Ireland's Broadband Performance and Policy Actions

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Forfás

Table of Contents

Executive Summary

The availability of high quality broadband is strategically important to exploiting the potential for e-business, improving the productivity of the Irish workforce, facilitating innovation and job creation, improving our status as an attractive location for foreign direct investment and enabling Irish firms to compete in international markets. This report focuses on the key indicators of Ireland's current broadband performance, highlights Ireland's position regarding the development of next generation networks (NGNs) and recommends a number of policy actions that are required to underpin a true knowledge economy.

Current Broadband Performance

Coverage and Take-up:

Ireland has made significant progress in the last two years in terms of the availability of current generation or basic broadband services. Specifically:

- Broadband connections now account for 90 percent of internet connections, compared to 58 percent in Q1 2007, which represents a significant transition from dial-up;
- Since the beginning of 2008, much of the growth has been driven by mobile broadband access, which has increased rapidly to account for 30 percent of broadband connections in Q3 2009; and
- Coverage and take-up rates are converging to the OECD average. Ireland has 21.4 subscribers per 100 inhabitants compared to the OECD average of 22.4 (excluding mobile broadband as defined by the OECD for international comparisons)[1]. However, further progress is required if Ireland is to converge with the leading countries such as the Netherlands (38.1) and Denmark (37).

Quality and Price:

The speed and cost of offerings available in Ireland have improved in recent years. DSL business services of up to 12 Megabits per second (Mb/s) are now available in many key urban centres and up to 24 Mb/s in parts of the main Irish cities. Cable services of up to 20 Mb/s are becoming available to residential users in the main cities. However, the download speeds available in Ireland, while greatly improved in recent years, remain substantially below the fastest speeds available to customers in other OECD countries. In Ireland 5 percent of broadband connections are above 10Mb/s – a much lower proportion than leading EU countries such as Portugal (47 percent), Belgium (45 percent) or Sweden (34.5 percent). In greater detail:

- The fastest DSL connection available to **businesses** in Ireland is 24 Mb/s. While this speed is comparable with many EU countries, this service is only available in a very limited number of locations in Irish cities. 12 Mb/s connections are more widely available for businesses in Ireland which means the speeds available to businesses in large parts of the country compare relatively poorly to that available in other countries. Businesses in many other countries can also procure significantly faster

1 The latest data for Ireland shows that the broadband penetration rate is 29.7 if mobile broadband is included.

services for the prices charged in Ireland, particularly those subscribing to the 12 Mb/s service;

- A leased line is a private symmetric telecommunications line connecting two locations – typically used by large companies. The cost of a 34 Mb leased line in Ireland is similar to the EU average but it exceeds leading countries by a considerable margin[2];
- In terms of **residential** connections, Ireland compares very poorly with leading countries in terms of the fastest speed broadly available which is 20.48 Mb/s at a cost of €423 per annum excluding VAT. This speed will become available to approximately 35 percent of Irish households - predominantly in cities - when the upgrade of the cable network is complete in 2010. Much faster speeds are available in many other European countries at a comparable cost – for example France, Sweden, Denmark, UK and Germany. The EU-15 average is a connection speed of 50.8 Mb/s at an annual cost of €430. In South Korea, France, Sweden, Finland and the Netherlands some residential customers can avail of speeds of over 100 Mb/s – though take-up rates vary considerably between countries; and
- The incumbent's fastest speed to residential customers represents the most widely available service to households. In Ireland, the incumbent operator offers a 7.68 Mb/s service to residential customers at an annual cost of €488. The service compares poorly with the EU-15 average in terms of speed (15 Mb/s) and price (€352).

While progress is being made in improving the cost and availability of basic broadband, Ireland is lagging at least 3 to 5 years behind competitor countries in terms of rolling out infrastructure capable of high speed next generation broadband.

- In Ireland only 0.6 percent of total broadband connections are fibre connections. This compares to 11.3 percent of subscribers in OECD-28 countries currently accessing the internet over fibre connections[3], 21 percent in Sweden, 46 percent in South Korea and 51 percent in Japan. Fibre to the home connections (FTTH) are increasing rapidly in a number of central European countries including Latvia (26.7 percent of fixed broadband connections are FTTH), Estonia (20.6 percent) and Slovenia (10.5 percent)[4]. Fibre connections are also growing fast in Denmark, Norway, the Slovak Republic, Hungary and the United States.
- Ireland remains behind leading regions in terms of upgrading the local access network to fibre and in offering very fast connection speeds over fibre and faces a significant challenge to upgrade the access network in particular to support next generation broadband. Ireland's key weakness is the lack of deployment of fibre in upgrading the existing copper network to an optical fibre network, namely fibre to the street level/cabinet (FTTC) and fibre to the home/premises (FTTH).

2 The annual cost in Ireland is €44,111, excluding VAT, which compares with the EU-12 average of €45,960. However, Ireland remains significantly more expensive than leading countries such as Germany where a comparable service costs €16,310.

3 OECD minus Mexico and Turkey. The OECD data includes fibre-to-the-home (FttH) and fibre-to-the-building (Ftth or apartment LAN) connections.

4 European Commission Working Document: Broadband access in the EU 1 July 2009.

Immediate Policy Requirements

Many telecommunications companies and States around the world are investing in next-generation networks that can cater for the bandwidth needs of industries in the future. Greater investment in telecommunications infrastructure, particularly in key enterprise and population centres, is essential if Ireland is to converge towards leading OECD countries in terms of high quality broadband availability. UPC is investing in the cable infrastructure in the main cities, wireless operators are rolling out higher speed services and Eircom is undertaking pilots of next generation access (NGA) technologies and architecture solutions. Eircom is also completing a major upgrade of its core network to NGN, as have a number of other operators. The State is also investing in the provision of basic broadband access in rural areas. Notwithstanding the progress on current generation broadband, and Eircom's and other operators' development of advanced fibre-based next generation core networks, ComReg note that we **'***have barely begun to see the deployment of next generation broadband access networks' in Ireland***.'**[5]

Forfás is concerned about the slow progress in developing the next generation of broadband networks necessary to support bandwidth-intense applications and services which are becoming increasingly available to consumers and businesses in other countries. Driving next generation connectivity is a key enterprise policy priority.

In the immediate term, the following measures are necessary to support the development of the market. Policy options are set out under two broad headings:

1. Actions to Facilitate the Necessary Investment by Private Telecommunications Operators:

- **Ensure an appropriate return on investment for private telecommunications operators to incentivise investment in** next generation networks**:** Investments in next generation networks require access to significant funds and entail risks for investors due to the high upfront cost of building the network. It is critical that there are adequate financial incentives to make these investments. Given the need to support further investment in the access network, potential may exist to review allowable rates of return in order to spur additional investment where risks associated with next generation investment are clearly identified. The impact on competitors and retail prices would also need to be assessed carefully;
- **Examine the potential for infrastructure sharing between telecommunication operators in an Irish context:** Draft European Commission regulations on next generation access networks indicate that national regulators will have scope to explore the feasibility of co-investment models where the high cost of civil construction works is shared among a number of operators, but each operates its own network and defines its own services and prices. Subject to the market being deemed competitive, regulation could be lightened or removed. In Ireland co-investment would represent a paradigm shift, not just for incumbents, but for alternative operators seeking access to the incumbent's network;

5 ComReg, 2009, Next Generation Broadband in Ireland - Promoting the timely and efficient development of high speed broadband infrastructure and services, July 2009.

- **Enable wireless spectrum to play a strong role in the delivery of higher-speed broadband:** Wireless spectrum policy is crucial for both fixed wireless and mobile services. The release of valuable spectrum due to the 'digital dividend' is contingent on a successful transition to digital terrestrial television and analogue switch-off. Despite current uncertainties about the commercial element of the digital terrestrial television service it is vital to ensure that the analogue switch-off date of 2012 is met and that valuable spectrum becomes available for broadband provision;
- **Ensure wholesale access to a range of advanced products:** It is important that ComReg and industry operators make progress in ensuring that a suitable range of wholesale products which are fit for purpose are made available by Eircom, including local loop unbundling and ethernet products;

2. Utilising Existing State Investment and Regulations:

- **Facilitate access to public ducting and other infrastructure for fibre deployment:** The Department of Communications, Energy and Natural Resources (DCENR) has committed to a "one-stop shop" for State broadband infrastructure to provide broadband operators with integrated access to State-owned infrastructure. DCENR is establishing an Implementation task force to oversee the project which entails a range of commercial, technical and legal complexities. Forfás is highly supportive of the completion of this initiative which should be progressed swiftly;
- **Require the provision of ducting in new developments:** The commitment in the DCENR policy paper on NGNs to mandate ducting in all new premises is a positive development and one that needs to be progressed as quickly as possible;
- **Mainstream broadband infrastructure into State investment plans:** The mandatory provision of ducting as part of all State infrastructure development programmes, such as roads and rail, water network upgrades, sewage and 'smart' electricity metering programmes, would support the development of an open access network. Changes in the planning regulations should be introduced to compel the inclusion of ducting in all relevant public works;
- **Extend two of the State's metropolitan area networks** (MANs) to meet existing enterprise needs by linking existing MANs to key IDA industrial sites in Cork and Waterford;
- **Build additional MANs** in a small number of outstanding National Spatial Strategy centres (Tuam, Castlebar, Ennis, Shannon, and Mallow) can support the availability of advanced broadband services in key urban centres; and
- **Reduce the costs of building access networks:** Civil construction works typically represent up to 80 percent of the total rollout costs of access networks. While the sharp downturn in the economy is likely to have lowered rollout costs, there are a number of planning issues which should be reviewed with a view to minimising the cost of network roll-out. For example, planning rules have made it increasingly difficult for operators to use overhead networks, rather than underground wires. Fees to local authorities and fragmentation between local authorities in terms of different charges and administrative processes for receiving permission to dig makes it more difficult for operators to invest in upgrading their access networks. These fees and processes need to be harmonised.

Conclusions

The Department of Communications, Energy, and Natural Resource's policy framework sets a vision for Ireland's broadband speeds to equal or exceed those in comparator EU regions by 2012. Forfás agrees that Ireland needs to be among the leaders in Europe in the provision of advanced telecommunications infrastructure, access and services by 2012. As illustrated in the benchmarks assessed, broadband speeds available are currently higher in other countries and take-up of fibre based access is growing rapidly. The actions taken to date and the investments being made currently are necessary but are not sufficient to achieve a leadership position.

Unless a way to stimulate additional private investment in next generation broadband networks is found, particularly in terms of access networks or the State makes the necessary investments itself or in partnership with the private sector, Ireland risks allowing a competitiveness threat for Irish firms to open up as significantly faster speeds become widespread in other countries.

A number of countries have determined that fibre connections are critical to developing a digital economy and are committed to strong public intervention to ensure this utility becomes widely available in a timely and cost competitive fashion, and in some cases are investing directly in the market. Forfás, in consultation with stakeholders, will assess the options for Ireland in this regard, so as to ensure that access to next generation networks will be delivered within a timescale that will allow Ireland to catch up with other countries and to harness the potential of advanced broadband for economic growth and jobs.

1. Ireland's Broadband Performance

1.1 Introduction: Broadband and Competitiveness

The availability of high quality broadband is strategically important to exploiting the potential for ecommerce, improving the productivity of the Irish workforce, facilitating innovation and job creation, improving our status as an attractive location for FDI and enabling Irish firms to compete in international markets. This report focuses on the key indicators of Ireland's current broadband performance, highlights Ireland's position regarding the development of Next Generation Networks (NGNs) and recommends a number of policy actions to underpin a true knowledge economy.

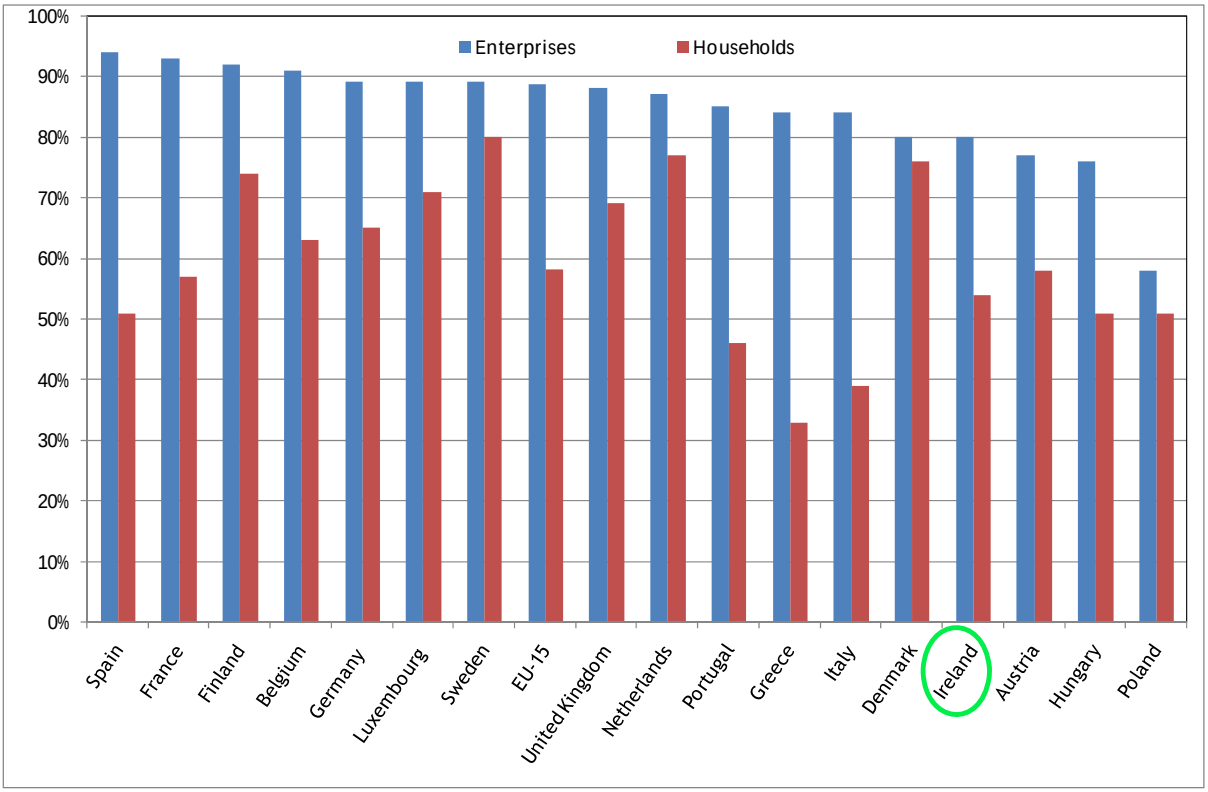
The telecommunications market is increasingly characterised by more widespread connectivity, mobile access for consumers, real-time information and media-rich content. **Internet usage by Irish citizens is similar to that for the EU-27 average**: 57 percent of the population uses the internet on a regular basis and 39 percent are frequent users which compares with the EU-27 average of 43 percent for frequent use[6]. The proportion of Irish people who have never used the internet is 32 percent. This cohort has been declining rapidly since 2005 and is now in line with the EU average.

1.2 Broadband Take-Up

There has been significant progress in the last two years in Ireland's performance in terms of availability of current generation or basic broadband services and increased take up by firms and households. In Q3 2009 there were 1.52 million active internet subscriptions in Ireland of which 1.36 million were broadband subscribers in Ireland. Broadband connections now account for 90 percent of internet connections, compared to 58 percent in Q1 2007 which represents a significant improvement in migrating people from dial-up internet connections to broadband.

6 Frequent users are defined as using the internet daily or almost every day. Regular users use the internet at least once a week. European Commission, Information Society, Annual Report 2009. Available at:
http://ec.europa.eu/information_society/eeurope/i2010/docs/annual_report/2009/sec_2009_1060_vol_2.pdf

Figure 1: Percentage of Enterprises and Households with Broadband, 2009



Source: Eurostat, Information Society Indicators

Ranking: Ireland 11th out of EU-15 for enterprises and households:

Figure 1 highlights that:

- 80 percent of enterprises and 54 percent of households in Ireland have broadband connections.
- Broadband penetration across firms in Ireland is lower than the EU-15 average, particularly among smaller firms.
- While Ireland's household penetration rate has improved since 2008, Ireland remains significantly behind leading countries such as Sweden (80 percent) and Netherlands (77 percent) and indeed the UK (69 percent) in terms of households with broadband access.

Figure 2: Irish Broadband Subscriptions by Mode of Access, 2007 – 2009 Q3

Source: ComReg, Quarterly Update, Q3 2009

Figure 2 highlights that:

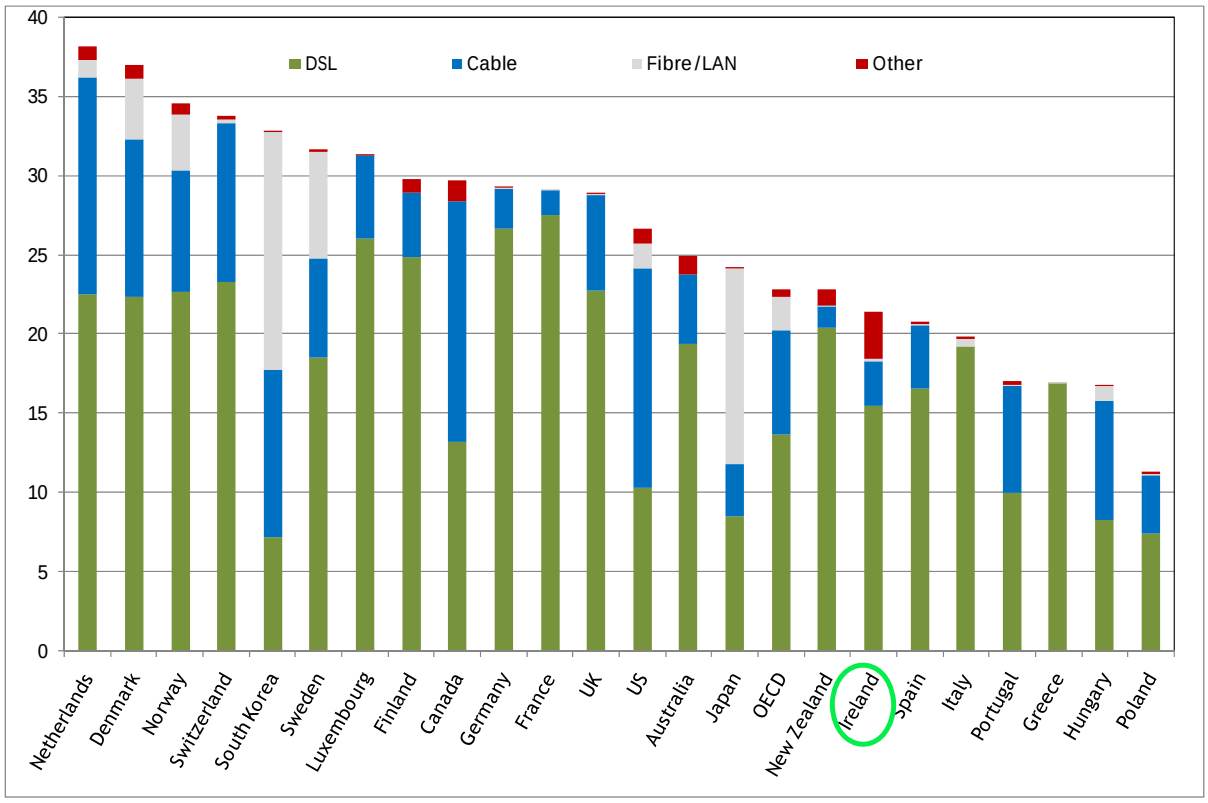
- Total broadband subscriptions in Ireland have grown rapidly in recent years, rising from 322,000 in Q1 2006 to 600,000 in Q1, 2007 to 1.36 million in Q3 2009.
- The choice of services for businesses and residential consumers has also improved considerably. Broadband is now delivered over multiple networks including fixed telephone line (DSL), fibre, cable, fixed wireless, satellite and mobile with over 40 service providers in the Irish market.
- Since the beginning of 2008, much of the growth has been driven by mobile broadband access, which has increased rapidly to account for 30.3 percent of broadband connections in Q3 2009[7]. DSL connections account for 51.2 percent of all broadband connections, fixed wireless access for 7.8 percent, cable for 10.1 percent and there are a very limited number of fibre and satellite connections.
- Cable broadband has been growing steadily in recent years from 64,420 in Q1 2007 to 137,601. UPC's cable network is capable of providing broadband to over 527,000 residential home[8].

7 **In the 12 months to September 2009 mobile broadband subscriptions increased by 53 percent compared to growth of 44 percent for cable and 10 percent for DSL. Fixed wireless subscriptions declined by 9.6 percent.**

8 ComReg, 2009.

- While the market share of DSL connections has declined over the last two years, the number of connections has increased from 436,005 in Q1 2007 to 696,641 in Q2 2009.

Figure 3: OECD Broadband subscribers per 100 inhabitants, by technology, June2009



Source: OECD, Broadband Statistics

Ireland's ranking is 20th out of the OECD-28 in terms of broadband penetration.

Figure 3 highlights that:

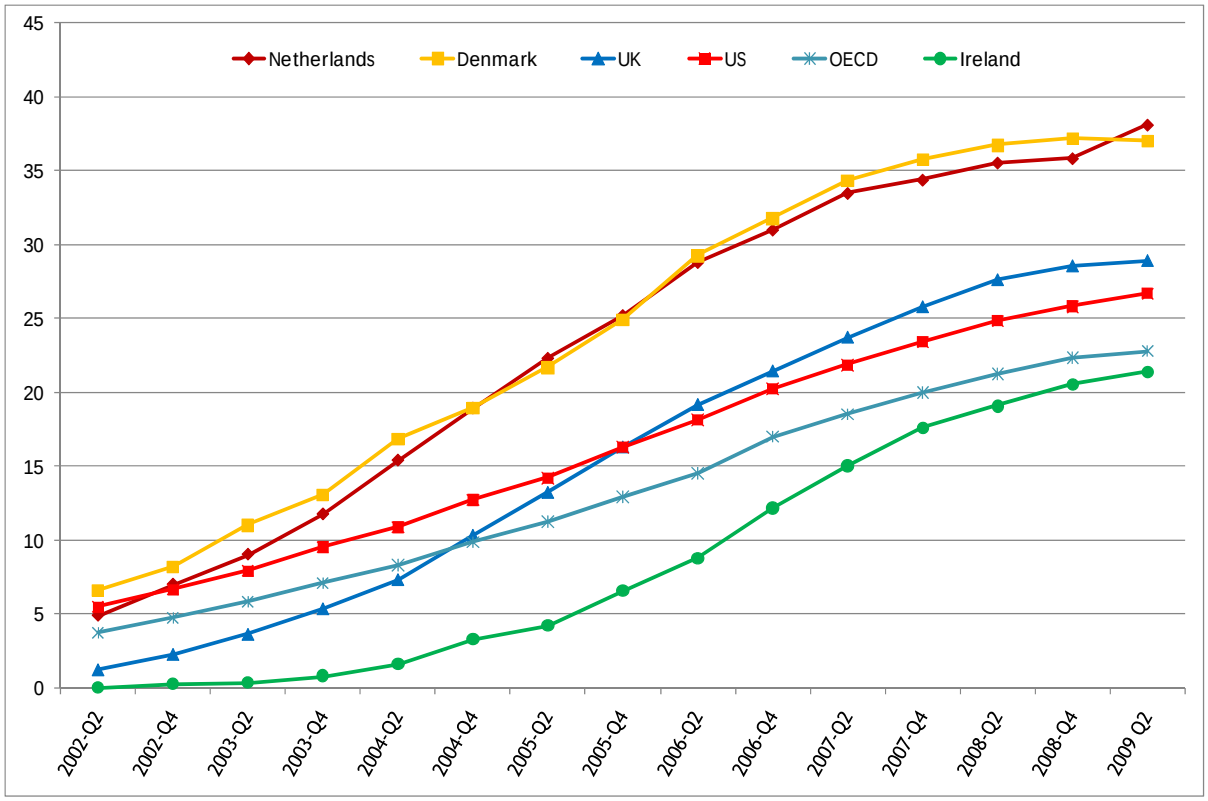
- While mobile broadband is not included in OECD subscriber statistics due to methodological difficulties[9], OECD data indicates that Ireland's performance in terms of broadband penetration rates lags the OECD average. Ireland has 21.4 subscribers per 100 inhabitants compared to the OECD average of 22.8[10]. Leading countries such as Netherlands (38.1) and Denmark (37) have achieved significantly higher broadband penetration rates per 100 inhabitants.

9. There are significant methodological challenges to address before the OECD can publish a comparable mobile broadband indicator across countries. One of these is how to separate connections used for Internet access from standard 3G mobile subscriptions where subscribers have the capability to access the Internet but choose not to. The OECD is in discussions with member countries to develop a common methodology which will be comparable across countries.

10 The OECD-28 average (excluding Mexico and Turkey) is 25.84 subscribers per 100 inhabitants.

Figure 4 below shows broadband subscriber rates per 100 inhabitants over the period 2002 to June 2009. While Ireland's performance in terms of broadband penetration has increased steadily in recent years and is now close to the OECD average, improvements have not been sufficient to catch up with the penetration rates achieved by leading countries. It is notable that the UK also started from a very low base in 2002 but has progressed rapidly and is now significantly above the OECD average.

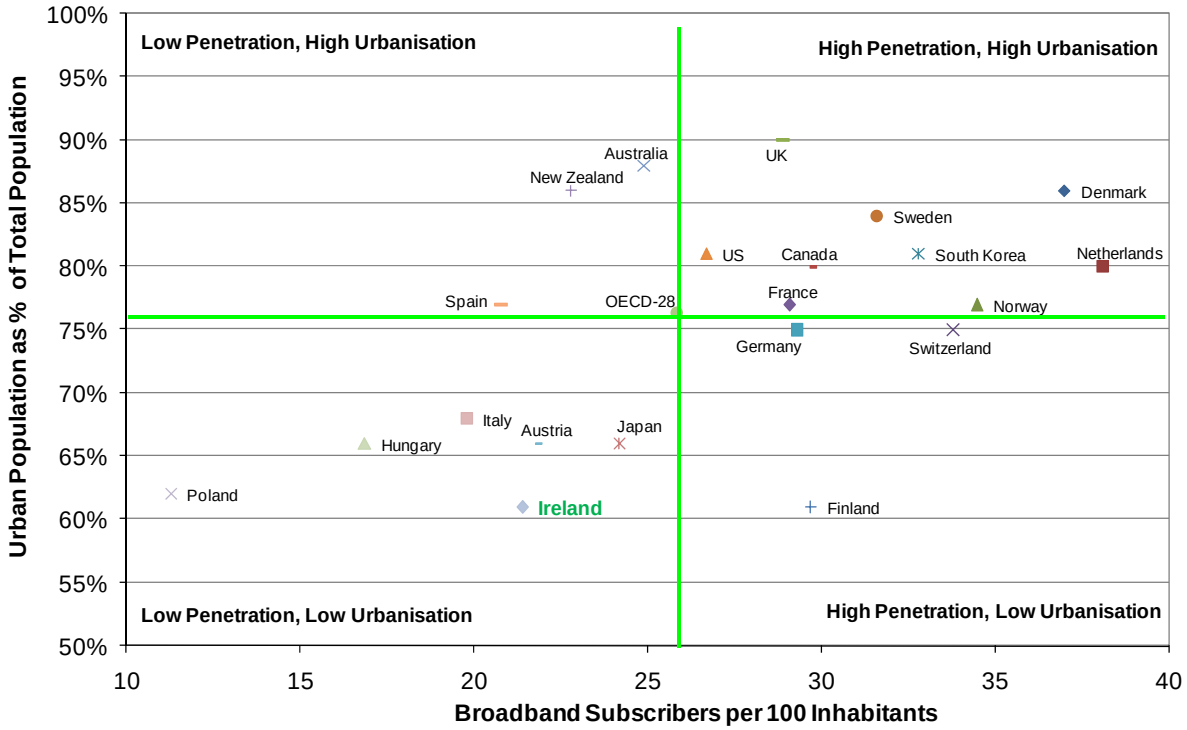
Figure 4: Broadband Subscribers per 100 inhabitants, 2002-2009



Source: OECD, Broadband Statistics

National broadband performance statistics reflect the differing economic, geographic and demographic challenges that face individual countries. Urbanisation and population density are crucial determinants of the economic case for investing in broadband infrastructure. The case for investment in broadband infrastructure is likely to be more attractive in countries with a high proportion of people living in urban areas and high population density. Figure 5 above plots fixed broadband subscribers per 100 inhabitants and urban population as a percentage of total population.

Figure 5: Broadband subscribers per 100 inhabitants and Urban Population, June 2009[11]



Source: OECD, Broadband Statistics; World Bank, World Development Indicators

It is notable that some of the best-performing countries such as Denmark, Netherlands and South Korea in the OECD have very high urban populations. By contrast, Ireland has a high proportion of people living in rural areas (39 percent in 2005 compared to the OECD average of 24 percent[12]). Finland is a notable exception as it achieves high levels of penetration despite similar urbanisation rates as Ireland.

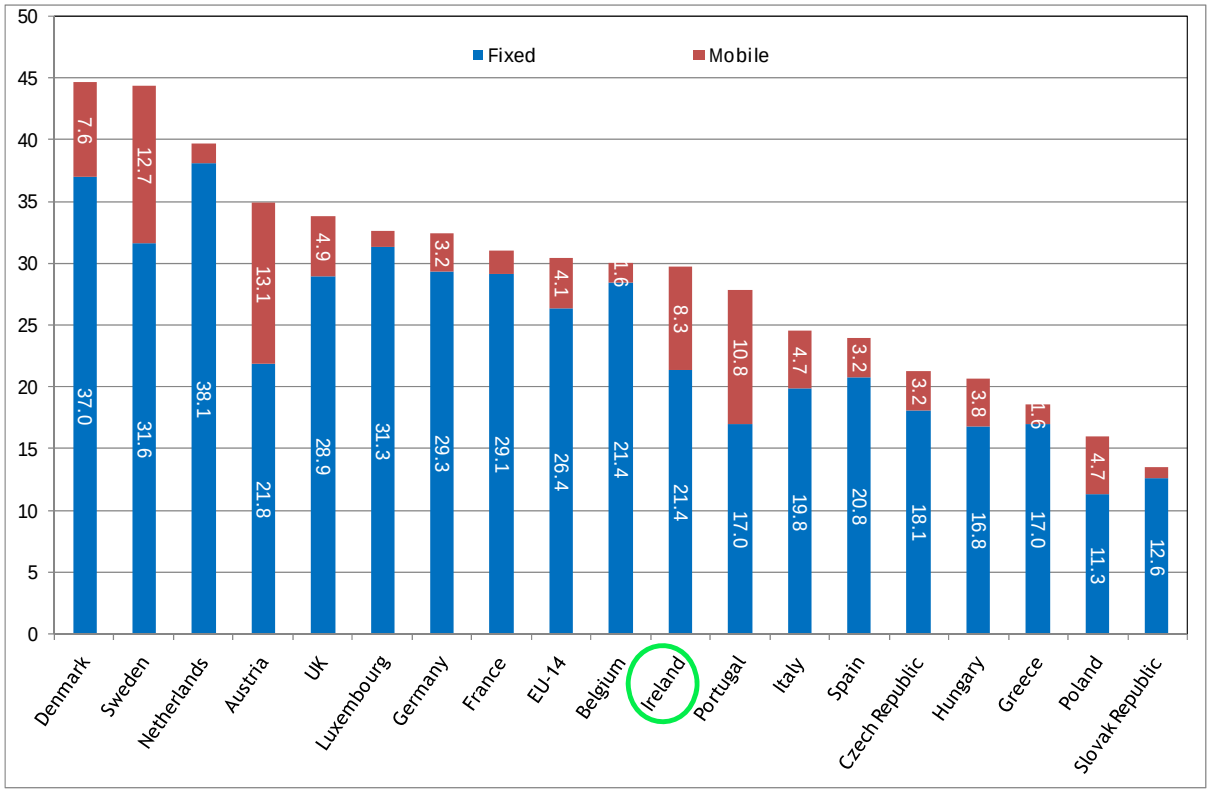
Ireland also has a low population density relative to other OECD countries; population density in Ireland is 62 inhabitants per square kilometre compared to 338 in Japan and 485 in South Korea where roll-out of fibre infrastructure is more widespread. Outside of urban areas, the dispersed nature of Irish population patterns makes returns on private investment more

11 World Bank, 2007, World Development Indicators. The data for urban population refers to 2005.

12 OECD average for broadband subscribers is the OECD-28. The OECD average for urbanisation of the population is the OECD-26 (excluding Iceland, Luxembourg, Mexico and Turkey)

difficult to achieve than in other markets. The mix of technologies deployed to provide services in Irish cities is likely to differ from rural areas with lower population density and to also impact on the commercial and business case for such deployment.

Figure 6: Fixed and Mobile Broadband Penetration per 100 Inhabitants, 2009



Source: OECD Broadband Indicators (fixed) and European Commission (mobile)[13]

Figure 6 combines OECD data on fixed broadband subscribers per 100 inhabitants with mobile broadband subscribers as collated by the European Commission. Mobile broadband can be a complement to, or a substitute for, fixed-line broadband. As many of those with a mobile broadband connection are also likely to have a fixed-line connection these figures are not necessarily cumulative.

- Including mobile subscribers, Ireland's overall penetration rate is 29.7 per 100 inhabitants. Penetration rates are significantly behind leading countries such as Denmark (44.6), Sweden (44.3) and the Netherlands (39.6). The EU-14 average is 30.4 broadband subscribers per 100 inhabitants.

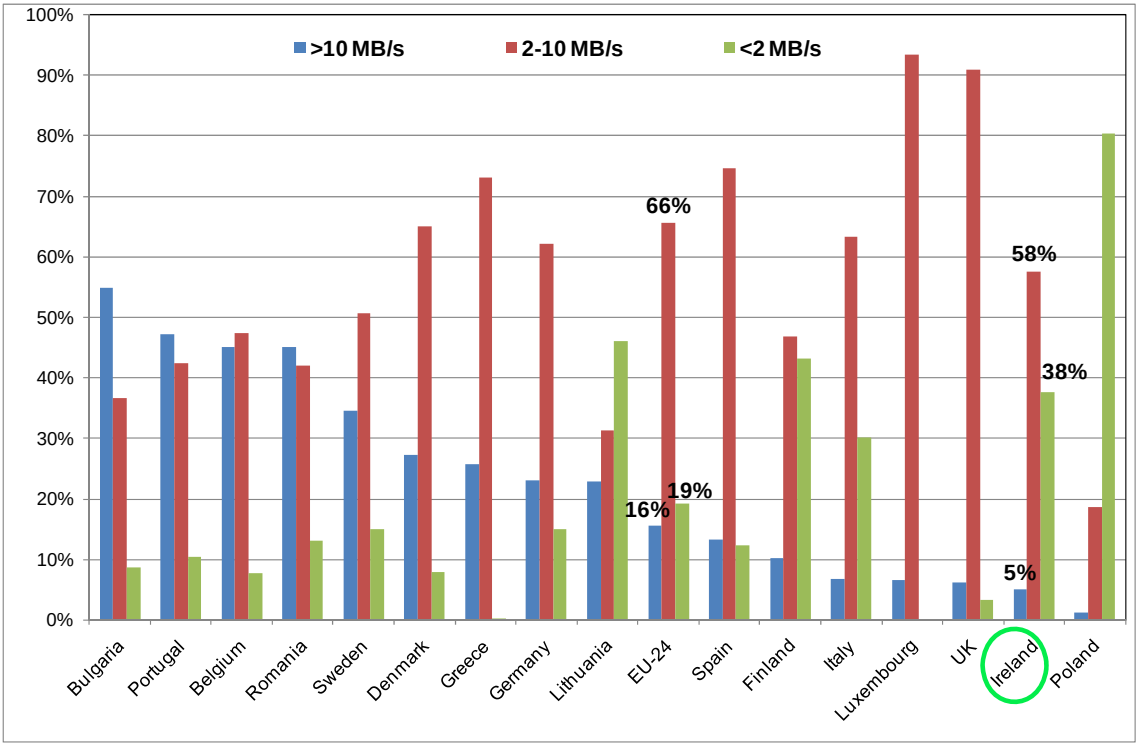
13 The OECD does not measure mobile broadband penetration due to methodological issues. This chart combines subscriber figures from two different data sources and should be treated with caution. The EU Commission note while some member states failed to provide any mobile broadband data, others have provided them only partially. In addition, it appears that data provided are not of the same quality across all countries. European Commission, 2009, Broadband access in the EU: situation at 1 July 2009. Mobile broadband refers to dedicated data services cards, modems and keys only as reported in Table 4 of this report.

1.3 Broadband Quality

The applications of the future will demand much higher speeds, symmetric services (similar upload and download speeds), low latency (speed of response of the system to the user) and uncontended access (user does not share bandwidth with others users due to network constraints). While broadband coverage has improved significantly in Ireland in recent years, it is notable that low speed broadband services dominate relative to those available in other countries.

Figure 7 below shows fixed broadband lines by speed in July 2009. Across most EU countries, the majority of broadband connections offer speeds between 2-10 Mb/s. In Ireland, more broadband connections are below 2Mb/s (38 percent) compared to the EU-12 average (15 percent). **In Ireland 5 percent of broadband connections are above 10Mb/s – this is a much lower proportion than leading EU countries such as Portugal (47 percent), Belgium (45 percent) or Sweden (34.5 percent). The EU-24 average is 15.5 percent of connections above 10 Mb/s[14].**

Figure 7: Fixed Broadband Lines by Speed, July 2009



Source: European Commission Working Document: Broadband access in the EU 1 July 2009.

Ranking: Ireland 12th out of EU-12[15]

14 EU-27 minus Austria, France and Netherlands where data is unavailable.

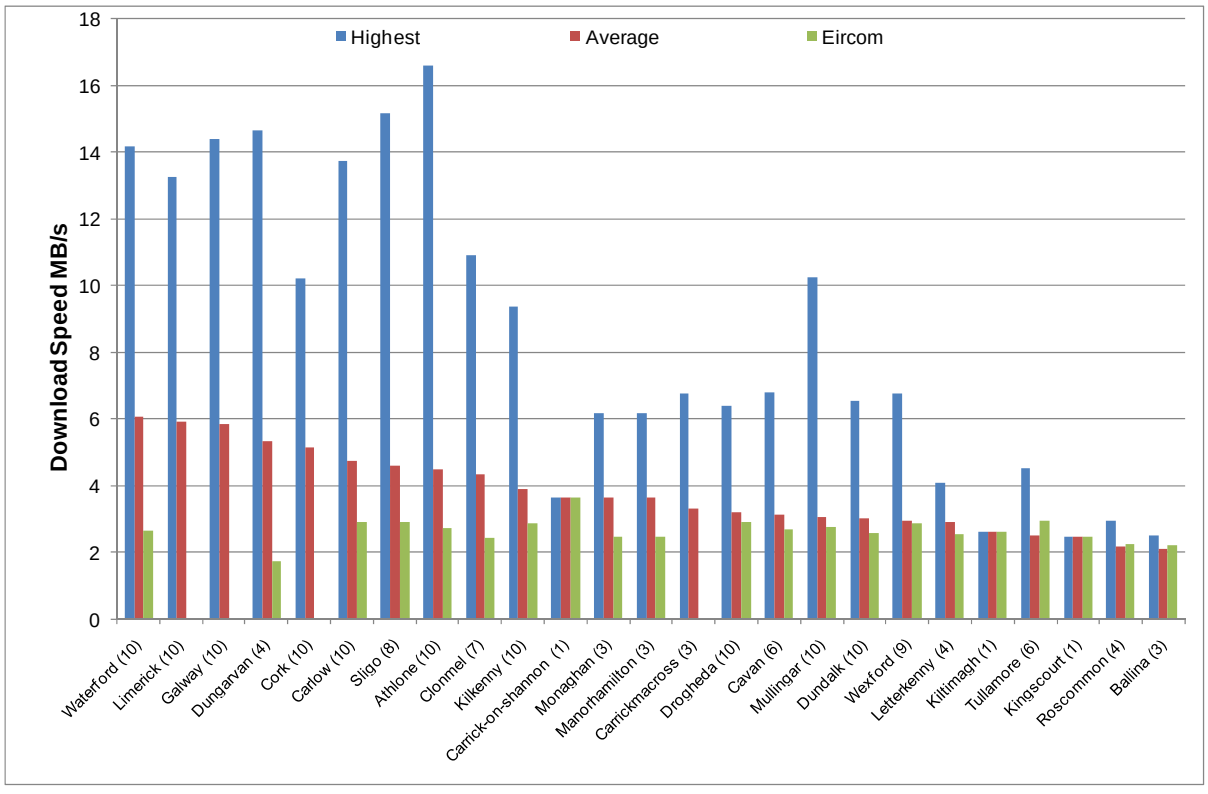
15 EU-15 minus Austria, France and the Netherlands due to data availability. Ranking based on proportion of speeds above 10Mb/s.

In greater detail:

- The number of fixed broadband connections above 10 Mb/s in Sweden has increased rapidly in recent years from 137,000 (13.6 percent of total broadband connections) at the end of 2003 to 1,017,000 (35 percent of total fixed broadband connections) by January 2009[16]. During 2008 the number of broadband subscriptions via fibre increased by 16 percent to 590,000 connections;
- In Denmark 17.6 percent of broadband connections offered download speeds of 10 Mb/s or greater in the second half of 2008 – by July 2009 this had increased to 27 percent. FTTH connections have increased from 49,778 connections in the second half of 2007 to 87,051 connections in the second half of 2008 – a growth rate of 75 percent[17].

Figure 8 below shows the speed of service delivered by the fastest internet service provider, the average of all ISPs and by Eircom in key towns.

Figure 8: Broadband Access Speeds in Towns with MANs Phase 1, (highest ISP, average of services delivered and Eircom's average speed), August 2009[18]



Source: Speedtest.net, Forfás analysis. Note: number of ISPs for each town in parentheses.

16 Swedish National Post and Telecom Agency, June 2009, The Swedish Telecommunications Market 2008.

17 National IT and Telecom Agency, Denmark, June 2009, Telecom Statistics – second half of 2008.

18 This data should be interpreted with caution, as speedtest.net does not indicate the number of tests carried out for each town. For the towns, the number of internet service providers tested is included in parentheses. The data is drawn from the Top 10 ISPs tested in towns. Where Eircom is not listed in 'Top 10 ISPs' on speedtest.net this has been left blank. This does not mean that Eircom does not provide services in that town.

In the majority of towns which received Metropolitan Area Networks (MANs) under Phase 1 of the Government's investment roll-out, significantly higher speeds are offered by alternative providers than by the incumbent Eircom[19]. In most cases the average speed of the top ten ISP providers, as measured by speedtest.net, is above the speeds delivered by Eircom.

Publicly available statistics and internet service providers tend to focus on maximum available speeds. However, the key issue from a customer's perspective is the average and actual speeds which they receive from their service provider and the applications that a given level of bandwidth enables. The actual speeds consumers receive have become more important to consumers as they increasingly use the internet to download video and audio and for video-conferencing and file exchange[20&21]. It would be very useful for ComReg to undertake research on actual delivered speeds in similar to that undertaken by OFCOM, the telecommunications regulator in the UK, to ensure consumers are properly informed as the broadband market develops and consumers avail of applications which require higher speeds.

- ComReg does not currently have the mandate to collect data on delivered speeds from service providers in Ireland. In a dynamic market, it is important that legislation is continuously reviewed to ensure that the regulator has the appropriate power to collect and publish any relevant information.

19 E-Net operates on behalf of the State as a wholesaler of access to the MANs. It offers a full suite of active and passive products and services, such as ducting, sub-ducting, dark fibre, high-level managed capacity, co-location and auxiliary services. It does not offer retail communications services, and thus does not compete with its own customers at this level (though it may do so at the wholesale level).

20 Recent research by OFCOM, the telecommunications regulator in the UK found significant variations between actual speeds delivered by various ISPs; on average broadband customers were receiving speeds around half the headline rate advertised by their ISP (3.9Mb/s actual speed for a connection advertised as up to 8Mb/s) OFCOM, 2009, UK broadband speeds 2009: Consumers' experience of fixed-line broadband performance. Available at http://www.ofcom.org.uk/research/telecoms/reports/broadband_speeds/broadband_speeds/

21 OECD, 2009, Communications Outlook. Research across the OECD has also found that actual connection speeds are often significantly lower than advertised headline speeds. Epitiro data shows that fibre connections provided the highest average download throughput within the OECD - the average actual speed of the sampled connections was 14 Mb/s over fibre, more than double that of any other technological platform. Cable throughput was just over 6 Mb/s on average while DSL was slightly lower at 4 Mb/s. Mobile and satellite connections had the lowest actual throughput of 1.7 Mb/s for mobile and 800 kbit/s for satellite. Upload speeds are significantly lower than download speeds across all platforms.

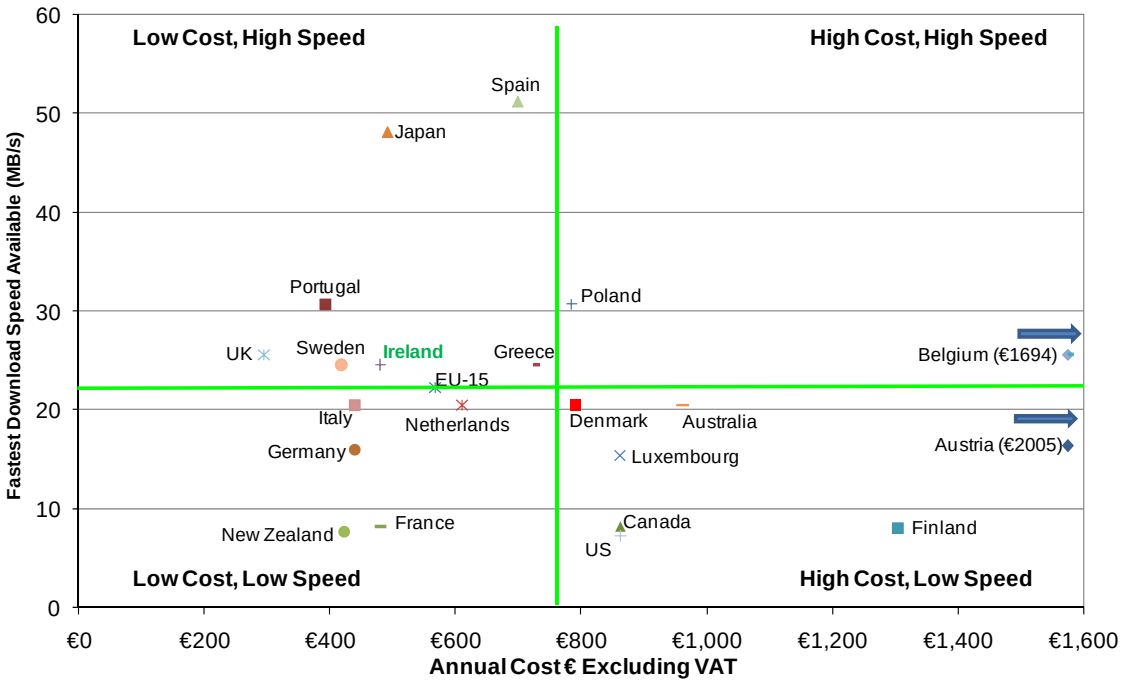
1.4 Cost and Speed of Broadband Services

The availability of fast, competitively priced broadband services is vital for enterprise development. As broadband services typically account for a small proportion of most firms cost base, the key issue in terms of enterprise development is the quality (where download speed is one key metric) of broadband services available to Irish firms and households. This section assesses the cost and speed of broadband services for businesses and residential customers respectively.

1.4.1 Cost and Speed of Business Connections

Figure 9 shows the fastest available broadband connection available to businesses and the cost in euro (excluding VAT) of the service. It is important to note that the fastest available connections may only be available in selected areas.

Figure 9: Fastest Available DSL/Cable[22] Connection offered and Annual € Cost[23]



Source: Teligen, September 2009

Ranking: Ireland ranks joint 6th fastest out of EU-15 on speed and joint 7th least expensive.

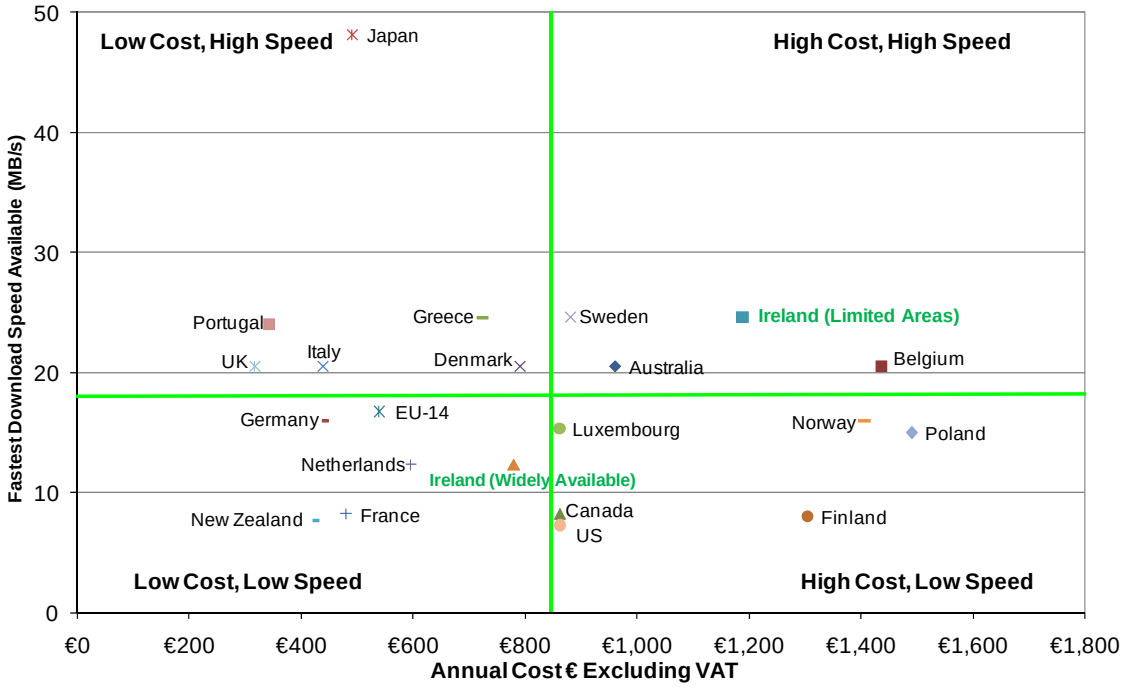
22 In Spain, Poland, Portugal and Belgium the fastest business connections are provided by cable operators. In Ireland the fastest available service at the lowest cost is BT Option 3 as of September 2009 – Eircom also provide a 24 Mb/s service but it is more expensive (see figure 10 below)

23 Low speed means that the speed of a given service is less than the average of the fastest speeds available in all countries. Similarly, high cost indicates that the cost is greater than the average of the cost of the services available in all countries.

- Ireland performs relatively well in terms of the fastest connection available – the fastest connection available to businesses is 24 Mb/s which is comparable with many EU countries and slightly above the EU-15 average of 22Mb/s[24]. **However, this speed is only available in a very limited number of locations in Irish cities**; 12 Mb/s connections are more widely available for businesses in Ireland;
- The cost of a 24 Mb/s business connection at €480 per annum is low in Ireland relative to the EU-15 average of €567. Nonetheless, Ireland remains more expensive than leading countries such as Sweden where a 25.6 Mb/s connection is available at a cost of €295. In Portugal a 31 Mb/s connection costs €392 and in Japan a 48 Mb/s connection costs €492.

Figure 10 below shows the fastest DSL business connection offered by the incumbent operator and the annual cost in euro of providing the service. The incumbent's fastest speed is a relevant metric, as it is the most widely available service to enterprises.

Figure 10: Fastest DSL Business Connection offered by the Incumbent and Annual € Cost



Source: Teligen, September 2009[25].

Ranking: Ireland ranks 12th slowest out of EU-14 on download speed and 8th least expensive.

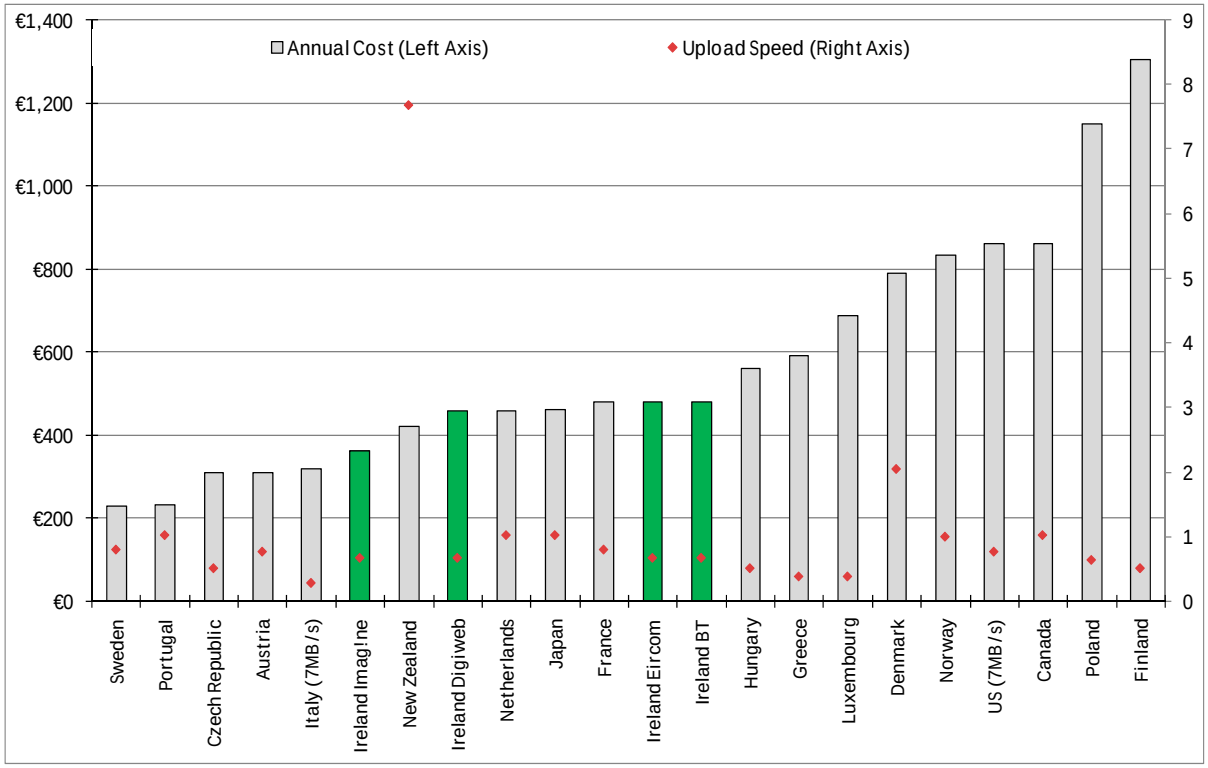
24 The average is based on the fastest speed available to businesses, weighted by 2008 population for the EU-15.

25 Bundles are not included in the Teligen data except where it is the only possible option. There may be geographical differences in that high speeds are only offered in certain restricted areas (where possible to allow for these geographical differences two data points have been included for Ireland to differentiate between speeds available in selected locations and those available widely across most parts of the country).

- In Ireland, the incumbent operator, Eircom, offers a 24 Mb/s service at a cost of €1188. The speed offered compares well with the EU-14 average of 17 Mb/s. However this service is only available in a limited number of locations in Irish cities[26]. The cost of the incumbent's fastest connection in Ireland compares poorly with the EU-14 average of €540. In Japan, a 48 Mb/s connection is offered by the incumbent at a cost of €492. In Sweden 24Mb/s services are widely available from the incumbent at a cost of €881 per annum. In Portugal a 24Mb/s connection costs €343 and in the UK 20 Mb/s is available at a cost of €318.
- In Ireland 12 Mb/s connections are more widely available to businesses in most parts of the country – this service is shown as a separate point on the chart with a speed of 12 Mb/s at a cost of €780. This is categorised as a low speed service in figure 9 relative to the speeds available in many other countries.

Figure 11 below shows the annual cost of the least expensive 8Mb/s broadband connection available for a business user in a range of OECD economies[27].

Figure 11: Cost of an 8Mb/s Business Connection (Annual € Cost, excluding VAT)



Source: Teligen, September 2009

- Irish providers perform relatively well in terms of the cost of an 8Mb/s connection. The cost of the cheapest provider in Ireland, Imagine, is €362 per annum. The cost of

26 EU-15 minus Spain.

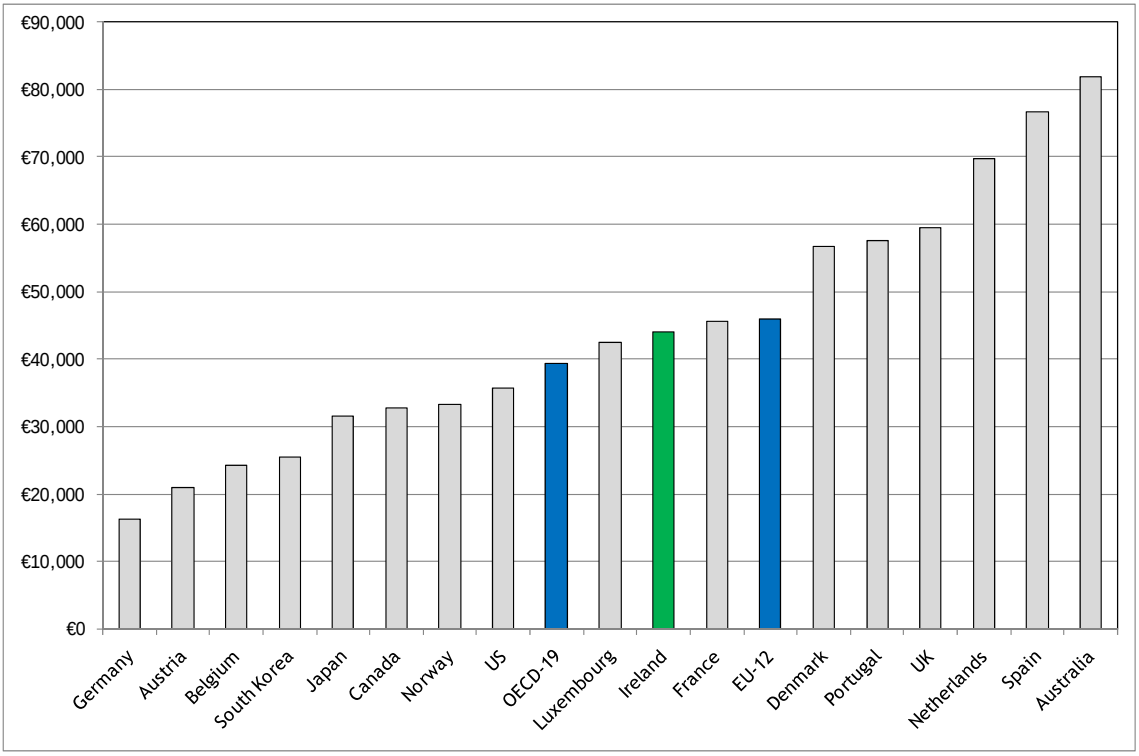
27 Some countries have been excluded from this chart as a comparable 8 Mb/s business connection was not offered by any provider. In most cases higher speeds are available; however these services have been excluded to ensure comparability across countries.

Eircom's 8Mb/s service is €480 which compares better than countries such as the US, Canada and Norway but remains more expensive than leading countries such as Sweden, Portugal and the Czech Republic.

- Figure 10 also shows the upload speed (red dot in the graph) for the cheapest 8Mb/s connection available. While there is considerable variation between countries, upload speeds in Ireland are typically low compared to the speeds available in leading countries such as New Zealand where a symmetric 8Mb/s upload and download speed is available at a comparable cost.

A leased line is a private symmetric telecommunications line connecting two locations. Typically, large companies are the main users of the leased line services while SMEs tend to use ADSL and SDSL services. However, there will be exceptions to this depending on how data intensive particular companies are - for example software, digital media and ICT SMEs would need leased lines. Figure 11 highlights the annual costs of a 34 Mb leased line service.

Figure 12: Annual € Cost of a 34Mb Leased Line[28]



Source: Teligen, August 2009.

Ranking: Ireland ranks 11th least expensive out of OECD-19.

28 The cost is shown in € excluding VAT amortised over 12 months. The distance of the leased lines is 2 kilometres. The following countries do not offer 34 Mb circuits; the relevant results have therefore been normalised to 34 Mb - Canada, Iceland, Korea and USA (45 Mb) and Japan (50 Mb).

- Ireland's performance is average in terms of the cost of a 34Mb leased line. The cost in Ireland is €44,111, excluding VAT, which compares favourably with the EU-12 average of €45,960 and the OECD-19 average of €39,363[29].
- However, Ireland remains significantly more expensive than leading countries such as Germany where a comparable service costs €16,310.
- Ethernet is likely to progressively replace leased lines in providing high speed, reliable services to business in Ireland and other advanced economies in coming years[30].

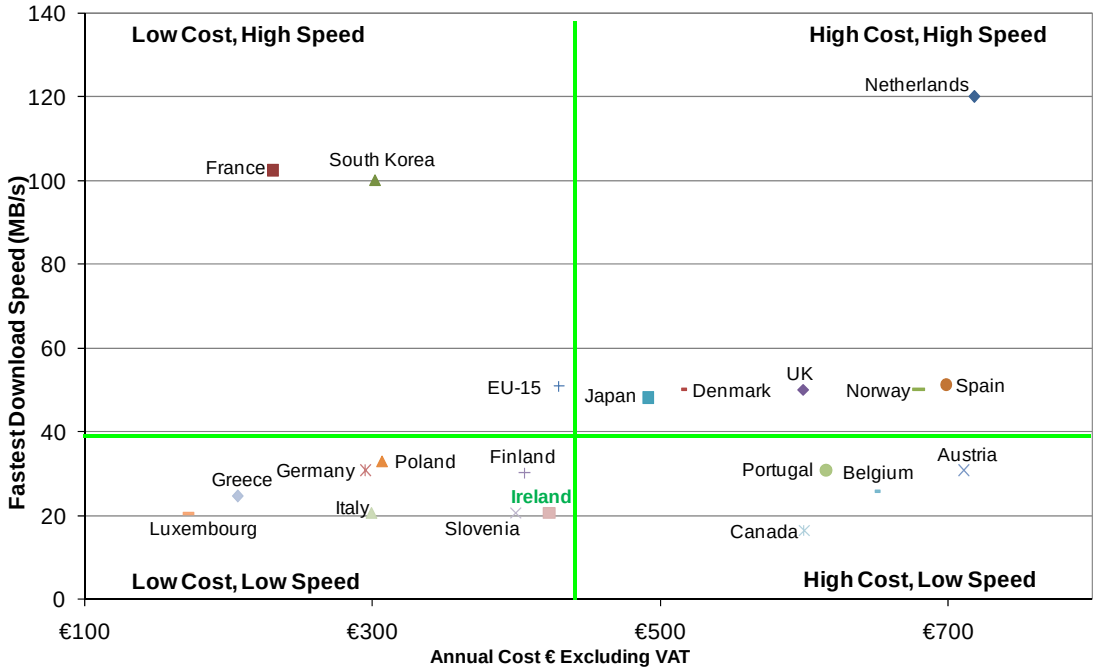
29 EU-15 minus Finland, Italy and Sweden. OECD-28 minus Czech Republic, Finland, Hungary, Italy, New Zealand, Poland, Slovak Republic, Sweden and Switzerland

30 ComReg, Quarterly Key Data Report, Q2 2009.

1.4.2 Cost and Speed of Residential Connections

Internationally, there is a trend towards high speed, high quality broadband connections to be available to residential consumers wherever and whenever they choose to access the internet for increasingly interactive entertainment services. In addition to downloading content from the internet, individuals are increasingly producing work and entertainment related content which requires faster upload speeds. This represents a shift away from traditional asymmetric broadband connections with faster downloads to symmetric connections capable of high-speed communication in both directions.

Figure 13: Fastest Residential Cable/DSL[31] Connection and Annual € Cost



Source: Teligen, September 2009.

Ranking: Ireland ranks joint 15th slowest out of EU-15 on download speed and 8th least expensive.

Figure 13 shows the fastest available connections for residential customers and the cost in euro of providing the service. It is important to note that the fastest available connections may only be available in selected areas:

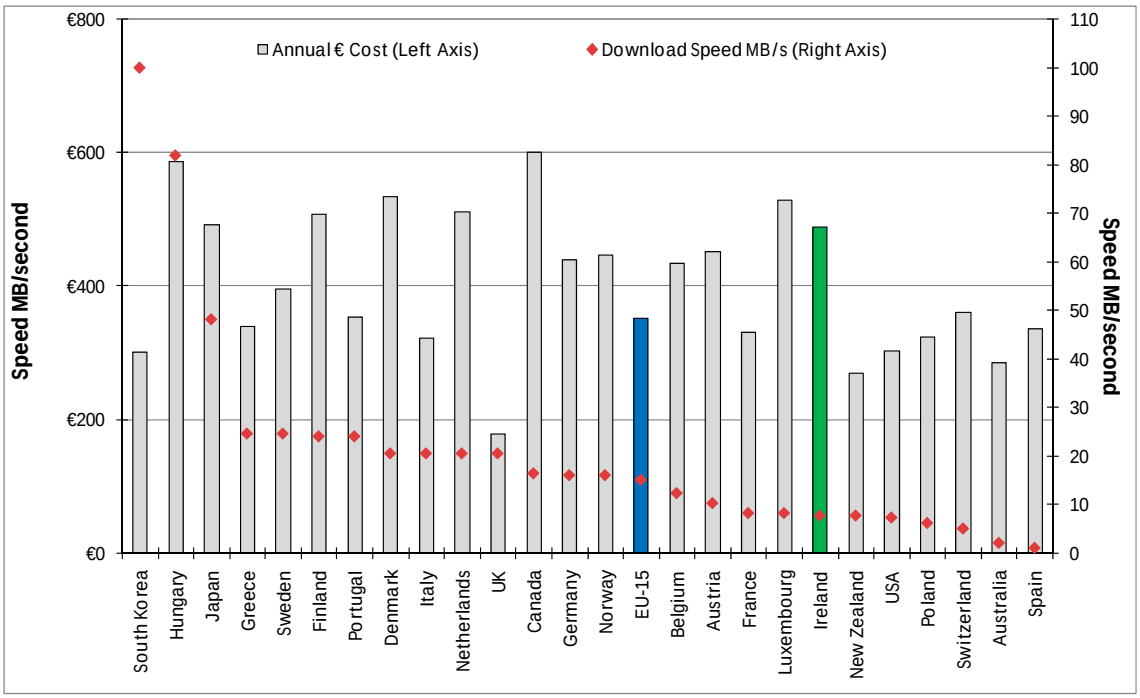
- Ireland compares poorly with leading countries in terms of the fastest speed available which is 20.48 Mb/s at a cost of €423 per annum. It is important to note that this speed will only become available to approximately 35 percent of Irish households - predominantly in cities - when the upgrade of the cable network is complete in 2010.

31 In the following countries the fastest available residential connection is offered by a cable operator: Netherlands, France, Spain, Denmark, Norway, UK, Germany, Austria, Poland, Portugal, Finland, Belgium and Ireland. In the remainder the fastest available residential connections are offered over DSL with the exception of South Korea which is a fibre connection.

Broadband services offered by DSL and fixed wireless providers are more widely available to Irish households at much lower download speeds (see Fig. 23, Appendix 1).

- Much faster speeds are available in many other European countries at a comparable cost – for example France, Sweden, Denmark, UK and Germany. The EU-15 average is a connection speed of 50.8 Mb/s at a cost of €430[32]. In South Korea, France and the Netherlands residential customers can avail of residential speeds of over 100 Mb/s. In France a 102Mb/s connection is available at a cost of €231 per annum.

Figure 14: Fastest Residential DSL Connection offered by the Incumbent and Annual € Cost



Source: Teligen, September 2009.

Ranking: Ireland ranks 14th out of EU-14 on download speed and 11th on cost.

The incumbent's fastest speed is a relevant metric, as it is the most widely available service to households in most parts of the country.

- In Ireland, the incumbent operator offers a 7.68 Mb/s service at an annual cost of €488. The speed offered compares very poorly with the EU-15 average of 15 Mb/s. **Ireland lags leading countries where much higher speeds are available at a comparable cost to households**. For example, in Sweden a 24.6 Mb/s connection is available at a cost of €395 and in Finland a 24 Mb/s connection is available at a cost of €508. In South Korea a 100Mb/s connection is available at an annual cost of €302.

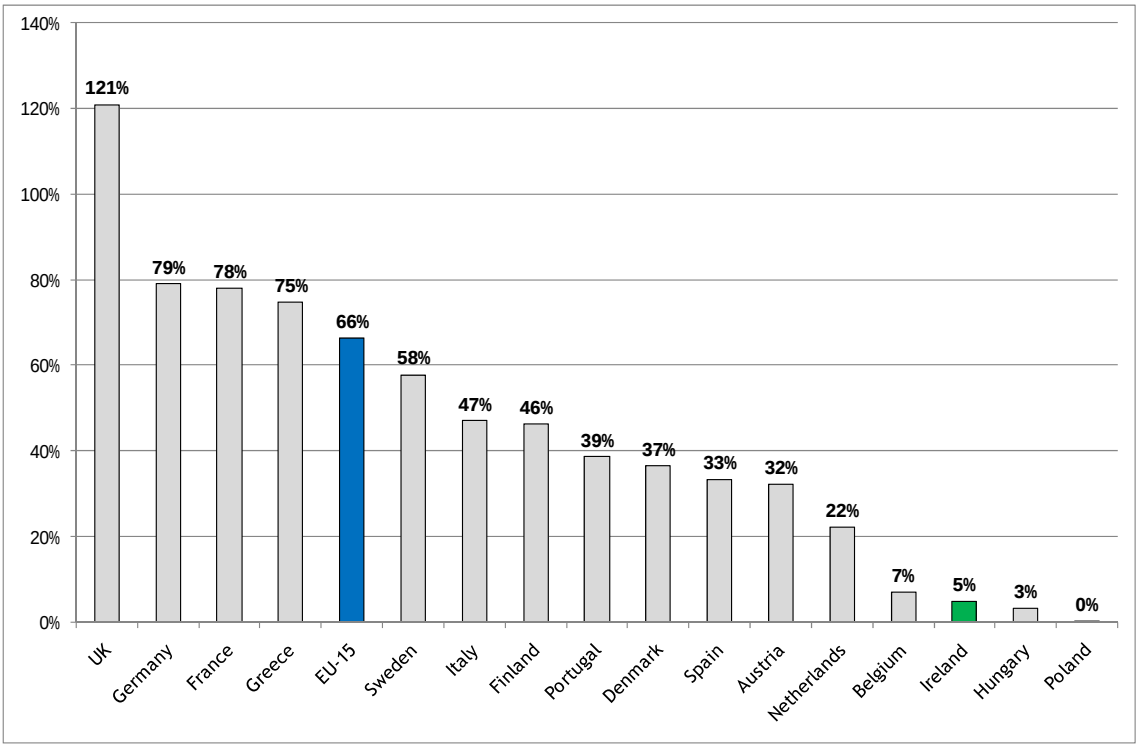
32 The average is based on the fastest available residential speed, weighted by 2008 population for the EU-15.

1.5 Competition

Competition between and within platforms has been a key driver of product and price innovation internationally. As highlighted in figures 2 and 3, DSL has traditionally dominated broadband provision in Ireland. More recently, cable and mobile access have emerged as stronger competitors which may drive development in the future. Nonetheless, the absence of nationwide platform competition in the past has slowed the development of the Irish market.

Competition within the DSL fixed line platform is driven by regulated access to the incumbent's 'local loop' – the last mile of the network connecting the customer to the local exchange[33]. Ireland lags other developed economies significantly. In Q2 2009, there were just 23,630 installed LLU lines – 17,124 were fully unbundled and 6,506 were shared access lines.

Figure 15: Unbundled Lines as a Percentage of the Incumbent's DSL Lines[34]



Source: ECTA Broadband Scorecard Q1 2009[35]

Ranking: Ireland ranks 14th out of EU-15.

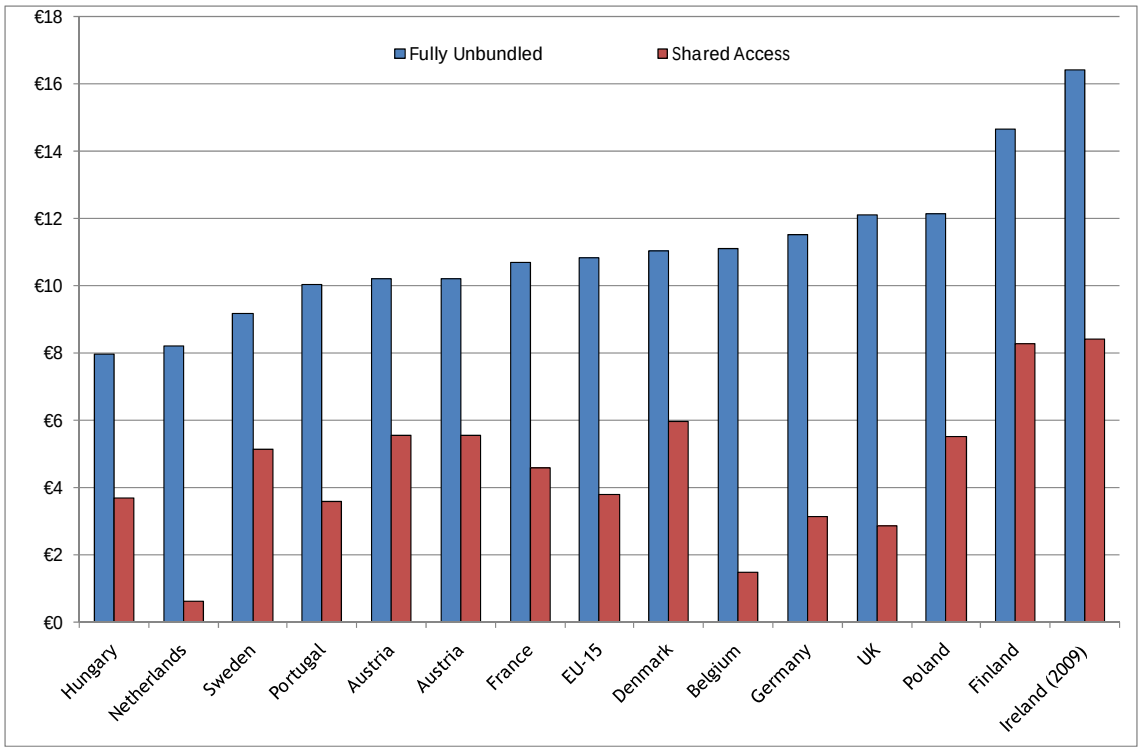
33 Local loop unbundling entails other operators to connect their own equipment to the incumbent's copper loop connecting final consumers to the local exchange. Bitstream access involves other operators re-selling products provided over the incumbent's own network.

34 Unbundled lines include fully unbundled lines supplied to other operators and shared lines. In the case of full unbundling, a copper pair is rented to a third party for its exclusive use. In the case of shared access, the incumbent typically continues to provide telephony service (narrowband) while the new entrant delivers high-speed data services (broadband) over that same local loop.

35 European Competitive Telecommunications Association. Data refers to end of March 2009 except for Netherlands which refers to Q4 2008 due to data availability.

Figure 15 above shows unbundled lines as a percentage of the incumbent's DSL Lines. Unbundled lines include fully unbundled and shared access lines. Ireland's performance in local loop unbundling, by this measure, is very poor internationally. In Ireland only 5 percent of the incumbent's DSL lines are unbundled compared to the EU-15 average of 66 percent. This has limited the level of competition with DSL services and reduced the incentives for the incumbent to progress to offering higher value services.

Figure 16: Local Loop Unbundling, Monthly Rental Cost, October 2008[36]



Source: European Commission, 14th Annual Implementation Report Volume 2; ComReg

Ranking: Ireland ranks 15th out of the EU-15 for both fully unbundled and shared access lines.

While connection fees in Ireland (€45) are below the EU average, the monthly rental charge for both fully unbundled local loop and shared access increased in 2007 and 2008 and is the highest in the EU in the case of full LLU[37]. In Ireland the wholesale monthly cost of renting a fully unbundled LLU line from the incumbent is €16.43 – this compares poorly with the EU-15 average of €10.83. The cost of renting a shared access local loop in Ireland is €8.41 which compares very poorly with the EU-15 average of €3.78.

The high cost of renting wholesale lines from Eircom has hindered the ability of operators to deliver competitive broadband and invest in infrastructure. ComReg recently proposed to reduce the cost for a fully unbundled line to €12.24 per line per month and €10.38 per line

36 Data for Ireland refers to the price of LLU products in September 2009. ComReg.

37 European Commission, 14th Implementation Report, Country Chapter on Ireland.

per month for sub-loop-unbundling[38]. ComReg recently decided to change the cost allocation between broadband and narrowband uses, which should result in the cost of renting a shared local loop falling from its current high level of €8.41 per line per month to €0.77. Falling rental costs should facilitate competition between service providers and allow alternative operators to provide more attractive retail offers to consumers[39]. Eircom has applied to the High Court for a hearing date to appeal this decision.

Vodafone and BT Ireland recently entered into a local loop unbundling (LLU) agreement, which will see Vodafone take over BT's 84,000 residential consumers and 3,000 small businesses customers. BT will provide wholesale network services to underpin Vodafone's business. This is a positive development for competition in the retail market and may also have a positive impact in stimulating competition at the network infrastructure level as BT and Vodafone seek to increase the number of unbundled exchanges.

38 Sub-loop unbundling refers to a partial local loop connecting to the subscriber

39 ComReg, 2009, Response to Consultation and Decision – Rental Price for Shared Access to the Unbundled Local Loop.

1.6 Next Generation and Fibre Network Development in Ireland

Services provided over next generation networks (NGNs) represent a significant step change from those over broadband as the typical user in Ireland experiences it today. The applications of the future will demand much higher speeds, symmetric services (similar upload and download speeds), low latency (speed of response of the system to the user) and uncontended access (user does not have to share bandwidth with others users due to network constraints).

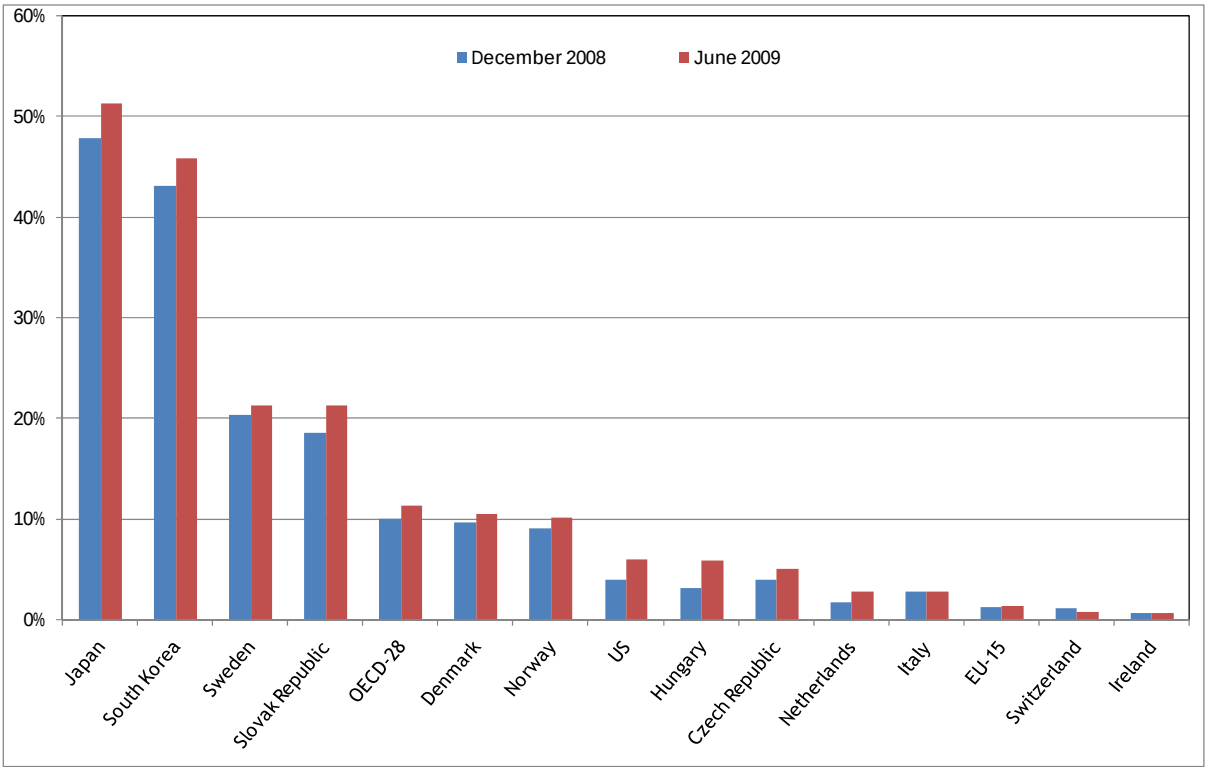
Advanced broadband services are required to position Ireland for export-led economic growth- particularly for services firms to capture new business opportunities. This can be driven by existing communications-intensive sectors such as medical devices, software development, and financial services and emerging sectors such as renewable energy, energy efficiency, cloud computing and personalised healthcare. The availability of high quality broadband is strategically important to improving productivity, facilitating innovation and supporting regional development.

While Ireland has made significant progress in the availability of basic broadband services in recent years, Ireland is falling behind in the deployment of more advanced telecommunications infrastructure.

Fibre networks are widely regarded as the most future proofed broadband access technology. According to the OECD, the optical fibre networks currently being installed in many OECD countries will form the foundation of wired data communication for at least the next 25 years and will support high-speed data, high-definition television and voice services[40]. Investment in fibre is increasingly extending access to individual homes and businesses with next-generation networks as a way to overcome the bottlenecks of copper networks.

40 OECD, 2009, Communications Outlook 2009. Chapter 1 Main Trends.

Figure 17: Fibre Connections as a Percentage of Total Broadband Connections, June 2009



Source: OECD, Broadband Statistics

Figure 17 shows that Ireland remains behind leading regions in terms of upgrading the local access network to fibre and in offering very fast connection speeds over fibre. In Ireland only 0.6 percent of total broadband connections are fibre compared to 51 percent in Japan, 46 percent in South Korea and 21 percent in Sweden. 11.3 percent of subscribers in OECD-28 countries currently access the internet over fibre connections[41]. Fibre is growing fast in Sweden, Denmark, Norway, the Slovak Republic, Hungary and the United States.

The latest European commission statistics show that the share of FTTH connections is also high and rising in several non-OECD countries such as Latvia (26.7 percent of fixed broadband connections are FTTH), Estonia (20.6 percent) and Slovenia (10.5 percent)[42].

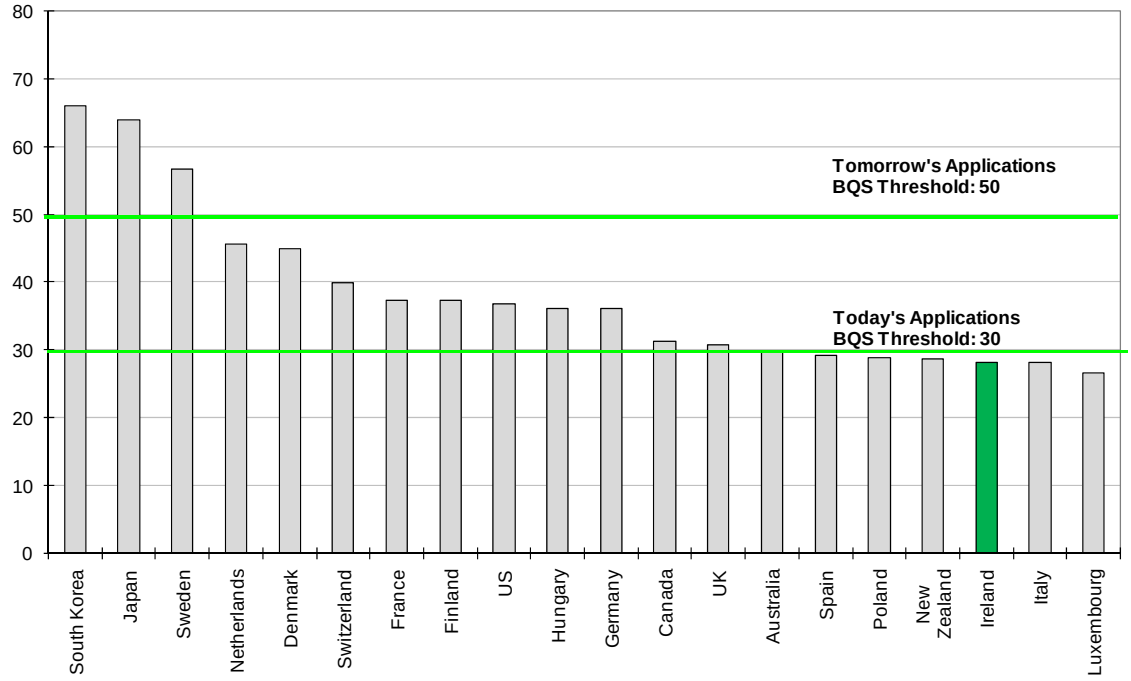
There is mixed evidence on take-up of very fast broadband services where they are currently available globally. Where very fast broadband services are available, take-up is growing. ComReg note that in the case of Japan, (at mid June 2008) 88 percent of homes were passed by fibre with 30.7 percent of such homes subscribing. For the Republic of Korea, 80 percent of homes were passed by fibre with over 41 percent of such homes subscribing. For Sweden,

41 OECD minus Mexico and Turkey. The OECD data includes fibre-to-the-home (FttH) and fibre-to-the-building (Ftth or apartment LAN) connections. Some OECD countries may have fibre but have not reported figures so they are not included in figure 16.

42 European Commission Working Document: Broadband access in the EU 1 July 2009.

approximately 17 percent of homes were passed by fibre with over 72 percent of such homes subscribing. According to the Finnish Ministry of Transport and Communications, 1 percent of households in Finland subscribe to services with speeds of 100Mb/s, even though they are available to more than a third of the country[43].

Figure 18: Readiness to Support Next Generation Broadband Services, 2009



Source: CISCO/Saïd Business School, University of Oxford, September 2009

Ranking: Ireland ranks 26th out of OECD-28

Figure 18 assesses the readiness of countries to support next generation video and web services[44]. Ireland ranks 26th in the OECD-28 in terms of its readiness to support next generation video and web services and remains below today's required standard[45]. As

43 ComReg, 2009, Next Generation Broadband in Ireland - Promoting the timely and efficient development of high speed broadband infrastructure and services, July 2009.

44 Using more than 24 million records from actual broadband speed tests conducted by users from May to July 2009 through www.speedtest.net, the researchers calculated averages of several key performance parameters used to determine the quality of a broadband connection. Broadband experience is mainly affected by broadband speeds in both directions, latency, network oversubscription, and packet loss. These parameters were grouped into three major categories: download and upload throughput, and latency. The Broadband Quality Score (BQS) threshold of 30 for today's applications required download speed of 3.75 Mb/s, upload speed of 1 Mb/s and latency of 95 milliseconds. In the case of Dublin the average download speed recorded was 3.75 Mb/s, upload speed was 0.55 Mb/s and latency was 103.2 expressed in milliseconds. The BQS threshold for tomorrow's applications of 50 requires download speed of 11.25 Mb/s, upload speed of 5 Mb/s and latency of 60 milliseconds.

45 The BQS for each country was determined using a formula that weighted each category according to the quality requirements of a set of popular applications now and in the future. The BQS is an

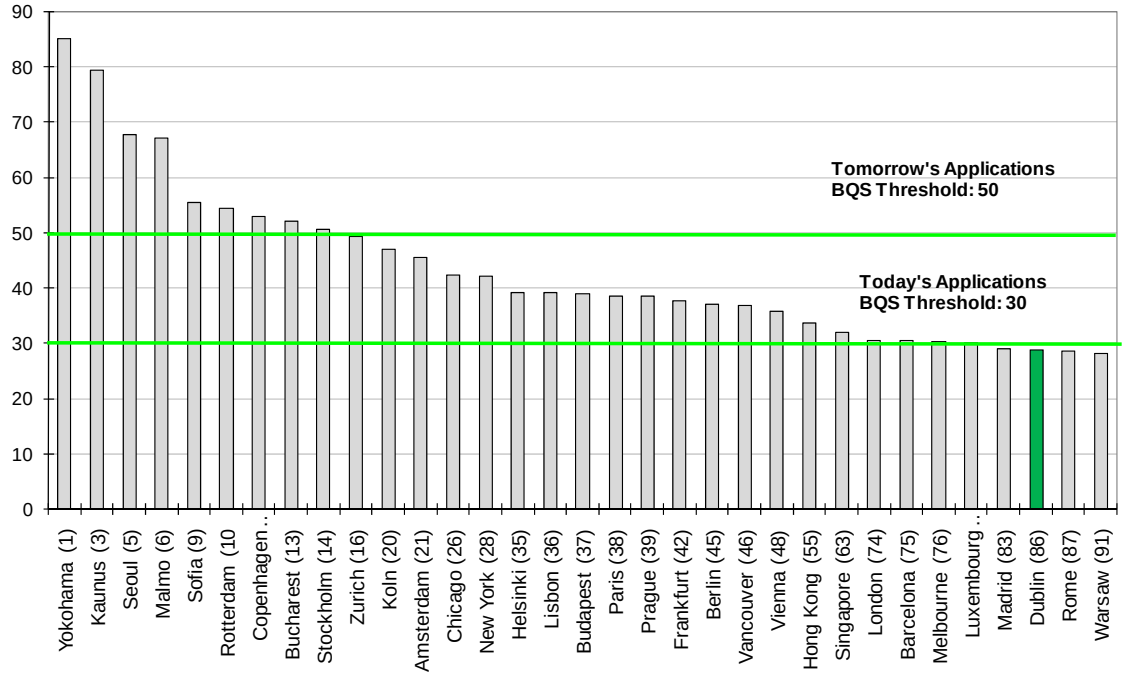
software applications require more bandwidth in the future many countries will need to upgrade their capabilities; however for Ireland this need is particularly acute. Despite the progress in recent years in expanding basic broadband services, there is a competitiveness gap between Ireland and leading countries in terms of next generation broadband infrastructure. As an increasing number of countries develop the capability to support next generation telecoms services, the concern is that Ireland is behind most of its competitors.

A recent report by Liberty Global found that given the gradual roll-out of next generation access (NGA) networks across Europe, broadband products delivered over NGA networks could reach 35 percent of households over the next three to five years. A sample of 15 Western European countries has already achieved coverage of 17 percent primarily through cable upgrades to Docsis 3.0 and FTTC/N technologies[46]. However take-up of very fast broadband services varies considerably between countries where they are currently available.

indication of each country's readiness to support next generation video and web services. Typical applications for today include web browsing, social networking, music downloads, basic video streaming and video chatting, standard definition IPTV, and enterprise-class home offices. Future applications which are likely to be widespread in three to five years include consumer telepresence for communications, healthcare and education, high-quality video file sharing and streaming, high-definition IPTV, cinema-quality live event broadcasts and advanced home automation.

46 Liberty Global, 2009, Next Generation Competition: Driving Innovation in Telecommunications. 17 percent is a weighted average of 15 countries by population. The 15 countries are Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, , Netherlands, Norway, Sweden, Portugal, Spain, Switzerland and the UK

Figure 19: Readiness to Support Next Generation Broadband Services in Cities, 2009



Source: CISCO/Saïd Business School, University of Oxford, September 2009

Dublin ranks 86th out of 100 cities[47]

Dublin lags leading European cities such as Malmo, Rotterdam, Copenhagen, Stockholm and Amsterdam by a considerable distance in terms of meeting the needs of today's applications and readiness to support next generation broadband services capable of delivering tomorrow's applications.

47 The ranking out of 100 cities benchmarked is shown in parentheses.

2. Immediate Policy Requirements

Ireland needs to ensure that there is the capability for businesses and other users to avail of speeds and levels of quality comparable to those in other countries with which we compete. This means we must aim for a degree of speed, symmetry, latency, and geographic coverage sufficient to achieve this goal.

Greater investment in telecommunications infrastructure, particularly in key enterprise and population centres, is essential if Ireland is to continue to converge with the OECD average in terms of broadband take-up, cost and quality. There is a trend internationally towards the availability of significantly faster speeds in the main cities than is available nationwide. It is essential that advanced broadband services comparable to those available in competitor countries become available in Dublin and other key National Spatial Strategy (NSS) centres as a matter of urgency. Maximising the impact of the Metropolitan Area Networks (MANs) is also critical to meet the needs of enterprise. Achieving basic universal broadband coverage with scalable technologies is also an important priority and progress needs to continue through the National Broadband Scheme[48].

From a policy perspective, it is important to distinguish between core networks and access networks. The core network is the high-capacity backbone network, using digital technology to carry voice calls and data traffic around the country by linking the access points at which traffic from different customers is aggregated together – usually at the local telephone exchange for wired broadband technologies. The access network links the customers' premises to the aggregation point. Core networks use optical fibres; access networks can use a twisted copper pair (i.e. a standard telephone line), optical fibre, co-axial cable, wireless platforms or a mixture.

2.1 Investment in Core Networks

Telecommunications companies in Ireland, in some cases with State support, have made significant progress in recent years in terms of enhancing our international telecommunications connectivity[49] and developing core networks.

48 The Government's National Broadband Scheme will provide all citizens with access to some level of broadband. The National Broadband Scheme will bring basic broadband services (1Mb/s minimum) to the 10-15 percent of the population currently without service by mid-2010. In November 2008, the Department of Communications selected the mobile operator, 3, as the tenderer for the scheme. Progress has been positive. However the benefits will be mainly social and the critical issue for enterprise is to ensure that world class competitively prices NGN services become available in key locations in a timely fashion.

49 Ireland is well served with high capacity international connectivity to the UK, Europe and the US. International connectivity is adequate for current demand and there is healthy competition in the market. Government investment in international telecommunications connectivity, through partnership with Global Crossing, played an essential role in stimulating the development of this infrastructure. Important initiatives, such as Project Kelvin in Donegal, are enhancing Irish international interconnectivity and will provide vital pathways for enhanced regional development in the future.

The business case for investing in fixed line core networks is strong. In the core network, NGN developments involve a migration from a multi-network system to an Internet Protocol-based network capable of supporting large amounts of bandwidth, multiple access technologies and common services. The advantage for operators of moving to a core NGN is that it should result in a simpler and more efficient network structure, leading to improved service quality, lower management overhead and lower operating costs. For this reason, there are strong incentives for operators to migrate their core networks to NGN technologies of their own accord.

For example, Eircom has largely completed the rollout of its next generation core network in the Dublin area and roll-out of fibre optic rings in other regional sites is scheduled for completion by June 2011[50]. ComReg has found that the market for leased lines displays good levels of competition resulting in improvements in product offerings and prices[51].

The State already has the components of a significant and extensive fibre core network (see appendix 1), including fibre infrastructure of by ESB Telecom, Bord Gáis, CIE, National Roads Authority and Waterways Ireland . The Metropolitan Area Networks (MANs) are also regarded as part of the core network, albeit at the edge, and several operators are using them to improve their core network capacity. Larger centres included in Phase 1 of the MANs project, which have both a choice of backbone networks and large business customers, have seen significant improvements in communications services in terms of speed and price. The MANs have also spurred competition by encouraging existing providers to lower cost and improve service provision[52].

A key concern from an enterprise development agency perspective is the absence of competitive provision of dark/un-lit fibre, that corporate customers can manage themselves.

To support the development of the core network, further progress is required in terms of the following:

- **Providing access to public ducting infrastructure.** The Department of Communication's 2009 report, "Next Generation Broadband: Gateway to a Knowledge Ireland" included a commitment to a "one-stop shop" for State broadband infrastructure to provide service providers with integrated access to State-owned infrastructure[53]. The Department is establishing an Implementation task force to

50 Eircom presentation on Next Generation Networks to the Joint Oireachtas Committee on Communications, Energy and Natural resources, March 2009. See here.

51 In its Review of the Wholesale Leased Lines markets, ComReg noted that Eircom, BT and ESB were all active in the Wholesale Leased Line trunk segments market, while eNet operated the MANs and connections to them. ComReg found that the market for the trunk segments of high-bandwidth Wholesale Leased Lines between main urban centres was effectively competitive.

52 At present there are 32 service operators using the MANs, an improvement over past levels of competition.

53 http://www.dcenr.gov.ie/NR/rdonlyres/F9B1D956-358D-4870-AA99-DD25A4417F59/0/NextGenerationBroadbandPaperGatewaytoaKnowledgeIreland.pdf

oversee the project which entails a range of commercial, technical and legal complexities. Proposals to oblige all State companies which own ducting infrastructure to provide service providers with open access to ducting should be progressed swiftly[54];

- **Extending two MANs** to meet existing enterprise needs (by linking existing MANs to key IDA industrial sites at Carrigtwohill in Cork and Belview in Waterford) and to achieve network benefits of State investment to date; and
- **Building additional MANs** in a small number of outstanding NSS centres can support the availability of advanced broadband services in key centres[55].

2.2 Investment in Access Networks

The key challenge in terms of next generation broadband services is at the access layer from the national/regional network to the customer premises. While much progress is being made in upgrading the core network to NGN capability, less progress is being made on upgrading the access network to support bandwidth-intense applications and services which consumers and businesses are increasingly demanding[56]. Investment by private telecoms companies in next generation networks is subject to a high level of uncertainty due to the expense of moving to the latest fibre and fourth generation mobile networks and uncertainties about the levels of demand and prices consumers are willing to pay for high-speed broadband.

In July 2009, ComReg published a policy paper to promote the timely and efficient development of high speed broadband infrastructure and services with a particular focus on the role of regulation. Forfás, in its submission, highlighted the central challenge for Ireland is how best to achieve the transition from copper networks to fibre and recommended that the bottleneck of constrained capacity on the copper access network to homes and small business needs to be a key focus of policy and regulatory attention.

Notwithstanding the progress on current generation broadband, and Eircom's and other operators' development of an advanced fibre-based next generation core networks ComReg note that '…**we have barely begun to see the deployment of next generation access network in Ireland.'**[57]

54 Part 5 of the Communications (Regulation) Act 2002 (which relates to carrying out communications work on public roads) is to be amended to allow the National Roads Authority to make ducts on national roads and motorways accessible to telecommunication companies. It is intended that these amendments will be introduced in the Committee Stage of the Premium Rate Services Bill 2009.

55 Potential additional locations include Tuam, Castlebar, Ennis, Shannon, and Mallow.

56 The problem is that operators see the revenue split between them and content providers as inequitable. While consumers see value in content, this is not necessarily translated into willingness to pay for infrastructure. Network operators are unwilling to be seen as providers of a "dumb pipe" while applications and services provided over their networks earn high revenues for others such as content providers. Those that stand to profit from next generation broadband, through services or applications, do not have to build the network capable of delivering next generation broadband and the applications and services enabled.

57 ComReg, 2009, Next Generation Broadband in Ireland - Promoting the timely and efficient development of high speed broadband infrastructure and services, July 2009.

Next generation local access to homes and businesses can be facilitated by rolling out fibre infrastructure deeper into the networks to street cabinet level and thereon to homes and premises. This may take the form of extending fibre all the way to the consumer's premises, known as FTTH (Fibre to the Home) or FTTB (Fibre to the Building), or part of the way into the local network – FTTC (Fibre to the Cabinet) or FTTN (Fibre to the Node), with the copper wires left in place for the final connection to the customer. Extending high-speed broadband out to the consumer would require considerable investment, since legacy twisted-pair copper networks are not capable of carrying the higher speeds and lower latency required.

It is notable that while fibre is widely regarded as the most future proofed access technology, a common theme in the responses to DCENR's consultation document on Next Generation Broadband was that widespread NGN rollout in Ireland will be achieved only through a range of technologies – including wireless technologies. Wireless technologies such as WiMax and Long Term Evolution (LTE) are expected to intensify competition between wired and wireless platforms – particularly in the market for relatively lower speeds as wireless performance has technical limitations. Wireless technologies may be a particularly good alternative to fixed line wired broadband in rural areas where subscriber densities are lower and the economics of investment in fibre to the home/premises is less attractive. However, wireless technologies require fibre infrastructure to be extended out to radio base stations which serve consumers. For technologies such as LTE to deliver high speed mobile broadband services, mobile stations will be required at closely spaced intervals and high-speed fibre will be required to reach these stations. This has implications in terms of complying with planning procedures.

Proposed and ongoing investment in operators' access networks in Ireland is mixed in terms of level of ambition, geographical focus of roll-out and ability to future-proof networks.

- Eircom has recently completed Fibre To The Cabinet[58](FTTC) and Fibre To The Home[59] (FTTH) trials in Dundrum, Stillorgan and Sandyford in Dublin. It had planned to roll out next generation access infrastructure to a further 35 Dublin exchanges, but now has indicated that it has no further plans to invest as it believes that the business case is no longer viable[60].

58 Current generation fixed broadband access deployments typically involve the installation of active electronics in the local telephone exchange. The copper telephone line then runs from the local exchange to the customer's home (known as the 'local loop') via a street cabinet. In a fibre to the cabinet (FTTC) deployment, active electronics are installed at the street cabinet, with the copper between this point and the local telephone exchange (or other aggregation point) being replaced with a fibre link. The existing copper 'sub-loop' from the street cabinet to the customer's home is retained. The shorter copper 'sub-loop' in a FTTC scenario allows higher bandwidths to be provided to customers.

59 A FTTH network deployment is similar to a FTTC scenario; however, the entire copper 'local loop' is replaced with a fibre link.

60 According to Eircom, the cost of upgrading its access network to an FTTC solution at the top 65% of exchanges (covering about 1 million lines or 68 percent of the population) would be between €400m to €500m. Eircom's estimates for its FTTH solution state that it could cost in excess of €2,000 per home to install FTTH in new build premises, and €2,500 per home for retro-fitting FTTH solutions into

- UPC is more than half way through a €350 million upgrade of its cable network which already covers most of the National Spatial Strategy centres. UPC intends to move to the DOCSIS 3.0 cable standard during the course of 2010 on a phased basis, enabling it to offer speeds of 100 Mb/s to consumers in areas where it is active. UPC's broadband-enabled network currently passes about one-third of Irish homes and they have a 13 percent share of the fixed broadband market[61].
- Imagine has launched a WiMAX service available initially Dublin, Athlone, Waterford and Sligo with speeds of up to 8Mb/s with rollout to other towns and cities to follow (based on a €100m investment in association with Motorola and Intel).
- There are approximately 5,500 fibre connections in Ireland[62]. Magnet currently offers fibre to the home connections in a very limited number of housing developments in the Greater Dublin Area. This service provides download speeds of 50 Mb/s.

In many countries (e.g. Netherlands and the UK) competition between the principal telecoms company and a rival cable operator is driving deployment of next generation access networks. To date, such competitive tensions have not been significantly prevalent in the Irish market. The current competitive and regulatory environment in Ireland does not appear to be providing a significant spur to investment in access network upgrades by the fixed-line incumbent and alternative operators.

Forfás is concerned about the slow progress in developing access to the next generation of broadband networks necessary to support bandwidth-intense applications and services which are becoming increasingly available to consumers and businesses in other countries. Driving next generation connectivity is a key enterprise policy priority. The State can play an important role in enhancing the availability of next generation infrastructure required to deliver the speed and quality of service for the applications of the future. In the immediate term, the following measures are necessary to support the development of the market. Policy options are set out under two broad headings:

1. Actions to facilitate the necessary investment by private telecommunications operators; and
2. Utilising Existing State Investment and Regulations to Facilitate Investment.

2.2.1 Actions to Facilitate Investment by Private Telecommunications Operators

If next generation telecommunications are to become available in Ireland in a timely fashion, significant investment in the access network is required. Given the trends in private investment in enhancing the telecommunications network, it is not clear that there are adequate incentives for private operators to deliver advanced broadband services. It is important that the regulatory framework provides the enabling conditions in the market to

existing homes. Eircom presentation on Next Generation Networks to the Joint Oireachtas Committee on Communications, Energy and Natural resources, March 2009.

61 ComReg, Quarterly Data Report, Quarter 2 2009.

62 OECD, Broadband Indicators, 2009.

facilitate efficient investment and competition to allow market dynamics to drive investments. This entails investigating options to increase revenues and reduce costs and risks for private sector operators (i.e., improving their return on investment) while continuing to support competition in the market. Forthcoming changes in EU regulations may enhance Ireland's ability to act in this area.

Ensuring an Appropriate Return on Investment to Incentivise Investment:

Investments in next generation networks require access to significant funds and entail risks to the investor due to the high upfront cost of building the network. It is critical that there are adequate financial incentives to make these investments. In a regulated wholesale pricing market, ComReg has to establish what it considers to be an appropriate rate of return that can be earned in providing regulated services.

ComReg has already indicated in its most recent review of Eircom's weighted average cost of capital (WACC) that, in principle, the rate of return on adequate capital employed could be adjusted, taking into account the risks involved. The challenge is to incentivise investment while not allowing the regulated company to earn excessive returns at the expense of its wholesale and retail customers. Given the need to support further investment in the access network, potential may exist to review allowable rates of return in order to spur additional investment where risks associated with next generation investment are clearly identified.

Examining the Potential for Infrastructure Sharing:

Draft European Commission regulations on Next Generation Access Networks indicate that national regulators may have scope to explore the feasibility of co-investment models, where the high cost of civil construction works is shared among a number of operators, but each operates its own services network and defines its own services and prices. Subject to the market being deemed competitive, regulation could then be lightened or removed[63].

In Ireland, co-investment would represent a paradigm shift, not just for incumbents, but for alternative operators seeking access to the incumbent's network. However, there are some recent examples of voluntary network sharing in the mobile telecommunications industry. For incumbents, the signals are clear: different levels of co-operation with other operators will result in different levels of regulation and in some cases in no regulation. For access seekers, this would require them to invest in network development.

One possible open-access model is a joint ownership model whereby two or more parties (potentially including the State) agree to invest in, roll out and jointly own the access infrastructure. If enough joint investors are involved, and each has equivalent access to the network, this raises the possibility that no operator has dominance (that the market is unregulated, and that any further access by late-comers who are not party to the joint ownership scheme is based purely on commercial negotiations). Another possibility could be

63 However, under the draft Recommendation, strict regulation would continue to apply where national regulators find significant market power exists.

where operators seeking access make binding capacity commitments in advance of the rollout of infrastructure, with pricing levels varying depending on the volume and duration of the commitments. This would allow the operator building the network to share some of the risk with access seekers. In terms of next steps:

- Further work is required to **explore the feasibility of co-investment** models in the Irish context. While such an approach would need to be driven by private operators, it could also have significant implications for the regulation of the market and the management of existing state owned telecommunications assets[64]. The Department of Communications has indicated that it intends to build on existing collaborative initiatives to support the transition to next generation broadband, and will form a Task Force, comprising industry, Government and ComReg to work collectively to ensure that the development of broadband will meet the demands of Ireland's smart economy[65]. This taskforce could assess the potential of co-investment and infrastructure sharing models.
- **Sustain regulatory pressure:** In the absence of progress on infrastructure sharing at the access network level, continued progress on **local loop unbundling** can play a positive role in spurring investment in infrastructure[66]. In countries, such as France, where a successful LLU regime has resulted in fierce competition in current generation broadband services, this has spurred fibre developments, as innovative new entrants roll out fibre to larger urban centres.
- It is important that ComReg and industry operators make progress in ensuring that a suitable range of **wholesale products which are fit for purpose**, including ethernet products, are made available by Eircom on a wholesale basis to alternative operators.

Enable Wireless Spectrum to Play a Strong Role:

Wireless spectrum policy is crucial for both fixed and mobile broadband services, particularly in less densely populated areas. Broadband services, which use radio spectrum, account for 38 percent of all broadband subscriptions (106, 519 fixed and 411,855 mobile connections) in Ireland[67]. While interest in Fixed Wireless Access has been declining somewhat, new technologies such as WiMAX may reverse this by offering higher speeds and lower prices. Developments in 3G mobile technologies in terms of offering faster broadband speeds are also promising.

Ensuring that spectrum is available to support emerging wireless services is an important priority. ComReg has operated a proactive policy towards wireless broadband, making

64 ComReg have highlighted that they will 'continue to engage with Eircom and industry in relation to NGB network developments and to respond in a timely manner regarding the application of the regulatory framework where collaborative wholesale NGB access models emerge. Next Generation Broadband in Ireland, Promoting the timely and efficient development of high speed broadband infrastructure and services, July, 2009.

65 Next Generation Broadband: Gateway to a Knowledge Ireland

66 Local Loop Unbundling is an example of where incumbents are forced to provide open access to the copper loop to their competitors.

67 Comreg, 2009, Quarterly Key Data Report, Q3 2009.

spectrum available in several frequency bands (3.4-3.8 GHz, 10 GHz, 26 GHz, and now consulting on 2.3 GHz, which could be used for mobile wireless broadband) and supporting European initiatives in this area. ComReg has also supported innovative pilot projects that require spectrum. In order to promote the more effective of spectrum: the following should be considered:

- Other countries have a variety of mechanisms to allow spectrum to change use (France through a system of re-farming[68], whereby the regulator effectively buys back the spectrum from a less productive use and reallocates it to a more productive socio-economic use; the UK through spectrum trading), but this appears challenging in Ireland. The 1926 Wireless Telegraphy legislation under which ComReg operates does not provide for some of the mechanisms used in modern spectrum management worldwide to increase flexibility – for example spectrum trading;
- Transferring current analogue terrestrial television broadcasting system to digital television will release extremely valuable spectrum[69]. The release of valuable spectrum due to the 'digital dividend' is contingent on a successful transition to digital terrestrial television and a definite date for analogue switch-off. There are currently uncertainties about the commercial element of the DTT service, although RTE is rolling out its digital network. It is vital to ensure that the analogue switch-off date of 2012 is met[70].

2.2.2. Utilising Existing State Investment and Regulations to Facilitate Investment

The State is an important owner of telecommunications infrastructure. Investment in international connectivity, regional infrastructure and the Metropolitan Area Networks has played an important role in spurring competition and improving the price and quality of services. While much of the infrastructure investment to date has been in the core network, the State through both investment and regulation can take a number of steps to support the development of an open local access network.

Requiring Provision for Ducting in New Developments:

Changes in the planning regulations should be introduced to compel the inclusion of ducting in all relevant public works. Mandating the provision of optical fibre ducting in the planning process for all new premises and developments will support the long term development of broadband services. The commitment in the Government's policy paper on NGNs to mandate

68 For instance, the 2.6 GHz band is being considered for harmonization in Europe, but this is in use by the MMDS service in Ireland to provide television services in rural areas. Legislation (whether national primary legislation or through transposition of the revised EU telecoms directives) may be required to increase flexibility in spectrum management.

69 The frequencies in question – in the UHF band – have very good propagation characteristics, meaning that they can provide high levels of coverage (including indoor coverage) and high bandwidth

70 By the end of 2008 twenty EU member states had begun digital terrestrial television transmissions. Ireland, Poland, Portugal, Romania, Slovakia, Slovenia and Cyprus plan to begin transmissions in 2009 or 2010. Germany, Finland, Luxembourg, the Netherlands and Sweden have already completed analogue switch-off. Analysys Mason, DotEcon and Hogan & Hartson, 2009, Exploiting the Digital Dividend – a European approach. Report prepared for the European Commission, August 2009.

ducting in all new premises is a positive development and one that needs to be progressed as quickly as possible. The Department of Communications, Energy and Natural Resources is working with the Department of Environment, Heritage and Local Government and ComReg to advance this proposal; however, no regulations have been drafted as yet.

Mainstreaming Access Infrastructure into Existing State Investment Plans:

The mandatory provision of ducting as part of all State infrastructure development programmes, such as roads and rail, water network upgrades, sewage and 'smart' electricity metering programmes, would support the development of an open access network.

Consideration should be given as to whether smart metering of energy and water can be integrated into the same platform as broadband access technologies. For example:

- **Water:** Many of Ireland's urban centres will be undertaking significant upgrades of their water networks over the coming years to reduce the current high levels of leakage[71]. This provides an ideal opportunity to install ducting in these centres in a cost effective manner[72].
- **Smart Metering**: The Commission for Energy Regulation is currently undertaking a smart metering pilot programme in 6,000 homes with variable pricing for electricity used. This pilot will be subject to a cost-benefit analysis to estimate the payoff to society of various roll-out options trialled. Both a 'smart grid' and NGNS will require substantial planning, spending on new wires, and the creation of major new digital infrastructure to connect homes in vastly expanded networks of information exchange. If Ireland adopts an ambitious national programme for smart meters in terms of coverage and technology levels, construction of the electricity grid and NGN infrastructure should go hand-in-hand and obey the principle of "dig-once, lay twice" which would allow for economies of scale and cost savings in any future deployment.

  In Denmark power companies have invested heavily in the roll-out of fibre to the home (FTTH) networks and have the bulk of fibre subscriptions at present. The number of fibre subscriptions in Denmark was just over 202,000 fibre lines in December 2008[73] equivalent to 10 percent of all broadband connections.
- **Sewers**: A trial is taking place in Dundalk whereby a company H20 Solutions is providing fibre to a small number of homes through ducting already in place in Council sewerage pipes. There are similar trials of a larger scale in several locations in the UK. There may be scope for roll-out of fibre wires at a relatively low cost compared to traditional methods and cost savings for local authorities as they can align the work with contracts for cleaning/maintenance of sewers.

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71 The level of public investment in water infrastructure is significant, as set out in the Water Services Investment Programme (€500 million in 2009) of the National Development Plan. This may be subject to revision as capital expenditure projects are prioritises.

72 H20 solutions is conducting research and development on the technologies required to deliver fibre to the home/premises via water pipelines.

73 Comreg, 2009, Next Generation Broadband in Ireland - Promoting the timely and efficient development of high speed broadband infrastructure and services, July 2009.

The Role of Local Authorities

Upgrades of access networks can be facilitated by better utilisation of existing ducting. Given the high cost of civil construction works, there is a better chance that roll-out of next generation access infrastructure can be economical if cables put in existing ducts can be used. This may require local authorities to undertake additional investment (mapping of assets, repair work, extension to connect to sites etc.) to make ducts fit for the purposes of telecommunications operators.

Local authorities can also promote the rollout of advanced services by seeking to extend existing Metropolitan Area Networks to improve their reach:

- There is potential for county managers to take a more proactive and medium-term approach in their own infrastructure planning and to coordinate with the plans of other infrastructure providers such as telecommunications companies as they upgrade and maintain their networks in future;
- The development of next generation access networks is not necessarily confined to the plans of existing large, fixed players, although the major operators will of course play an important role. There are more than 300 open-access schemes across Europe, with 200 of these in Sweden[74]. These are generally owned by municipalities or other public agencies. Funding these initiatives remains challenging. Some are funded by householders paying a relatively high up-front fee or through borrowings on mortgages;
- Aggregating demand for broadband services across government departments, agencies and other bodies (for example universities, schools, libraries, local authorities) can also support investment by creating a critical mass of demand and reducing risk for private investors in network upgrades.

Reduce the Costs of Building Access Networks:

Civil construction works typically represent up to 80 percent of the total rollout costs of access networks. The sharp downturn in the economy is likely to have lowered some rollout costs. However, administrative costs remain significant. Some costs are unavoidable – e.g., health and safety rules on guarding, lighting and signage in connection with civil works. However, there are a number of planning issues which affect the cost of network roll-out which should be reviewed with a view to incentivising investment by minimising costs[75]:

- Planning rules have made it increasingly difficult for operators to use overhead networks, rather than underground. Only in rural areas or towns of less than 50 people is overhead generally allowed. This stems from individual decisions taken by local councils, rather than national rules, but seems to be a nation-wide phenomenon[76];

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74 Sweden has a high penetration of fibre connections which account for 20 percent of total connections at the end of 2008. See figure 3. Source: OECD Broadband Statistics.

75 For a more complete discussion of some of these issues, see ComReg document 09/39, "Response to Consultation Document No. 08/56 and Further Consultation on Local Loop Unbundling ('LLU') and Sub-Loop Unbundling ('SLU') Monthly Rental Charges".

76 A recent report prepared for the UK Government quoted figures from Cisco which suggested that the cost for next generation rollout in eight major English cities could be reduced from £1,200 to £400 per home passed. This report recommended that the Government should amend the planning laws so that

- Local authorities charge up-front bonds to contractors which open up roads or footpaths, to cover the risk of inadequate reinstatement of the road surface. While it is reasonable for local authorities to cover their costs, additional charges increase the cost for operators of upgrading their access network. Local authorities should be open to the possibility of "quid-pro-quo" deals, whereby they possibly forego some up-front revenues in return for improved infrastructures for their areas;
- The bureaucratic obstacles and time involved in securing way leaves from different local authorities is an issue for operators; and
- Fragmentation between local authorities in terms of charges and application processes for receiving permission to dig makes it more difficult for operators to invest in upgrading their access networks. It is necessary to examine whether local planning rules can be amended to make construction of access networks easier and to reduce the cost and time for operators of dealing with the patchwork of local authorities individually.

Finally, in the development agencies' response to DCENR's 'Next Generation Broadband Consultation Paper' in October 2008, it was recommended that a dedicated unit be established in Government, fully-resourced and empowered to coordinate the activities of both public sector authorities and other government initiatives in the telecommunications market. Such an office could play an important role now to ensure the planning and delivery of next generation broadband access infrastructure in Ireland.

overhead deployment could take place where necessary, subject to local consultation and certain constraints in sensitive areas. The Next Phase of Broadband UK: Action now for long-term competitiveness: Review of Barriers to Investment in Next Generation Access, Final Report, September 2008.

2.3 Conclusions

DCENR's policy framework sets a vision for Ireland's broadband speeds to equal or exceed those in comparator EU regions by 2012. Forfás agrees that Ireland needs to be among the leaders in Europe in the provision of next generation telecommunications infrastructure and services by 2012. As a first step it will be important to drive swift implementation of the actions set out in DCENR's framework published in July 2009.

As illustrated in the benchmarks assessed, broadband speeds are currently higher in other countries than in Ireland. Many telecommunications companies and States around the world are investing in next-generation access networks. It is not clear that sufficient investment in upgrading access networks is taking place or planned to enable Ireland to catch up with leading countries.

Unless a way to stimulate private investment in next generation broadband networks is found, particularly in terms of access networks or the State makes the necessary investment itself or in partnership with the private sector, Ireland risks allowing a competitiveness threat for Irish firms to open up as significantly faster speeds become widespread in other countries.

A number of countries have determined that fibre connections are critical to a digital economy and are committed to strong public intervention to ensure this utility becomes widely available in a timely and cost competitive fashion, and in some cases are investing directly in the market. The EU has changed its State Aid rules to facilitate such joint public-private initiatives in both rural and urban areas, where such investments are contributing to economic recovery and social cohesion objectives.

Forfás, in consultation with stakeholders, will assess the options for Ireland in this regard, so as to ensure that access to next generation networks will be delivered within a timescale that will allow Ireland to catch up with other countries and to harness the potential of NGNs for economic growth and jobs.

Appendix 1: Summary of all State assets that have fibre or ducting available in the development of a NGN telecommunications infrastructure

Metropolitan Area Network (MANs)	The Metropolitan Area Networks are fibre based rings, technology neutral, at the outskirts of a number of towns around the country. To date 27 MANs have been completed under Phase I of the Programme and 65 MANs have been completed under Phase II of the Programme, covering a total of 93 towns. Listed below are the towns that are covered in phase 1 and phase 2 of the MANS. Phase 1 MANs – 27 towns Athlone, Ballina, Carlow, Cavan, Carrick-on-Shannon, Carrickmacross, Clonmel, Cork, Drogheda, Dundalk, Dungarvan, Galway, Gweedore, Kilkenny, Kiltimagh, Kingscourt, Letterkenny, Limerick, Monaghan, Manorhamilton, Mullingar, Portlaois, Roscommon, Sligo, Tullamore, Waterford, Wexford. Phase 2 MANs – 66 towns Bantry, Blarney, Carrigaline-Ringaskiddy-Passage West, Charleville, Dunmanway, Fermoy, Kanturk, Kinsale, Midleton, Mitchelstown, Skibbereen, Youghal, Ballybofey-Stranorlar, Ballyshannon, Buncrana, Bundoran, Carndonagh, Donegal Town, Donabate/Portrane, Lusk, Skerries. Athenry, Ballinasloe, Clifden, Gort, Loughrea, Castleisland, Killarney, Listowel, Tralee, Longford, Ballinrobe, Claremorris, Knock Airport, Dunboyne/Clonee, Dunshaughlin, Kells, Navan, Trim, Edenderry, Ardee, Bailieborough, Castleblaney, Clones, Coothill, Cahir, Carrick-on-Suir, Cashel, Thomastown, Tipperary, Abbeyfeale, Banagher, Birr, Kilrush, Nenagh, Newcastlewest, Roscrea, Templemore, Blessington, Kilcoole / Newtownmountkennedy
ESB Telecom / Eirgrid / ESB Networks	The backbone fibre assets are primarily those of ESB Telcom which has an aerial fibre network of 2,880 kms based on 110 kV cables, roughly shaped as a figure eight across the country with spurs to Sligo and Donegal.
CIE / Iarnrod Eireann	A nationwide fibre network is laid alongside the rail tracks and is currently used exclusively by BT under contract. It covers all major towns along the rail route
Bord Gáis	There is available ducting that crosses the country and that is currently lying empty. It was initially installed with the gas pipeline to the west. This is a valuable asset that is currently unused. Additionally there is a fibre network "Aurora" which comprises of 25 km of fibre in rings around Dublin, centred on business parks.
RTE	The vast majority of this network is wireless radio links with capacity used primarily by RTE. It does support some small local operators. It does not have any fibre deployment.
National Roads Authority	There is some ducting available along primarily the major motorways –M1, M7, M9, M6 and the M4. In some cases ducts are placed under both verges and in other cases under one verge.

Appendix 2: Technologies for a High-Bandwidth Future

A number of different technologies can be used to deliver broadband access; DSL, cable, mobile using 3G or HSDPA[77], wireless and fibre optics. The competition among these technologies to offer broadband internet service exists primarily in providing last mile service, because the major long distance wires that comprise the Internet backbone around the world are primarily made out of optical fibre. Many provide asymmetric services, where the downstream speed is significantly higher than the upstream speed. Each technology (except fibre) has limitations on the maximum amount of bandwidth it can supply, based on physical restrictions such as distance and interference. Although several technologies can meet projected interim bandwidth needs, only two can realistically deliver 100Mb/s symmetrical in the future; fibre to the home (FTTH) and upgraded cable technology using DOCSIS 3.0.

Wired Hardware

DSL or xDSL is a family of technologies that provides digital data transmission over the copper wires of a local telephone network.

ADSL (Asymmetric Digital Subscriber Line) uses the existing copper network from the telephone system. Various improvements to the ADSL standard such as ADSL+ and VDSL offer further improvements but are dependent on the quality and the nature of the legacy network. Variants on DSL over the copper telephone wires are particularly susceptible, as maximum speeds can only be reached within a specified distance from the exchange. Speeds tail off rapidly the longer the local loop. Also older copper and copper that has been patched and added to over the years will not deliver advanced services.

Coaxial cable is widely used for television networks in urban areas, and this can also be used for the provision of broadband and telephony. Parts of the main cable TV network can be upgraded by replacing them with fibre, and extra switching equipment can be added that then enables broadband services. The advanced standard for this is Docsis 3, which allows for peak speeds of up to 152Mbits/s. Across the OECD, cable network operators are in the process of upgrading their networks by installing fibre closer to consumers and using the new DOCSIS 3.0 standard, which allows operators to offer customers faster speeds by benefitting from lower and more gradual network upgrade costs than FTTH/FTTC upgrades.

Fibre

Internationally, the deployment of FTTH is regarded as the ultimate next generation broadband solution. On a purely technological level it is widely accepted that fibre currently offers the safest bet to reach speeds greater than 100Mb/s. FTTH is a one-off investment that can be exploited for the next 30-40 years. Continued innovation in fibre optic technology means that once an end-to-end fibre connection is in place, the local access layer would no longer be a constraint in the network. To future-proof long-term investment, only fibre can be used to meet the forecasted bandwidth demand of 100Mb/s in the future. Fibre to the home is already delivering speeds of 1Gbit/s to domestic consumers in Tokyo.

77 High-Speed Downlink Packet Access (HSDPA) is a 3G mobile telephony communications protocol which allows networks based on Universal Mobile Telecommunications System (UMTS) to have higher data transfer speeds and capacity.

Wireless Hardware

Wireless technologies can also be deployed to deliver significantly improved broadband performance. Wireless infrastructure providers are emerging as competitors to wired providers in broadband markets throughout Europe, as speeds increase with evolving technical standards. Wireless is effective in reaching wide areas without costly infrastructure investment, but delivered speeds for wireless are often much slower and vary with the number of users and the distance from the base station.

WiMAX and Long Term Evolution technologies have very similar characteristics and advanced features with the commercial decision to deploy depending on factors such as the lifecycle of equipment in the operators' legacy network, access to spectrum and the timing and sequencing of future spectrum release in various countries.

While suitable for delivering higher speed broadband, Wimax requires available bandwidth to be shared between users in a given radio sector, so performance could deteriorate in the case of many active users in a single sector.

LTE (Long Term Evolution) is the last step toward the 4th generation (4G) of radio technologies designed to increase the capacity and speed of mobile telephone networks. The LTE specification will provide downlink peak rates of at least 100 Mb/s[78]. There are major investments in LTE under way – most notably in the US. Many European operators are taking a more cautious deployment approach, awaiting availability of more attractive spectrum bands (e.g. 2.6 GHz and 800 MHz) and having failed to realise the gains expected from substantial 3G investments in the past.

78 The current (theoretical) peak downlink network speed for 3G networks is 14.4 Mb/s. While there is considerable uncertainty regarding the speed of technological development, this is set to evolve, first to 42 Mb/s and later to more than 100 Mb/s with the Long Term Evolution (LTE) standard. Speeds of up to 42 Mb/s can be supported with the IEEE 802.16e standard while speeds greater than 100 Mb/s may be supported in future by the IEEE 802.16m standard. The first LTE deployments are expected to be launched in 2010. 45 operators in 23 countries have committed to LTE deployments - 16 LTE networks are expected to launch in 2010 and 31 by 2012.