Major software companies developing software and customising software developed elsewhere for different markets | 15% | 53 | 70 | 100 |
| Public services | Major Government departments, social security offices, etc. | - | 20 | 20 | 20 |
| Healthcare | Major hospitals | - | 48 | 48 | 48 |
| General | Internet Service Providers | 5% | 5 | 6 | 7 |
| | Call centres | 10% | 40 | 48 | 78 |
| Total | | | 464 | 517 | 625 |

Source: Analysys

It is important to remember that the numbers of sites shown in Exhibit 2.2 represent the sites which are likely to subscribe to broadband services up to 2001. These represent a very small proportion even of large business sites in Ireland.

The use of employment as a proxy for demand for broadband services is less accurate for some sectors than others. For example, the development of the International Financial Services Centre in Dublin is likely to lead to the creation of a number of finance houses with high broadband communications requirements in comparison to the number of employees. The demand in the finance sector would therefore be underestimated by this method. However, there are a number of sectors - particularly public service and healthcare - where employment will overstate the demand for broadband. Nevertheless, for the purposes of such an approximate estimation of demand, the use of employment as a proxy for broadband demand is sufficiently reliable.

2.2 The Cost of Meeting Demand

Having estimated the addressable market for broadband services in Ireland to 2001, the next step is to model the cost of providing broadband services to meet that demand. Clearly, there is no unique approach to meeting the demand for broadband services in Ireland - different technologies and network architectures could be chosen with equal merits - and it is therefore not possible to model all of the options by which demand could be met. Instead, it is necessary to opt for a plausible solution to providing broadband services and model the costs of providing that solution.

¹³ Compound Annual Growth Rate

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An important input to the modelling of broadband infrastructure investment in Ireland is the regulatory background against which the investment takes place: the role of telecoms regulation is central to shaping the investment decisions to be made. In May 1996, the Irish Government requested a number of derogations from the timetable for liberalisation of European telecoms laid down by the European Commission:

- derogation from competition in the provision of basic voice telephony until 1 January 2000 rather than on 1 January 1998;
- derogation from competition in the provision of alternative infrastructures until 1 July 1999 rather than on 1 July 1996;
- derogation from unrestricted interconnection of mobile networks until 1 January 2000 rather than on 1 July 1996.

The European Commission's response to these requests was delivered in November 1996. It granted the Irish Government's request for delaying the liberalisation of voice telephony and underlying networks until 1 January 2000. However, the use of own/alternative networks for other already liberalised services was deemed to be urgently required by the Commission and the provision of telecoms infrastructure was liberalised on 1 July 1997, two years earlier than requested by the Government. In addition, the international interconnection of mobile networks with other mobile or fixed networks will be permitted from 1 January 1999, one year earlier than requested.

The actions of the Irish Government and the Director of Telecommunications Regulation in the light of the derogation decision of the European Commission will be critical to the evolution of broadband investment in Ireland. A full and timely liberalisation with reasonable licensing procedures and prompt treatment of applications will enable organisations which already provide services on Telecom Eireann infrastructure, and other potential operators such as the ESB, CIE and RTE, to build their own infrastructure and provide services (other than basic voice services) independent of Telecom Eireann. Indeed, CIE and the ESB have made positive moves to enter the market, in partnership with Esat and BT respectively.

Analysys has therefore modelled the cost of meeting demand for broadband services under two scenarios based on possible evolutionary paths for infrastructure liberalisation in Ireland:

- a **rapid development scenario**, where the necessary administrative procedures are established in advance of this deadline, allowing new operators to develop infrastructure rapidly. This would provide an impetus for Telecom Eireann to launch ATM services significantly ahead of current plans. Other operators would also enter the market rapidly;
- a **slow development scenario**, where administrative procedures are delayed and it takes some time for licences to be granted. This results in commercial ATM services being launched in mid to late 1998.

The modelling under both scenarios assumes that Telecom Eireann is the main player rolling out broadband infrastructure and services until 2001, but is more or less stimulated by the threat of competition. In the course of this study, Telecom Eireann has discussed with Analysys its plan to provide an overlay network of ATM switches based in the main population centres. This is a credible approach to providing broadband services for business customers in the short term, because:

- the bulk of the addressable market is located in or near those population centres. As time progresses, organisations further away from these centres will take up ATM services, using high-speed links to the population centres;

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- as previously mentioned, ATM is an attractive technology for broadband communications because of its high-speed capabilities and ability to handle different types of traffic.

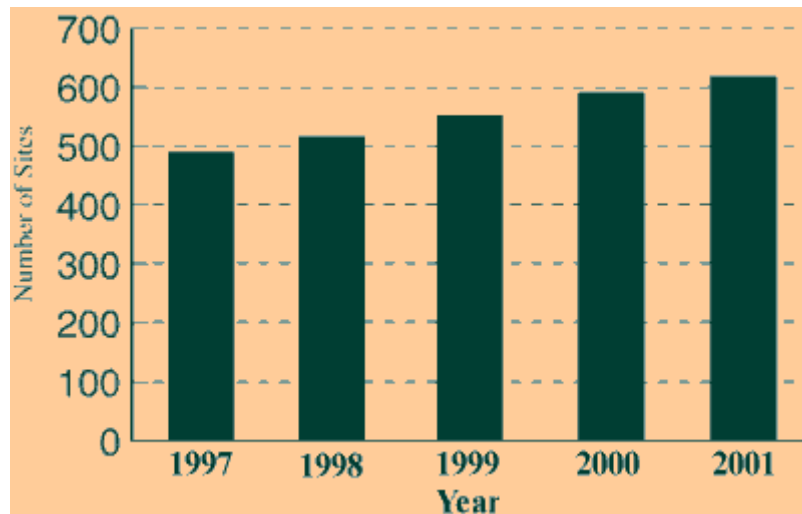
This approach was defined and modelled in advance of the Information Society Steering Committee's acceptance of the Norcontel recommendation for 22 interconnected broadband areas, each having its own ATM switch. However, the two approaches are reasonably compatible, the one allocating a greater proportion of investment to switching costs and the other to transmission. The Norcontel approach is more future proof, in that it caters better for a large amount of broadband traffic within each of the 22 designated service areas.

The approach taken to costing the provision of broadband infrastructure was to model the Telecom Eireann architecture described above using Analysys' proprietary modelling tool, Analysys STEM". The STEM model uses cost estimates for the different components of the network based on commercial prices for equipment and civil works where known, or estimates where the cost is not known.

2.2.1 Modelling Assumptions

The STEM model takes as an input the estimates as shown in Exhibit 2.2 of the number of business sites requiring broadband communications, which represent one measure of the potential market for broadband services in Ireland.

EXHIBIT 2.3: Estimated Potential Market for Broadband Communications, 1996 to 2001

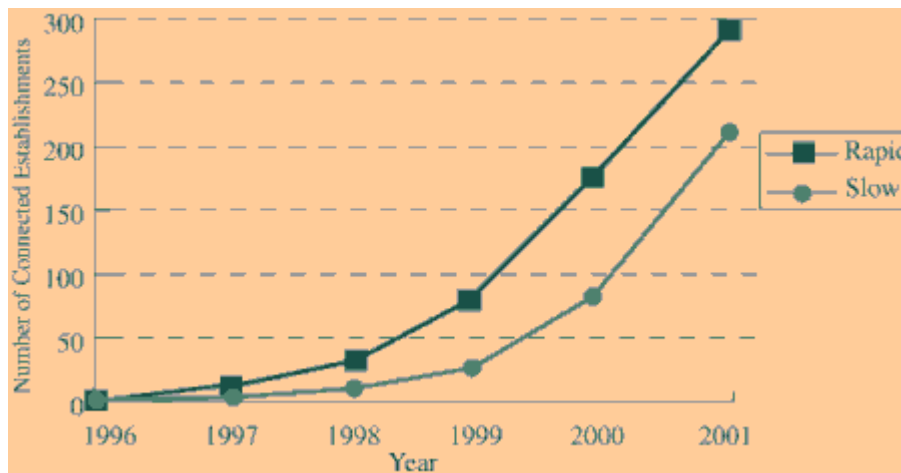


[Source: Analysys]

Exhibit 2.3 shows the growth in the estimated number of sites in the period 1996 to 2001: it should be noted that no attempt was made to model the effect of increased broadband penetration in the market, which would be likely to make broadband services attractive to smaller users. We have therefore used the same potential market for both scenarios. However, we have assumed different penetration profiles of the potential market for both scenarios, as illustrated in Exhibit 2.4.

EXHIBIT 2.4: Penetration of Broadband Communications under the Scenarios

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[Source: Analysys]

As Exhibit 2.4 shows, under the scenario of rapid growth a small number of customers begin to receive services before the end of 1997, but connections grow rapidly in subsequent years, so that by the end of 2001 nearly 300 sites are connected, representing a penetration of just over 50% of the addressable market. Penetration for the second scenario follows a similar growth pattern, but lags behind the rapid scenario by one year, resulting in lower total penetration by 2001.

These demand profiles were used as inputs to the STEM model, together with a description of the network components required. The cost of providing broadband infrastructure was estimated by summing the costs of the components required and taking into account the staff and other costs (e.g. network management systems and billing systems) associated with establishing and running the network:

Shared Cost The model assumes that a minimum of two switches are installed in advance of service launch, with the remaining switches being installed in the second year. Trunk traffic between the switches in the first year is assumed to be carried on existing transmission infrastructure. However, additional trunk capacity is installed between the switches in the second year of operation in anticipation of increased traffic in subsequent years.

Per Customer Costs Other costs are incurred as customers join the network: network terminating equipment needs to be installed on their premises and optical fibre links to a suitable telephone exchange need to be deployed. We have assumed that 30% of the customers requesting services will require new ducting to be installed to their premises: the majority of customers will be served by existing ducting or by wireless broadband access technologies. If no ducting is available, the cost would be increased significantly, particularly in later years as many more users subscribe to the service.

EXHIBIT Schematic Outline of the Broadband

2.5: Infrastructure Modelled

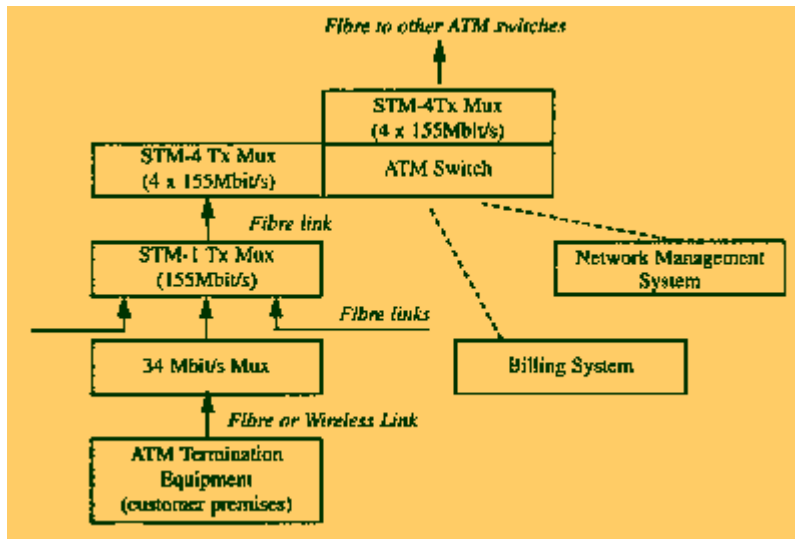


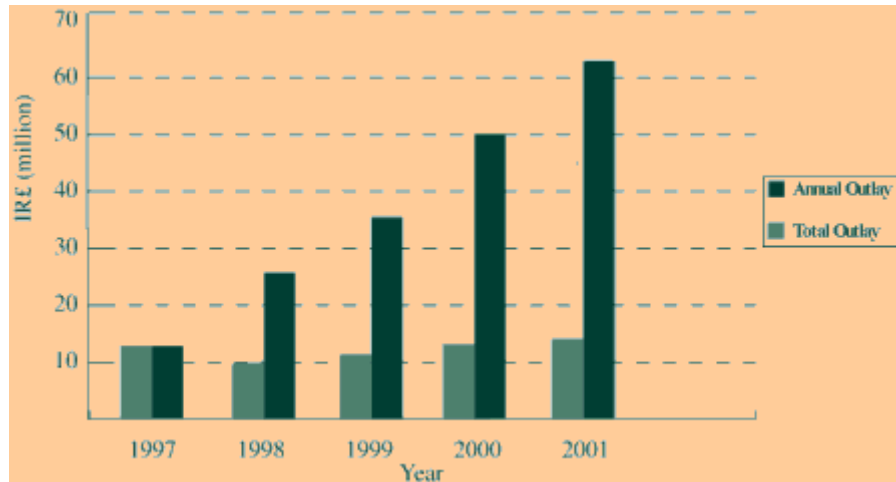
Exhibit 2.5 above shows a schematic outline of the network architecture for the costed broadband network. The model assumes that the capital cost of equipment falls by 10% per annum, reflecting the fact that the market for this equipment is still relatively undeveloped. Annex A describes in detail the capital and maintenance costs and capacities for each component of the network modelled.

2.2.2 Model Results

The cost of providing broadband infrastructure for each scenario is illustrated in Exhibits 2.6 and 2.7. These exhibits show both the annual expenditure and the cumulative cost of providing the infrastructure described above. The cumulative cost of the broadband infrastructure to 2001 is IR£65 million for the rapid development scenario, and IR£47 million for the slow development scenario. In both scenarios the costs in the first two years of service are dominated by the installation of shared network equipment, such as switches and trunk transmission. The cost of connecting customers in these years is low by comparison, because of the small numbers of customers in those years. In later years, the proportion of the total cost incurred connecting customers will dominate overall annual costs.

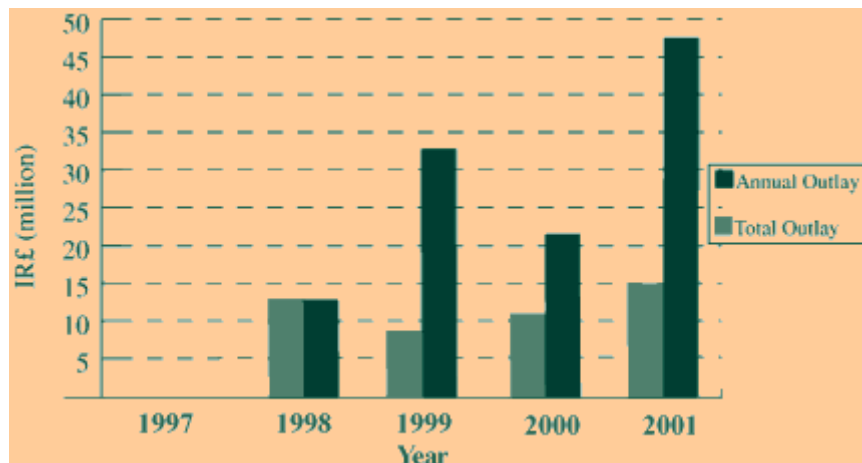
Broadband Telecommunications Investment in Ireland

EXHIBIT 2.6: Broadband Infrastructure Investment for the ATM Network - Rapid Development Scenario



[Source: Analysys]

EXHIBIT 2.7: Broadband Infrastructure Investment for the Network - Slow Development Scenario



[Source: Analysys]

The forecast expenditure on broadband services under the rapid development scenario is consistent with a forecast by Norcontel that an investment of IR£50 million would be required to meet the broadband requirements of 22 designated broadband service areas¹⁴. The full Norcontel recommendations presented in a report to the Information Society Steering Committee are set out in Annex B. The Norcontel report to the Information Society Steering Committee on telecoms infrastructure in Ireland goes on to describe strategies for rolling out broadband communication to the whole of the business community in Ireland. It describes its primary option as "Fibre to the Enterprise", aiming to install as much fibre as is economically feasible in locations as close as possible to the expected business demand for broadband services in the medium term (to 2002). The cost of this programme is forecast to be in the region of IR£150 million in the period 1998 to 2002.

¹⁴ Study of Telecommunications Infrastructure in Ireland: Norcontel report for Forfás. October 1996.

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We agree that the proposal that fibre should be deployed extensively to business premises in Ireland requiring 2Mbit/s access or faster is a sensible approach to 'future-proofing' the access network to cope with increases in capacity requirements in the long term. A similar policy is already being followed by BT in the UK, where every customer requiring ten or more basic telephone lines is being connected by fibre-optic cable. The fibre-optic cable is capable of carrying enormous volumes of traffic and that capacity can be 'switched on' for the customer in future as required. Indeed, BT's policy states that customers currently require little more than 0.5Mbit/s traffic - less than a quarter of the capacity of the primary rate ISDN line provided - between their premises and the exchange before upgrading access to a fibre link. Where there is a strong case against deploying fibre for economic reasons, broadband services could be supplied to business customers using copper access mechanisms such as ADSL or cable modems. In order to be cost-effective solutions for business customers, these technologies would need to be widely deployed.

One of the results of the convergence of sectors such as telecoms, computing and the media is that Digital Television has potential as a medium for broadband communications. There are plans to introduce Digital Terrestrial Television (DTT) in many countries, including Ireland, where RTE is investigating the possibilities of operating such a service. Digital television broadcasting is far more spectrally efficient than analogue broadcasting. It allows a much larger number of channels than analogue broadcasting, which creates the possibility of some channels being used for communications services other than entertainment. Services such as World Wide Web browsing could be offered over channels, involving the use of a telephone link to request information and digital broadcasting to download the response. RTE is well placed to provide such services. However, RTE's structure will need to be examined in advance of launching such services - for example, it may be necessary to separate the distribution network from the rest of RTE, as has been done by television companies in other liberalised telecoms markets.

The architecture described above will be likely to meet demand for broadband services from large business customers in the short term. However, one issue which needs to be considered is whether to address existing demand or whether to take a more active approach to stimulating demand for these services, through active marketing of broadband services and incentive schemes for operators to provide such services and for customers to use them. Such a pro-active approach could be seen as a strategic investment which would place businesses in Ireland at a competitive advantage, and provide an attractive telecoms environment that would encourage overseas investment in Ireland. The approaches which need to be considered to achieve this advantage for the Irish economy are discussed in Chapter 3.

2.3 The Benefits of Rapid Deployment

Having discussed the requirements for technology deployment and the investment costs that will be incurred in meeting those requirements, this section discusses the benefits which will arise from the investment.

Rapid deployment of broadband telecoms services is a key ingredient if Ireland is to meet its forecasts of employment growth as currently planned. The growth foreseen in the Forfas report *Shaping our Future* is premised on Ireland achieving a high standard of communications comparable with that of the most advanced competitor nations. Failure to achieve this will undermine achievement of the targets for employment in manufacturing and internationally traded services. Any shortfall will be particularly pronounced for overseas investors, who will always view Ireland in competition with other countries for their investment. Moreover, failure to provide world-class communications will also result in Irish firms locating outside Ireland in order to do business in European and global markets.

Broadband Telecommunications Investment in Ireland

One of the top priorities of the Irish Government is the creation of jobs. For a country like Ireland, inward investment has always been a very important part of job-creation strategies. IDA Ireland has been successful in attracting new jobs to Ireland through the promotion of the advantages that Ireland possesses. 1997 was a record year for IDA, resulting in the creation of 15,000 jobs (gross). Great strides have been made, particularly in the areas of financial services, call centres and software development and customisation.

The availability of broadband communications is of increasing importance as a determining factor in investment decisions. However, some important distinctions are beginning to emerge (particularly in relation to the availability of digital leased lines of capacity greater than 2Mbit/s and the commercial availability of ATM services). These are discussed in more detail in Section 2.4. Looking forward in time, if the gap between the broadband communications available in Ireland and other countries grows, it will cause investment decisions (by Irish as well as overseas companies) to change, as the disadvantages of relatively poor communications begins to outweigh the advantages which Ireland offers.

The location of telecoms investment in Ireland will also be an important issue. There will be a tendency for investment in broadband infrastructure to be concentrated in the Dublin area and to a lesser extent around the other cities. To achieve a broader dispersal of jobs associated with the industry and to maximise employment benefits, measures will need to be taken to ensure that the deployment of broadband infrastructure is as widespread as possible.

Analysys has studied the forecasts made by Forfas for manufacturing and internationally traded services employment¹⁵. These are the sectors of the economy where organisations have most flexibility as to the location of their investments and which have heavy requirements for transfer of information. These figures were broken into net new jobs forecast for Irish and overseas-owned businesses in each of these categories. Exhibit 2.8 summarises these employment forecasts for these sectors.

EXHIBIT 2.8: Forfas Total Employment Forecasts for the Manufacturing and Internationally Traded Services Sector (000s)

| | 1995 | 2000 | 2005 | 2010 |
|---------------------------------------|------|------|------|------|
| Manufacturing (total) | 235 | 257 | 268 | 280 |
| Irish owned | 128 | 135 | 137 | 140 |
| Foreign owned | 107 | 122 | 131 | 140 |
| International traded services (total) | 22 | 45 | 63 | 80 |
| Irish owned | 9 | 17 | 24 | 30 |
| Foreign owned | 13 | 28 | 39 | 50 |

Source: *Shaping Our Future, Forfás, 1996*

Forfas expects that these two sectors will contribute 103,000 net new jobs to the Irish economy by 2010 (45,000 in manufacturing and 58,000 in internationally traded services). However, this forecast assumes that Irish telecoms is comparable with that

¹⁵ Includes financial services, software services, online information services, consultancy services, telemarketing services, technical support groups, back office administration services and R&D services.

Broadband Telecommunications Investment in Ireland

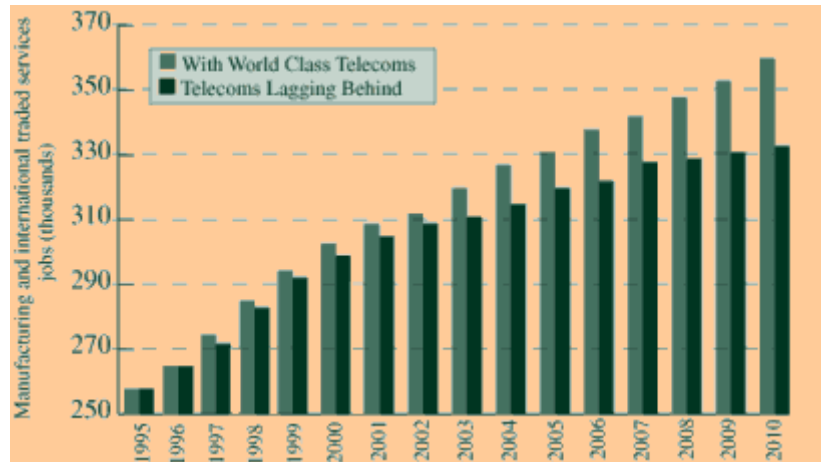
in competitor nations. If Irish telecoms lags behind other countries, many of the forecast jobs will not materialise. The effect of the shortfall will become greater as time progresses and as communications become even more essential to the running of successful businesses.

Analysys has modelled the effect of a significant shortfall in telecoms between Ireland and competitor nations by 2010. We assumed that the shortfall would have a different effect in manufacturing and internationally traded services and that the effect would vary further depending on the ownership of the business (Irish or foreign):

- **Manufacturing (Irish owned).** The effect on these businesses will be small but measurable. Irish-owned companies are more likely to locate and expand in Ireland, and owing to legacy constraints expansion will also tend to be located in Ireland. However, if the availability of telecoms services is limited and the price unfavourable, many of the jobs expected to be created by Irish manufacturers in Ireland either will not materialise or will be located overseas;
- **Manufacturing (foreign owned).** This sector will see a much stronger effect if there are serious deficiencies in Irish telecoms. Multinational corporations with distributed design teams and automated production techniques are likely to be heavily dependent on broadband communications, and will be very sensitive to differences in availability, service quality and price. These factors will be taken into account when making investment decisions and, without the legacy and loyalty constraints faced by Irish organisations, they will be more likely to direct investment away from Ireland;
- **Internationally traded services (Irish owned).** Internationally traded services is a sector which is location independent and very dependent on telecoms to do business. It is also a highly competitive sector, with global competition forcing companies to cut costs ruthlessly. Irish organisations will be forced to compete in this environment. If Irish telecoms are lacking in availability or quality, or if the price of telecoms services in Ireland is high, then many Irish companies hoping to compete in this sector will be forced to relocate outside Ireland;
- **Internationally traded services (foreign owned).** These organisations have no particular attachment to Ireland. If the conditions for investment are not the best available, they will locate elsewhere. Telecoms of sufficient quality and at the right price will be central to their decision on the location of their business. If Ireland is not in the first division, then very significant numbers of jobs which are expected to be created by these companies will be located outside Ireland.

Exhibit 2.9 illustrates the potential effects of a significant failure to offer broadband communications services, in terms of net new jobs which are currently planned for but which will not materialise. It shows that by 2010 inadequate telecoms infrastructure could cause a shortfall of 25,000 jobs in the manufacturing and international traded services sectors alone, relative to Forfas' anticipated levels of employment.

EXHIBIT 2.9: Net New Jobs in the Manufacturing and Internationally Traded Services Sectors



[Source: Analysys]

This illustrates how first-class broadband communications should be seen as an integral part of any Government development strategy, rather than as an optional extra element. This result is consistent with previous forecasts of the employment effects of broadband communications, which estimate that widespread deployment of broadband communications in all sectors of the economy will result in an additional 30,000 to 40,000 jobs¹⁶.

These employment forecasts were used as the input to an economic model which was used to determine the knock-on effects on other aspects of the higher employment. The model employs a widely-used technique based on a simple multiplier-based model to estimate the effects of increased employment in the manufacturing and internationally traded services sectors. It models the impact of investment in telecoms infrastructure, to develop possible evolutionary paths for the Irish economy. The two paths modelled reflect the impact on the economy of differing levels of investment in broadband infrastructure. The model does not attempt to prove causalities, but makes the case for individual effects on a logical and reasoned basis and calculates a set of coherent potential overall impacts. A more detailed description of the model used is contained in Annex C to this report.

The model was used to construct a possible evolutionary path for the Irish economy under the two scenarios (with world-class telecoms or with telecoms lagging behind) described in Exhibit 2.9. Both scenarios assume the same fundamental macro-economic policy conditions within Ireland and the same outlook for the EU economy.

The results of the model show that employment benefits accruing from having world-beating broadband communications will be associated with improvements in other macro-economic headline figures. GDP would be 5% higher in 2010 if broadband communications in Ireland were comparable with the best in the world. In addition, exports would be higher by more than 10%, with imports rising by 8%, leading to an improved trade balance.

¹⁶ 'Telecommunications and Enterprise: 'Building and Investing for our Future'. Forfás (1996).

2.4 Broadband in Ireland Today

When assessing the state of advanced telecoms infrastructure in Ireland, it is valuable to examine the situation in other countries in the OECD which are setting benchmarks in the roll-out of broadband infrastructure. We have therefore compared the broadband environment in Ireland with that in Sweden, the UK and the USA, which have some of the most advanced telecoms markets in the world. We have also identified special projects in Singapore and Malaysia - two of Ireland's major competitors for inward investment. The comparison is made on the basis of advanced services which deliver broadband services to the business customer. The key services on which the comparison are made are:

- availability and price of leased lines above 2Mbit/s;
- ATM services in the public network and planned services;
- development of alternative access networks such as cable TV, wireless local loop operators and alternative broadband network operators.

2.4.1 High-Speed Leased Lines

Digital leased lines at speeds greater than 2Mbit/s and priced as such are not available in Ireland, and at the time of writing Telecom Eireann had no plans to offer such leased lines. The situation is radically different in the other countries under consideration:

- In the UK, leased lines are available from BT at speeds of 8Mbit/s, 34Mbit/s and 140Mbit/s, in addition to 64kbit/s and 2Mbit/s as mandated by European law. Leased lines of 8Mbit/s and 34Mbit/s are also available from Cable & Wireless Communications, and high-speed access is available from a number of new entrant operators offering services in metropolitan areas.
- In Sweden, digital leased lines are available at a published price at 34Mbit/s from Telia (the incumbent TO).
- In the USA, high-speed lines at a variety of speeds, including 45Mbit/s and 155Mbit/s, are available from the long-distance operators and the Regional Bell Operating Companies (RBOCs).

The lack of high-capacity leased lines in Ireland is a serious restriction on the development of broadband business services. It is prohibitively expensive to use multiple 2Mbit/s lines to achieve higher bandwidths. In addition, one of the benefits of high-capacity broadband lines is that, because they are inherently cheaper (per volume of bits carried - see Section 3.2) to provide than multiple 2Mbit/s links, users frequently purchase capacity in excess of their immediate needs. This spare capacity can then be used creatively to experiment with new applications. This is already happening in the other countries discussed above.

Singapore and Malaysia - both strong competitors of Ireland in attracting inward investment - are investing significantly in broadband technologies in excess of current demand. The Singapore ONE programme is rolling out a broadband multimedia infrastructure in Singapore over the next seven years. In Malaysia, the Multimedia Super Corridor between Kuala Lumpur and the airport at Sepang will be developed to offer high-speed transmission to all business premises in its coverage area. The data rates which will be available in these areas will be in the order of hundreds of Megabits per second to each business premises.

2.4.2 ATM Services in the Public Network

ATM¹⁷ services are not available on a commercial basis in Ireland. Telecom Eireann has some ATM capability, which it is using in trials. The situation in the other countries studied is as follows:

- In the UK, BT has already launched ATM services under the product name Cellstream, and Cable & Wireless Communications offers ATM services under the product name Datastream. In London, ATM services are also available from WorldCom. In addition, ATM services are provided by a number of the cable TV operators such as General Cable and Videotron.
- In Sweden, commercial ATM services have been available from Telia since mid-1995. High-speed access at 155Mbit/s is available and also access by Ethernet connection. Telia is considering offering ATM access at lower speeds, to expand the customer base from its current level of 300 connections. Telenordia and Tele2 also offer ATM services.
- In the USA, all major providers of public telecoms services will have ATM services available to their customers by the end of 1997, according to an article in Communications Week in late January 1997.

2.4.3 Alternative Access Networks

The only alternative access network in Ireland is cable TV. Cable TV penetration in Ireland stands at more than half a million subscriptions, with cable serving the major cities and Multi-channel Microwave Distribution System (MMDS) being used to offer services in rural areas. The Cablelink network in Dublin is long established and was upgraded in 1993. With significant investment this infrastructure could be used for the provision of broadband services including multimedia, Internet and telephony services. Cable distribution in other cities and MMDS distribution are more recent, having begun mostly in the 1980s. Telecom Eireann is a major shareholder in Cablelink, which offers services in Dublin, Galway and Waterford and accounts for more than half of all cable subscribers in the country. At more than 50%, cable TV penetration is high in comparison with some European countries and the USA:

United Kingdom Cable TV has developed only recently in the UK. Serious investment in cable TV began in the early 1990s, when the end of the BT/Mercury duopoly allowed cable TV operators to offer switched telephony services, thus making the economics of cable TV more viable. About 14 million of the UK's 22 million households are now within a cable TV franchise. Infrastructure investment is substantial as cable TV operators roll out their networks. BT, the incumbent TO, is not involved in the cable TV business, except for a small franchise in London (Westminster Cable). Recently, Cable & Wireless Communications merged with three of the major cable TV companies. This merger will see the emergence of a real competitor to BT, with local access through the cable TV telephone networks and a national network via Cable & Wireless Communications.

In addition to cable TV, several companies in the UK are in the process of rolling out wireless access services. The best known of these is Ionica, which holds a national licence. Ionica uses radio to communicate between the exchange and the subscriber's home. This is believed to offer considerable cost advantages, and Ionica and other wireless access operators hope to capture a significant share of the UK local access market.

¹⁷ ATM broadband switching technology which allows voice, data, audio, video and other kinds of telecommunications traffic to be carried on the same network.

Broadband Telecommunications Investment in Ireland

Sweden Cable TV penetration in Sweden is high: more than 50% of homes in Sweden subscribe to cable TV. Services were launched in the late 1980s and early 1990s. The market is dominated by Svenska-Kabel, a wholly-owned subsidiary of Telia.

United States There are about 65 million cable TV customers in the USA. A number of powerful companies dominate the market: TCI, Time Warner Cable, Comcast and Continental Cable. The 1996 Telecommunications Act allows the cable companies to compete with the telecom operators in providing telephone and other communications services.

2.4.4 Conclusion: The Growing Broadband Gap

The primary conclusion to be drawn from the above comparisons is that, far from the stated aim of being ahead of or keeping pace with these nations, Ireland is lagging behind. High-speed leased lines and ATM services are already commercially available in the other countries examined, but, as far as we can determine at the time of writing, Telecom Eireann has not announced plans to launch such services in Ireland in the near future. Thus, a broadband gap has opened between Ireland and many of its competitor countries. At the moment, this gap seems to be widening. Although Ireland does have a high penetration of cable TV in comparison to the other countries, the powerful presence of Telecom Eireann in this market, through its shareholding in Cablelink, must be viewed as an impediment to the development of cable TV networks as alternative access infrastructure for telecoms services.

The stimulation of competition in other markets such as the Swedish, UK and US markets is causing the gap to widen with the passing of time. As more operators enter the markets in each of these countries, more services become available and the prices of existing services are driven down towards the cost of providing the services. More widely available and cheaper services are encouraging take-up of broadband communications, and the availability of relatively cheap, high bandwidth capacity is encouraging experimentation with spare capacity. None of these developments are visible in Ireland.

Chapter 3. Securing the Investment

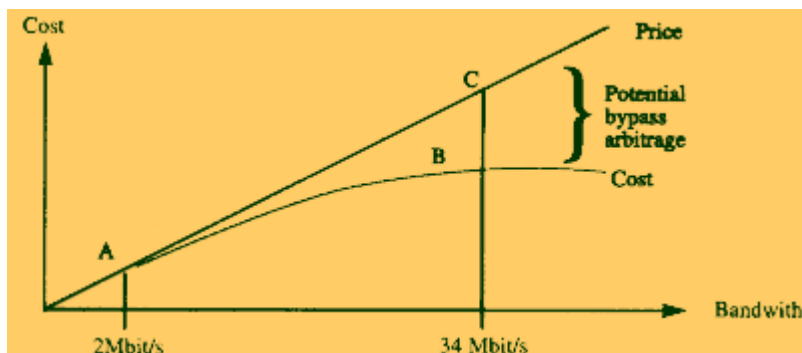
3.1 Introduction

Securing infrastructure investment for broadband telecoms is essential if the benefits of broadband services are to be available to Irish business. Section 3.2 argues that the lack of infrastructure competition discourages the dominant operator from offering broadband services on a competitive basis, while Section 3.3 discusses creating the right conditions for alternative infrastructure provision for broadband services in Ireland. Section 3.4 reviews some of the options to stimulate broadband investment in Ireland. Section 3.5 emphasises the requirement for infrastructure competition, referring to interviews conducted with organisations that have expressed an interest in investing. Finally, Section 3.6 summarises our conclusions.

3.2 The Impact of Infrastructure Liberalisation on Broadband Provision

The supply of broadband capacity in Ireland is constrained by the lack of competition in infrastructure. In a monopoly market the dominant operator is the only potential provider of broadband infrastructure. This means that it will not only be induced to charge a higher price for its broadband services, but it may also in fact create disincentives to promote new broadband services. Indeed, as noted in Section 2.4.1, Telecom Eireann does not offer leased lines at speeds greater than 2Mbit/s and priced as such and has no plans to do so in the future. This disincentive is discussed below with the help of Exhibits 3.1 and 3.2, which depict a typical but hypothetical case faced by an incumbent operator. These illustrations do not purport to represent Telecom Eireann's condition or motives, but do shed some light on the (dis)incentives faced by a commercially-motivated operator which faces reseller, but not infrastructure, competition. In Exhibit 3.1, the curve AB represents the cost of providing a broadband link of a given capacity. As can be seen, costs rise with bandwidth, but at a rapidly declining rate. This means that the cost of supplying a 34Mbit/s (point B) line should be significantly less than the cost of supplying 17 2Mbit/s lines (point A). These economies of scale arise because of the extensive sharing of ducting and transmission facilities that can be achieved with the higher bandwidth links.

EXHIBIT 3.1: Pricing Bandwidth: Status Quo



Suppose that the 2Mbit/s service were offered by the dominant operator at an unspecified margin over cost; in Exhibit 3.1, the price and cost of 2Mbit/s links is made to coincide at point A through rescaling of prices to simplify the analysis, with no loss of generality. If the operator priced its 34Mbit/s service by scaling the price of

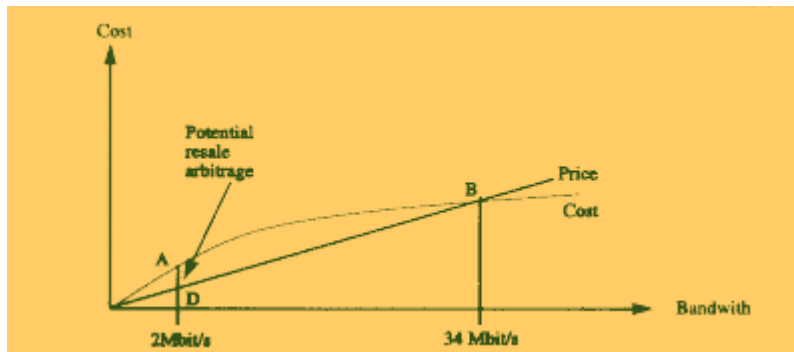
Broadband Telecommunications Investment in Ireland

the 2Mbit/s service, the price would be fixed at point C. This would be the price of piecing together 17 2Mbit/s lines to achieve a level of service equivalent to 34Mbit/s. However, the cost of supplying a single 34Mbit/s link (as opposed to 17 separate 2Mbit/s links) is given by point B. Thus, with a uniform price per 2Mbit/s, the operator makes a profit equal to the distance BC for each 34Mbit/s link it sells priced as 17 2Mbit/s links. In effect, the operator is able to price the 34Mbit/s service off point A while costing it off point B, by the simple device of not offering 34Mbit/s as a distinct service, but rather requiring customers to piece together that capacity from 2Mbit/s lines.

With the pricing structure depicted by line AC in Exhibit 3.1, the operator minimises the scope for competitive arbitrage from resellers in the 2Mbit/s market segment, as they cannot profit from 'breaking up' a 34Mbit/s capacity into separate 2Mbit/s links. Thus, by over-pricing the 34Mbit/s 'service' in relation to its cost, the dominant operator extracts higher rents from the 34Mbit/s segment (at the cost of severely limiting the development of this market), but, more significantly, it shelters its 2Mbit/s service from reseller competition.

The situation depicted in Exhibit 3.1 is sustainable as long as there is no way to realise the potential bypass arbitrage, i.e. as long as infrastructure competition is not allowed. Otherwise, alternative providers could enter the 34Mbit/s market profitably by laying down their own infrastructure, because of the very high profits earned by the operator in that segment (represented by distance BC in Exhibit 3.1). (Note that until 1 July 1997 they were not authorised to compete with Telecom Eireann on the basis of their own infrastructure.) With infrastructure competition, an operator could not sustain the prices of 34Mbit/s at point C; nor could it sustain the prices of 2Mbit/s at point A, as shown in Exhibit 3.2 (in which the cost curve AB is identical to that in Exhibit 3.1).

EXHIBIT 3.2: Pricing Bandwidth: Competitive Provision



Suppose that vigorous infrastructure competition drives the profit on 34Mbit/s links down to zero. This will occur when prices drop to point B in Exhibit 3.2, which equates prices to costs. At this point, resellers will be in a position to arbitrage the price of 2Mbit/s and 34Mbit/s links: the dominant operator might be selling 2Mbit/s links at price A (at which it is not making any extra profits). However, resellers can sell 2Mbit/s links at one-seventeenth the price of 34Mbit/s links, which is represented by point D. The effects will be to:

- lower the price of 2Mbit/s links;
- induce users to switch from 2Mbit/s links to 34Mbit/s links, even though they may not be expecting to use that capacity fully. In other words, if the broadband communications of a business were of the order of 20Mbit/s, then

Broadband Telecommunications Investment in Ireland

it would be cheaper to lease 34Mbit/s of capacity rather than ten separate 2Mbit/s links. The 14Mbit/s spare capacity could be used by the company in innovative ways - for example to experiment with video communication. This will create demand for 'spare' capacity, which in turn will induce users to increase their utilisation of bandwidth;

- induce the dominant operator to focus on providing higher bandwidth capacities at which it faces less reseller competition.

To sum up, a policy of infrastructure liberalisation would result in greater take-up by fully exposing the dominant operator to both bypass and reseller arbitrage. The dominant operator would be induced to both decrease its prices and broaden its service offerings, and in particular to offer, and effectively market, higher bandwidth services. The announcements made on 1 July 1997 by Esat Telecom and TCL Telecom of their plans to build infrastructure in Dublin and, in the case of Esat, throughout the country in collaboration with CIE, are likely to result in a dramatic change in the provision of high bandwidth leased lines in Ireland when they begin offering services.

3.3 Creating Conditions to Encourage Investment

The crucial policy objective in realising the latent investment potential in Ireland is to create conditions that will encourage operators to make the desired investments. This necessitates above all setting a credible, consistent and transparent regulatory framework within which private providers can exploit the identified market opportunities in broadband services. Important elements of such a framework are:

- licensing procedures for new entrants, including submission requirements and timescales;
- nature and scope of regulatory powers and mechanisms for enforcing these powers;
- restraints to ensure that there is not abuse of a dominant market position with respect to issues such as price controls and interconnection.

In Sections 3.3.1 to 3.3.3 below we explore these aspects in greater detail. Finally, Section 3.3.4 reviews the 1996 Telecommunications (Miscellaneous Provisions) Act, which establishes the Office of the Director of Telecommunications Regulation and is an important step towards a liberal telecoms regime in Ireland.

3.3.1 Licensing and Administrative Procedures

Entry into infrastructure provision, even if legally permissible, can easily be hampered by onerous and lengthy licensing procedures. These may constitute an artificial yet powerful barrier to entry in several ways:

- there might be a significant cost involved in meeting the procedural requirements, which add to the already significant start-up costs of new operators;
- administrative delays may preclude potential entrants from seizing market opportunities as they arise, or at the very least may allow established operators some time to adapt to potential market entry;
- uncertainty on the outcome of administrative procedures may significantly raise the risk of, and hence the expected return on, committed capital for new operators.

For these reasons, it is crucial to ensure that the procedures involved in qualifying for a licence are put in place in a timely manner and are not unduly burdensome. Failure to have procedures in place or instituting complicated procedures increases the risk that organisations will reject investment because of the delay or the overhead of complying with regulations. Most importantly, the procedures need to be transparent,

so that potential entrants understand on what basis licensing decisions will be made. Although some discretion must be granted to the Regulator in licence evaluation for wider policy reasons, it is particularly important that the Regulator should establish some accountability mechanism and that licence applicants have recourse to regulatory reviews.

The procedure adopted in allowing Esat Telecom and TCL Telecom to begin constructing their networks in parallel with their licence applications is progressive and has eliminated many of the potential licence delay problems.

3.3.2 A Strong, Credible, Professional and Independent Regulatory Body

One of a Regulator's¹⁸ key roles is to instil confidence in the fundamental fairness and stability of the regulatory framework. The credibility of the policy framework is derived entirely from the credibility of the agency that interprets and applies it. The critical aspects that determine the industry's confidence in the Regulator are the following:

Structure of authority

The Regulator's powers may be vested in an individual (the Regulator), in a Board (which approves the Regulator's recommendations, and may delegate certain powers to the Regulator), or in a combination of the two (depending on the issue). Vesting the powers in the Regulator (as in the UK) leads to more rapid decisions and strengthens the agency's hand by avoiding conflicting interests within the institution. On the other hand, a Board structure (e.g. the USA's Federal Communications Commission) serves as an accountability device and may provide a larger sense of continuity, primarily due to the staggering of appointments. It also distinguishes between policies and the individuals who developed them.

The Telecommunications (Miscellaneous Provisions) Act 1996 established the Regulator as an individual, the Director, who inherited the regulatory powers of the Minister for Transport, Energy and Communications (now Minister for Public Enterprise). The Director is given power to "do all such acts or other such things as are necessary or expedient for the purpose of the exercise of his or her functions". Under the terms of this Act, the Director is appointed for a maximum period of six years and can only be removed by the minister on grounds of ill-health interfering with his or her ability to perform his or her duties or on the grounds of unacceptable behaviour.

Legal status

The Regulator requires solid legal standing, specific responsibilities, and managerial and budgetary autonomy in order to carry out its duties forcefully, credibly and consistently. In particular, it needs to be sheltered from political influence and has to be recognised as a technical agency with a long-term perspective. International experience clearly demonstrates the importance of having a strong and independent regulator in building confidence in competitive processes.

¹⁸ In May 1997, the first Director of Telecoms Regulation was appointed. She began her role as Director on 1 July 1997

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The Director inherits the telecoms powers of the Minister for Transport, Energy and Communications (now Minister for Public Enterprise) and has access to the Department's budget and staff to carry out his or her duties within the normal constraints of financial prudence.

Enforcement powers

The Regulator needs a flexible set of powers and sanctions to enforce the regulatory framework. The sanctioning powers should apply to non-compliance with the existing legal framework and not just to the contravention of regulatory orders.

Scope for discretion

The Regulator needs to be given some discretion in its interpretation of the telecoms law and its implementation of sectoral regulations within the overall guidelines enshrined in the law. This discretion is necessary to avoid burdening the law with too much detail, so that situations not currently envisaged can be handled in the future. The scope for discretion granted to the Regulator needs to be commensurate with its objectives, legal standing and resources.

Access to information

To regulate the sector effectively, the Regulator needs to have access to extensive information from operators, especially with regard to costs. However, this information should be kept strictly confidential by the Regulator. If the Regulator does not feel it can guarantee confidentiality (because of staff turnover or organisational constraints), it might want to restrict the information to which it has legal access.

Staffing

As the duty of the Regulator is to exercise the discretion vested in it by the legal framework, it requires credibility not only in its integrity, but also in its technical capacity to review the pertinent issues. The Regulator must have sufficient means to attract independently-minded, high-calibre staff.

Accountability and review

Credibility in the regulatory framework will be enhanced if there are adequate external mechanisms for accountability and review of the Regulator's discretionary policy-setting and enforcement actions. However, such procedures may be counter-productive if they are not credible and swift. Accountability should not become a means of politicising the institution. The accountability provisions in the 1996 Act, which require the Director to report annually to the Minister and the Oireachtas, seem appropriate.

3.3.3 Protection Against Potential Abuse of a Dominant Market Position by an Incumbent Operator

The dominant operator in any telecoms market may use its entrenched market position to drive out competition in several ways, as discussed below.

Predatory retail pricing To drive out competition the dominant operator may choose to adopt a predatory pricing strategy. It may find that it is in its best interest to make a loss on some of its services facing competition, so long as it can cross-subsidise those services from more sheltered market segments in which the operator can charge quasi-monopolistic rates. Such a pricing policy may be used to reduce competition in the more competitive segments, with a view to subsequently raising prices in all segments.

Price regulations and monitoring must, therefore, ensure that the dominant operator does not engage in 'predatory pricing'. This requires setting a floor on retail prices of the more competitive services, and/or a cap on retail prices of the less competitive services.

Interconnect pricing The need for regulatory scrutiny of interconnect prices arises from the fact that a single incumbent owns a set of essential fixed assets for which bypass (duplication) is deemed to be socially undesirable or so costly as to deter entry by prospective competitors. This is specifically the case for the incumbent's local access network, which puts a dominant operator in the position of being the sole carrier for the origination and termination of the majority of calls. By denying access to this network to potential competitors or pricing interconnection at prohibitive rates, the incumbent may be in a position to stifle competition.

Interconnect policy should, therefore, be geared towards giving access to, or gaining access from, bottleneck assets or services derived from them on a non-discriminatory basis, at a fair price, under set service quality and inter-operability standards. In particular, interconnect prices should be expected to cover reasonable costs of providing interconnect without yielding monopoly rents to the incumbent.

Biases in the numbering scheme A dominant operator may also seek to bias the allocation of numbers in its favour, by:

- limiting the availability of numbers to other operators;
- requiring that extra digits be dialled to access competing networks and so denying equal access to competitive networks;
- keeping the 'best' numbers to itself.

The numbering scheme must be seen as a national resource, and must be administered in a fashion that serves the best interests of the entire sector. In Ireland, the numbering scheme is administered by the Office of the Director of Telecommunications Regulation. As the sector is opened up to competition, it will need to devise a policy for ensuring that customers can access their carrier of choice on a non-discriminatory basis. This will require implementing a scheme of equal access, based on customer choice of carrier and digit parity across operators. Number portability between operators will also be very important, to ensure that customers are not deterred from changing to more competitive operators by the inconvenience of being forced to change their number. The Regulator can limit its intrusion in the market by recognising that the level of regulation and supervision it needs to exercise is not the same for all operators. Regulatory policy towards a dominant operator clearly needs to focus on ensuring a rational price structure, so as to preclude that dominant operator from extracting monopoly profits or cross-subsidising services for unfair competitive advantage. The Regulator's policy towards entrants, on the other hand, might be to assist them, both directly and indirectly, because they can be effective in checking the dominant operator's market power. The Regulator, therefore, needs to recognise these different objectives through an asymmetric regulatory approach and, furthermore, to take advantage of opportunities to act on the basis of regulatory asymmetries.

The Regulator should set these policies through a consultative process with industry players and other interest groups such as users or Government departments and development agencies. Such consultative processes can provide the Regulator with a better understanding of the market, as it may acquire more up-to-date, comprehensive and detailed information on costs and technologies than would be otherwise available to it.

3.3.4 Assessment of the Telecommunications (Miscellaneous Provisions) Act 1996

The Telecommunications (Miscellaneous Provisions) Act was passed by the Oireachtas in November 1996. One objective of the Act is to provide a legal framework for an independent regulator of telecoms in Ireland. The Act establishes the office of the Director of Telecommunications Regulation, defines the functions of the Director and transfers powers from the Minister of Transport, Energy and Communications (now the Minister for Public Enterprise) to the Director.

The 1996 act will need to be built upon in a number of ways in order to create an environment in which competition can thrive and telecoms investment from alternative operators will be encouraged. Some necessary steps are outlined below.

Overall objectives of the Regulator (Section 3)

The overall objectives of the Director are not sufficiently clearly defined in the Act. Section 3 of the Act states that one of the primary functions of the Director is to ensure that a Radio Frequency Plan is put in place, but there is no further description of the objectives of the Director in terms of developing a competitive telecoms market in Ireland in accordance with the requirements of the European Commission or of protecting the interests of consumers of telecoms services in Ireland. These are major omissions, which result in a lack of transparency in the role of the Director.

In Ireland, the Director's overriding responsibility should be to develop a competitive, liberalised market. In particular, the Director should have a public interest responsibility, to look after the interests of different categories of consumer (e.g., enterprise sector clients), to ensure that the requirements of the European

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Commission are satisfied (e.g., ensuring the availability of services and minimum levels of infrastructure capacity), and to promote efficiency in the telecoms sector.

The January 1998 Statutory Instrument: European Communities (Interconnection in Telecommunications) Regulations, 1998¹⁹ which transposes the European Directive on Interconnection²⁰ into Irish law notes that in the exercise of his or her functions under the Regulations in the Statutory Instrument the Director is to have regard to:

- (a) the need to ensure satisfactory communications for users;
- (b) the need to stimulate a competitive market in competitive services;
- (c) the need to ensure a fair and proper development of a harmonised telecommunications market;
- (d) the need to co-operate with regulatory authorities in other Member States;
- (e) the need to promote the establishment and development of trans-European networks and services, and the interconnection of national networks and interoperability of services as well as access to such networks and services;
- (f) the principles of non-discrimination (including equal access) and proportionality; and,
- (g) the need to maintain and develop universal service.

A similar set of guiding principles requires to be defined for the exercise of the functions of the Director in carrying out the rest of his or her role.

Such regulatory responsibilities have been established by legislation or by public policy statements in other countries. In the UK, for example, Section 3 of the Telecommunications Act 1984 states that the Regulator:

"... has a duty to exercise the functions assigned or transferred to him in a manner which he considers is best calculated:

- to promote the interests of consumers, purchasers and other users in the United Kingdom ...
- to maintain and promote effective competition between persons engaged in commercial activities connected with telecommunications in the United Kingdom ...
- to promote efficiency and economy on the part of such persons ...
- to promote research into and the development and use of new techniques by such persons ...
- to encourage major users of telecommunications services whose places of business are outside the United Kingdom to establish places of business in the United Kingdom ...
- to promote the provision of international transit services by persons providing telecommunications services in the United Kingdom ...
- to enable persons providing telecommunications services in the United Kingdom to compete effectively in the provision of such services outside of the United Kingdom

¹⁹ Statutory Instrument No. 15 of 1998

²⁰ 97/33/EC - Official Journal of the European Communities L199, 26 July 1997.

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- to enable persons producing telecommunication apparatus in the United Kingdom to compete effectively in the supply of such apparatus both in and outside the United Kingdom."

Other countries, such as France and Australia, publish general principles which guide the actions of the regulator and can be used as yardsticks when judging its actions. It is strongly advocated that the Government in Ireland should publish similar guiding principles for the Irish Director of Telecommunications Regulation.

Levies on telecoms service providers (Section 6)

Section 6 of the Act describes the powers of the Director to impose levies on providers of telecoms services to finance the operations of the Office of the Director of Telecommunications Regulation. However, the powers described carry certain risks. If levies are imposed in proportion to revenues, then the Office of the Director of Telecommunications Regulation will be funded largely by Telecom Eireann, which presents a danger that Telecom Eireann might be able to exert undue influence on the Director. Imposition of levies not proportional to revenues carries the danger of discouraging new operators into the telecoms market in Ireland. Furthermore, any surplus (excess of levies over administration costs in a financial year) can be taken by the Government in the form of a back-door tax on the industry. Such an approach can serve only to deter investment in telecoms. Any surplus thus collected should be offset against the following year's contributions. Another possibility is to make the fees payable for the use of national radio spectrum available to the Director of Telecommunications Regulation as funding for the office of Telecommunications Regulation. This approach would avoid new entrants to the telecoms market being deterred by the charges imposed on them.

Price-cap mechanism (Section 7)

Section 7 of the Telecommunications (Miscellaneous Provisions) Act 1996 which establishes the framework for a price-cap mechanism also requires to be changed. The Minister retains most, if not all, power in determining and reviewing the scope and magnitude of a price cap for five years. This is a situation for concern, as it must be borne in mind that the Minister is also responsible for the major shareholding in Telecom Eireann and this may lead to the perception that s/he may be unlikely to act in the interests of consumers if it would adversely affect the value of the Government's shareholding.

The regulation and monitoring of prices for telecoms services should be vested in the office of the Regulator as soon as possible and certainly before the five-year price-cap period expires.

The Act also specifies that the Minister may direct the Director to review the price-cap order after two years. It is imperative that the Minister should use this power to ensure that the Director reviews the 1996 price-cap order - effective from 1 January 1997 - by January 1999. The Director should also be given adequate powers and sanctions to ensure that operators do not engage in predatory pricing.

Surrender of information (Section 12)

Section 12 of the Act gives the Director rights to require surrender of information to his or her office and rights of inspection, but the Act is not explicit about whether any information thus gained will be treated as confidential. Such information ought to be regarded as confidential unless disclosure is in the public interest.

Fines for non-compliance (Section 13)

Section 13 describes the fines which can be imposed for non-compliance with various sections of the Act, and these are very low. It would be possible for an operator to refuse to comply with the law for a whole year and face a fine of less than IR£2£million. In circumstances where compliance could cost an operator tens of millions of pounds, this level of fine will not be an adequate deterrent. Fines for non-

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compliance should significantly outweigh any benefits that may be gained. In other countries, such as the United Kingdom, failure to comply with the directives of the regulator exposes an operator to damages claims in the civil courts by those adversely affected by non-compliance.

Interconnection

The 1996 Act does not mention interconnection. This has been rectified in the Statutory Instrument: European Communities (Interconnection in Telecommunications) Regulations, 1998¹¹ which transposes the European Directive on Interconnection¹² into Irish law. This deals in great detail with interconnection and brings the situation in Ireland in line with most other European countries. However, transposition of the Directive is only the first step in the process of ensuring a fair interconnection regime in Ireland. It is now necessary to carry out the actions required by the Directive. A priority should be attached by the Director to examining the prices currently charged for interconnection in Ireland which seem high when compared to those charged in the United Kingdom. Action is needed to determine how cost related these charges are and to reduce them if their current high levels cannot be shown to be consistent with the costs experienced by an efficient operator.

Numbering

The 1996 Act makes no mention of numbering, beyond stating that the national number plan is the responsibility of the Director. The Statutory Instrument which transposes the European Directive on Interconnection into Irish law elaborates on the role of the Director with respect to administration of the "national telecommunications numbering resource", and establishes the responsibilities of the Director to ensure non-discrimination by operators and equal access for users. The Director's role in encouraging the earliest possible introduction of number portability is also described in this text. However, the final deadline for the introduction of number portability is set at 1 January 2003 - the latest date allowed for by the directive.

Number portability is very important for a properly competitive telecommunications market. The technology and techniques for portability are well understood and have already been implemented in other countries. We recommend that the deadline for the introduction of number portability should be no later than 1 January 2000 (the date for liberalisation of basic voice services in Ireland) if Ireland is to enjoy the full benefits of telecommunications competition from that date.

Timescale for Liberalisation

There are also problems of timing, as the independent Regulator took office in July 1997 and infrastructure liberalisation came into effect in the same month. The Regulator's initial priorities will be to set up an administration and meet its statutory obligations to draw up a frequency plan for the use of radio spectrum. Consequently, it could be difficult for the Regulator to devote the required resources to the matter of infrastructure liberalisation until some time after liberalisation had been required by European law. Recent experience has shown that even where European law dictates that liberalisation should proceed (in the form of a second GSM operator), many delays can result from administrative processes (e.g., planning procedures).

However, the Director's approach of allowing infrastructure roll-out to proceed in parallel with licence applications addresses many of these problems and indicates that these delays should not be significant.

Conclusion

Notwithstanding the deficiencies of the Act identified above, there is scope for the Director to have a profound effect on the development of telecoms in Ireland and on the development of an economy increasingly dependent for competitive success on a competitive telecoms sector of excellence and depth. An open and competitive market will be the measure of the effectiveness of the new regulatory regime at present being put into place.

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It is understood that further telecoms legislation is being prepared by the Department of Public Enterprise. It is recommended that this legislation should address the issues and required legislative changes described above, as well as establishing the framework for a competitive telecoms market in Ireland.

3.4 Making Funding Available to All Operators

There is an in-built possibility of market failure to the delivery of broadband infrastructure investment if operators wait until customers begin to ask for a service. This demand-led approach ignores the possibility that advance investment could stimulate demand for broadband services. Therefore, in addition to implementing a pro-competitive regulatory framework which protects opportunity without guaranteeing outcomes, the Government could introduce funding schemes to direct resources towards those broadband investments it considers worthwhile (based on an economic analysis of benefits and costs). Any scheme of financial incentives for infrastructure provision must address the following issues:

- the source of the funds, i.e. who is taxed or which activities are penalised in favour of broadband infrastructure provision;
- the amount of funding to be made available for this purpose, which is, in principle, related to the economic benefits of the proposed scheme in relation to alternative uses of the funds;
- how the funds are applied, which requires defining the eligible uses of the funds and any associated terms and conditions for eligibility, and establishing the allocation mechanism among bidding providers.

These questions raise not only logistical problems but also issues of principle on the economic and political case for publicly supporting broadband infrastructure. It is essential for any funding scheme to be applied in a non-discriminatory fashion, so that it does not favour some players in the market at the expense of others. Two traditional ways of increasing spending on telecoms infrastructure cannot be applied under current conditions:

- In the run-up to a competitive telecoms market it would be difficult for the Government to mandate that Telecom Eireann should invest in broadband infrastructure in advance of market demand. Telecom Eireann could argue that it is the Government's responsibility to fund such investment if it considers it is such a high priority;
- It is not acceptable for the Government to give a sum of money to Telecom Eireann for investment in broadband infrastructure as the other telecoms organisations in the Irish market would object to a State subsidy to their main competitor.

As alternatives to these traditional approaches, there are a number of possibilities which need to be investigated when identifying sources of public funds for investment in telecoms infrastructure. The main possibilities in the case of Ireland are:

- funding from Government sources through a fiscal transfer scheme;
- funding from the EU;
- internal funding from within the telecoms sector through a compensatory transfer scheme.

These possible sources of funding are discussed below in Sections 3.4.1 to 3.4.3.

3.4.1 Fiscal Transfer Schemes

Provision of funding from general taxation has the advantage that it gives the Government considerable freedom in specifying the size of the investment and the

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use to which it is put, according to its perception of the telecoms requirements of the nation. The fiscal transfer scheme would be the fairest and least distorting mechanism for raising funds, as it could be designed so as to minimise the effect on the dynamics of competition. It would also spread the cost across a base of contributors in a similar manner to other social policy objectives.

However, the disadvantage of this approach is that by returning the responsibility for telecoms investment to the Government, the sector would once again have to compete with schools, hospitals and other social priorities for limited Government finance. The political sensitivities related to public spending frequently mean that telecoms investment is not treated as a high priority: the telecoms sector is, in the public mind, a profitable sector - potentially too profitable, which is why telecoms price regulation receives widespread support - so that it would be difficult to secure budgetary appropriations for this sector. Therefore there would be risks in relying on general taxation as a source of funding for important broadband investment.

Any transfer scheme would have to be designed carefully to avoid these disincentives, which would tend to erode the benefits of the policy. There would be several ways for the Government to support broadband investments through a fiscal transfer scheme:

- provision of equity by the State
- credit guarantees
- targeted fiscal subsidies
- tax advantages
- subsidies targeted to users

Provision of Equity by the State

A traditional approach for securing public investment would involve the State taking an equity stake in specific broadband investment projects. This approach is implicit when the State owns the monopoly provider. In a market comprising several private providers, the State could participate directly in individual investment projects only if these are structured as legally separate entities from the operating companies, for example through joint ventures with the State. Given the resolute intention of the Irish Government and the EU to minimise State involvement in telecoms ventures, this option is not advisable and is not further addressed.

Credit Guarantees

Another common approach for State sponsorship of private projects is for the State to guarantee the project's financing, most commonly through debt guarantees. One advantage for the State is that, because of their contingent nature, guarantees generally do not enter the national budget, until claims are made upon them. Of course, from a fiscal point of view this renders them less transparent.

Credit guarantees involve various degrees of project risk-shifting and subsidisation. A credit guarantee is analogous in its effects to an exchange of private for public debt, and as such may be contrary to the spirit of privatisation and State disengagement from the telecoms sector. Credit guarantees create a number of disincentives: they are likely to dilute the incentives of bondholders to monitor project performance and, unless there is strong accountability of the financed enterprises to the State, the purported objectives of the guarantee scheme will not be achieved.

The effects of credit guarantees are particularly troublesome since they are intrinsically more valuable for riskier, badly-conceived projects, which are rewarded with a higher implicit subsidy. On the other hand, public guarantee schemes designed to support riskier, innovative but worthwhile projects may succumb to bureaucratic incentives to avoid potentially embarrassing failures. Thus, guarantee schemes may

be biased in favour of safer projects for which there is less need for Government support.

Targeted Fiscal Subsidies

Under this approach a defined fiscal subsidy is provided to selected projects as an inducement for private operators to enter into a venture which, while economically and socially sound and desirable, is not viable on strictly commercial terms. Subsidy schemes are generally fraught with incentive problems, which mean that the ultimate objectives of the scheme are rarely met, despite the funding pumped into it. Disincentives can be reduced if the subsidy granted by the State is made payable at a future date rather than at the inception of the project, subject to the fulfilment of a performance contract by the private operator.

There are a number of examples of this type of subsidy in evidence in other rapidly developing economies. In Malaysia, for example, the Government is funding a project called the Multimedia Super Corridor, which provides a corridor of broadband infrastructure operating initially at 2.5Gbit/s and rising to 10Gbit/s between Kuala Lumpur and the airport at Sepang. In Singapore, a broadband multimedia infrastructure called Singapore ONE, which is financed by the Government, is being planned by TAS, SingTel and SingCable for installation over the next seven years. Annex D contains a description of the Singapore ONE programme.

Tax Advantages

Under this approach the Government would offer certain tax benefits to firms undertaking broadband investments. Insofar as the same benefits would apply to all operators, such an approach would be transparent. However, the fiscal cost of the scheme (tax revenue foregone) would not be explicitly identified in the national budget. Tax advantages could be implemented in several ways:

Tax holidays A 'tax holiday' refers to the exemption of an operator from corporate income taxes for a specified period. Its temporary nature is generally justified on the grounds that new networks require a critical mass of clients before they are economically viable, and hence the State should not tax them until such time as the network is consolidated.

Tax holidays are generally granted under eligibility criteria, and the tax exempt status is periodically reviewed against agreed plans. These criteria might relate to:

- fulfilment of an investment and employment plan;
- service coverage of less developed geographical areas or economically deprived market segments;
- expansion of the range of service offerings, to include more advanced services.

In Singapore, the early users of the ONE broadband network mentioned above will be allowed tax holidays, and there will also be tax holidays for organisations which participate in associated R&D activities (see Annex D for a description of Singapore ONE).

Investment tax credits

Investment tax credits are essentially a mechanism for the State to share proportionally in the cost of investment programmes, with the State 'co-investing' an amount equal to the tax revenue foregone.

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They are a common instrument for rewarding physical investments, and compared to other investment promotion vehicles are more attractive as they operate through the tax system and hence do not require an additional administration system. Unlike tax holidays, they do not require any special negotiation, approval or supervision process. Investment tax credits tend to be available to all firms making specific types of investment. This probably enhances their fairness and transparency in comparison with tax holidays, but reduces their efficiency as an investment promotion device, since they may apply to investments that are not 'additional', i.e. they would have taken place even without the tax credit. This risk of not inducing 'additionality' of investments is mitigated if tax credits are restricted to investments in more technologically advanced projects. Investment tax credits are essentially a mechanism for the State to share proportionally in the cost of investment programmes, with the State 'co-investing' an amount equal to the tax revenue foregone. They are a common instrument for rewarding physical investments, and compared to other investment promotion vehicles are more attractive as they operate through the tax system and hence do not require an additional administration system. Unlike tax holidays, they do not require any special negotiation, approval or supervision process.

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Accelerated depreciation schemes

Accelerated depreciation schemes favour investment by deferring taxes. An accelerated depreciation schedule results in higher accounting costs in the early years of the life of an asset which can be used to offset current income; depreciation charges in subsequent years will be correspondingly smaller, thereby generating a higher taxable income. Thus, their effect is analogous to an interest-free loan from the State to the taxpayer (as opposed to a direct grant which is the economic interpretation of an investment tax credit).

While investment tax credits can be targeted to specific types of investment, it is difficult to justify different depreciation rules for different firms or sectors. Discriminatory application of depreciation rules is not generally accepted, as it suggests an abuse of a technicality. Thus, while they can promote investment generally, it is much harder to bias accounting rules in favour of broadband investment in particular.

Tax loss carry-forwards

A 'tax loss carry-forward' refers to the ability to offset current taxable income against past losses. Tax loss carry-forward provisions are important in sectors which are characterised either by high volatility of income or high start-up costs. In the case of broadband providers, the high fixed investment requirements and the uncertainties in customer take-up would make carry-forwards very attractive.

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As in the case of accelerated depreciation schemes, it is politically difficult to allow loss carry-forwards only in specific cases. However, the intrinsic characteristics of carry-forwards mean that the tax benefits would naturally be geared towards broadband providers more than others, whereas investment tax credits have a much more symmetrical incidence across sectors.

Favourable tax treatment of financing vehicles

The tax code can embody some preference for vehicles financing broadband investments in two main ways:

- on the operator side, through the deductibility of financing costs from taxable income;
- on the investor side, by allowing, for instance, tax exemption on interest income from bonds specifically earmarked to finance broadband investment.

Subsidies Targeted to Users

Alternatively broadband investments can be promoted by targeting the demand side. The intent of these policies is to facilitate or subsidise take-up of broadband or information services. This can be achieved:

- directly, by specifically subsidising users of broadband services;
- indirectly, by subsidising sectors or industries which are likely to be users of broadband services.

Direct subsidies, in turn, can be targeted in different ways:

Encouraging investment

Subsidies on the use of broadband could be provided - possibly as part of a broader package of promotion - to attract investment in projects that are information intensive. These subsidies could take a number of forms:

- funding the cost of installation (in full or in part) of the broadband connection between the business premises and the appropriate exchange;
- funding part of the standing charges for connection to broadband services;
- funding part of the cost of broadband usage charges for traffic above a certain threshold, thereby stimulating use of broadband traffic.

This approach has the attraction that it will not favour particular suppliers of broadband services, which would allow a competitive market to develop. Targeting investment for broadband promotion has the advantage of 'additionality', i.e. increasing the likelihood that subsidies go to investments that would not otherwise take place.

If this approach were chosen, it would be necessary to market the attractions offered by Ireland to potential investors in telecoms

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infrastructure. Active promotion by the relevant Government departments and State Agencies should ensure that the benefits are made clear to international telecoms operators.

Promoting the use of broadband communications

Subsidising the equipment and software required for the use of broadband has the advantage of not discriminating according to the origin of the financing and the ownership structure. These subsidies can take different forms:

- outright subsidies
- rebates on purchase prices
- reduction of indirect taxes (such as VAT) to which broadband equipment and software applications are subjected
- exemption from import duties.

The overall lack of market awareness of the range of potential broadband service applications and how they can be exploited is a prime obstacle to broadband development. Development agencies and telecoms operators could actively market and raise awareness of the potential and growth opportunities offered by broadband telecoms for enterprises. This could foster demand for broadband, to strengthen market signals and promote 'demonstration' projects/effects. It is a proposal which could also be considered by the Information Society Steering Committee.

As part of an active marketing approach to stimulating demand for broadband and to drive the take-up of leading-edge telecoms equipment, the development agencies could consider introducing a guideline encouraging the use of broadband technologies into their project appraisal systems. This could provide extra assistance on the capital cost of installation and connection of broadband telecoms to enterprises that are information intensive or require high-capacity telecoms as part of a business development plan. Such a guideline could be similar to that laid down for regional projects.

Such assistance would not only stimulate the take-up of broadband services, but is also likely to assist in attracting projects that might not otherwise consider locating in Ireland.

Training programmes and educational materials

The State can finance the introduction of broadband by easing users' transition to new technologies and ways of organising work. The introduction of broadband can be very disruptive, with companies having, for example, to acquire a new set of skills, redesign the way they manage their inventories and supplier relationships, introduce new marketing techniques and establish new inter-office communications channels and protocols. The Government could provide an indirect form of subsidy to support relevant training programmes and educational materials that are designed to facilitate the incorporation of broadband into companies' processes.

Access to Government information

Another indirect form of subsidy would be to give broadband users free access to a broad range of information and other Government sources. The Government could also facilitate the distribution of

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sources other sources of information by acquiring rights over them and distributing them freely. Access to useful information could therefore be made available free of charge to those accessing over broadband networks - creating an incentive for those requiring access to that information to use broadband communications.

Development of applications A key problem with introducing new communications technologies is that take-up is retarded as long as the number of available applications remains limited, while the development of new applications may in turn be hindered by lack of user demand. The Government could try to break this vicious circle by promoting the development of new applications and subsidising their adoption. In the United Kingdom there was a Ministerial initiative recently to encourage officials in the Department of Trade and Industry to use videoconferencing, as a means of encouraging commercial enterprises to do the same.

Evaluation of Fiscal Transfer Schemes

It is our judgement that a prime obstacle to broadband development in many countries is lack of market awareness of the range of potential service applications and how they can be exploited. The novelty of the technology means that potential users face significant uncertainty on the usefulness of broadband to their specific circumstances. This is aggravated in Ireland by the lack of offerings from the dominant operator, for whom broadband is as much a threat from resale competition as an opportunity.

In this situation, broadband investment can be best promoted by fostering demand, in order to strengthen market signals rather than by 'planning' for a certain level of broadband capacity. Subsidies targeted to broad categories of users might be justified to create a certain 'demonstration effect', spreading the market's understanding of the potential usefulness of these technologies and inducing the emergence of new applications and services.

For these reasons, we would favour limited subsidies to users over subsidies to producers. These would be provided for a short period, to support a demonstration of the usefulness of broadband services.

3.4.2 Funding by the EU

The two main possibilities for funding by the EU are joint research programme funding and funding from European Structural Funds (primarily the European Regional Development Funds and the Cohesion Fund).

Funding from Joint Research Programmes

Limited funding is available to provide infrastructure under the joint research programmes run by DGXIII of the European Commission. Programmes such as ACTS, Telematics and TEN-IBC have made contributions towards the funding of small infrastructure developments of an experimental nature. However, the constraints on the use of this funding are considerable (it must be used primarily for research purposes) and so it is unlikely that Irish organisations applying for funding for broadband infrastructure via this route would be successful. Even if they were successful, the proportion of the investment costs met from these sources would be very small.

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Structural Funding

European Commission Structural Funds are used to assist development of regions with inferior infrastructure (e.g. roads, railways and telecoms), in order to diminish some of the economic disadvantages they experience. Ireland as an "Objective 1" region is eligible for a high level of assistance from these funds. Funds are at present fully allocated to a range of infrastructure projects. However, DGXVI of the European Commission (responsible for administration of the Structural Funds) is currently carrying out a review of its application of Structural Funds in the Member States, and it is possible that if under-spending is found, the funds identified could be redirected to telecoms, subject to the Irish Government deciding that telecoms infrastructure is a sufficiently high priority.

Two of the criteria used by DGXVI in deciding whether a project qualifies for funding are:

- does it address shortcomings in telecoms infrastructure which disadvantage the Member State?
- does it satisfy identifiable requirements, currently not being met, that would advance the development of the Information Society in the Member State?

DGXVI has indicated to Analysys that broadband infrastructure investment in Ireland would be seriously considered as a target for Structural Funds, even where such investment would put Ireland at an advantage relative to other Member States. This is because DGXVI believes that the advantage would be short lived, due to the investment policies of TOs in other Member States.

The Structural Fund does not provide 100% funding for infrastructure investment. The normal arrangement is that between 50% and 75% of the necessary total funding is made available by the EC, whilst the remainder is provided by organisations in the Member State. Thus, in the case of telecoms investment in Ireland, the remaining investment would be provided by the organisation(s) actually providing the infrastructure. There is no obstacle to providing such funding by a process of public tendering either to Telecom Eireann or to other organisations wishing to invest in the required new infrastructure.

The limited amount of Structural Funds implies choosing between infrastructure priorities. The question for the Irish Government is whether the extra economic and social benefits of advanced investment in broadband telecommunications infrastructure are greater than those attached to investments in other forms of infrastructure such as roads, rail or water developments. As noted above there is an in-built possibility of market failure to the delivery of broadband infrastructure investment if operators wait until customers begin to ask for service. It may be the case that diverting Structural Funds in certain circumstances could be justified from an economic and regional development perspective where it is expected that the market will fail to deliver the required investment for the provision of broadband services to enterprises. The reallocation of Structural Funds to broadband could also have significantly greater economic benefits than if a similar amount were to be reallocated to other more capital intensive projects.

3.4.3 Internal Sectoral Funding Through Industry Transfer Schemes

A third approach would be to induce a redirection of resources within the telecoms sector to broadband investment. Under this approach, no external funding would be made available. Instead, the State would seek to bias the price structure of the various telecoms services and the application of funds by operators through incentive and compulsory schemes. This is the approach that has generally been followed to

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satisfy policy objectives of universality of service. By mandating certain unfunded Universal Service Obligations (USOs) on telecoms operators individually or collectively without providing the corresponding funding, the State has in effect left the industry to devise its own compensatory taxation scheme.

An intra-industry transfer scheme may be more or less explicit, and may reflect varying degrees of regulatory involvement. Possible arrangements include:

- self-funding, with cross-subsidies;
- a formal broadband infrastructure support fund;
- inter-firm transfers implemented as an add-on to interconnect payments.

Self-Funding with Cross-Subsidies

Under this arrangement, operators would support broadband investments without external financial assistance, and there would be no direct transfers across firms. The Government would merely mandate certain levels of broadband investment on an operator-by-operator basis, which they would need to fulfil as part of their licence requirements. The transfer would occur across classes of customers, since operators would seek to pay for the cost of their mandates by raising prices on services not covered in their mandates. This approach would be the simplest, although not necessarily the most efficient, in a monopolistic environment. In a competitive environment, such an arrangement might result in very significant indirect transfers across firms, to the extent that:

- the mandates might have an unequal incidence on each operator;
- some operators might be in a better position to pass the cost of the mandates onto other categories of customers. In essence, operators with a more price-sensitive customer base would be most adversely affected.

Thus, such unfunded mandates would very likely alter the playing field among operators. A further negative side-effect would be that negotiations with the Regulator on other policy issues (retail prices, interconnect, etc.) would almost inevitably be linked to the cost of these mandates. Negotiating the cost of mandates would thus pervade all other discussions with the Regulator, and the result would be a much more complex dynamic of regulatory negotiations in all areas. Examples of how mandates have biased policy-making include:

- constraints on price rebalancing giving rise to Access Deficit Contributions²¹.
- Universal Service Obligations giving rise to complicated interconnect costing issues.

Setting up a Broadband Infrastructure Fund

Under this approach, operators each contribute to a fund which is then disbursed to broadband infrastructure providers according to certain pre-defined rules and criteria. One advantage is that issues of transparency, fairness and proportionality would need to be addressed explicitly. It would also allow greater flexibility in the choice of a cost-sharing formula, allowing the system to be more flexible in meeting future needs. It would probably result in a more transparent transfer scheme, making it easier to understand who is paying for what and how much it is costing. Despite this, such a scheme still creates a number of disincentives associated with the eligibility criteria and the common efficiencies associated with any tax, so that the total economic cost of the scheme cannot be readily ascertained. The principal disadvantage of this option is that it would create an institution - the fund - with its own administrative costs and, like all institutions, a tendency to become permanent and to broaden its scope.

²¹ Where line rental charges do not cover the cost of providing lines, incumbent operators have argued that, if a price gap prevents them from recovering access costs fully, the shortfall should be shared by all operators in a competitive market. Access Deficit Contributions (ADCs) were devised as a mechanism for recovering a part of the cost from competitive operators by the incumbent. As prices become re-balanced towards costs then ADSs become less of an issue.

Transfers Through Interconnect Payments

Under this system, intra-operator transfers are effected through the interconnect payment scheme: broadband infrastructure providers would add an amount onto their interconnect prices to cover their respective costs of broadband investments. This approach has the advantage of 'piggy-backing' onto an existing system of inter-operator interconnect payments, thus saving the administrative expense of establishing a separate fund. In this case, the 'tax base' for the scheme would be the volume of interconnect traffic. However, there is no obvious reason why the size of intra-firm transfers to support broadband need be related in any way to the volume of interconnect traffic. Moreover, this system would make the interconnect charging system less transparent and the regulatory role in negotiating or mediating interconnect agreements between operators that much more complex. For these reasons, such a mechanism would not be appropriate.

Evaluation of Internal Sectoral Funding

An internal industry transfer scheme to support broadband investment is not advisable, as the bottom-line effect under any of the schemes discussed above would be to burden basic telecoms services with the cost of providing more advanced ones. On efficiency grounds, basic telecoms services are so central to the operation of any business in its co-ordination with its customers, suppliers and its own operations that depriving businesses of the cheapest possible basic communications is not likely to further national productivity. On equity grounds, any such scheme represents a redistribution from the bulk of Ireland's production base to a relatively few telecoms-intensive businesses.

A second and perhaps more basic objection is that any internal transfer scheme will, by definition, dampen market signals on the requirements for broadband. These schemes must be based on certain mandates which clearly define the parties to the transfer. These mandates must specify not only how much infrastructure or service will be derived, but also, crucially, at what price. The policy objective, after all, would be to provide a certain level of service at an affordable price. Once in place, these schemes cannot be market-tested because their very existence is premised on displacing market signals. Given that broadband is barely at its inception phase in Ireland and internationally, it is particularly important that public policy displays awareness of market needs. The role of policy as regards new technologies and services ought to be to support market demands rather than to suppress market signals.

For these reasons, we would not favour supporting broadband investments through internal telecoms industry transfer schemes.

3.5 Requirement for Competitive Provision of Broadband Services

Considerable investment potential is available in Ireland in the form of the many organisations which are currently involved in the telecoms market, or which wish to be involved, but are forbidden from offering basic voice telephony services. If the Government wishes to encourage investment in broadband infrastructure from these organisations and to stimulate Telecom Eireann's efforts in this market, then it is important that the regulatory authorities in Ireland embrace infrastructure competition and award licences to provide infrastructure without delay.

A good start has been made in allowing Esat Telecom and TCL Telecom/Worldcom to build in parallel with their licence applications. Moreover, there has been a flurry of activity in the Irish telecoms market since infrastructure competition was introduced on 1 July 1997. Esat Telecom has begun building a fibre infrastructure in Dublin as has Worldcom. Two strategic alliances in the utilities area are also aimed at providing

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competitive telecommunications services. Esat and CIE have entered a joint venture arrangement to use railway lines for a new national phone network. The ESB and British Telecom have also entered a partnership arrangement to use the ESB infrastructure to lay down fibre optic communications network that would link up with business parks in major urban centres, the IFSC and major companies and give access to the global BT Consort services. The role of the Head of British Telecom in Northern Ireland has been expanded to include BT's operations throughout Ireland. Telenor Ireland have also been awarded a licence for the provision of Vsat satellite communications in Ireland. This satellite technology can support broadband applications and deliver bandwidth from 9.6kbit/s up to 35Mbit/s and is particularly suitable for enterprises in the regions.

These events demonstrate a pent-up interest among many organisations in building telecoms infrastructure in Ireland, which until now has been stifled by regulation.

In addition to competition in the provision of infrastructure within Ireland, it is important that there is adequate, reasonably priced communications infrastructure between Ireland and other countries. Telecom Eireann currently operates the submarine cables between Ireland and other countries. International connections are also available through Northern Ireland (both to BT and Cable & Wireless). Both Telecom Eireann and Esat Telecom have recently announced plans to build further submarine cables across the Irish Sea; Telecom Eireann will connect with Cable & Wireless Communications, while Esat has a UK international facilities licence which would allow it to control both ends of the cable.

The route between Ireland and the UK is one of the ten busiest international telecoms routes in the world. The announcement by Esat Telecom that it plans to invest IR£7.5 million constructing a new cable between Wexford and Land's End in the United Kingdom is a strong indication that this route is attractive for private investment in international infrastructure. It is important that nothing is done to deter investment of this kind. At the moment there seems to be little impediment to an organisation wishing to build its own international infrastructure. It is recommended that this situation should continue.

There is a considerable body of opinion in Ireland and in the European Commission that Telecom Eireann should be required to sell its stake in Cablelink (the cable TV provider in Dublin and other cities in Ireland), in order to stimulate infrastructure competition. Cable & Wireless Ireland has indicated in press announcements that Cablelink has become more attractive to it in the light of the formation of Cable & Wireless Communications. It is possible that Cablelink's network could be used as the basis of a broadband network covering the Dublin area. Any mandated sale of Cablelink should only go ahead if there are indications that a buyer would invest sufficiently in the network to ensure its suitability as a platform for basic and advanced telecoms services within a well-defined time period.

The introduction of infrastructure competition has a number of attractions:

- it is likely to stimulate Telecom Eireann into launching commercial broadband services offered over infrastructure which is currently only being used for R&D purposes;
- it will free spare capacity on existing infrastructure owned by organisations other than Telecom Eireann for use by business customers;
- it will allow organisations to provide their own infrastructure if they so choose and will in some cases make services available which would be uneconomic under the current regulatory regime.

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As part of the research for this study, Analysys and Forfas interviewed a number of organisations which are possible investors in telecoms infrastructure. These organisations were drawn from three main categories:

- organisations with infrastructure in Ireland which could be extended to offer services to external customers;
- organisations without infrastructure but with a presence in Ireland;
- organisations with infrastructure in other European countries.

The organisations were approached on a confidential basis so that they would talk freely on the subject of investment possibilities. The objective of the interviews was to determine the circumstances which would encourage these organisations to invest in infrastructure in Ireland.

A number of clear messages came out of the interviews:

- An absolute prerequisite to investment of any form is confidence that there is genuine competition in Irish telecoms. This view was given by every organisation interviewed as potential investors in Irish telecoms. Without this confidence none of the organisations interviewed would be willing to make any significant investment in telecoms infrastructure of any kind.
- There is a perception that the political climate in Ireland may not be welcoming to new organisations which enter the Irish market in competition with established organisations. The perceptions of the experiences of Esat Digifone and BUPA have reinforced this view.
- There is a perception of potential conflict for organisations such as CIE and ESB which own existing infrastructure, in that they are also under the control of the Department of Public Enterprise (which also has responsibility for Telecom Eireann). However, the collaboration between Esat Telecom and CIE indicates that this potential conflict is not realised.
- Financial and/or other incentives could help to stimulate investment. One operator considering investing in Ireland said that the case for investment in Ireland is not very clear; in instances such as this, incentives could tip the balance on an investment decision.
- If incentives are offered, the most attractive would be those which reduce operators' up-front investment costs. As a result, tax holidays and tax loss carry-forward schemes are less attractive, because the benefits accrue to the investor later in the process, once an operator is in operating profit.
- The monopoly on voice telecoms which Telecom Eireann will retain until the end of the decade is a considerable deterrent to investment. Any operator considering entry to the market will evaluate the opportunity on the basis of offering a range of services. The inability to offer basic voice services is a significant deterrent to investment in infrastructure.
- A satisfactory interconnect regime is essential for organisations considering entering the Irish telecoms market.
- A situation where one competitor is allowed to enter the market significantly earlier than the others could deter entry by those other competitors. For example, if Cablelink were separated from Telecom Eireann and allowed to compete with Telecom Eireann in advance of other operators, those operators might not regard Ireland as an attractive investment. It will be necessary to open the market to a wide number of competitive operators at once. Allowing a duopoly to exist for a period of time would deter further investors in a relatively small market such as Ireland.

3.6 Conclusions

Experience in other countries has shown that when alternative infrastructure provision is allowed, substantial private capital is expended on building new infrastructure to

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offer services to business customers. The most effective way to stimulate investment in broadband infrastructure in Ireland is therefore to ensure that infrastructure competition is not delayed or hindered in any way by any of the potential pitfalls mentioned in this report. Furthermore, liberalisation of basic voice telephony should also be considered in advance of the scheduled date of 1 January 2000, as this restriction is a significant deterrent to potential investors in telecoms infrastructure in Ireland.

Annex A. Table of Cost Assumptions

The following table lists the assumed capital and operations and maintenance costs of network components used in our model of a broadband network. For equipment the prices shown are the 1996 costs. These prices are assumed to fall at 10% per annum - reflecting price trends for new telecoms technologies.

| <i>Description</i> | <i>Capital cost (IR£)</i> | <i>Maintenance and operations cost (IR)</i> | <i>Unit capacity</i> |
|---|---------------------------|---|----------------------|
| ATM network termination | 8,000 | 240 | 1 connection |
| 34Mbit/s mux | 8,000 | 240 | 1 connection |
| STM-1 Tx mux | 50,000 | 1,500 | 4 connections |
| STM-4 Tx mux | 100,000 | 3,000 | 16 connections |
| ATM switch | 300,000 | 9,000 | 64 connections |
| Fibre without ducting or wireless access (per Km) | 5,000 | 150 | |
| Ducting (per Km) | 50,000 | 1,500 | |
| Repeater | 100,000 | 3,000 | 16 connections |
| Network management system | 5,000,000 | 400,000 | 1 per network |
| Billing system | 5 000,000 | 400,000 | 1 per network |

Annex B. Recommendations of the Information Society Steering Committee

Broadband for Enterprise and Residential Customers

Approach Broadband capacity at competitive cost should be deployed on a phased basis to satisfy the future demand for services from the enterprise and residential sectors.

Broadband Services for Enterprise

A three-phased programme for the provision of broadband services should be implemented for up to 20,000 enterprises by the year 2002.

Phase 1: Designated Broadband Service Areas

1. **Broadband in 22 high density enterprise areas**

The objective would be to provide guaranteed broadband services, competitively priced, in selected areas of high demand. The programme should include major industrial estates, business parks and areas with particularly high density of business. This initiative would provide international access, Internet access and interconnect services.

It would involve the installation of a multi-service broadband switch in each designated area. Services should include frame relay, ATM and SMDS at high bitrates, as well as ISDN-PRA. Enterprises would connect to the switch over short leased lines or their own fibre. Given the short link lengths required, leased line prices should be low.

The designated broadband service areas would be areas of high density of manufacturing or service sector activity. They should initially include eight in Dublin, four in Cork and two each in Athlone, Galway, Limerick, Waterford, and Sligo. The development agencies should play a role in defining the designated areas. The regulator should ensure availability of high capacity leased lines at competitive prices.

Estimates prepared for the Steering Committee indicate that the deployment programme would cost about IR£2.5 million for each designated area, at a total expected cost of IR£50 million, over two years, for the 22 proposed areas. Deployment should commence in mid-1997.

Phase 2: Fibre to Enterprise

2. **Build-up of fibre infrastructure**

The overall objective of this phase is to install as much fibre as is economically feasible, in locations as close as possible to the expected demand. The target is to achieve a build up of a fibre infrastructure. Roll-out should be to those enterprises or industry sites requiring capacity of 2Mbit/s or higher. As the location of these customers is predictable, reasonable penetration should be achieved by the year 2000. The fibre overlay network from exchanges to businesses should be planned in advance minimising

deployment costs. As the provision of infrastructure will be deregulated from 1997, the telecommunications regulator should create the environment which encourages the rapid deployment of fibre.

3. *Optical fibre to all new building and industrial estates*

Phase 3: Ongoing Deployment

As part of the ongoing upgrading of the existing network, optical fibre should be deployed to new buildings and industrial park developments. This phase, commencing immediately, would make a significant contribution to achieving a reasonable build-up of fibre by the year 2000. The net effect of this would be to connect up to 20,000 enterprises via optical fibre by the year 2002.

Broadband services for the home...

Broadband Services for Residential Customers

Two programmes for the provision of broadband services to residential customers are recommended. The regulator may find it appropriate to invite private investment through the mechanisation of public tender.

...through telephone wires...

Programme 1: ADSL²² Franchise

A public tender should be offered for the deployment of ADSL on a large scale using the existing network. The service would not interfere with the voice telephony service offered by Telecom Eireann, but would offer:

- fast Internet
- video on demand
- home shopping
- other ICT-based services from which revenue and profit could be generated.

Estimates prepared for the Steering Committee indicate that the programme would cost about IR£60 million over two years to set up, following which the expenditure will be mainly on the roll-out of ADSL modems and incremental expansion which would cost about IR£13 million to IR£19 million per year.

The total expenditure to achieve 400,000 houses connected is about IR£200 million.

...or through the cable network

Programme 2: Cable Modem Franchise

The deployment of cable modems, which would allow broadband access on Cablelink and smaller CATV networks, should be encouraged. The same services as listed above for ADSL could be offered.

The provision of a cable modem-based system should be put to public tender, covering the Cablelink part of the CATV network, if Cablelink does not wish to provide the service. It is likely that the provision of other services such as telephony and digital TV may be

²² Asymmetric Digital Subscriber Loop

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necessary to ensure a commercial return.

Deployment could take place in parallel with the provision of ADSL, providing some competition. Potential penetration would, however, be lower than ADSL.

Cable modems are expected to be slightly cheaper to implement than ADSL, though the initial set up costs may be similar. However, to initiate this programme, the existing cable network would have to be upgraded, at an estimated cost of about IR£120 million.

The costs for the deployment of cable modems were estimated for the Steering Committee at IR£47 million over two years followed by roll-out costs of IR£10 million to IR£16 million per year. The total cost to reach 400,000 customers is estimated at IR£275 million.

Planning this programme should commence immediately with initial deployment in 1997 at the latest.

TABLE B1: Estimated Expenditure on Broadband Deployment Programmes to Enterprise and Residential Customers (IR£ millions)

| | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | Total |
|------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|
| Enterprise : | | | | | | | | | | | | | | |
| Designated areas | 20 | 30 | | | | | | | | | | | | 50 |
| Fibre to business | | 30 | 30 | 30 | 30 | 30 | | | | | | | | 150 |
| Total enterprise expenditure | 20 | 60 | 30 | 30 | 30 | 30 | | | | | | | | |
| Small enterprise and residential : | | | | | | | | | | | | | | |
| ADSL franchise | | | 32 | 32 | 19 | 18 | 17 | 16 | 15 | 14 | 13 | 12 | 11 | 199 |
| and/or cable modem | 50 | 50 | 35 | 32 | 16 | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 275 |

[Source: Norcontel Telecommunications Consultants, 1996]

Annex C. Description of Economic Model Used

C1. Introduction

This section examines the linkage between advanced investments in broadband and Irish economic growth, employment, trade performance and investment. Although it concentrates on qualitative impacts, it also assesses these impacts within a quantified framework so that the relative scale and scope of possible impacts can be understood.

Few would question the firm-level benefits accruing from greater accessibility, affordability and functionality of information that would be derived from larger broadband investments. This position can be supported by a mass of anecdotal evidence, conventional wisdom and innovative business theories. Moreover, most observers would agree that sophisticated telecommunications has a positive impact on overall economic growth and trade. Indeed, intensive use of information is generally deemed to be one of the principal economic driving forces - if not an essential requirement for survival - in the competitive, services-orientated age.

Despite this consensus, the specific links which drive micro-macro interactions can at best be characterised as a tenuous thread. The intangibility of the micro-macro linkages manifests itself vividly in the well-known 'productivity paradox' - the apparent willingness to spend on telecoms and IT without there being significant measurable benefits in terms of higher productivity²³.

This chapter adopts a widely-used technique based on a simple multiplier-based model to produce estimates of the economic impact of broadband investments on the Irish economy. The results indicate that broadband telecoms will increase Irish GDP by IR£4 billion in the year 2010. The impact of extensive investment in broadband telecoms on the Irish economy is modelled by developing a scenario where such investments occur and contrasting it against a status quo scenario where the gap between advanced telecoms services in Ireland and those in competitor nations is not closed. Rapid deployment may generate some 35,000 net new jobs by the year 2010.

The macroeconomic model is driven by estimated multiplier effects and has been used to ensure that trade, investment, output, and employment figures are mutually consistent and plausible. However, because of the well-known limitations of such models, it has a limited predictive capacity for detailed quantification of the impact of broadband investments in the Irish economy.

C2. Modelling Approach

This section sets out the quantified framework for assessing the macroeconomic impacts of broadband investments which is consistent with the collective impacts of individual effects. We do not attempt to prove causalities, but make the case for individual positive and negative effects on a logical and reasoned basis, and calculate a set of coherent potential overall impacts. Our objective is to scope out the relative magnitudes of the various effects and show how they inter-relate. To do so, we have constructed a pragmatic model in which the collective impact of the various effects can be described in a straightforward and consistent fashion. These are expressed in a self-contained macroeconomic model based on identities and key multipliers. It is an ad-hoc model based on observed macro-behavioural relationships rather than on microeconomic first principles; as such, it does not pretend to capture the wealth of general equilibrium effects.

²³ This problem has been described in graphic terms: "How to measure and thus enhance, productivity in a business where it's hard to tell selling from schmoozing, research from woll-gathering and brainstorming from BS-ing?": (Davis, S.: "The Productivity Paradox," Institutional Investor, Vol. 27, No. 7, July 1993, pp. 86-94).

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We have constructed scenarios which encapsulate two possible evolutionary paths for the Irish economy to 2010 based on the level of broadband investments. These correspond to Irish telecoms closing the gap with telecoms in competitor countries and failing to close that gap. Both scenarios assume the same fundamental macroeconomic policy conditions within Ireland (e.g. monetary and fiscal policy stance) and the same outlook for the world economy.

The 'base case' for these macroeconomic conditions is a best guess of the likely evolution of the Irish economy to the year 2010 on the basis of widely-available forecasts, using IMF, World Bank, OECD and Eurostat sources as appropriate. Because of the linkages between the development of the telecoms sector and the macroeconomy, we have associated this economic base case with the scenario where Ireland closes the telecoms gap with competitor nations. We have correspondingly reduced the GDP projections for the scenario where the telecoms gap is not closed in accordance with the multiplier effects generated by this scenario's smaller telecoms sector.

The main micro-to-macro transmission links incorporated in the model are: investment, productivity (as captured by the output-labour ratio) and external trade. These links, which underpin the structure of the model, are shown in Exhibit C1.

EXHIBIT C1: Functional Representation of Macro Model

Changes in the outputs of the telecoms sector were used to drive the output of the macroeconomic model through the inter-linked capital investment, productivity and trade channels. Although this provides an assessment of the overall implications of the benefits of broadband investments, it should be noted that it is not possible to attribute GDP gains to these factors separately because they interact strongly, or are different manifestations of the same underlying dynamics, or simply affect the spending patterns of all users of telecoms, and hence tend to increase the purchasing power of most economic agents.

The model is constructed around three basic identities for aggregate internal demand, balance of payments and labour utilisation. The variables calculated residually from these equations are, respectively, domestic consumption, the capital account of the balance of payments (on the assumption of no accumulation of net international reserves) and unemployment. There is no monetary sector, and the impact of broadband communications on the government's fiscal balance is not modelled explicitly.

The key macroeconomic parameters that support the scenario simulation exercises are summarised in Exhibit D2. These multipliers are associated with the main arrows in the schematic representation of the model in Exhibit D1. Therefore, they constitute the basic driving equations of the model. As the multipliers are specified in elasticity terms, each multiplier specified in Exhibit D2 corresponds to a log-linear equation between the corresponding variables. The multipliers were set on the basis of multi-country statistical analyses, literature surveys and the requirements for consistency of internally-generated results.

These parameters are structural, in the sense that they are common to both scenarios. The differences between the scenarios are driven by differences in the value added, employment and capital expenditures of the telecoms sector under each scenario. In other words, we do not assume different behavioural relationships between scenarios. While it might be reasonable to posit that the level of investments in broadband could affect behavioural relationships, and in particular the magnitudes

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of the basic multipliers describing the main equations of the model, we opted for keeping these constant to make the results easier to interpret (in the sense of being able to trace differences in scenario results to particular modelling assumptions or equations). The interactions within the model and the justification for the main assumptions are described below in the context of the discussion of the results.

Exhibit C2: Key Parameters of Analysys' Macro Model

Output elasticities. 1% broadband investment-induced incremental growth in Irish GDP (relative to the base case) is associated with:

- (a) 0.53% growth in employment
- (b) 1.3% growth in indirect (i.e. non-telecoms) non-residential investment
- (c) 2.1% growth in exports
- (d) 1.6% growth in non-telecoms-sector external imports

Import content requirements. Every IR£100 of additional capital expenditure by telecoms operators requires IR£20 of imports.

Base case assumptions. Constant annual growth rates for the period 1995-2010 associated with the scenario where the telecoms gap is closed.:

- (a) 5.0% for GDP
- (b) 0.22% for population
- (c) 5.20% for exports
- (d) 5.70% for imports
- (e) 5.44% for non-residential investment

[Source: Analysys]

C3. Quantitative Scenario Results

Below we review the differences in the major macroeconomic aggregates (output, investment, employment and trade) under the three scenarios.

C3.1 Output

Information-induced micro-efficiency gains affect aggregate output by allowing the production of an expanded set of goods from a given level of resource inputs. Similarly, they affect aggregate employment by requiring fewer input resources to produce a given set of goods. The overall impact on aggregate output depends on whether and how the resources liberated by the higher productivity are redeployed in the economy. This is determined by the extent to which productivity gains and the corresponding lower production costs translate into lower output prices. If lower labour input requirements are not eroded through a corresponding rise in wages, aggregate demand could be affected in two ways:

- a. lower output prices increase international competitiveness, and hence tend to increase foreign demand through the trade balance

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- b. rising real wages as output prices fall should stimulate domestic demand, and in particular consumption.

The results indicate that competitive broadband investments may increase Irish GDP by 5% cumulatively by the year 2010

C3.2 Investment

Rolling out broadband communications generates a direct investment requirement on the part of telecoms operators. The indirect (non-telecoms sector) effects on aggregate investment depend crucially on the extent to which corporate spending on telecoms complements or substitutes for corporate capital spending.

- Complementarities would arise if investment in information and communications technologies (ICTs) induced technological advances, either through greater automation of production processes or through increasing technical sophistication of products and services offered. For example, information might induce greater product customisation which would result in the need for more sophisticated capital equipment.
- Companies might substitute access to cheaper and better information for capital investments if, by using communications, the same capital investment could be used for a wider range of tasks or if new comparative advantages were created in activities which did not require such high levels of capital investment. Cronin²⁴ documents econometrically strong substitution possibilities between capital investment and spending on telecoms services at the sectoral level, especially for non-manufacturing segments of the US economy. However, we note that substitution possibilities at the sectoral level need not result in substitution at the aggregate level because of induced relative price changes.

Incremental investment effects (i.e. total change in investment less direct investment by telecoms operators) are estimated to be positive, with each IR£1 invested in broadband services resulting in as much as IR£7 of additional economy-wide investments. Accordingly, total non-residential investment as a proportion of GDP rises from 11.4% to 12.4% if Ireland has competitive telecoms.

The incremental investment and GDP growth between the two scenarios imply output-investment multipliers rising from 2.1 to 2.8 if investment in Irish telecoms closes the gap with competitor nations. This is at the higher end of the range of telecoms investment multipliers estimated for Ireland from NERA²⁵ (2.7 to 4.4) and for six rural areas of the EU²⁶ from Telecommunications Policy (2.2 to 5.2). It is also higher than the estimated multiplier of 2.5 for the West German economy²⁷ in 1980, the 1.5 estimated for the European economy in the early 1980s²⁸, and the 1.3 estimated in 1983 for the case of France Telecom²⁹. These prior estimates of the investment multiplier suggest that the multiplier has been increasing through time, a position which would seem to be supported by several arguments:

²⁴ Cronin F., Gold, M Herbert, P., and Lewitsky, S: "Factor prices, Factor Substitution, and the Relative Demand for Telecommunications across US industries," *Information Economics and Policy*, Vol. 5, 1993, pp. 73-85.

²⁵ National Economics Research Associates (NERA): *Telecommunications Infrastructure, Productivity, and Economic Development*, Report for the US Telephone Association, April 1990.

²⁶ Hansen, S., Cleevly D., Wadsworth, S., Bailey, H. and Bakewell, O.: "Telecommunications in Rural Europe: Economic Implications," *Telecommunications Policy*, June 1990

²⁷ DIW: *Economic Evaluation of the Impact of Telecommunications Investment in the Communities*, Report prepared for the Commission of the European Communities, 1984.

²⁸ Sicrana, R., and de Bonis, R.: "The Multiplier Effects of Telecommunications Investments on Economic Growth and Restructuring," paper presented at the ITU Europa Telecom 92 Conference, Geneva, 1992.

²⁹ Reported in Gensollen, M., and Laubie, A.: "The Role of Telecommunications in Economic Development," *Annales des Telecommunications*, Vol. 50, No. 2, 1995, pp.315-324.

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- Telecoms and IT have become more central to many economic processes and have played an increasingly crucial role in realising benefits from other investments. This should translate into greater 'leveraging' of investments at the aggregate level and hence high multiplier values.
- Investment in new kinds of communications and IT take a while to pay off because of the time taken to learn how to fully exploit new technology. It could be argued that European economies are only now in a position to reap more benefits from telecoms and IT investments compared to a decade ago when such investments were just taking off (by current standards). The full benefits of telecoms advances may take up to 15 years to be realised³⁰. Such inherent lags in the manifestation of benefits from increased capital and telecoms intensity would result in low estimates of multipliers during the early stages of such a process.

Another reason for our higher estimate for the input-investment multiplier is that we are considering a much longer time frame, thereby allowing more time for induced secondary effects to unfold.

C3.3 Employment

Employment is forecast to be about 35,000 jobs if Ireland has competitive telecoms infrastructure. This is consistent with the forecasts from the other model focusing on manufacturing and internationally traded services which forecasts an increase in employment of 25,000 in 2010 with competitive telecoms. Most of these jobs are likely to be in the corporate IT sector, financial services, and related sectors as well as call centres.

In this model we posit only a modest input substitutability between telecoms services and labour. This is in line with the wealth of empirical studies that have been triggered by what has become the 'productivity paradox'³¹. Increased reliance on telecoms usage as an input in production probably induces a significant change in firms' skills mix, but it does not seem to have a significant effect on overall employment levels. It is commonly held that telecoms services might substitute for blue collar jobs due to plant-level co-ordination efficiencies, but this is significantly off-set by an expansion in the white collar, information-based jobs which are needed to manage the increasingly sophisticated information processes. This latter effect is supported by the accompanying increase in importance of services and customer service. Several empirical studies have documented a low or negligible value for the substitutability between telecoms services and labour³².

However, we believe that investment in telecoms and IT and increased usage will result in productivity gains in the future. There will be increasing productivity gains from greater and more efficient utilisation of information because in the coming years the economy will be in a better position to reap the efficiencies not only from the incremental investments in telecoms and IT forecast here but also from past investments. The European economies have only just begun to reap the benefits of a long learning process which will enable them to take much better advantage of telecoms and IT (as discussed above). Accordingly, in the quantitative scenarios, labour productivity in the Irish economy (as measured by the aggregate value added per employee) increases with rapid broadband deployment. For the year 2010, average labour productivity is to be IR£1250 higher with competitive telecoms investment than would otherwise be the case.

³⁰ This proposition is stated in Cronin, F., Collieran, E., Herbert, P., and Lewitsky, S.: "Telecommunications and Growth: The Contribution of Telecommunications Infrastructure Investment to Aggregate and Sectoral Productivity," *Telecommunications Policy*, December 1993, pp. 677-690.

³¹ For a discussion of possible reasons, see Brynjolfsson, E.: "The Productivity Paradox of Information Technology," *Communications of the ACM*, Vol. 36 No. 12, December 1993, pp 67-75.

³² An example is Cronin, F., Gold, M., Burnham Mace, B., and Sigalos, J.: "Telecommunications and Cost Savings in Educational Services," *Information Economics and Policy*, No. 6, 1994 pp. 53-75.

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Productivity effects can be broken down into labour productivity gains resulting from the additional capital investments discussed above, and total factor productivity gains from informational benefits that cannot be attributed to specific factors of production. Whether these productivity gains translate into enhanced competitiveness depends on the extent to which they are dissipated into higher remuneration to the factors of production, namely labour. We assume a labour demand elasticity of output of 53%. The lower growth rate in employment than in GDP is a result of rising wages and the substitution of capital for labour rather than by a substitution of telecoms services for labour. This is consistent with the relatively high output-investment multiplier discussed above.

C3.4 Trade

Trade has always rested on the flow of information, and the creation of our current global trading system has depended on the development of an effective global communications infrastructure. Accordingly, better access to better communications should enhance Ireland's ability to tap foreign markets as well as to liberate some productive resources through imports. The increased tradability of goods and services assumed in the model results from three factors:

- the removal of geographical constraints on production
- the revealed competitiveness of activity as a result of productivity gains
- the direct effect on trade in communications equipment.

In both scenarios, trade forms an important component of GDP, with the increase in exports being estimated at 168% of the growth in GDP. Note that this marginal rate is higher than the average values for exports and GDP. Ireland's external trade balance registers a modest deterioration in currency terms - largely due to the import requirements to support TOs' incremental capital expenditures - but remains unchanged in relation to GDP.

Annex D. Description of the Singapore ONE Programme

D1. What is Singapore ONE?

Singapore's IT2000 Master-plan seeks to transform Singapore into an intelligent island by the turn of the century where information technology will be present in every aspect of Singapore society - at work, home and play. The objective of the IT2000 Master-plan is to improve the quality of life by the extensive use of information technology.

As part of the IT2000 Master-plan, a high performance broadband national information infrastructure will form the foundation of this intelligent island and play a central role in delivering applications and services to every sector of society.

Singapore ONE is the national high-capacity multimedia broadband network platform that will deliver a potentially limitless range of multimedia services to the workplace, schools and homes under the IT2000 Master-plan.

At the signing ceremony for Singapore ONE on 23 September 1996, Mr Teo Ming Kian, the chairman of the Telecommunications Authority of Singapore (TAS), said that an "initial roll-out of broadband multimedia services direct to homes, businesses and schools" will be made before the end of 1997 and that tariffs for using Singapore ONE will be made "highly affordable", to encourage a proliferation of services to the public.

Singapore ONE consists of two closely related parts:

- the physical network infrastructure component with cables, switches and terminal equipment
- the applications and multimedia services component.

D2. Infrastructure

The network infrastructure will be in the form of a nationwide core multimedia broadband network and several Local Access Networks (LANs) that will reach homes and businesses. The core network will have open access interfaces for connection to the various service providers and the LANs. The LANs may be based on various technologies, such as hybrid fibre coaxial cable and asymmetric digital subscriber loop (ADSL).

At present, Singapore Telecom (SingTel) and Singapore CableVision (SCV) have extensive LANs which can be used for the delivery of multimedia services. In future, it is envisaged that advanced technologies such as fibre-to-the-home or broadband wireless may become available as access networks.

D3. Applications and Services

Four important areas of applications and services will be emphasised in Singapore ONE. These are its use in government, in education, at home and for business.

Government

Singapore ONE will enable the public to deal with government officers and carry out government transactions, such as paying bills, renewing licences and applying for public housing, through the use of interactive technology. For example, services are to include:

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- multi-functional interactive kiosks
- one-stop government centres with videoconferencing facilities.

Education

Singapore ONE will support:

- distance-learning through virtual classrooms
- easy access to multimedia learning materials
- multi-party collaboration by students at different locations

Home

Potential applications for the home include:

- high-speed Internet access
- LAN emulation for telecommuting
- electronic shopping malls
- multimedia information services
- entertainment on demand
- home banking.

Business

Singapore ONE will provide new and improved channels for trade. Potential business applications include:

- electronic commerce
- multimedia information services for corporations
- telecommuting
- videoconferencing.

D4. Implementation

Plans for Singapore ONE were announced by the Minister of Communications in June 1996. The Singapore ONE project will be implemented in two phases:

Phase I

Phase I will take place between 1996 and 2001. It will consist of the establishment of a pilot core broadband network, which will consist of several broadband ATM switches linked to homes, public places and businesses by way of LANs.

By 1997, the following are to be available on the pilot Singapore ONE network:

- access to school curriculum materials from homes
- access to digital libraries from homes
- high-speed Internet access from homes
- commercial services for homes
- virtual government services in public sites, each offering several services.

The pilot run is likely to involve a few thousand Singaporeans. Details of the pilot scheme are currently being worked out.

Phase II

Phase II should take place between 1999 and 2004, during which period the network is expected to grow in capacity and coverage, and more applications and services will be developed. It is likely that costs will decline over the years, which will result in home connections being upgraded to fibre or other advanced technologies to allow

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users at home to take advantage of the high bandwidth of Singapore ONE. In phase II, the government will play a key role in strengthening collaboration between the public and private sectors in developing the network further. Major industry players will be encouraged to participate actively in the construction and use of Singapore ONE and the private sector is expected to take the lead and become the main driving force for the further development of the network.

D5. Key Players in Singapore ONE

Government agencies

The Singapore government is spearheading the development of Singapore ONE by funding part of the initial investment and operating costs of the physical network.

The three government agencies involved in Singapore ONE are TAS, the National Computer Board (NCB) and the National Science and Technology Board (NSTB):

- TAS will be driving the development of the infrastructure with the participation of major Singapore network providers such as SCV and SingTel as well as providing the policy framework for the project
- NCB will drive the development of applications in collaboration with various government ministries, statutory boards and private agencies
- Research and development institutions funded by the NSTB such as the Institute of System Science and the Information Technology Institute will provide the technical expertise in network and advanced multimedia applications developments.

TAS' role

TAS, SCV and SingTel will invest S\$20 million in total over the next two years to build Singapore ONE. SCV and SingTel will each take a 30% stake in the project. TAS' wholly-owned subsidiary, Singapore Communication Investments, will hold the remaining 40%³³.

Singapore ONE has been earmarked as an infrastructure provider from 1 April 2000 when Singapore's basic domestic and international telephone markets will open up to competition with the end of SingTel's monopoly over basic telecommunications services. This would mean TAS would, through Singapore ONE, have to compete with other network providers such as SingTel to lease parts of its network to new telephone operators. Industry players have expressed concern that this may undermine TAS's role as industry regulator³³.

In response, TAS has said that it will retain its 40% stake in the consortium as long as it is necessary to nurture development in the broadband industry. However, once the Singapore ONE project takes off, TAS has indicated that it will divest most if not all of its 40% stake to avoid compromising its role as industry regulator. TAS has said that after 2000, if Singapore ONE is successful, new operators or even SingTel may decide to put in their own broadband networks and that as part of the Singapore ONE initiative, all these networks would be integrated as one network³³.

D6. Participation and Incentives for Singapore ONE

Industry players are viewed as vital in providing content, services and technology which can be used for Singapore ONE. Financial and tax incentive schemes are available to attract industry players to participate in Singapore ONE³³.

To encourage early participation, TAS has said that a "Pioneers Club" has been formed to bring on board early innovative applications and content providers using

³³ The Straits Times, 24 September 1996

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Singapore ONE as a roll-out platform. Members of this club are to enjoy benefits such as preferential rates for broadband usage and access to other firms and users of Singapore ONE.¹⁵

Tax incentive schemes for Singapore ONE applicable to Singapore companies, both foreign and locally owned, include:

- **Pioneer Status Incentive.** This incentive provides for the exemption of corporate tax on profits arising from pioneer activities for 5-10 years.
- **Investment Allowance.** This incentive provides for tax exemption of income equivalent to a specified percentage (up to 50%) of a new fixed capital expenditure incurred for qualifying activities within a period of up to five years.
- **Double Deduction for Expenditure on R&D for Services Project.** This incentive provides for double deduction of qualifying R&D expenses incurred for a specified period on an approved R&D project against the company's income.

Other financial incentive schemes include:

- **Broadband R&D Grant.** This grant provides up to 80% funding or a maximum of S\$400,000 for each project relating to the development of broadband products and services.
- **Initiatives in New Technology Scheme.** This scheme is designed to encourage manpower development in the application of new technologies and provides grants to defray the costs of training.
- **Innovation Development Scheme for Information Technology.** This scheme is designed to encourage developments in the innovation of products, processes, applications and services and provides grants to cover qualifying costs; and
- **IT Cluster Development Fund.** This fund was developed to encourage the development of IT2000 flagship projects and to nurture the new information technology industry.

D7. Electronic commerce

Clearly, many of the objectives to be achieved under the Singapore ONE project will require secure systems of identification, communications, fund transfers, payments and electronic banking.

NCB has launched an electronic commerce hotbed (ECH) programme to address the main challenges facing the deployment of electronic commerce applications. The ECH programme has been designed to:

- provide a common framework for addressing technical, social economic, legal and regulatory issues
- develop a common set of electronic commerce standards and evolve an effective infrastructure
- accelerate the deployment of an initial test-bed of electronic commerce
- provide a match between application developers, technology suppliers and infrastructure providers.

The ECH programme pilot trial period will be from October 1996 to June 1997.

Given the commitment of the Singapore government to the success of Singapore ONE, issues relating to secure electronic commerce may be addressed and resolved in Singapore ahead of most countries in the world.

D8. Conclusion

Singapore ONE will be a major milestone for Singapore in achieving the IT2000 Master-plan and developing its national information infrastructure.

Baker & McKenzie, Singapore

Wong & Leow

October 1996

Glossary

| | |
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| ADSL | Asymmetric Digital Subscriber Loop: a digital communications technology which allows broadband communications over conventional copper telephone lines. |
| ATM | Asynchronous Transfer Mode: a broadband switching technology which allows voice, data, audio, video and other kinds of telecoms traffic to be carried on the same network. |
| Bandwidth | (Also known as "capacity") In simple terms, how much information or traffic can be carried on the telecoms infrastructure in a given amount of time. The simple rule is that the greater the bandwidth, the greater the opportunities for commerce. As a specific example: with low bandwidth, transferring the contents of a music CD via the Internet is not feasible; with higher bandwidth, it is entirely feasible. |
| Browser | A program used to access the World Wide Web. |
| Bit | A contraction of the term "binary digit;" a unit of information represented by a zero or one. The speed of information transmission is measured in bits per second. |
| CAD | Computer Aided Design: using computers to aid the design and drafting process. |
| CAD/CAM | Computer Aided Design/ Computer Aided Manufacture: integrating CAD information in the manufacturing process. |
| CATV | Community Antenna TV: a type of cable TV system; shorthand for all cable systems. |
| CD-ROM | Compact Disc with Read Only Memory; compatible with computers, compact discs are inexpensive, high-capacity storage devices for data, text and video. |
| Convergence | The "coming together" of formerly distinct technologies, industries or activities; the most common usage refers to the convergence of computing, communications and broadcasting technologies. |
| Digital | Information expressed in binary patterns of ones and zeros. |
| DTT | Digital Terrestrial Television: digital television broadcast from ground- based antennae. |

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| EC | European Commission. |
| EDI | Electronic Data Interchange: allows information in agreed formats to be exchanged between organisations. |
| Electronic Commerce | Consumer and business transactions conducted over a network, using computers and telecommunications. |
| EU | European Union |
| Fiber Optic | A modern transmission technology using lasers to produce a beam of light that can be modulated to carry large amounts of information through fine glass or acrylic fibres. |
| ICT | Information and Communication Technology. |
| Internet | A vast international network of networks that enables computers of all kinds to share services and communicate directly. |
| Internet Service Providers (ISPs) | Organizations which provide individuals and businesses with access to the Internet. (including commercial web sites). ISPs may be wholesalers or retailers or both. A wholesaler normally resells bandwidth and certain other services to smaller ISPs who act as retailers. The most significant component of the sale price is the amount of bandwidth purchased. |
| ISDN | Integrated Services Digital Network: the telephony standard which allows end-to-end digital telephony. |
| ISDN-PRA | ISDN Primary-Rate Access: ISDN where 30 64kbit/s channels are accommodated on a 2Mbit/s line. |
| LAN | Local Area Network: a network which allows the sharing of computer information within a building or business site. |
| MAN | Metropolitan Area Network: a high-speed digital network which allows the sharing of voice and data communications over a relatively large area, within a city. |
| MMDS | Multi-channel Microwave Distribution System: an analogue broadcasting medium which allows distribution of a number of analogue television channels (typically ten). Used to provide 'cable television' in areas where cable-laying is not viable. |
| Modem | A contraction of "mo(dulator)" and "dem(odulator)," an accessory that allows computers and terminal equipment to communicate |

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through telephone lines or cable; it converts analog data into the digital language of computers.

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|-----------------------|--|
| ONP | Open Network Provision: a European Commission policy initiative to provide open access to the networks of dominant TOs. |
| PoP | Point of Presence: a point at which one network operator can hand traffic onto the network of another. |
| Protocol | A standard procedure for regulating data transmission between computers. |
| PSTN | Public Switched Telephone Network: the basic telephony standard for voice communications. |
| RBOC | Regional Bell Operating Company (USA): local telephone companies in the USA, formed when AT&T was split into AT&T (the long distance carrier) and seven local telephone companies (including Bell Atlantic, US West and Nynex). |
| SMDS | Switched Multimegabit Data Service: high-speed switched data service. |
| TO | Telecommunications Operator: term used to describe both a national monopoly supplier of public telecoms services and infrastructure, and a private company operating public telecoms services and infrastructure, nationally or locally, either as a concessionary monopoly or in competition with others. |
| USO | Universal Service Obligation: the obligation placed on one or more telecoms companies to provide telecommunications services to customers in areas where providing service is not economic or to customers which are not economic. |
| Vsat | Very Small Aperture Terminals: Suitable for point-to-multipoint applications such as transmission of voice and data from head office to branch office providing bandwidth from 9.6 Kbit/s up to 35 Mbit/s. |
| World Wide Web | The graphical, hypertext interface to information on the Internet, Web, or WWW. |