BSG
Broadband
Stakeholder
Group

Demand for Superfast Broadband

Understanding demand in Europe, the US and Asia; how the UK is currently performing; and what might impact take-up in the UK in the future

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Executive Summary

We publish this report as part of a broader objective of the Broadband Stakeholder Group (BSG) to raise the profile of demand side issues in broadband policy debates.

In recent years attention has rightly been paid to the supply of improved broadband networks and how networks that can support superfast broadband services can be financed, deployed and reach across the whole of the UK, not just those areas that are ripe for commercial investment.

These supply side issues are important and there is still some way to go in executing the government's ambition that the majority of the country will have access to superfast services by 2015. However the BSG is of the view that now is the time to focus further attention on issues concerning the demand for and use of these new services that this infrastructure will support.

Ultimately broadband is important, not only because of the potential benefits its usage can bring to both individuals and society but also the role it could play in supporting the central focus of the government: economic growth.

A necessary component for building understanding of use and benefit is consumer demand for and take-up of superfast broadband services[1] and this is the focus of our report. In this study we go beyond the headline take-up figures reported for superfast broadband across a number of markets to try and understand better the underlying demand and specifically, actual consumer willingness to pay for such services.

We believe this is an important metric as it sheds more light on what types of services consumers value and gives insight to the increased usage of broadband by consumers which is hoped will yield wider benefits. It is also of central importance to operators investing in and retailing superfast broadband services, providers of broadband-enabled services who may wish to develop new services that require superfast connectivity and policy makers who are keen to incentivise and encourage operators to invest in and offer superfast services.

This report brings together data regarding take-up of superfast services that will be a useful input to those interested in exploring comparative demand data for superfast broadband. The report also puts forward some analysis alongside this data regarding how the UK is faring against its international peers, demonstrating that initial consumer demand for superfast services in the UK gives good reason to be confident that the foundations are in place to build upon in the coming years.

In this report we put forward that:

- Within Europe, the UK is a solid mid table performer, gaining on European leaders such as the Netherlands, Denmark and Sweden and outperforming major peers such as France, Germany and Spain. Furthermore the UK's initial subscriber growth rate for

[1] In this study we define superfast broadband as a service that goes beyond the capabilities of ADSL technology, i.e. over 24 Mbps. This definition excludes services delivered over NGA networks which are not superfast, but captures higher speed services on cable networks. Please refer to the glossary for a full explanation of terms used within this report.

superfast broadband compares well, and coupled with the pace of deployment of fibre networks by BT and the upgrades Virgin Media is making to its cable network provide a good foundation on which to build.

- Looking to the United States, despite the level of infrastructure investment, the percentage of consumers actually actively choosing superfast broadband services on these networks is comparatively low. This is possibly a consequence of operators competing more heavily for Pay TV customers on their fibre networks rather than focusing on driving demand for superfast broadband. We believe European markets offer more competitive superfast broadband services to customers and that there could be a potential opportunity for the UK to challenge the US in broadband enabled service innovation given that less than 3% of US homes currently subscribe to genuinely superfast broadband services.

- Looking east to Asia, the world leaders in next generation network deployment, it is no surprise that these markets also lead take-up for superfast broadband. That said however, our analysis demonstrates that the UK's initial growth curve for superfast broadband services compares favourably to that of Japan's when superfast services were first offered in that market. Our analysis also highlights some pricing challenges operators in the Far East have experienced in selling superfast broadband services. In making these points we are not criticising the trajectory that Asian markets have followed nor are we suggesting that the UK is likely to mirror their development. However this comparison shows that the UK has made a solid start on its next generation journey when you compare the figures to those of these broadband trailblazers.

Our analysis also explores the factors that may have an impact on take-up levels to give a view on the potential opportunities and challenges that lie ahead for the UK.

Network quality, including what speeds are available, is we believe one important factor. Anecdotal experience suggests that in areas where ADSL services are of poor quality then demand for superfast services will be higher. Conversely where ADSL services deliver a better quality and lower tier legacy cable services are also available it may be more challenging to persuade consumers onto an enhanced service if they fail to see what the tangible benefits would be of upgrading if they are broadly happy with the characteristics of their current service.

This links across to the issue of **price**. The data in this report reflects the underlying challenge for operators – how to price a superfast product so that a premium is charged that both offsets investment costs whilst enticing the consumer. This is no mean feat and it is no surprise that the figures show plentiful free or low costs upgrades to consumers across all markets. A key question we pose is what happens to demand after the free upgrades and early adopters. Looking at this issue now is crucial if we wish to see growth for superfast broadband demand in the UK that both supports investment and links to the increased usage and exploitation of superfast broadband networks.

Service innovation is also an important influence on demand. In a number of markets we have seen, entry to the Pay TV market through an IPTV service can act as both a strategic driver for an operator's deployment of superfast broadband and as a stimulator of consumer adoption of superfast broadband. In the UK, it is possible that developments in the IPTV

market, both free to air and Pay TV, may bolster take-up with YouView, Sky's NowTV, and additional offerings from BT providing new compelling consumer products into the market. It is also apparent that at this time no market has established itself as a centre for the development of innovative services that require superfast broadband connectivity. Given the lack of genuine superfast broadband in the US, the usual market in which services are developed, this may provide an opportunity for the UK to develop a leadership role in this regard, if an innovative market and service ecosystem can be developed. This suggestion however should be tempered with the example of the Asian markets, where despite leading deployment and take-up of superfast broadband, subsequent service innovation has not occurred to the same degree.

In setting out these views we are of course starting a debate and not aiming to conclude one. We are at the beginning of a journey and it is difficult to accurately predict the bends in the road ahead and where we will eventually end up. Many forthcoming developments will impact on demand for superfast broadband in the UK. The results of the Broadband Delivery UK (BDUK) process will impact on the services available for consumers to take-up in the final third of the UK. The rollout of Long Term Evolution (LTE) services will provide alternatives to consumers and will add competitive pressure into the market. Regulatory developments will be important in building and sustaining competition in a superfast environment. Online service innovation will inevitably impact consumer decisions about what type of broadband they need in order to access the services they want. Consumer behaviour will ultimately drive the market and it is right that it should.

However in stripping away some of the myths and preconceptions about the performance of different markets this study urges policy makers to ensure that they set realistic expectations in respect of superfast broadband take-up. Superfast broadband has had a gradual development in all markets, even those world leaders in Asia. In this context there is no cause to believe that the UK is not currently performing solidly and indeed there are several elements of the UK's experience to date that give cause for confidence and optimism.

Furthermore we also hope that this study demonstrates the importance of focusing more attention on what services consumers are choosing to take-up and what they are using them to do. It is the use of exploitation and use of broadband networks that deliver economic and social benefits. In order to justify the investment in and attention given to broadband infrastructure over the last few years the challenge now is to focus on its use. It is here where national ambitions will succeed or fail and is, in the BSG's view, the most important metric in assessing the quality of broadband in the UK.

1. Introduction

The debates concerning superfast broadband have to this point been largely about the supply side. Governments and regulators have sought to remove barriers to investment, creating environments that will encourage investors to build networks that will bring superfast broadband to businesses and consumers. In the UK, this has led to successive governments outlining plans to ensure near universal coverage of superfast broadband for consumers; the coalition's plans are now being delivered with the ambition to see in excess of 90% of homes with access to superfast broadband in the next few years.

Once this infrastructure is built, however, what can we expect it to deliver? What will be the likely consumer reaction? What innovations will occur, what new services might emerge and will superfast broadband change the economy and society? These are big questions, and in many cases unanswerable at present. However, what is clear is that the focus over the next few years will be on how these services are taken up by consumers, and what they might do differently with superfast speeds.

This study is the BSG's first examination of the take-up of, and demand for, superfast broadband. This is an issue that will be at the heart of the BSG's interest for the foreseeable future, and this report is intended to start a debate, not to conclude one. Fundamentally, however, we are looking at one issue: what does the evidence tell us about consumer demand and willingness to pay for superfast broadband?

To answer this we consider the evidence from a number of countries; look at some factors that are likely to impact on consumer demand; and compare superfast broadband with other similar services. We will set out some early conclusions that look at the linkages between superfast broadband and other markets and services, and crucially where we think the UK is and how we think it might develop.

A note on methodology

The study is concerned with understanding residential consumer appetites to pay a premium for superfast broadband. In the UK, superfast services are available at a premium to ADSL and lower-tier cable services; this is the same in the majority of Western markets where superfast broadband is commercially available. Therefore, in order to understand the likely consumer response to the availability of superfast broadband, we need to review the evidence of residential consumers paying this premium.

There is value in understanding the total number of users of superfast services in a market. For example, if you wanted to understand users' ability to adopt new high-speed Internet-based services, or to make an estimation of the ability of the broadband infrastructure in a country to support innovation. However, for our purposes counting consumers who have been given superfast broadband for free, or at no premium compared to lower speed services, will not help us to understand the genuine demand or willingness to pay a premium for a superfast service. We seek to understand this as consumer appetites to pay more for broadband are a crucial consideration in the investment decisions of operators; for stakeholders and policymakers interested in ensuring that operators invest in broadband infrastructure, this is important to understand.

To be clear, we are focused on the residential market and not business users (although some of the figures will likely include small and medium enterprises (SMEs) as well as residential customers). Investment in next generation access (NGA) coverage concerns services being delivered to the residential market; the business market is very different, both in services available and infrastructure in the ground. While there are clear relationships and interdependencies between the two, the focus of achieving coverage and take-up of NGA services is very much on the residential market, and this is the focus for this study.

To gather evidence, we selected a number of markets to review. Along with the UK, we looked at a number of other European countries: Belgium, Denmark, France, Germany, Italy, the Netherlands, Portugal, Spain and Sweden. These countries were chosen because of similarities of regulation, market structure, environment and relevance – these markets are amongst those seen as the UK's peers within the EU. We also examined the USA: although the regulatory environment and market structure are very different to the UK, the consumer behaviour is likely to be more similar. Finally, we looked at three Asian markets: Hong Kong, Japan, and South Korea. These are held up as the leaders in terms of superfast broadband, and are cited by politicians and government ministers as being case studies of what the UK should aspire to be. In reality, these countries have very different geographies, regulatory and policy environments, and consumer behaviours from European and US markets, and thus comparisons should be made with caution. Nevertheless, as the most mature superfast broadband markets in the world it is worth understanding the consumer journey in these markets and seeing what can be learned that could inform our thinking on the development of the UK market.

In determining what services to review, we also need to define what we mean by superfast broadband. Our general definition is any service that is beyond the capability of ADSL technology, i.e. over 24Mbps download. This definition will exclude services delivered on NGA networks that are not superfast, but will capture higher speed services on cable networks. We are not interested in an academic debate about what a superfast broadband service is; what we are interested in is capturing adoption of higher speed services that consumers must pay a premium for and that have required investment from operators in order that they can deliver them. We are also focusing on wired services. Although 4G services will likely have an impact in this market, in most instances these services are too new to be able to include in this report. However, we will return to 4G in future work in this area.

There are some services that are borderline superfast on this definition. In the US, for example, broadband services offered by AT&T and Verizon over their NGA networks have advertised, headline download speeds that are no faster than advertised ADSL services in other countries such as the UK, but the upload capability is beyond ADSL. It seems intuitively unlikely that residential customers are paying a significant premium for higher upload speeds rather than download, and so we will address this when we discuss the US data. There will also be users on services that meet the definition but that have been uplifted on to that service by their provider – for example many 30Mbps and above cable service subscribers. As we are interested in a willingness to pay for superfast broadband, and these subscribers have not demonstrated a willingness to pay, we need to adjust for these subscribers where possible.

In compiling the following study we have undertaken extensive desk research, utilising data from operators where possible, augmented with national regulatory authority (NRA) data and other sources where available. In some instances, however, data of one type or another (coverage, take-up, pricing etc) is not available from a particular operator. Where appropriate and where we can have confidence in our estimates, we have extrapolated and interpolated from other available data to resolve unknowns in our dataset.

2. Superfast broadband – deployment

The first point to highlight, however, is not about demand at all, but about the pace and extent of deployments.

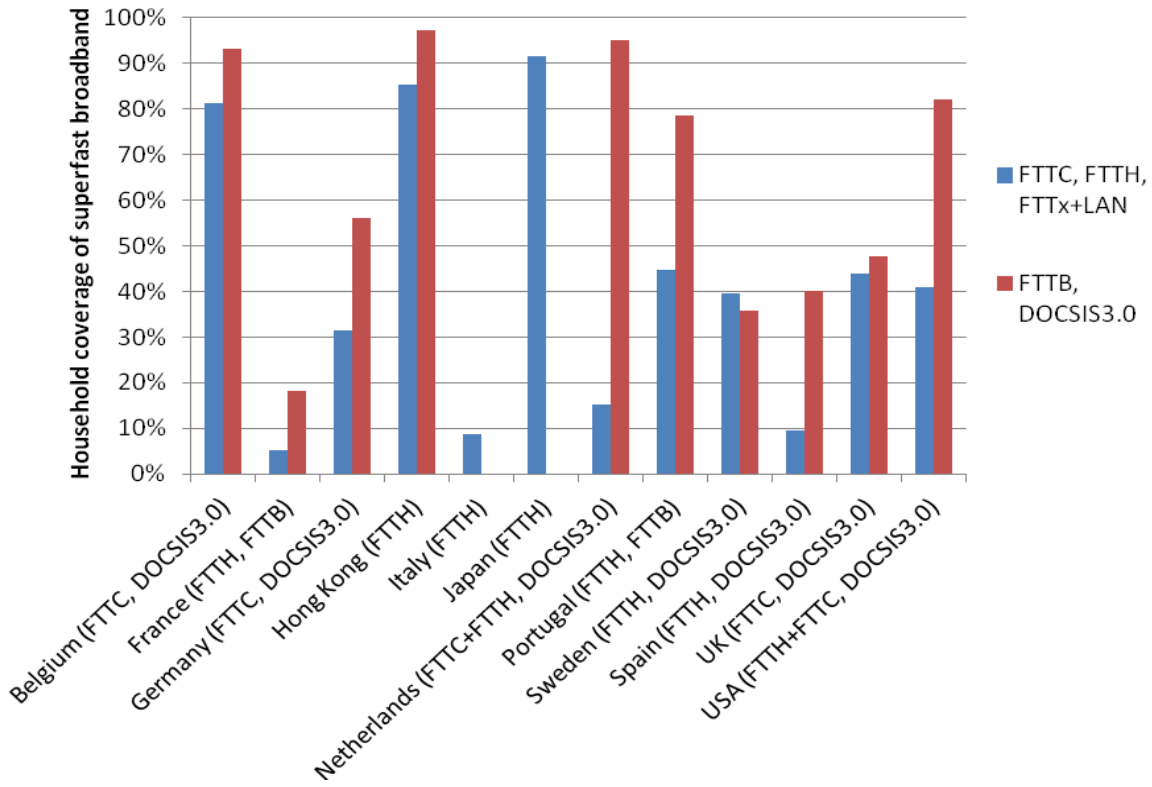
Current coverage of superfast broadband

Unsurprisingly, the markets in the Far East have the greatest coverage of fibre-delivered superfast broadband. These markets saw deployments begin far earlier than other markets in Europe and the US, and rollouts are relatively mature. Although we do not have coverage data for South Korea, coverage for both Japan and Hong Kong highlights this, while the level of take-up seen in South Korea would not be possible without widespread, near-universal deployment.

The US has most likely seen the end of its period of market-led investment in fibre-based access infrastructure: AT&T and Verizon have both slowed or completed their investments, and are now focused on other capital investments in their wireless services. This leaves the US at a coverage level of around 40% for NGA infrastructure deployed by the copper line incumbents, focused on the major urban areas and cities. Cable operator DOCSIS3.0 coverage extends to around 82% of homes.

In the European markets we have examined, coverage of superfast broadband speeds has usually been led by the cable operator deploying DOCSIS 3.0 technology or, in some cases, fibre-to-the-building or –home (FTTB/H) technology. In the UK, coverage of superfast speeds was initially led by Virgin Media, who cover nearly 50% of UK households, while in France, Numericable have led the way on superfast with their FTTB deployment that currently serves 4.4m homes in France (17% of households). The coverage achieved by cable operators has usually preceded the deployment of next generation access by incumbent operators, and provided the first superfast broadband services to the residential market.

Figure 1: Household coverage of superfast broadband

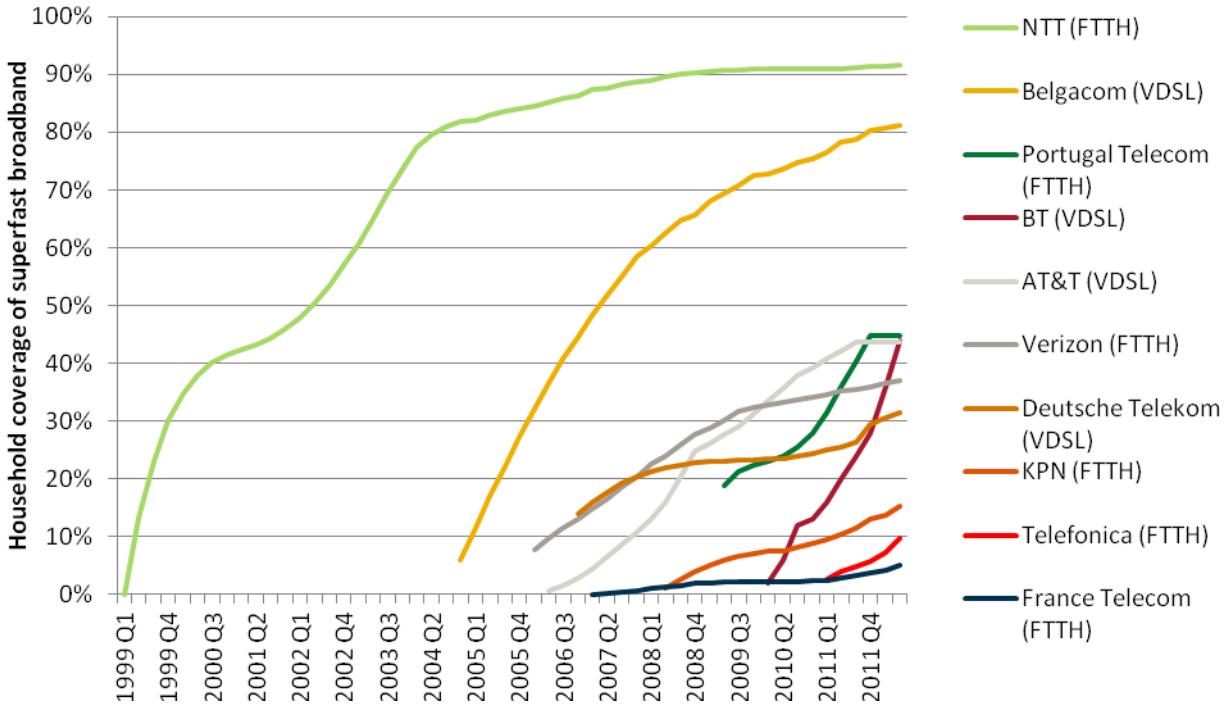


Source: Operator, NRA, association data. As at Q2 2012 for FTTC and FTTH data, and between Q4 2011 and Q2 2012 for FTTB and DOCSIS3.0 data

Pace of deployment

Incumbent deployments of NGA will naturally be slower than DOCSIS 3.0 upgrades are for cable providers: they are more resource-intensive, both in terms of cost and required manpower. However, when we look at the coverage being achieved by incumbent deployments, what is interesting is that there is no obvious split between the pace of build-out of fibre-to-the-cabinet (FTTC) and FTTH deployments. Instead, differences in deployment speed tend to reflect specific circumstances within particular countries. France, for example, has seen its incumbent investment held back by technical and regulatory challenges posed by the policy of mutualisation, where all operators share the final fibre connection to the end user premises. KPN's deployment vehicle Reggefiber, meanwhile, builds out slowly as it first creates sufficient demand in an area in order to ensure that the deployment will be commercially viable.

Figure 2: Growth of household coverage of superfast broadband, incumbent operators



Source: Operator results

Against this backdrop, BT's deployment has been amongst the quickest and broadest, in terms of coverage. Given the contrasting speeds of deployments in the markets we are reviewing in this study, it is worth considering whether this of itself could impact on the likely take-up of superfast broadband. Certainly, there is a question as to whether it is more beneficial to have fast speeds available more quickly and ubiquitously, or to have the fastest speed available on a future-proofed network, but less ubiquitously and at a much slower rate. At present we do not know; however, the pace of deployment may be a factor in the speed at which benefits accrue from service innovation and consumer adoption.

3. Superfast broadband – take-up

Before looking at the actual data for the take-up of superfast broadband, it is worth revisiting the intention of this study. We are interested in understanding the underlying demand for superfast broadband – that is, the desire amongst consumers to pay a premium for superfast broadband. We are interested in this, as opposed to the overall number of subscribers to superfast broadband, as it is this underlying growth that provides the revenue premium that justifies the investments being made by operators. If there is little propensity amongst consumers to pay for superfast connectivity, the outlook for continued and future investment is weaker.

This is not to say that the total take-up in any country does not have value. Certainly, this is of interest if your concern is for the size of the potential superfast market for innovative services, or for the capacity available to entrepreneurs and small businesses. This is indeed important data, and we will report this where relevant in this report. However, our interest is in understanding what the demand picture might be looking like for network operators who have invested in superfast broadband, or for policymakers and regulators aiming to best incentivise such investment.

3.1 Understanding underlying demand

In order to get to the underlying demand, we first need to understand what the numbers reported by Internet Service Providers (ISPs), cable operators and NRAs are made up of. There are two issues in particular that need to be addressed: for cable operators, understanding who has paid for a superfast service compared to who has been uplifted on to that service; and for FTTx operators, identifying those that have paid for superfast broadband as opposed to those that take lower speeds (such as those that can be achieved over ADSL2+) over a fibre network.

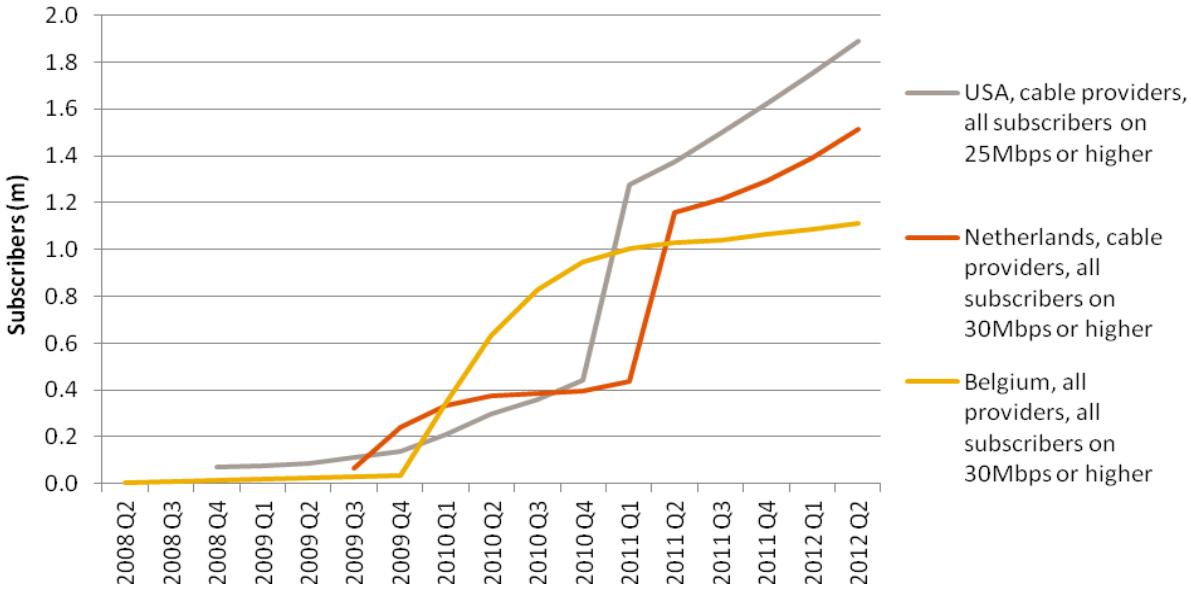
Cable operators

Data for cable operators has been sourced from both the operators themselves and their NRAs. In the cases of Virgin Media in the UK, Numericable in France, ONO in Spain, ZON in Portugal and JCOM in Japan, the numbers have come directly from the operators. In these instances, the operators are reporting either the number of subscribers to their NGA/NGN network, or the number of subscribers taking a particular speed service (30Mbps and above, or 100Mbps and above).

For cable providers in Belgium, Denmark, Germany, the Netherlands, Sweden, and the USA, the data is sourced from the respective NRA and is an aggregate of the cable providers in those individual countries. The data is reported in terms of the number of subscribers at a particular speed. For all countries except the USA, we have taken all those subscribers to services at 30Mbps and above to be subscribers to superfast services. The speed for the USA is 25Mbps, as this is the threshold at which this data is available from the FCC.

Reviewing the data for Belgium, the Netherlands and the USA, we can see the clear impact that uplifting subscribers to higher tiers has on the take-up data. In each case, there are clear steps up on the graph that represent where subscribers have been moved en masse by an operator.

Figure 3: Belgium, Netherlands, USA, superfast cable subscribers, as reported

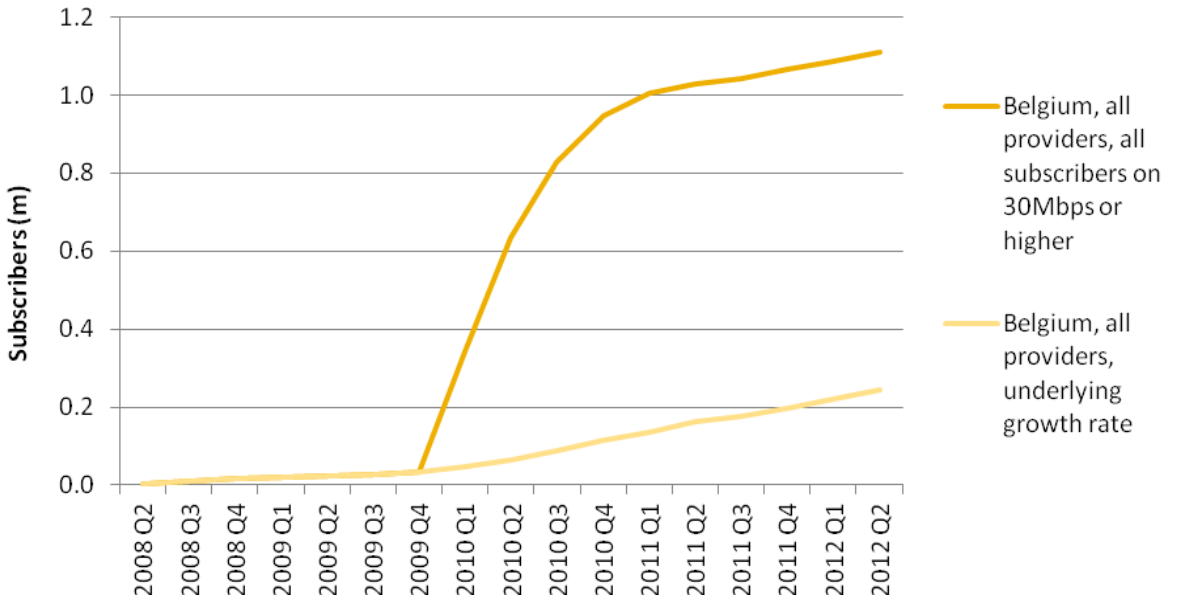


Source: NRAs; data available to Q1 2012, extrapolated to Q2 2012

(NB: Although the data for Belgium is technically for all providers and not just cable providers, in reality the vast majority is cable – Belgacom did not begin offering a 30Mbps service over its VDSL network until Q3 2010, while Telenet (the largest cable provider) has now set its entry level product at 30Mbps).

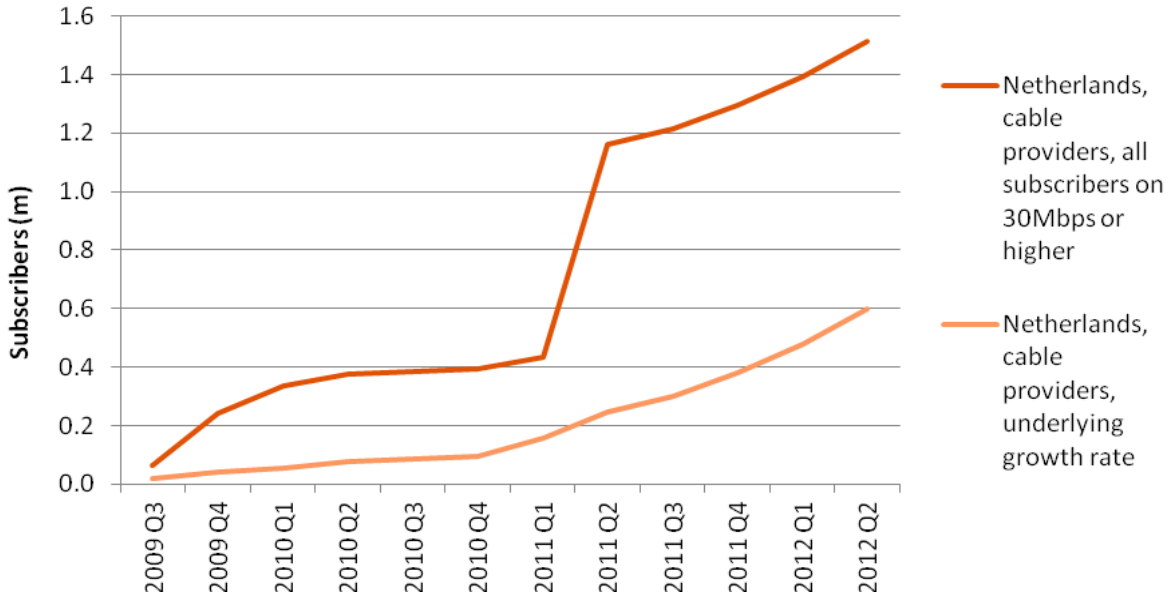
To understand the underlying growth rate, we need to remove the step increases and reflect the underlying growth rates. The resulting growth rates in each country are set out below, compared to the 'as reported' figure; it is this adjusted number that we will mostly be using throughout the report.

Figure 4: Belgium, superfast cable subscribers, adjusted



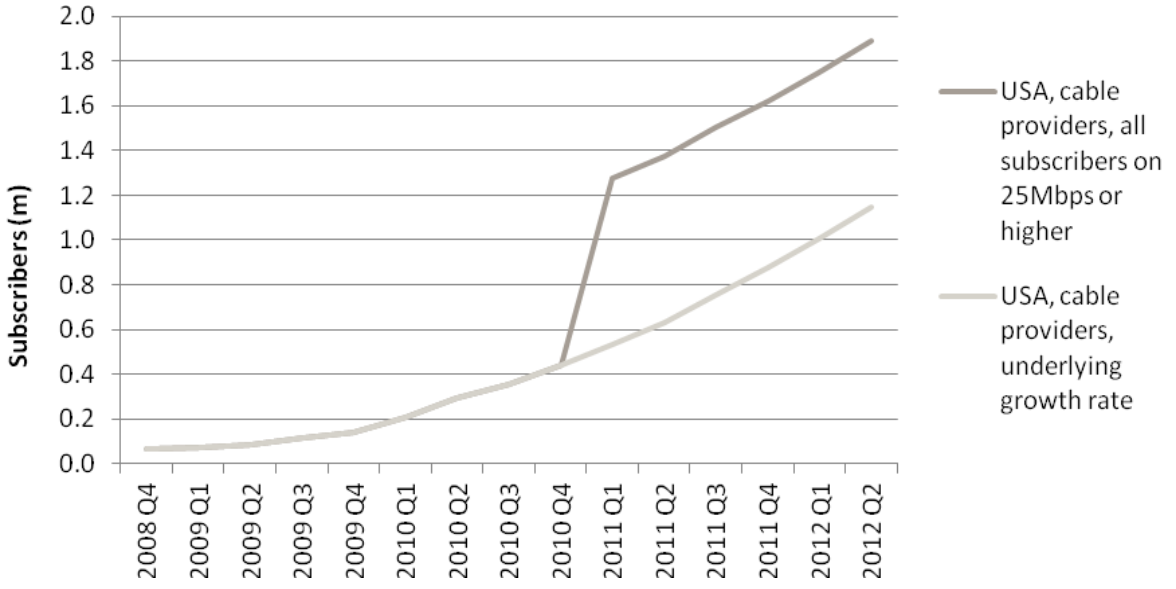
Source: BIPT

Figure 5: Netherlands, superfast cable subscribers, adjusted



Source: OPTA; BSG estimates

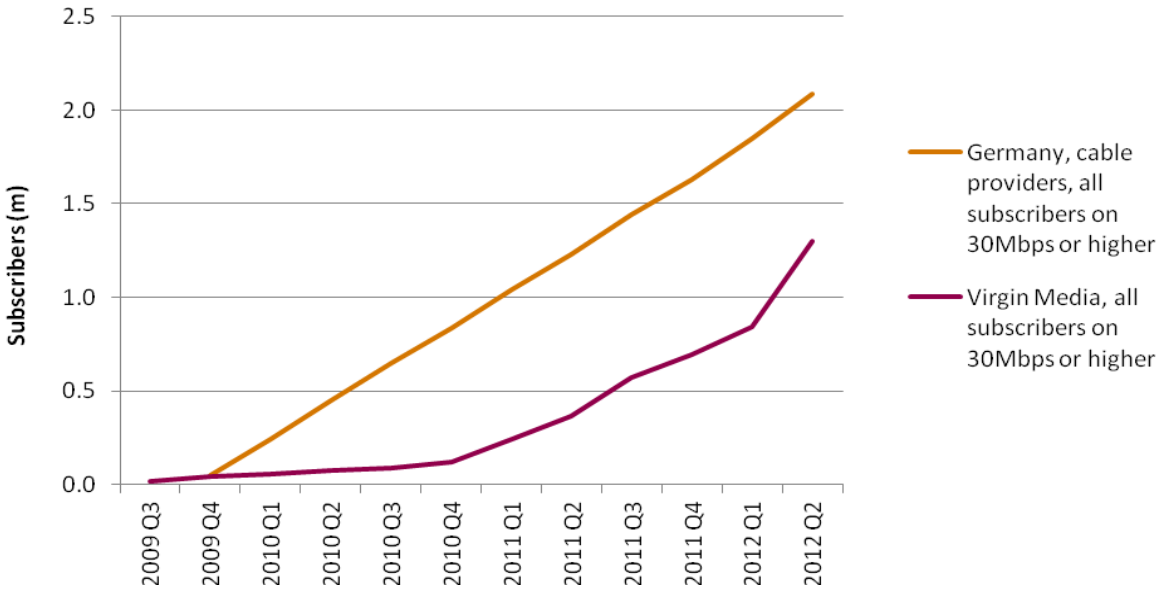
Figure 6: USA, superfast cable subscribers, adjusted



Source: FCC; BSG estimates

For the UK and Germany, we have a slightly more subtle issue to resolve as the uplifts are not so obvious – staggered uplifts over territories and time mean that the results look relatively normal.

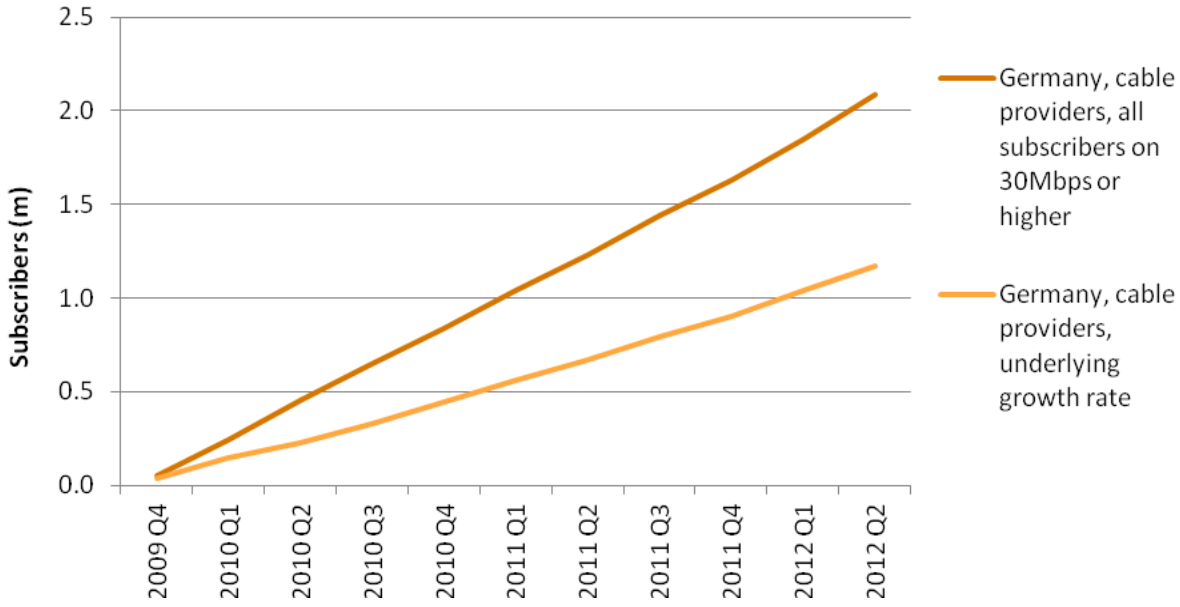
Figure 7: UK, Germany, superfast cable subscribers, as reported



Source: BNetzA (data up to Q1 2012, extrapolated for Q2 2012), Virgin Media

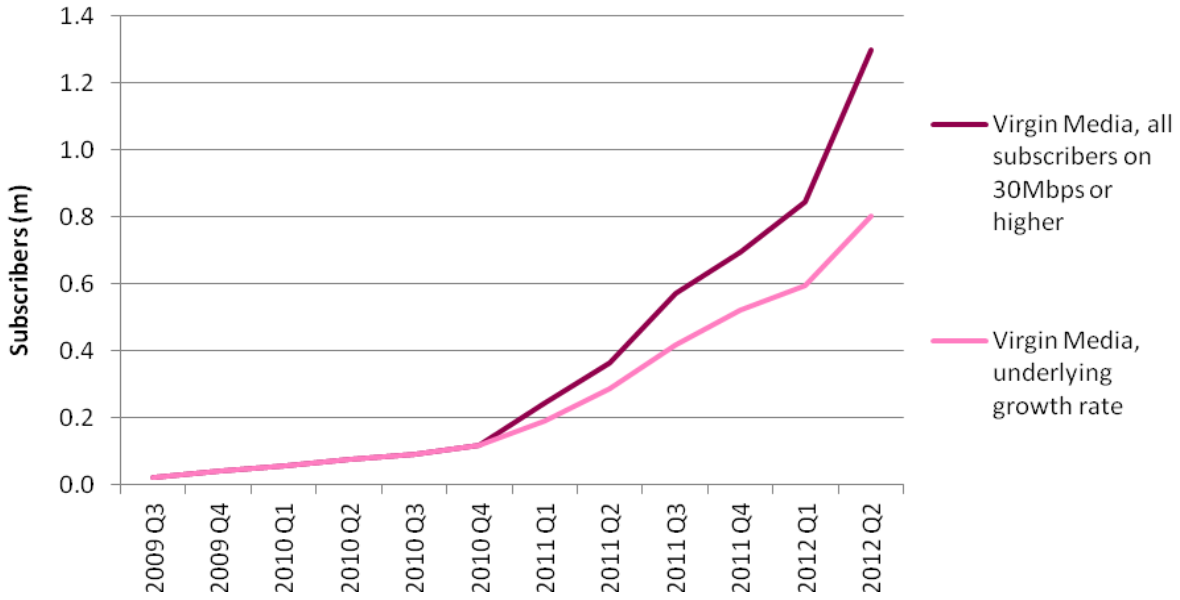
However, we know from reviewing the results of these operators that subscribers have been uplifted to higher tier speeds and included in these results. From breaking down the available data, based on the number of new subscribers taking superfast speeds plus assuming a number that would choose to take a superfast service from the existing customer base, we can adjust these results also, in order to get to the underlying growth rate – the results of this are set out below.

Figure 8: Germany, superfast cable subscribers, adjusted



Source: BNetzA, Kabel Deustchland, BSG estimates

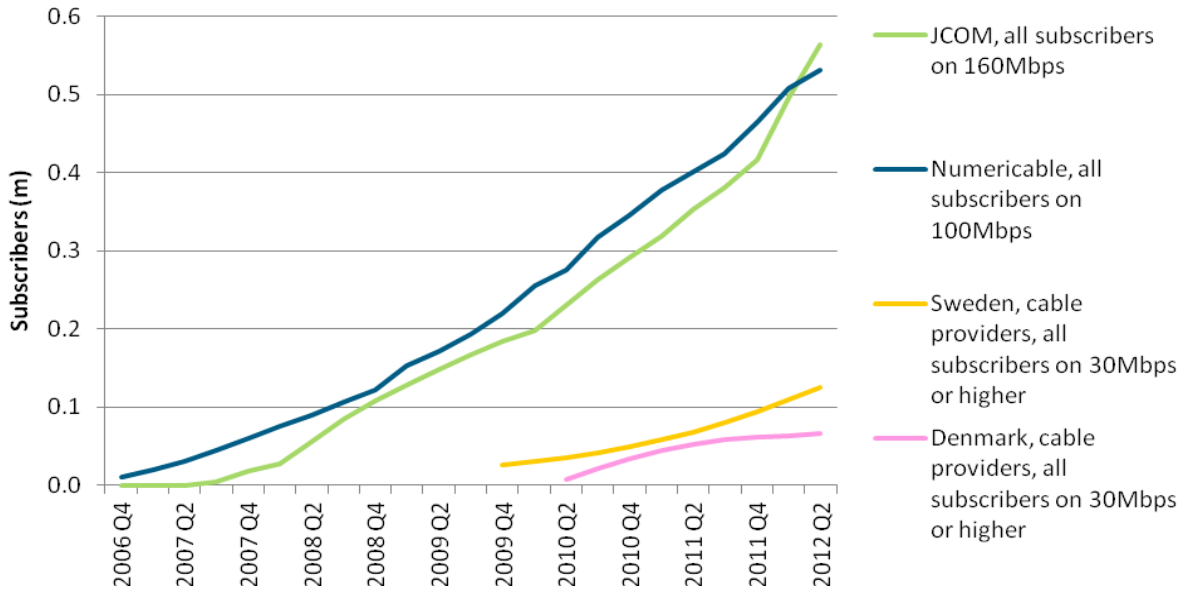
Figure 9: UK, superfast cable subscribers, adjusted



Source: Virgin Media, BSG estimates

This leaves a number of other providers – Numericable in France; ONO in Spain; ZON in Portugal; JCOM in Japan; and the Swedish and Danish cable operators. The numbers for Denmark, Sweden, Numericable and JCOM are less in need of revision. The Danish numbers are very small and do not grow particularly quickly; similarly, the Swedish numbers are relatively low, although show some recent growth. The numbers for Numericable and JCOM reflect their 100Mbps and 160Mbps subscribers respectively – set as premium services to the existing offer, these do not appear to have been used to uplift existing subscribers.

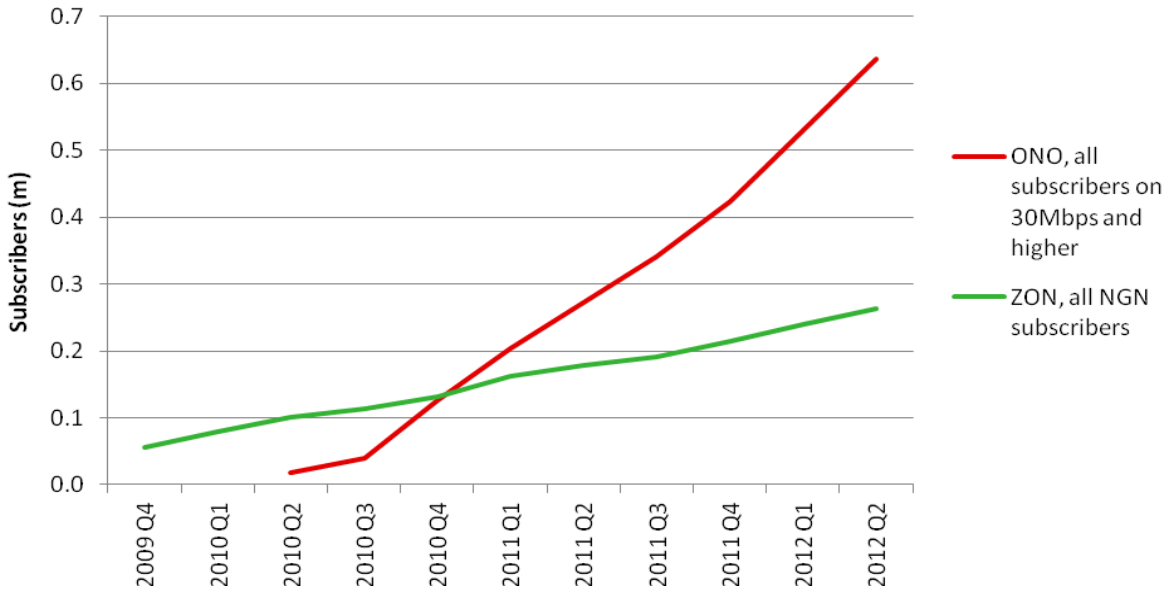
Figure 10: Denmark, France, Japan, Sweden, superfast cable/FTTB subscribers, as reported



Source: Operator results, NRAs (data available to Q4 2011 or Q1 2012, extrapolated for Q2 2012)

The numbers for ONO in Spain and ZON in Portugal, however, are more difficult to interpret. It is very likely that uplifting is occuring given the rate of growth for ZON, which on a per home passed basis outstrips almost all other providers, and the fact that ONO have offered free speed uplifts to subscribers in exchange for extending their contracts as a retention tool during the recession – as of June, 472,000 subscribers had taken advantage of this offer (though at speeds ranging from 6Mbps to 100Mbps, so not all have been uplifted to superfast services). However, we have been unable to find an appropriate way to revise the data to reflect these likely uplifts. As such, these numbers will be used with caution throughout the report; readers should understand that a read-across will not necessarily provide a like-for-like comparison where these two countries are involved.

Figure 11: Spain, Portugal, superfast cable/FTTB subscribers, as reported



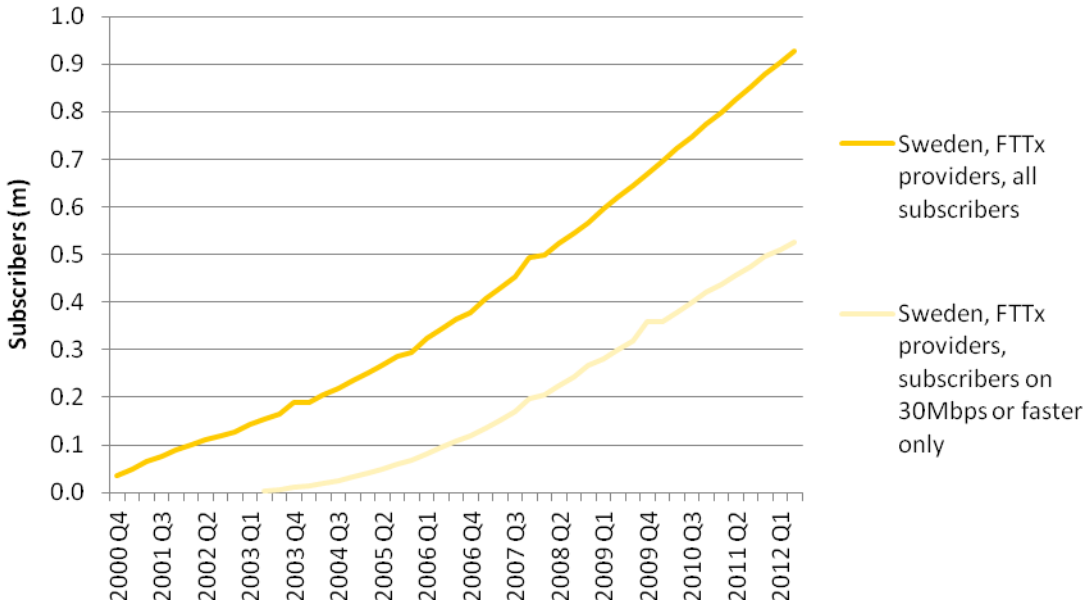
Source: Operator results

FTTX operators

Particularly for FTTx operators that are new entrants, and who deployed early, there is the issue that many of their subscribers will not be on superfast broadband services, despite receiving the service over a fibre-based network. In Scandinavia, Italy and the US in particular this has occured; it has also been the case in the Asian markets that we are examining, although this is somewhat more challenging to unpick.

In Sweden there have been a number of local FTTH networks that have been deployed, often in partnerships with municipalities and/or utility providers. For over a decade there have been subscribers on these networks. However, according to data gathered by the Swedish regulator PTS, the number that have subscribed to a superfast service (30Mbps and above) is less than those taking services from fibre-based networks. Although the speeds delivered over fibre are likely to be close to the headline of the service, which would set it apart from headline speed comparative ADSL services, subscribers have not indicated a willingness to pay for a higher speed connection.

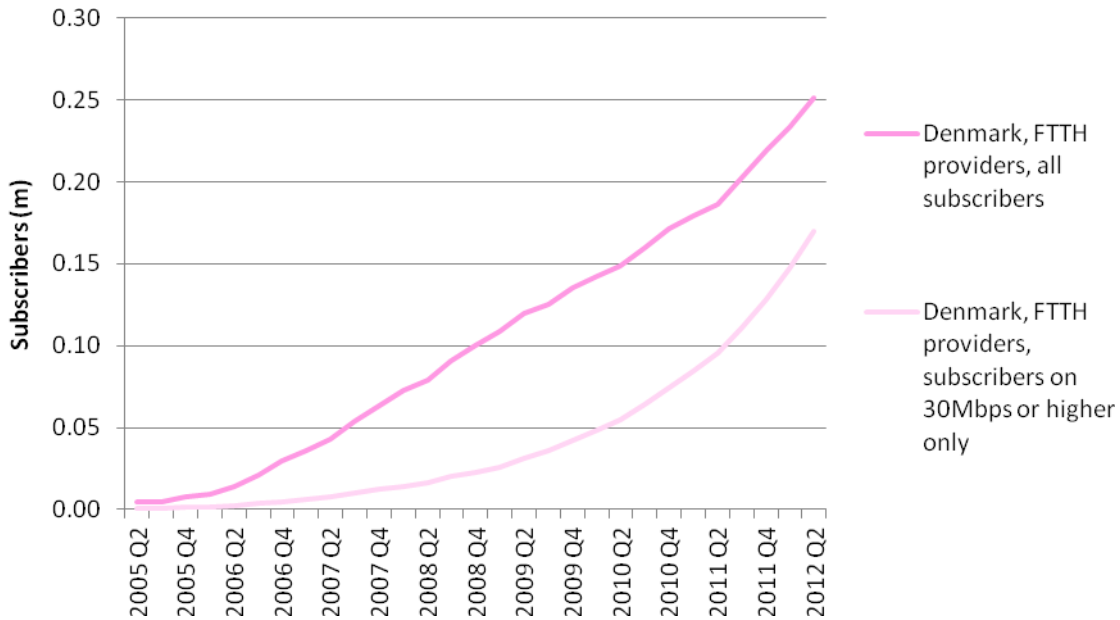
Figure 12: Sweden, total FTTH subscribers and FTTH subscribers on 30Mbps and faster services only



Source: PTS, BSG estimates

Similarly in Denmark, although there have been a number of FTTH networks deployed with a significant subscriber base, only a percentage of these are on services providing superfast speeds.

Figure 13: Denmark, total FTTH subscribers and FTTH subscribers on 30Mbps and faster services only

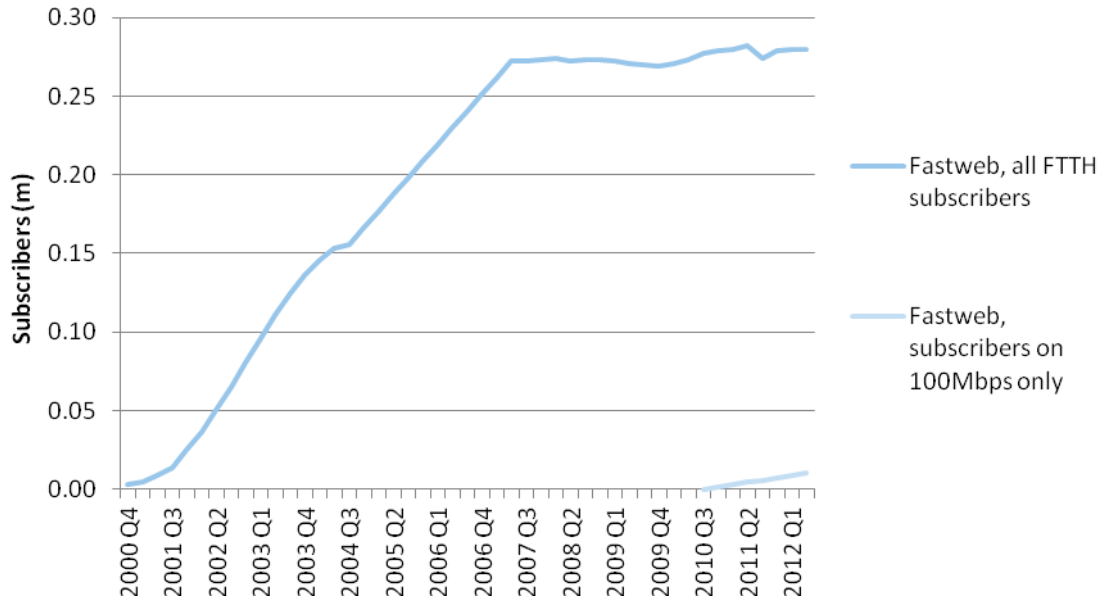


Source: NITTA, BSG estimates

In Italy, there is a starker divide. Fastweb deployed its FTTH network at the turn of the millennia as there was no suitable wholesale option available in the Italian market at that time. However, deployment ceased after a couple of years when unbundled DSL became available, and until Q3 2010 they did not differentiate between services they provided on

their FTTH network and services they provided over ADSL. Only in Q3 2010 did they begin to offer a 100Mbps service, which received a muted response from consumers.

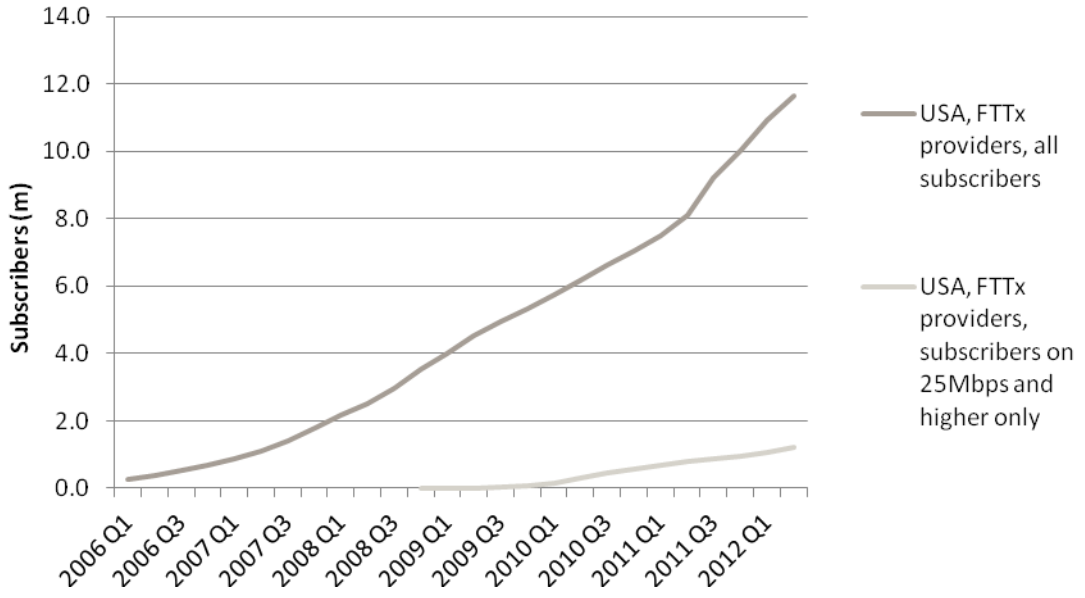
Figure 14: Italy, total FTTH subscribers and FTTH subscribers on 100Mbps services only



Source: Swisscom, Fastweb

The US data is slightly more challenging. This is due to the relatively poor quality of copper-based services (due to longer lines from exchanges to premises), which means that advances in ADSL have not delivered the same up to 20Mbps or 24Mbps capabilities found in European markets. Verizon and AT&T, having deployed NGA networks, began offering broadband services that were faster than those available on ADSL, but not necessarily superfast – Verizon's most popular entry-level FTTH service provides a download speed of 15Mbps, while AT&T's top tier FTTC broadband service is only at 25Mbps. Data gathered by the FCC demonstrates that, despite the relatively high numbers of subscribers using these NGA networks, the number of subscribers taking services of 25Mbps and beyond is limited.

Figure 15: USA, total FTTx subscribers and FTTx subscribers on 25Mbps and faster services only



Source: Operators, FCC (data available to Q2 2011, extrapolated through to Q2 2012)

This poses an issue, as consumers are demonstrating a willingness to pay for faster broadband (they could not achieve these speeds on ADSL connections), but not paying for superfast broadband. The US market, as we will explore later, is also focused on the battle for TV subscribers first, and broadband subscribers as part of the bundle, which makes assessing the willingness to pay for faster broadband alone quite difficult. We will return to this later.

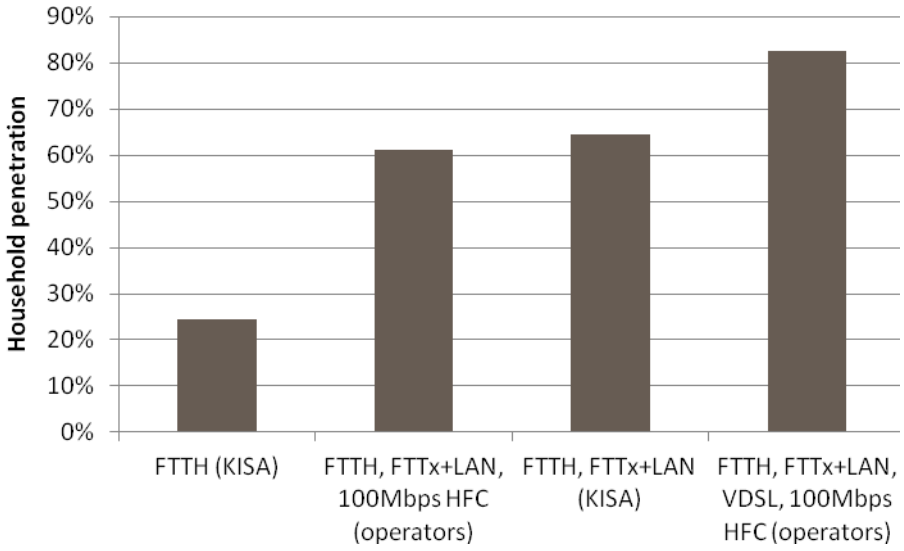
Asian markets

The Asian markets present similar problems. In Hong Kong, for example, HKBN had broadband subscribers that they served via technologies other than FTTH prior to deploying their FTTH network. Since the deployment they have migrated subscribers to their fibre network and uplifted them to higher speeds, much like the cable operators discussed above, and so identifying those who have demonstrated a willingness to pay for a higher speed is extremely difficult.

In South Korea we find the same issue. For a number of years after the availability of 100Mbps services, a large number of subscribers were on very low speed tiers – SK Broadband reported that in Q3 2006 nearly 70% of their 3.6m subscribers was on an 8Mbps service or slower (indeed, 60% were on the 1Mbps 'Lite' service). Only once these tiers were discontinued and subscribers were migrated to higher-speed FTTH/FTTx+LAN[2] based services did the number of superfast subscribers really take off. Indeed, it can be difficult to assess exactly which figures are the right ones for the South Korean market: depending on how we classify superfast, which technologies we include and which sources we use, we can get a range of different figures, as per the below.

[2] FTTx+LAN meaning fibre to the apartment block, with in-building distribution thereafter.

Figure 16: South Korea superfast broadband, different ways to count subscribers



Source: Operators, KISA; operator data as at Q2 2012, KISA data as at Q3 2011

Of the Asian markets we have examined, Japan is the least difficult to read across from. There has always been a clear service and speed advantage to the FTTH services over the ADSL-based services available in the market. There are other issues, however, that have a role to play in this market, not least the pricing of these services. We will explore this further later.

Analysing take-up

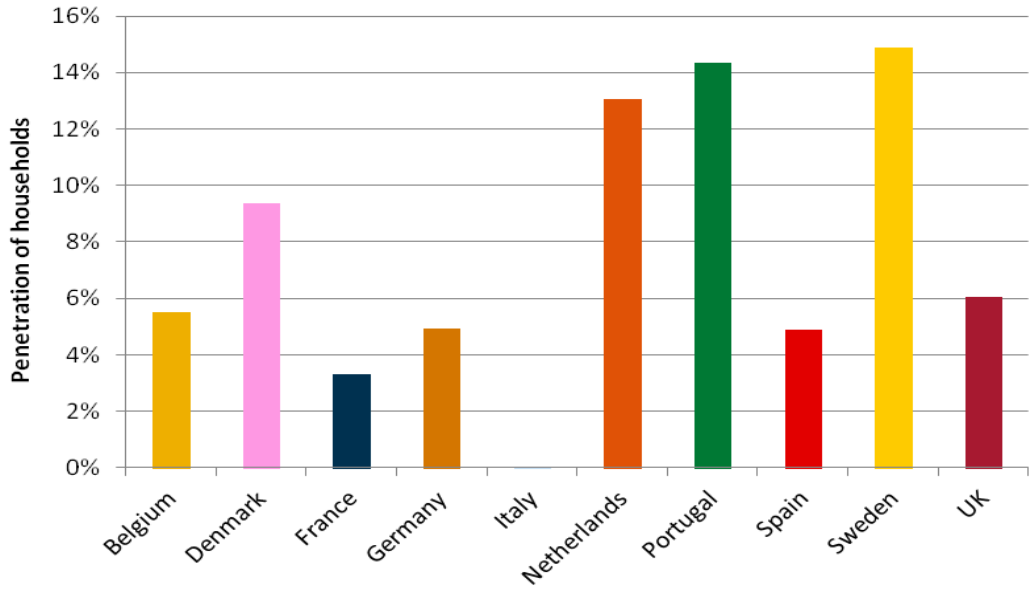
Given both the above adjustments and the different stages of maturity that each market and indeed global region have reached, we will review the three regions independently, rather than comparing them side by side. In such a review there would be no surprise to see the Asian markets far ahead of their European and North American peers. However, we are interested in what the experiences of other markets might be able to tell us about the possibilities for the UK, and so adding to the global rankings that place Asian markets far ahead of the UK and others is of little value here, and will likely distract from other analyses that we wish to make.

To be clear, from this point on we will use the adjusted figures we have described above, unless otherwise stated.

3.2 Europe

In terms of the relative position of the UK, it currently sits midway amongst the European markets we have examined. Unsurprisingly, Sweden, Denmark and the Netherlands are amongst the highest, also joined perhaps more surprisingly by Portugal (although, as raised above, the FTTB subscribers for Portugal have not been adjusted as they have been for the other markets). The UK comes out ahead of peers such as France, Germany, Spain and Italy, where superfast has been very slow to develop, relative to the rest of Europe.

Figure 17: Superfast broadband household penetration, selected EU markets

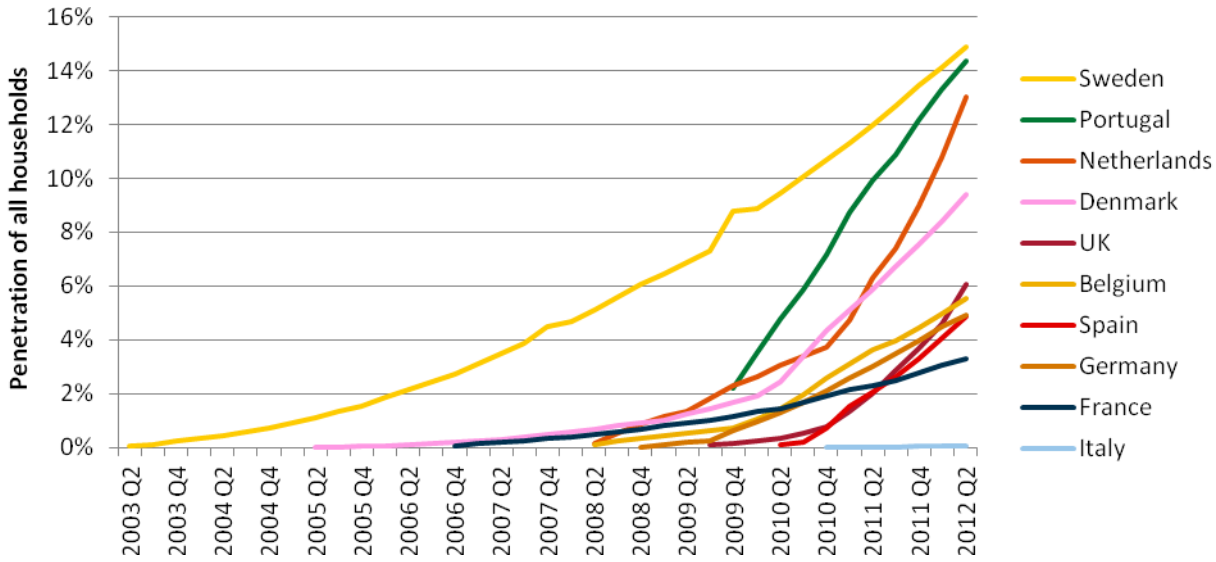


Source: Operators, NRAs

Growth rates

Looking at the growth of household penetration of superfast broadband, we can see that the UK is one of the faster growing superfast markets. Only the Netherlands, with a more extensive cable network, and Portugal – whose cable subscribers have not been adjusted – have a subscriber growth rate higher than the UK. France's figure has remained perhaps artifically low, due to the previously mentioned regulatory and technical issues operators faced regarding the mutualisation policy, while Italy has not had a superfast market to speak of.

Figure 18: Growth of superfast broadband household penetration, selected EU markets



Source: Operators, NRAs

When we look at the number of superfast subscribers in the selected EU markets, there are a couple of observations that appear. The first is that, for cable operators, the purpose of deployment of DOCSIS3.0 or FTTB has been very clear – the delivery of superfast broadband, to exploit the network advantage that cable networks have over DSL-based networks. These networks have largely been built out within the same timescales, and superfast services have come to market around the same time. By contrast, however, there appear to be three different groups into which FTTC/H deployments have fallen.

The first are the early deployments, built out by new entrants as alternatives to ADSL when broadband was first introduced to the market. These markets include Denmark, Sweden, and Italy. Although these networks were used to deliver broadband primarily, they were not used exclusively for superfast broadband. As a result, many subscribers to these networks do not take superfast broadband services – hence why figures for these markets have been adjusted accordingly.

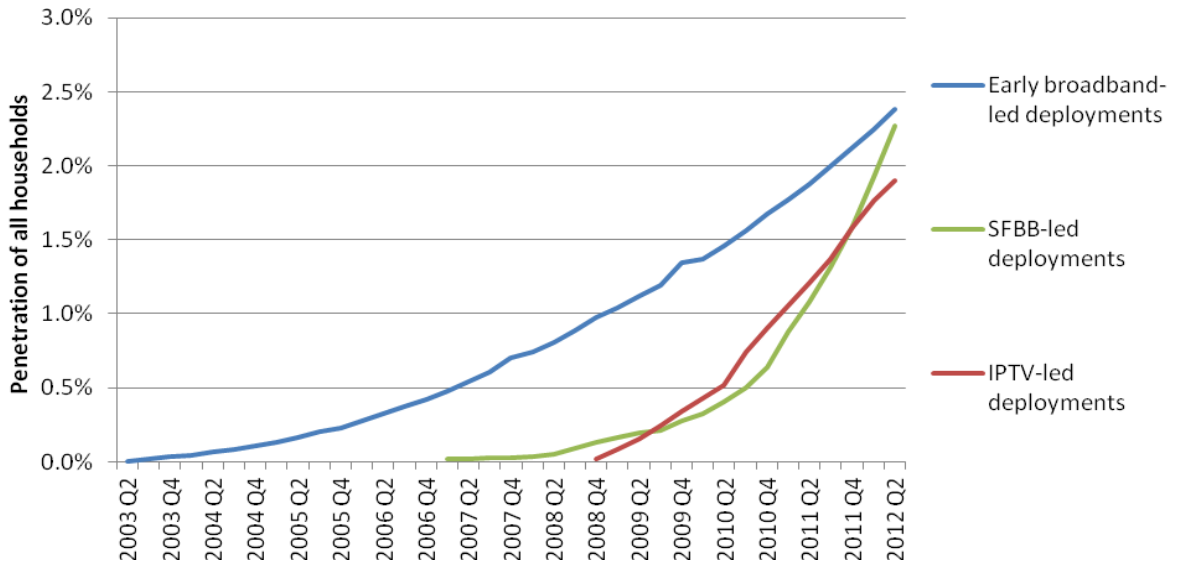
The second group is those that deployed NGA infrastructure in order to provide IPTV services, at least initially, rather than to provide superfast broadband. Belgacom began rolling out its VDSL network in 2004 in order to support its IPTV service in competition with the cable operators. Similarly, Deutsche Telekom began deploying VDSL alongside ADSL2+ into support its IPTV service in 2006. Deutsche did not offer a superfast service over this infrastructure until 2009; similarly Belgacom began offering a 30Mbps service only in 2010.

The final group is those operators that have deployed NGA networks to deliver superfast broadband, with or without IPTV. BT, France Telecom and the other French operators, Portugal Telecom and Telefonica fall in to this category.

These differences may be important when it comes to understanding how demand may evolve in the future. For those who made early deployments, they may see slower growth in demand for superfast broadband, given the capabilities of their network (much like for cable operators, as we shall discuss later) and the spread of subscribers on their various tiers. For those who initially deployed networks to support IPTV services, there may be a balance to be made between offering superfast services and driving take-up of the TV services – as we shall explore further when we consider the US market. For the final group, the focus will be on driving adoption of superfast broadband, and so may see a faster rate of growth in demand.

The graph below amalgamates the growth rates of the countries in each of the groups (excluding cable providers; for Belgium we have made a very optimistic estimate of Belgacom's share of 30Mbps+ subscribers based on their market share), which suggests that this growth trend may be what to expect in each market.

Figure 19: Growth of superfast broadband household penetration, early deployments v IPTV-led deployments v superfast broadband-led deployments

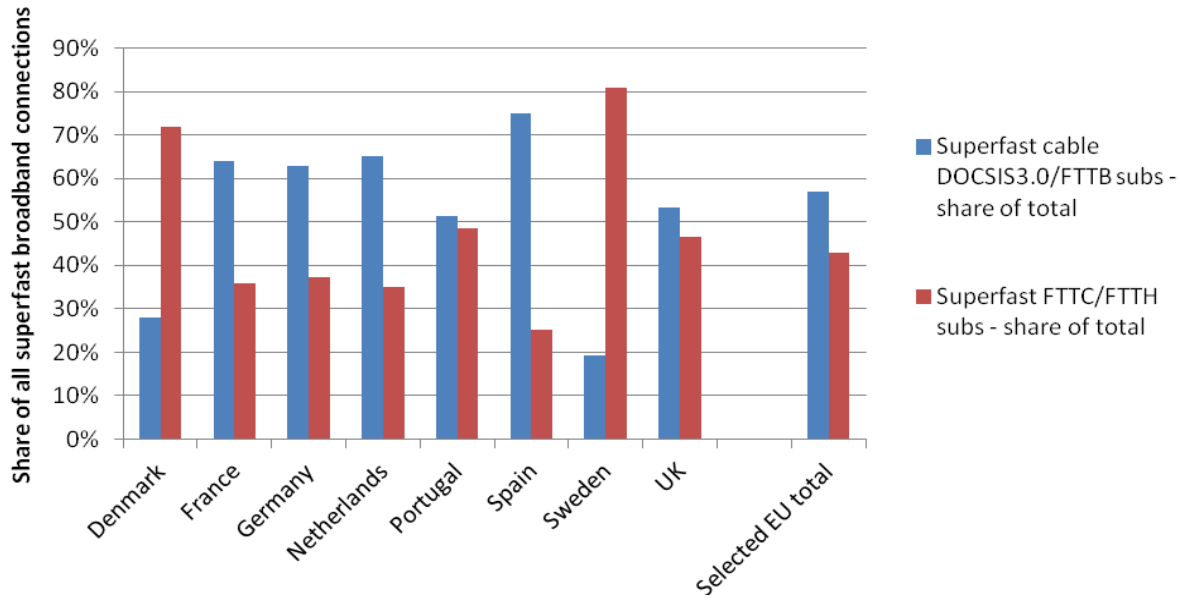


Source: Operators, NRAs, BSG estimates

Superfast cable v superfast fibre

In those markets where cable is available, with the exception of the early deployment markets (Denmark and Sweden) it has been the cable operator that has usually offered superfast broadband services first, and currently has a higher share of the superfast broadband market (noting that in both Portugal and Spain, the cable operator figures have not been adjusted).

Figure 20: Selected EU, superfast cable subscribers and superfast FTTC/H subscribers



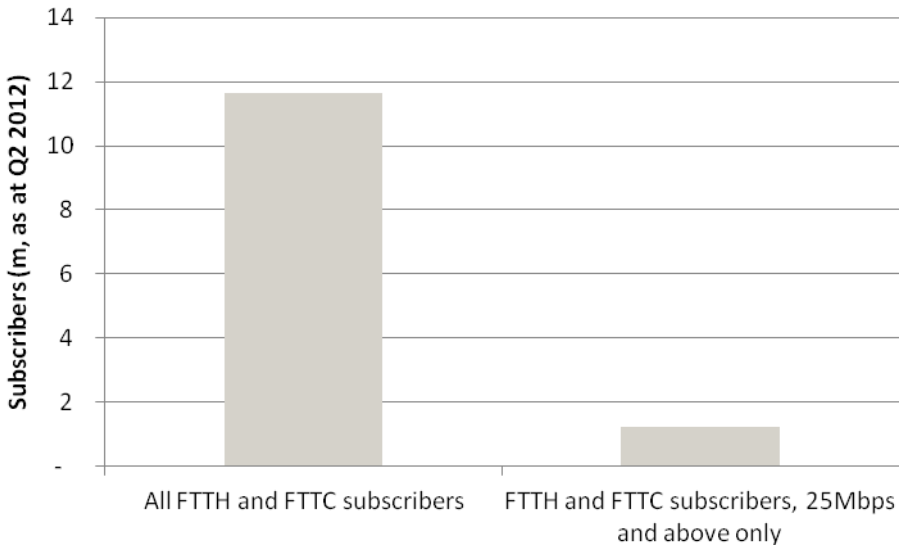
Source: Operators, NRAs

However, when we look at relative growth rates we can see that they have tended to build more slowly than FTTC/H deployments. This may highlight that the network advantage of cable operators could be a double-edged sword, the slow pace of take-up of superfast broadband reflecting the fact that their lower tier services are often much faster than the equivalent headline-speed service on ADSL. We will return to this later in the study.

3.3 USA

The US market is essentially a series of duopolies in different territories between the copper incumbents AT&T and Verizon, and the cable companies, led by Comcast. When considering the evidence of superfast broadband take-up in the US, we have two issues that need to be addressed. The first we have already discussed, which is how the copper incumbents' investments in NGA have led them to offer sub-superfast speed services on the new networks, but that are faster than those available over ADSL-based services and lower-tier cable services. As such, consumers are revealing a preference for paying for higher speed broadband, though not for superfast broadband.

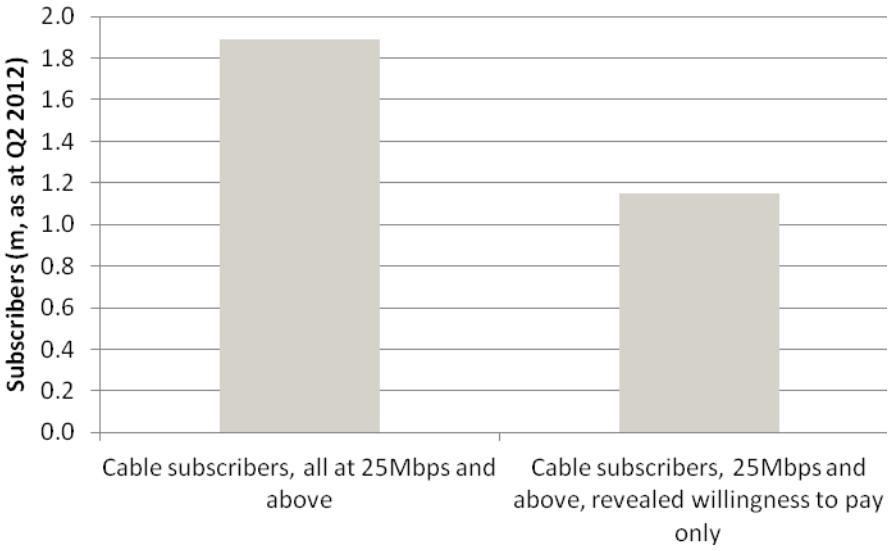
Figure 21: USA, FTTx subscribers total and those on 25Mbps services and above



Source: Operators, FCC

Similarly for the cable operators, when we adjust the number of superfast subscribers they have for the likely number that have been uplifted to a higher speed service, we significantly reduce the number of subscribers to superfast broadband that have shown a willingness to pay a premium.

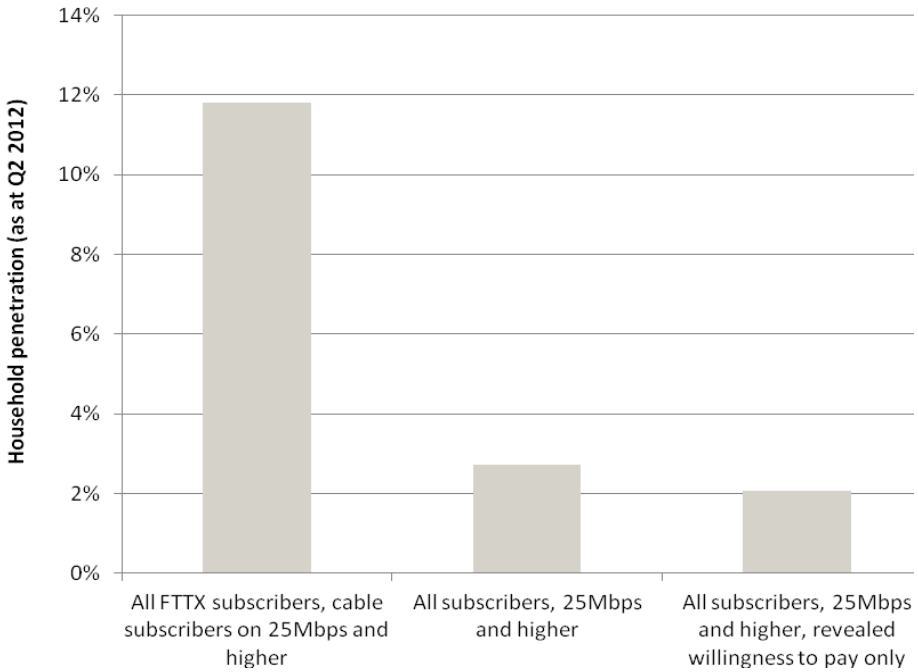
Figure 22: USA, cable subscribers, 25Mbps and above



Source: FCC (data until Q2 2011; extrapolated through to Q2 2012)

Combined, the number of subscribers that have determined to pay for a superfast broadband service is comparatively low – just 2% of all US households.

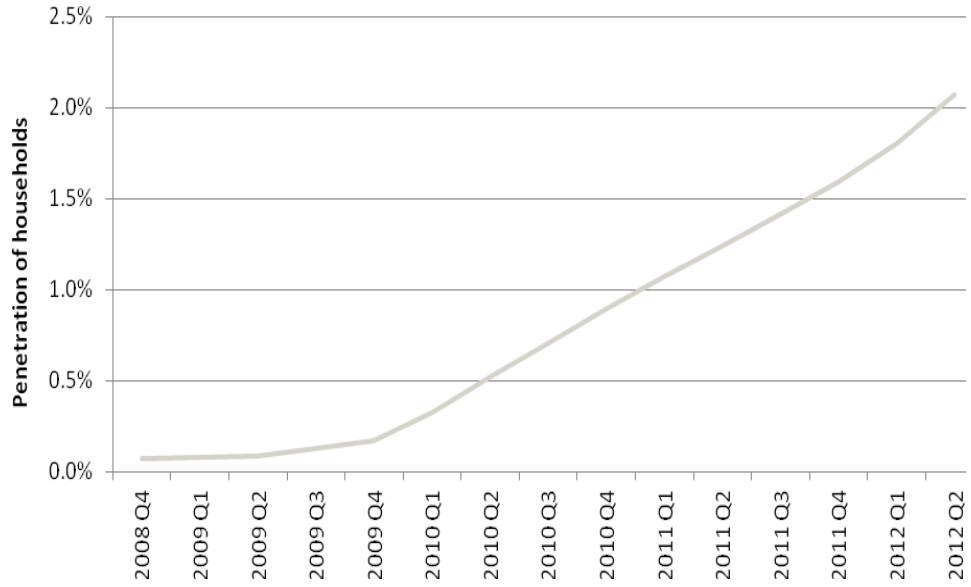
Figure 23: USA, 25Mbps and higher subscribers, all v revealed willingness to pay



Source: Operators, FCC

With this particularly low number of subscribers, the growth rate has also been expectedly slow. Despite widespread availability over the last few years, superfast broadband has not yet taken off.

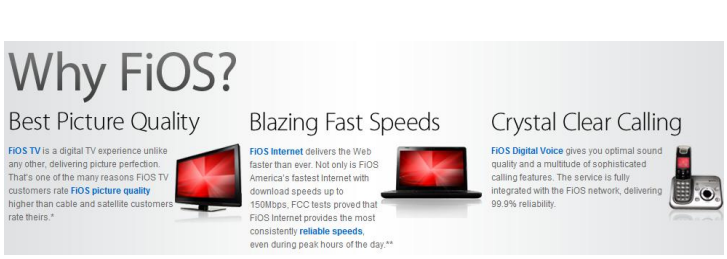
Figure 24: USA, 25Mbps subscribers with revealed willingness to pay only, growth



Source: Operators, FCC

This can likely be explained by two factors. The first is that both cable operators and copper incumbents are focusing on selling their TV services first, with broadband part of the bundle with that service. Although this has usually been the approach for cable TV providers in most markets, in the US the focus on Pay-TV services by the copper incumbents above the broadband service is unique.

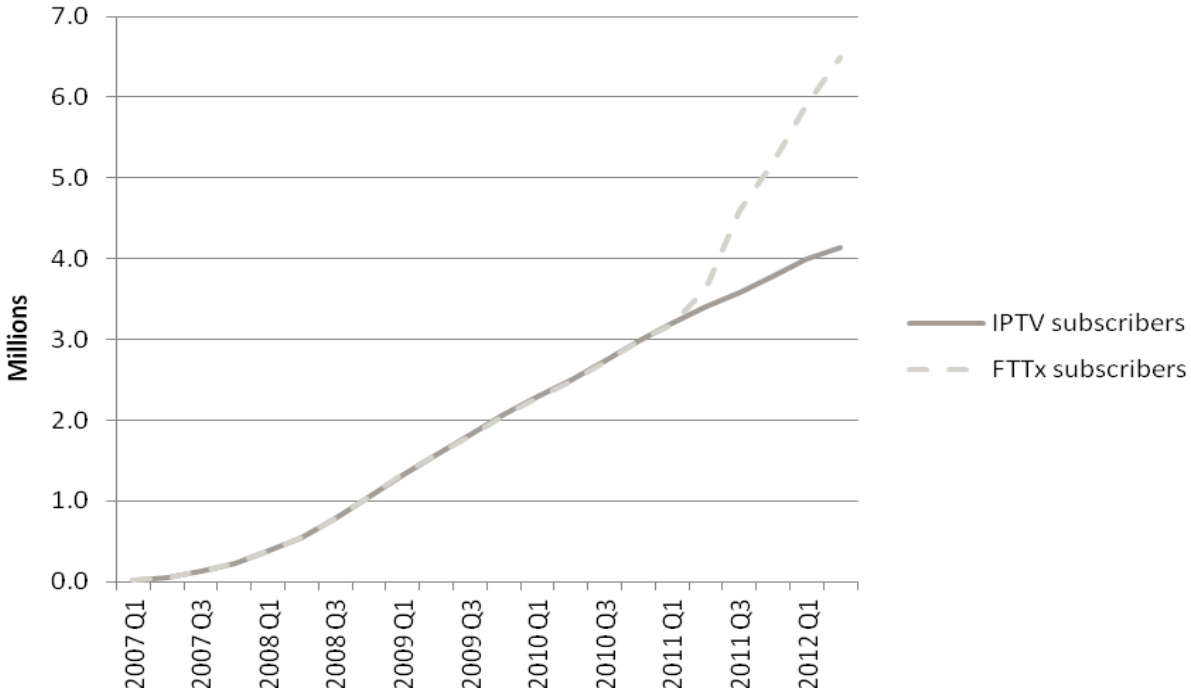
Figure 25: Verizon, AT&T NGA service website advertising



Source: www.verizon.com; www.att.com

This focus can be seen in the level of attachment between the numbers of IPTV subscribers and broadband subscribers on the new networks for each company.

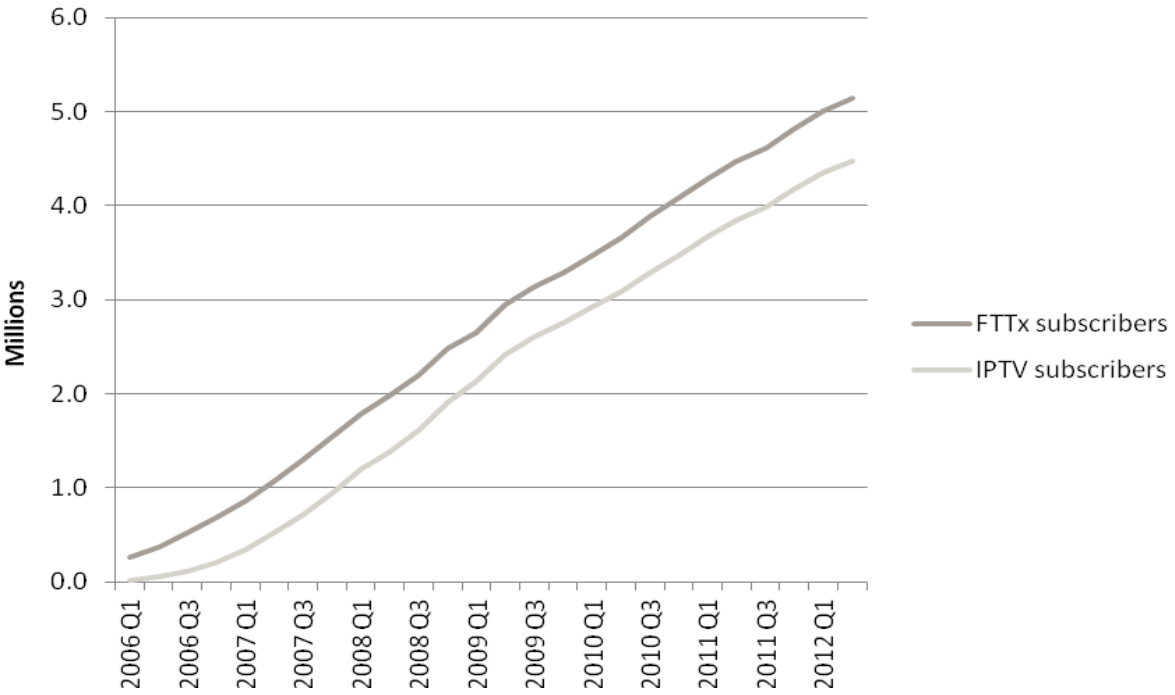
Figure 26: AT&T, IPTV subscribers v superfast broadband subscribers



Source: AT&T

[N.B. AT&T altered their reporting towards the end of 2011 to capture some DSL broadband subscribers in the U-Verse broadband numbers. This explains the broadband kick at the end of the graph.]

Figure 27: Verizon, IPTV subscribers v superfast broadband subscribers



Source: Verizon

(Verizon's consistent gap between broadband subscribers and IPTV subscribers is in part due to delays to territorial broadcast licences being awarded, which meant that for a time Verizon could only sell broadband in those regions.)

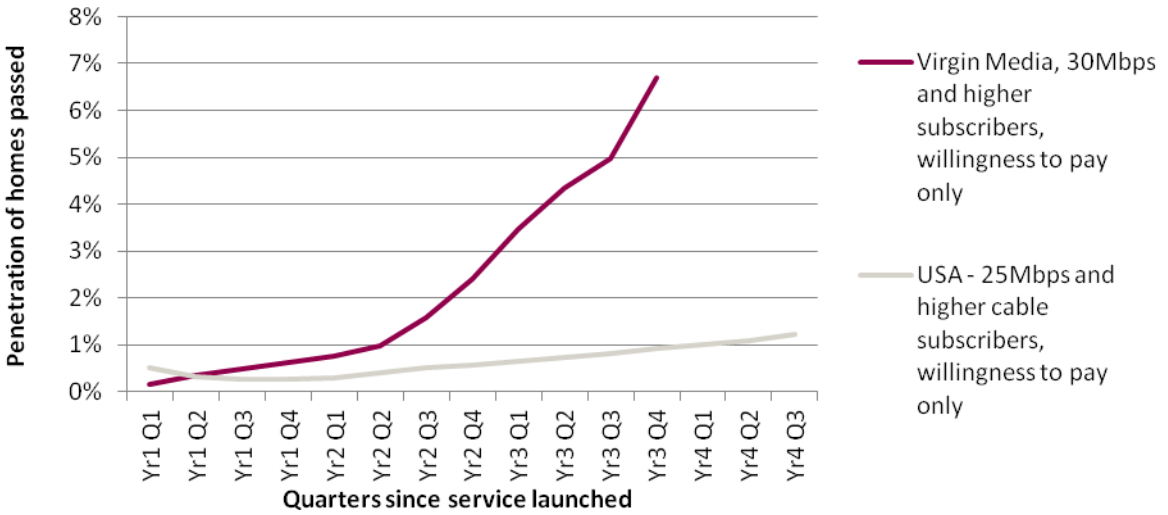
In reality, neither Verizon nor AT&T are heavily promoting superfast broadband services: AT&T do not even offer a superfast service based on download speed, as their top tier U-Verse speed is 25Mbps; while until recently Verizon's top-end bundle offered broadband speeds of 50Mbps, while their most popular packages feature speeds of 25Mbps and 15Mbps, though all speeds have since been doubled except for the entry-level 15Mbps service. Interestingly, Verizon do offer faster superfast services: a top tier of 300Mbps is available for $209.99 per month as a standalone service. Verizon's bundle with its top TV tier service, home phone and 75Mbps broadband is available for significantly less ($144.99). Such a pricing strategy suggests that Verizon are most interested in ensuring subscribers adopt their TV service, rather than move up to take ever faster superfast broadband packages. Indeed, the threat from over the top services such as Netflix likely plays a far stronger role as a commercial driver than the limited competition on broadband that is restricted by the existence of the territorial duopolies. This has meant that operators have not competed on broadband speed in the same way that they have in other markets, particularly in Europe.

This relatively low number of subscribers on genuinely superfast services (less than 3% of homes, even allowing for cable operators uplifting customers) may have knock-on effects on the online service world. The US was home to the first wave of innovation for broadband-enabled services, which were then exported around the globe. The extent to which this might occur for next generation broadband, given the lack of an addressable market currently, is uncertain, and may suggest that the next wave of innovation could occur elsewhere. Certainly, it is worth noting that Google, one of the beneficiaries of the large addressable market for first generation broadband in the US, have entered the telecom operator world with their FTTH deployment in Kansas City, perhaps a recognition that they do not see that the services that are currently available are adequate for their future plans.

Comparison with the UK

It is doubtful that a direct comparison of incumbent results would hold much meaning, given the discussed differences between the US market and European markets, and the relative lack of subscribers to genuinely superfast services. A comparison between the cable operators would be fair; this is set out below. Virgin Media has seen a far higher demand for its superfast services than US cable operators, which again likely reflects the competitive dynamic in the US rather than saying anything in particular about Virgin Media's success to date.

Figure 28: USA cable operators, Virgin Media, growth of superfast broadband subscribers



Source: Virgin Media, FCC, NCTA

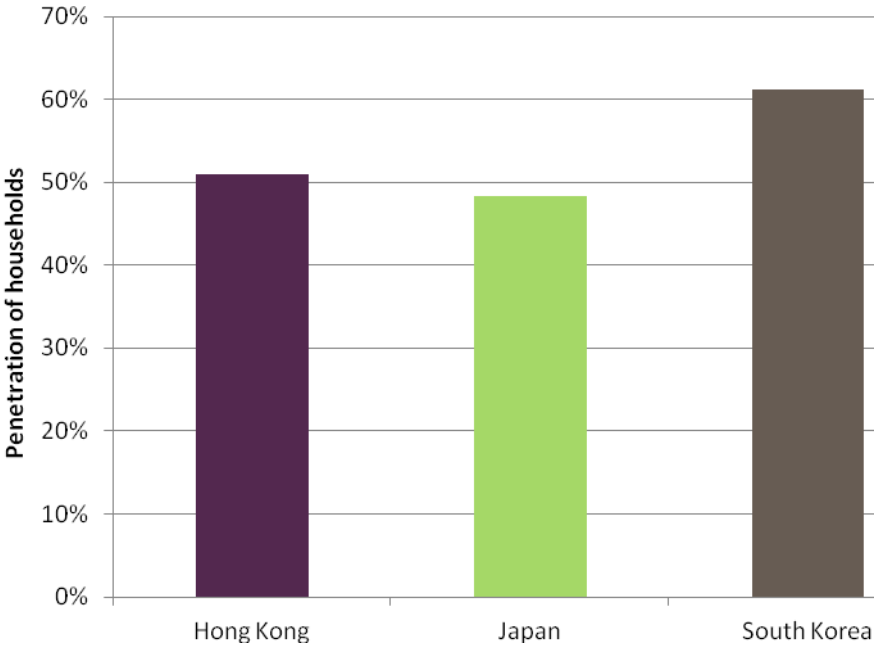
Perhaps the most salient point to be drawn from the US market is the importance of the Pay-TV service to the business cases of the incumbent operators. We have already noted that in Europe, entering the Pay-TV market has been a driver for some operators in their deployments of NGA networks; the US is the extreme example of this, and highlights that for operators the possibility of alternative revenue streams in adjacent markets, such as Pay-TV, could be an important part of the business case behind any investment in new access infrastructure.

3.4 Asia

The markets in Asia have seen the earliest deployment of superfast broadband, and consequently adoption rates are relatively mature. Some deployments began even before, or just as, ADSL was being deployed in markets around the world. Their deployments are now largely complete, save for the most rural of areas, while a mix of technologies is used to deliver very high speed services to consumers. In South Korea, for example, a national strategy to deliver FTTH was revised when ADSL became available, with ADSL becoming the key technology while a VDSL network was constructed for higher speeds as a stepping stone to a full FTTH network. In reality, a mix of all of these technologies remains in play in the South Korean broadband market.

Below is the current household penetration of superfast broadband in these markets. For South Korea there are a number of ways to count superfast subscribers, as discussed earlier in section 3.1 and figure 16. For this study, we will use the operator reported numbers for FTTH, FTTH+LAN and 100Mbps HFC (cable network) subscribers. This leaves out VDSL subscribers, however given that VDSL was the intermediate technology between ADSL and FTTH in South Korea it makes sense that the premium services are on FTTH and not delivered via VDSL, despite this technology being able to deliver superfast speeds.

Figure 29: Hong Kong, Japan, South Korea, household penetration of superfast broadband



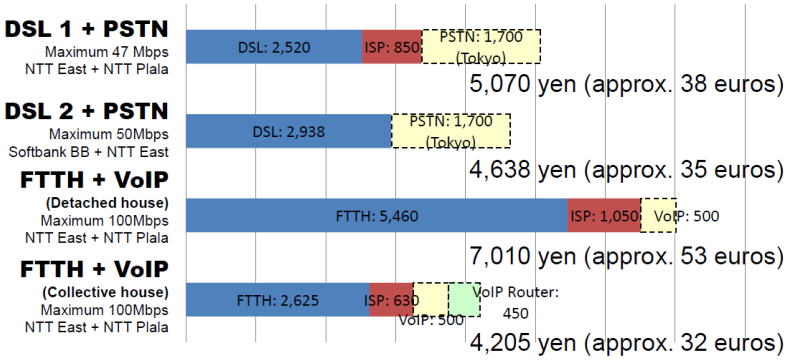
Source: Operator data

Given their maturity, the growth rates are the best indication available of how the take-up of superfast broadband services might develop in markets at the intial stages of deployment and service availability, such as the UK. However, the data from these markets is not clear cut. We discussed in section 3.1 that identifying any consumer willingness to pay from these markets is challenging. The early LAN services in South Korea, for example, did not deliver superfast broadband; many subscribers have been uplifted on to higher speed services over time as possible speeds have increased. Indeed, improving the take-up of superfast services was a stated government policy, and so users were migrated from DSL to FTTH services without paying a premium to do so.

In Hong Kong the market leader in FTTH, HKBN, began offering broadband services over existing infrastructure prior to the deployment of its FTTH network. Once this began operation subscribers were migrated over; even then, the entry level product remained 10Mbps and then on to 25Mbps, as well as services up to 1Gbps being offered. As no data is available about how many subscribers took which speed, and how many chose to pay a premium for this, it is difficult to say what a Hong Kong consumer's willingness to pay a premium for superfast broadband might be.

Paying a premium is also at the centre of analysing the data from Japan. Research by Japan's Ministry of Information and Communication identified that, although pricing in Japan can be complicated, FTTH services delivered to apartments can be cheaper than DSL-based services (see below). If FTTH services are undercutting DSL-based services, then there is no opportunity for consumers to demonstrate a willingness to pay a premium for a superfast broadband service.

Figure 30: FTTH and ADSL broadband pricing in Japan

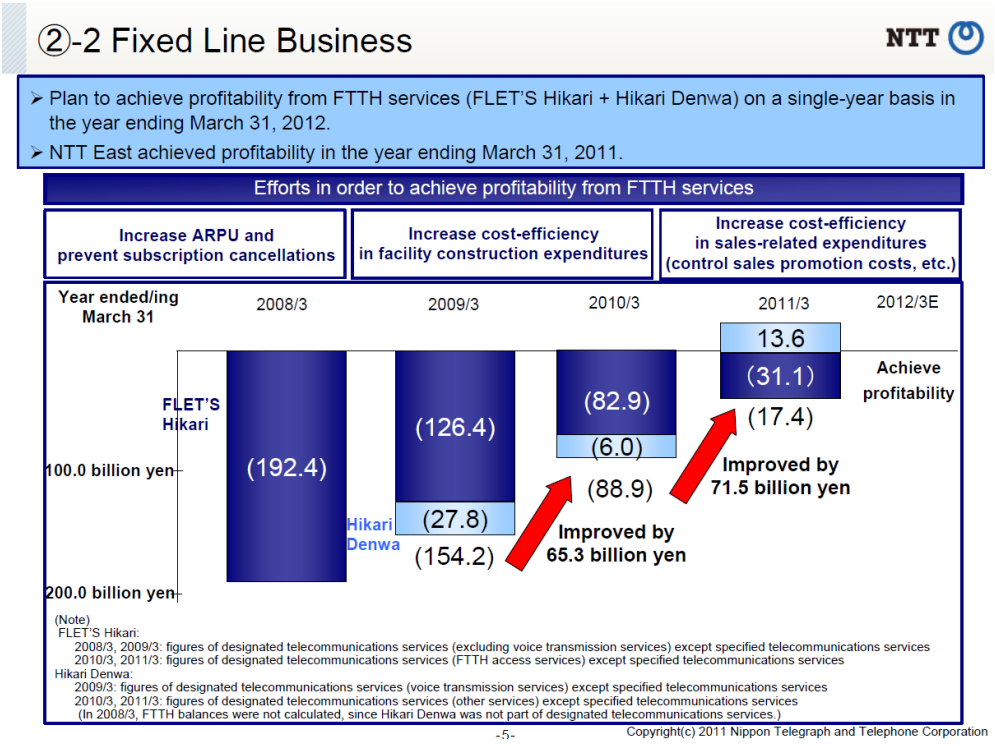


Source: Ministry of Internal Affairs and Communication research, March 2008

Pricing in South Korea is also at a low or zero premium: KT offer their 50Mbps fibre service for the same price as their 8Mbps ADSL product, while LGU+ offer 100Mbps services at a premium of 12%. This contributes further to the lack of clarity concerning migrated subscribers being counted as amongst superfast subscribers. Hong Kong has also had similar experiences: as the new entrant has made its investment it has offered FTTH services at lower prices than those previously available in the market for DSL-based services, forcing its competitors to respond.

It is worth noting that although this approach to pricing may be beneficial to consumers and result in far higher take-up, the impact of this can be seen on the profitability of the operator. NTT, for example, admitted in their results for the year ending in Q1 2011 that despite achieving considerable subscriber growth and having significantly lower capex than their European peers, their FTTH investment is still losing money year on year. NTT plans to turn a profit on its FTTH investment by the end of the next financial year, but it is striking that even with penetration above 50% of all subscribers the investment is still loss-making for the operator. This suggests a note of caution for calls to follow this model – it is unlikely that shareholders of European telecom operators would permit operators to follow this type of investment case.

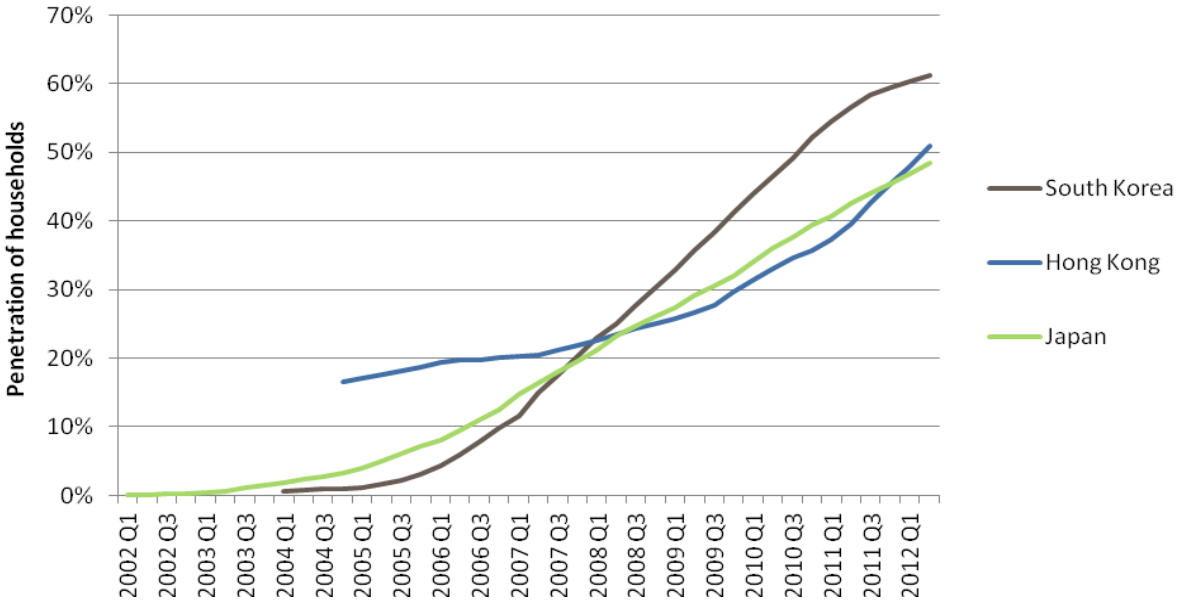
Figure 31: NTT's FTTH network profitability



Source: NTT 2011 Q1 results

Returning to the growth rates within these markets, the below shows the growth of superfast broadband in terms of the household penetration. Each of the markets has seen a consistent take-up curve, although with the caveats set out above, particularly concerning Hong Kong and South Korea. This might suggest that demand for superfast broadband could follow a normal, if flattened, adoption S-curve.

Figure 32: Hong Kong, Japan, South Korea, growth of household penetration of superfast broadband



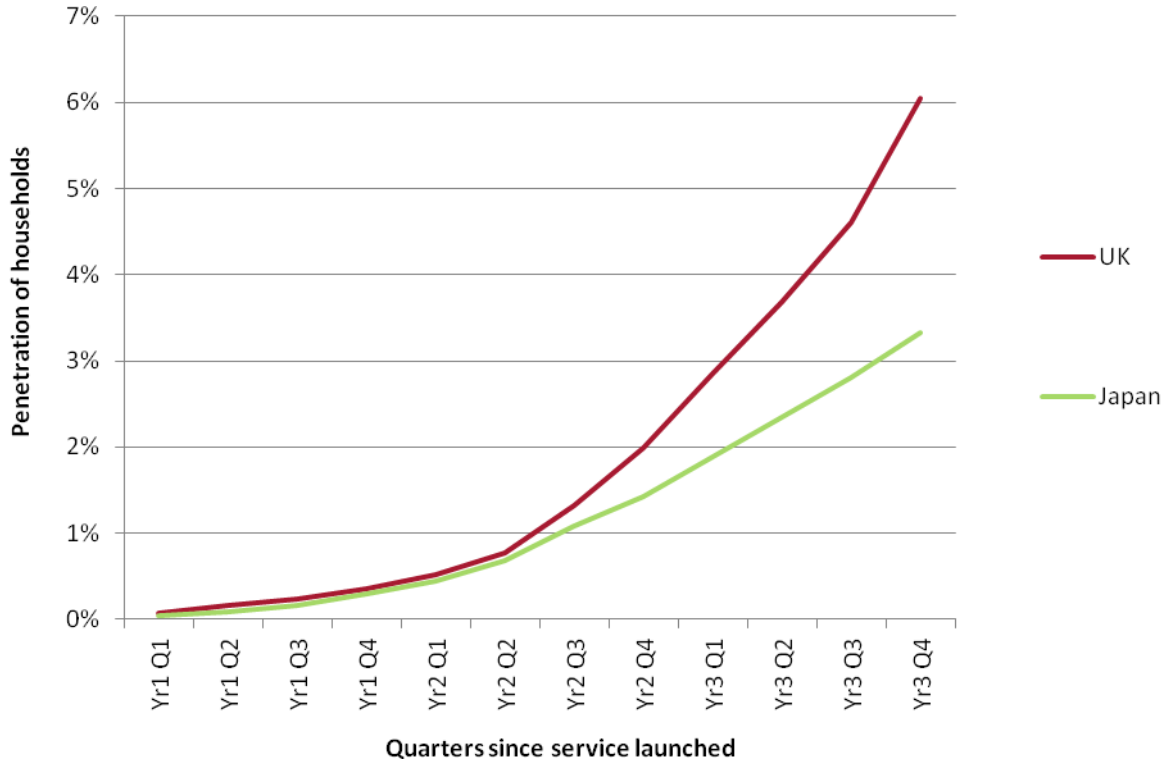
Source: Operators, NRAs, BSG estimates

Asian comparisons with the UK

Despite these caveats we shall look more closely at how the UK compares to Japan. We chose Japan because of its importance in international comparisons, and the fact that it has marketed superfast services separately to ADSL, a distinction that is less clear with South Korea given its VDSL 'stepping stone' approach. Hong Kong's early period of adoption is unclear, given the migration of subscribers to the first FTTH network, and so comparisons with the UK's early period are not possible.

In terms of total household penetration of superfast broadband, Japan is behind where the UK currently is in its development. As we can see from figure 32, Japan's growth rate began to increase after the third year, but not dramatically.

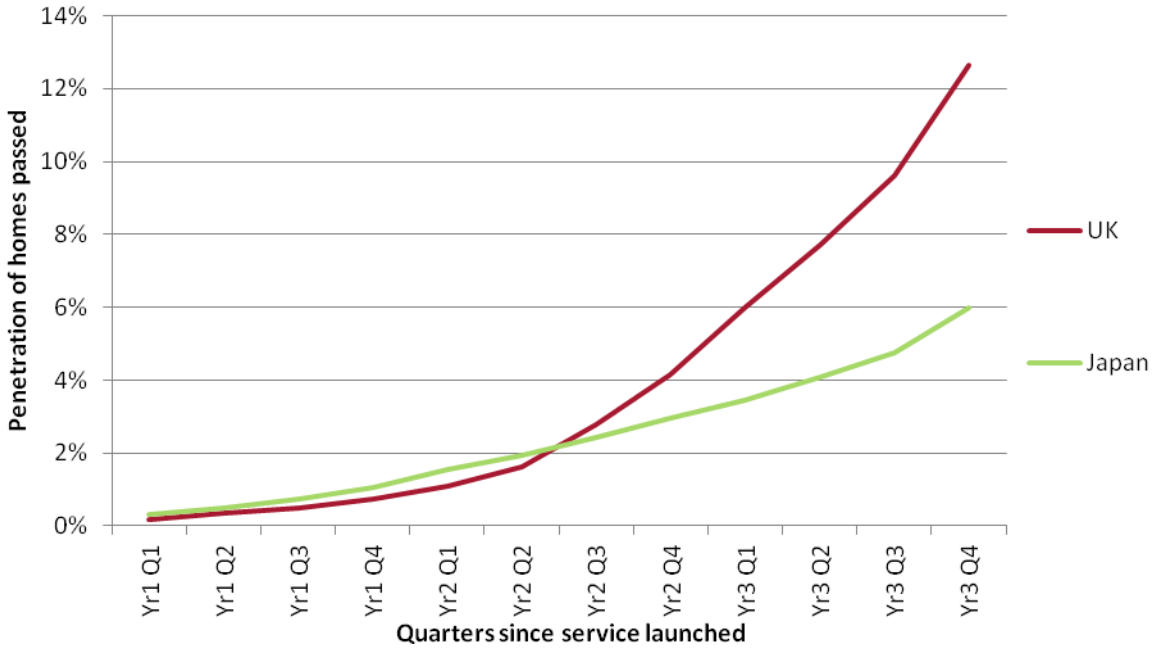
Figure 33: UK, Japan, superfast broadband subscriber growth



Source: Operators

We see a similar story when we compare the penetration of the network footprint, rather than all households. Here again, the UK is currently ahead of where Japan was at the same stage of its development.

Figure 34: UK, Japan, superfast penetration of NGA homes passed



Source: Operators

NB: UK rate calculated based on cable footprint, which was larger than BT's FTTC footprint

We highlight this comparison not because we therefore expect the UK to have a faster growth rate than Japan. We do not. These two deployments happened at very different times. In Japan, many households will have first subscribed to a fibre service, and not had to make a decision to upgrade from ADSL. FTTH in Japan is also a political strategy, and the widespread take-up has been encouraged by a regulatory environment that is favourable to competitors to NTT (which in part explains its issues with profitability). We do not necessarily expect that the UK will see Japan-like levels of superfast broadband take-up in the next five years.

We highlight this, however, to put the international comparisons that are often made in to context. Even in Japan, one of the global FTTH leaders, take-up began slowly and built over time. We will likely be behind Japan in absolute terms for many years to come; this will not change over night. However, what we should be concerned with is whether the market for superfast broadband in the UK is developing as it should; appropriate comparisons with other markets, such as this, can help to inform that view, and currently it would appear that it is.

4 Factors that may impact take-up and take-up growth

4.1 Network quality

The attractiveness or otherwise of superfast broadband services could be influenced in part by the quality of services already in the market. This hypothesis is behind the claims of those advocates of subsidising superfast deployments in rural areas: existing ADSL services are poorer or non-existent when compared to the average, and so there is a nascent demand for superfast services that may well go beyond the demand seen in urban areas where ADSL services deliver higher speeds.

In the UK this issue is particularly important. Government has committed to delivering superfast broadband in rural areas; although the supply side dynamics are well understood at this point, questions remain about the levels of take-up that these networks will achieve, what the business cases look like and therefore what the government can expect to achieve through its delivery programme.

Speed as a proxy for network quality

To attempt to assess this we reviewed available data for average experienced speeds in the markets we are reviewing. Speed is the best available proxy for network or service quality – although there are more characteristics to a service than speed, speed is considered the most important to consumers and is also the most widely-reported.

We tested data available from Ookla to see whether the average speeds in a market prior to the availability of superfast broadband correlated with the take-up of superfast broadband. We used Ookla data as it is available for almost every market we are studying. However, the dataset is not ideal for this purpose – it is produced by a self-selecting set of users, and does not distinguish between residential and business grade services – and our results were inconclusive.

With a dataset more fit for this purpose this type of analysis may be possible. A future avenue may be to analyse any data that comes from the work that the European Commission is currently doing with SamKnows on European broadband speeds. If this produces a level of detail similar to that produced by Ofcom then this would enable us to take another look at whether there is a relationship here.

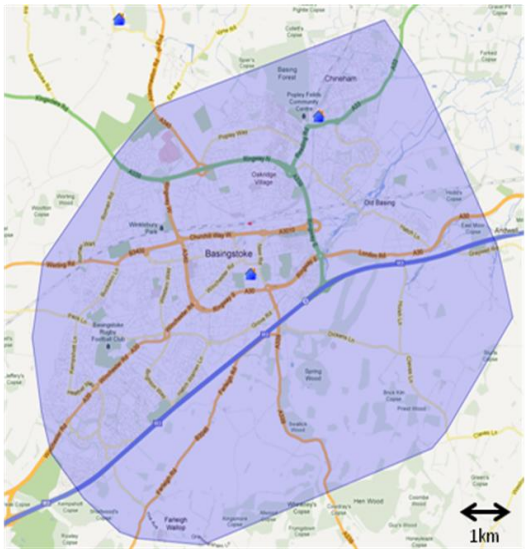
Network quality – a qualitative assessment

Given that the quantitative approach yielded no conclusive answers, we need to examine whether there are any qualitative indicators that could tell us whether network quality matters. In the UK, we have identified three possible indicators of an answer either way.

<u>Basingstoke</u>

Basingstoke has notoriously poor ADSL-based broadband. Significant suburban areas are served by the centrally-located exchange; the long line lengths in areas such as Chineham have led to Basingstoke having a very high number of notspots and very slow spots, and has spawned numerous local broadband campaigns.

Figure 35: Basingstoke exchange area



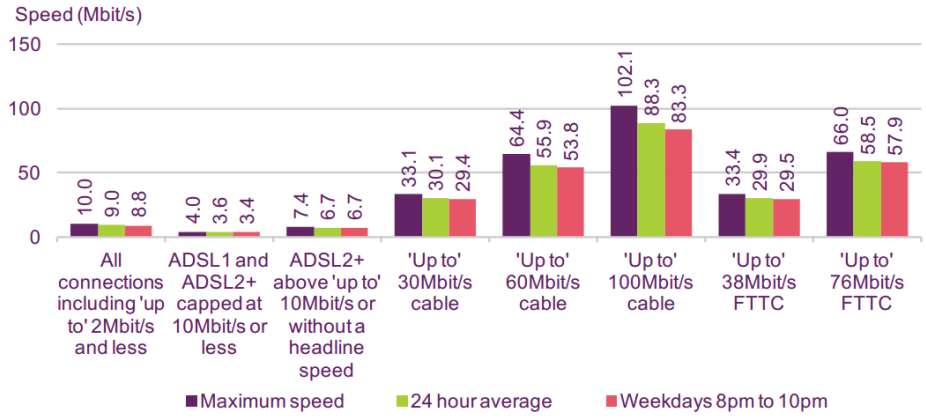
Source: SamKnows

BT deployed FTTC to Basingstoke in the summer of 2009, and experienced a significantly increased level of take-up on the cabinets further out of Basingstoke compared to other areas of its deployment – 12-13% within a matter of months, compared to a UK average of 4% at that time[3]. This suggests, anecdotally, that where consumers have been receiving no or poor quality ADSL there is a higher demand, and willingness to pay, for superfast services.

Cable

The corollary to this could be the experience of Virgin Media in the UK. Based on Ofcom's broadband speed research, on average ADSL2+ services in the UK deliver average speeds of around 8-9Mbps despite headline speeds of 20-24Mbps. Cable services, however, by and large deliver the headline speeds that are advertised – indeed, the average speed for customers on the 30Mbps cable service was actually 30.1Mbps.

Figure 36: Average download speed per service type, UK



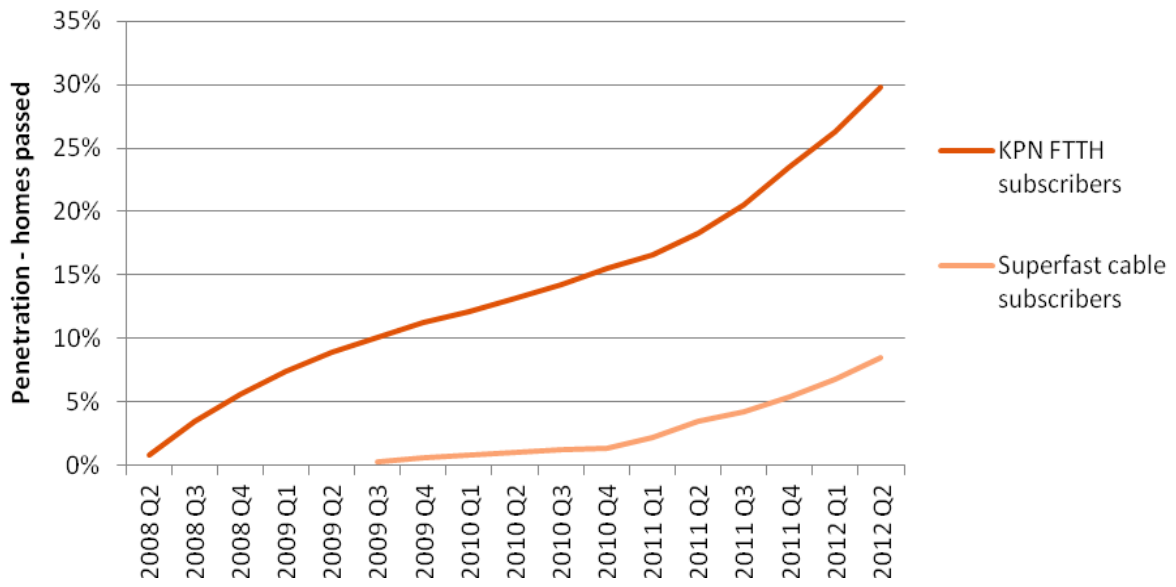
Source: Ofcom

[3] Q2 Results Transcript, BT Group Plc, (13 November 2008),p.15.

Virgin Media's superfast services have been available in the UK since Q3 2009. The growth in adoption of Virgin's superfast services has been slower than that of BT's Infinity (once uplifted subscribers have been adjusted for). This may be in part due to pricing, as Virgin initially priced its superfast services at a significant premium – over 40% compared to the previous top-tier service. However, over time this premium has come down, and is now around 20% – indeed, recent changes to their services has seen 30Mbps become the entry-level service for new customers. The slower growth, therefore, may also be because of the quality of Virgin's lower tier services is superior to ADSL-based services, and therefore consumers have less of an incentive to migrate to a superfast service. A similar conclusion was reached by Analysys Mason, in a study for the French regulator ARCEP[4]. The quality of ADSL services in France is generally accepted to be high on account of shorter last mile copper lines, and so the service uplift to superfast services is lower for consumers than in other markets.

Other cable providers may be having similar experiences. From a review of the early available data, we can see that subscriber growth rates for incumbent FTTx deployments may be higher than for the respective cable operators in their market. It is interesting, in this regard, to note that a number of cable operators (such as Virgin Media in the UK, UPC in the Netherlands,Telenet in Belgium, and ZON in Portugal) now offer entry level products with speeds in excess of those delivered by ADSL.

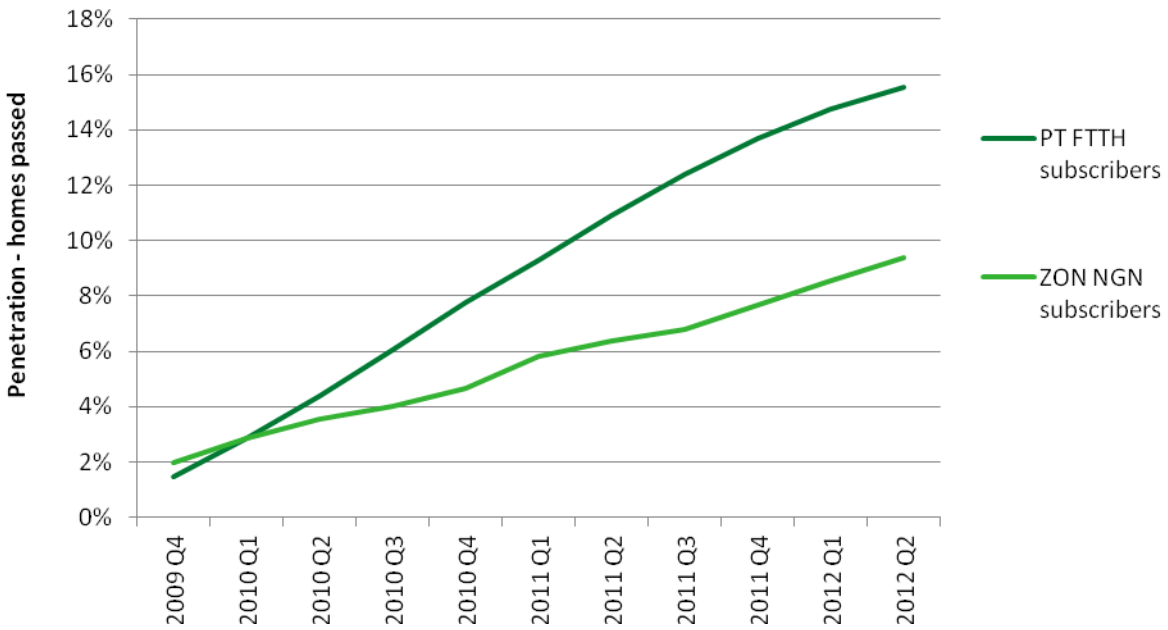
Figure 37: Netherlands, growth of penetration per home passed, KPN v cable providers



Source: KPN, OPTA

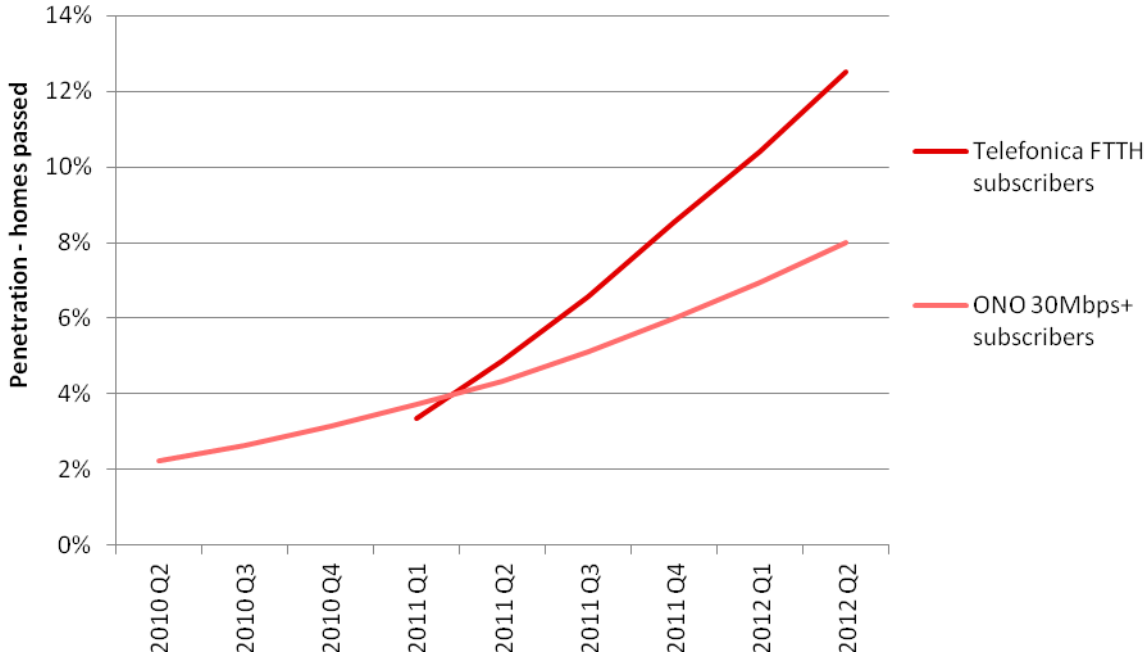
[4] Analysys Mason for ARCEP, *Etude sur le très haut débit :nouveaux services, nouveaux usages et leur effet sur la chaîne de la valeur*, February 2012

Figure 38: Portugal, growth of penetration per home passed, Portugal Telecom v ZON



Source: PT, ZON. NB: ZON data unadjusted for uplifted subscribers

Figure 39: Spain, growth of penetration per home passed, Telefonica v ONO



Source: Telefonica, ONO. NB: ONO data unadjusted for uplifted subscribers

It is also worth noting that a similar challenge may be facing the new entrant municipal FTTH networks, built out to offer first generation broadband initially. We have already seen that they have a much slower rate of adoption of superfast broadband; this could be explained by the fact that their existng lower-tier services also provide a much faster service than headline speed-comparable ADSL services.

4.2 Price

We have variously referenced price as a factor through the discussion so far. Pricing is very difficult to compare from one operator to the next, and one market to the next. Bundles of services make breaking out the costs of individual services difficult, while bundles themselves are often not directly comparable from one operator to the next. Across countries, there is the challenge posed by consideration of purchasing power parity, while broadband services and prices are often structured differently in each market, depending on operators' costs, legacy networks, and the competitive environment. Ofcom's price benchmarking activities reflect this complexity, comparing a basket of services to build up a picture of the relative price competitiveness of each market.

For superfast services, we are interested in the premium operators charge for superfast services. This is easiest to capture when the services are available as standalone products, the figures referenced in the report so far have been compared on this basis. The obvious issue is that standalone services are not how the majority of consumers consume broadband and related services. The challenges with assessing bundles make them difficult to reliably assess, however, and so we will look primarily at standalone prices and suggest that these are representative of the premium that would be attached to superfast services in the bundle also.

The first region to consider is Asia. We have already highlighted that there is only a small premium if one is charged at all for superfast broadband services. The table below demonstrates this for the three Asian markets that we are reviewing.

Figure 40: Service pricing in selected Asian markets

Operator	Service	Price (per month)	Premium?
NTT East (JPN)	FTTH 100Mbps/100Mbps – individual home 100Mbps/100Mbps - MDU , 16+ subs ADSL 47Mbps/5Mbps (with existing phone line) 47Mbps/5Mbps (no phone line)	 ¥6,720 (US$85) ¥3,989 (US$50) ¥4,788 (US$60) ¥7,077 (US$90)	It's complicated... But FTTH can be cheaper than DSL (and vice versa)
LG Uplus (SK)	10Mbps/0.8Mbps 100Mbps/100Mbps	₩29,500 (US$26) ₩33,000 (US$30)	Small

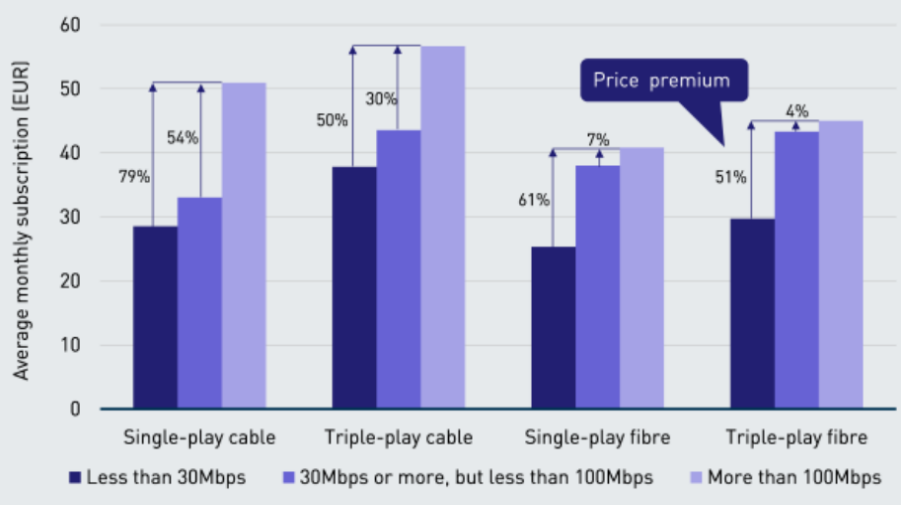
KT (SK)	8Mbps/0.6Mbps 50Mbps/50Mbps	₩30,000 (US$27) ₩30,000 (US$27)	None
HGC (HK)	10Mbps/10Mbps 50Mbps/50Mbps	HK$188 (US$24) HK$228 (US$29)	20% premium within operator packages; 10/10 more expensive than other 100/100 offers in the market
PCCW (HK)	8Mbps/0.6Mbps 100Mbps/100Mbps	HK$398 (US$51) HK$298 (US$38)	FTTH cheaper than DSL
HKBN (HK)	100Mbps/100Mbps	HK$169 (US$22)	100Mbps significantly cheaper than other services in HK market

Source: Operator websites, Q1 2012

This type of approach to pricing is difficult for operators in European markets to replicate. To deploy superfast services they will have incurred significant capex, likely far higher per subscriber than the operators in South Korea, Japan and Hong Kong (indeed, HKBN have reported that their deployment costs are around US$200 per home passed, compared with well over US$1500 for other markets such as Australia, Switzerland, France and the US).[5] In these markets dense living in urban areas significantly reduces deployment costs, as does the ability to deploy overhead cable. Furthermore, in some cases financial support from government has supported the deployment of infrastructure to deliver superfast services. These are conditions that are unlikely to be found by incumbents in European markets, as their approach to pricing suggests – both cable operators and fibre providers on average charge a premium for superfast services that is significantly higher than any found in the Asian markets we have examined.

[5] HKBN, 2010-11 Q4 results presentation, published 11 January 2012

Figure 41: Superfast cable and fibre pricing premium - EU markets



Source: Analysys Mason

It is less clear what impact this pricing approach may have had on take-up – there are too many variables at work across the markets to single out the impact that price alone may have had. However, it seems reasonable to assume that take-up of superfast broadband should be stronger in markets where the premium is lower and in particular those markets where no premium is charged.

This said, in the UK the premium charged by BT is relatively low. Indeed, there is no premium between BT's top tier ADSL package (Option 3) and the comparable Infinity package (Option 2). This could well be impacting on initial take-up; for existing top-tier subscribers, the option of an ostensibly free upgrade is akin to the subscriber uplifts that occur on cable operator networks (which we adjusted for when considering the evidence of cable networks). There will remain a question, therefore, as to what growth rate the UK can expect once the 'free' upgrades and the early adopters have all subscribed to superfast in this initial phase.

4.3 Services

IPTV

We have already noted the role that IPTV has played in the commercial case for deployment for a number of operators, particularly in Germany, Belgium, and the USA, where it was the main driver. Additional services delivered over superfast broadband networks that provide an alternative revenue stream for operators are an important part of the business case – all of the incumbent operators we have studied in Europe have a Pay-TV service, although with different market shares depending on the market environment. While it is not necessary for operators delivering an IPTV service to do so over fibre at present – improvements to ADSL technologies and enhanced compression technologies have meant that operators can deliver IPTV today via ADSL connections – future TV services such as multi-room HD, Ultra HD and 3D will test the limits of ADSL-based services. The ability for ADSL-based broadband to keep up with the requirements of increasingly capacity-heavy IPTV services

over time will be challenged, and may necessitate a move by consumers to a superfast broadband infrastructure.

What we have seen in the US in particular, is that the adoption of the incumbents' Pay-TV services has led significant numbers of subscribers to also adopt higher speed broadband (although not necessarily superfast broadband). While it may be that IPTV-led deployments could see slower take-up of superfast compared to deployments selling broadband alone, as the focus is selling the IPTV service, this may not always be the case if the US scenario can be replicated in other markets. Off the back of the adoption of IPTV services, countries could see a higher penetration of superfast broadband.

In terms of what this might mean for the UK, BT is already seeing that, in areas where ADSL speeds are poor, subscribers are taking both the Infinity product and BT Vision, their IPTV service[6], while TalkTalk have noted that they expect IPTV to increase the demand for fibre-based services in the future.[7] New developments in the IPTV market such as the rollout of YouView could play a positive role in boosting superfast broadband rollout, however it is difficult to predict both developments in the UK IPTV market over the coming years and what interplay these might have in selling broadband to customers.

Online services

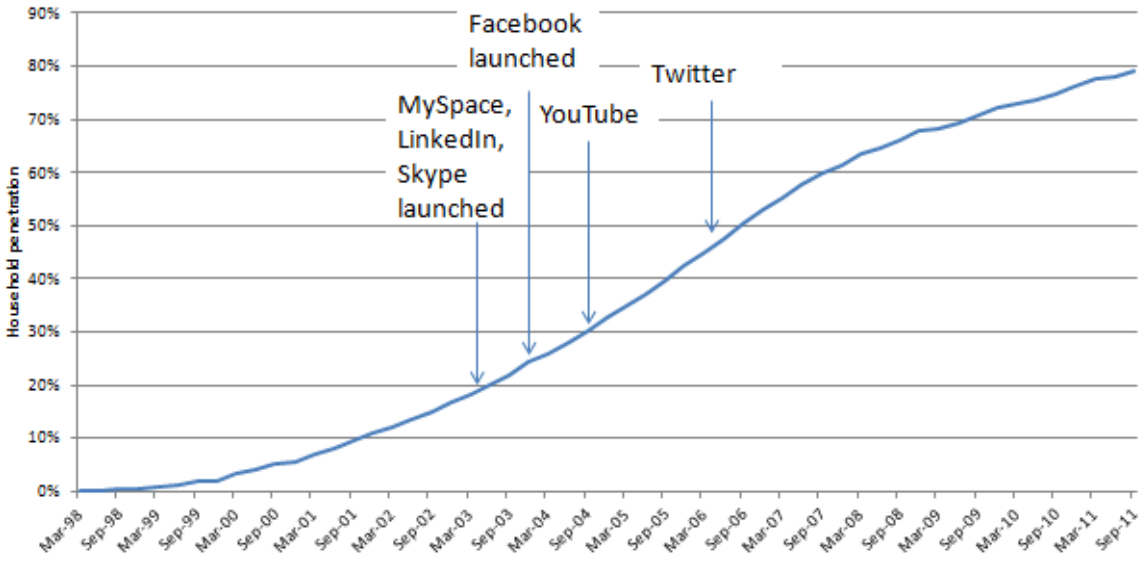
The role of online content is crucial to the consumer proposition for broadband. At this stage, however, there is no one single online service that requires a superfast broadband service in order to be utilised. Indeed, existing marketing for superfast services focuses on the ability to do things online faster than first generation broadband allows. For providers of content online the focus has been on ensuring services require the minimum possible capacity, in order that they have as wide a reach as possible and work well during periods of congestion.

That there is not yet a market of services that require superfast broadband speeds should not be a surprise. In this regard, demand for first generation broadband was previously ahead of the period of innovation that led to services that utilised that capability being developed. The graph below demonstrates this for US broadband subscribers.

[6] BT, 2011-12 Q3 Results Call Transcript, call on 03 February 2012

[7] TalkTalk Group, 2011-12 Q2 Results Presentation, published 15 November 2011

Figure 42: USA broadband subscriber growth and online service innovation



Source: FCC, Operators, MySpace, LinkedIn, Skype, Facebook, YouTube, Twitter

For online services to create demand for superfast broadband, the experience of first generation broadband is that service innovation occurs once a critical mass of subscribers is reached. For superfast we are likely not there yet; more importantly, for the early period of take-up the online service pull will need to come from existing services that will simply work better and faster over superfast broadband.

This does raise a further issue, however, which we raised briefly earlier. The US was the home to online service innovation for the first generation of broadband. A number of these companies have become global giants. Whether such innovation will occur in the US this time, for next generation broadband, is perhaps a more open question. We have already seen that the US has a very low number of subscribers on genuinely superfast services, even counting those cable subscribers that have been uplifted. With the relative lack of competition in the US market, there is less of an incentive to compete on broadband speeds when the dominant product in the bundle is the Pay-TV service – this applies as much to the cable operators as it does to the copper-line incumbents.

If this is to continue for any period of time, then the US will not reach a critical mass of superfast subscribers, and so will not reach the type of addressable market size that encouraged the early broadband innovators to develop new services – we have previously noted Google's foray in to FTTH buildout in Kansas City as perhaps a sign that they do not perceive the US's broadband to be developing as they would wish.

This could, therefore, leave a gap to be filled, perhaps by European innovators. Indeed, if an addressable market of superfast broadband users can be created in Europe then it may become the new test-bed for online service innovators. Although this discussion idea should be tempered by the experience of the Asian markets, which have not seen the development of an innovative online service environment based on superfast broadband despite their high levels of adoption, there remains an open question as to where the next wave of innovation will come from.

5. Comparisons with other technologies and services

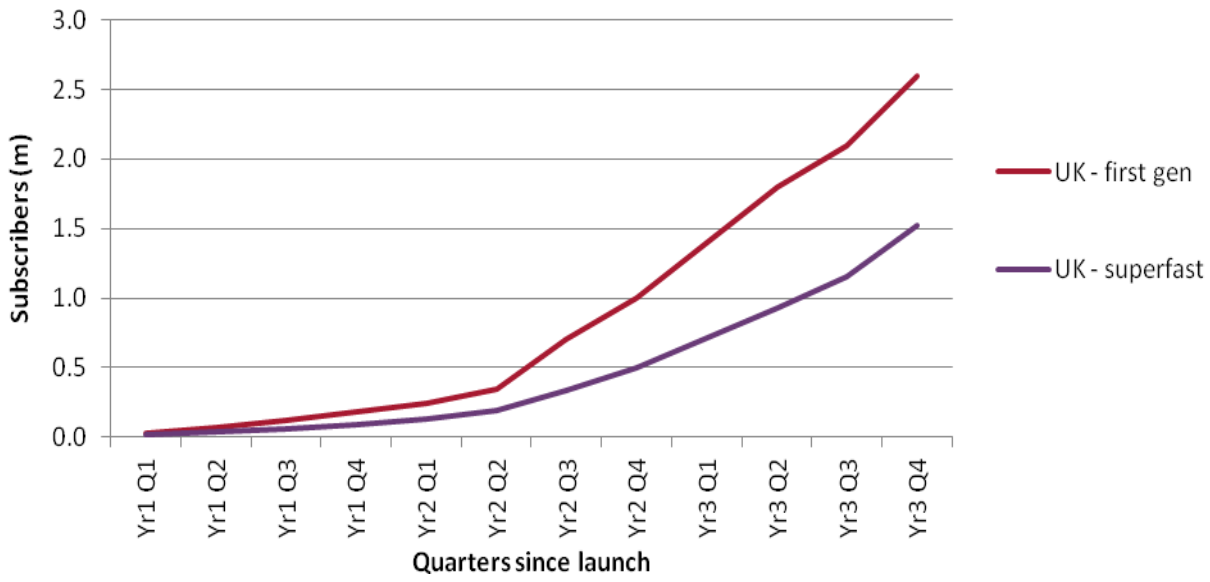
To try to shed further light on the likely take-up of superfast broadband in the UK, we can also look to other types of service, not just superfast services in the UK and other markets. In the following section we examine comparisons with two other services: first generation broadband and HDTV.

5.1 First generation broadband comparisons

First generation broadband was launched when existing dial-up services were available, albeit at considerably lower levels of penetration. Therefore, there are parallels between the step from dial-up to first generation broadband, and from first generation broadband to superfast broadband.

In the UK, we can see that superfast broadband take-up has occurred more slowly than that of first generation broadband. The graph below compares the take-up, in total numbers of subscribers, of both superfast broadband and first generation broadband from the point at which each service became available in the UK.

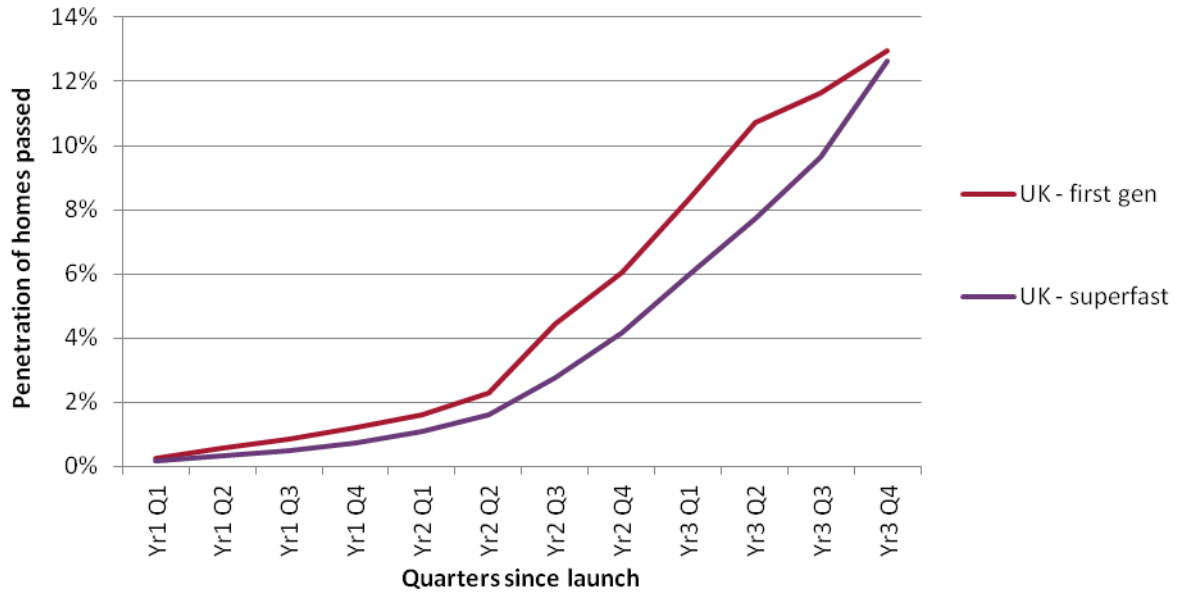
Figure 43: UK, first generation broadband subscribers v superfast broadband subscribers



Source: Operators, Ofcom

The gap between the two curves decreases when the pace of deployment is factored in, although this analysis is difficult to make accurately given the role of cable operators in first offering broadband services and driving the initial take-up – coverage data is not available for the franchisees at that point in time.

Figure 44: UK, penetration of homes passed, first generation broadband v superfast broadband

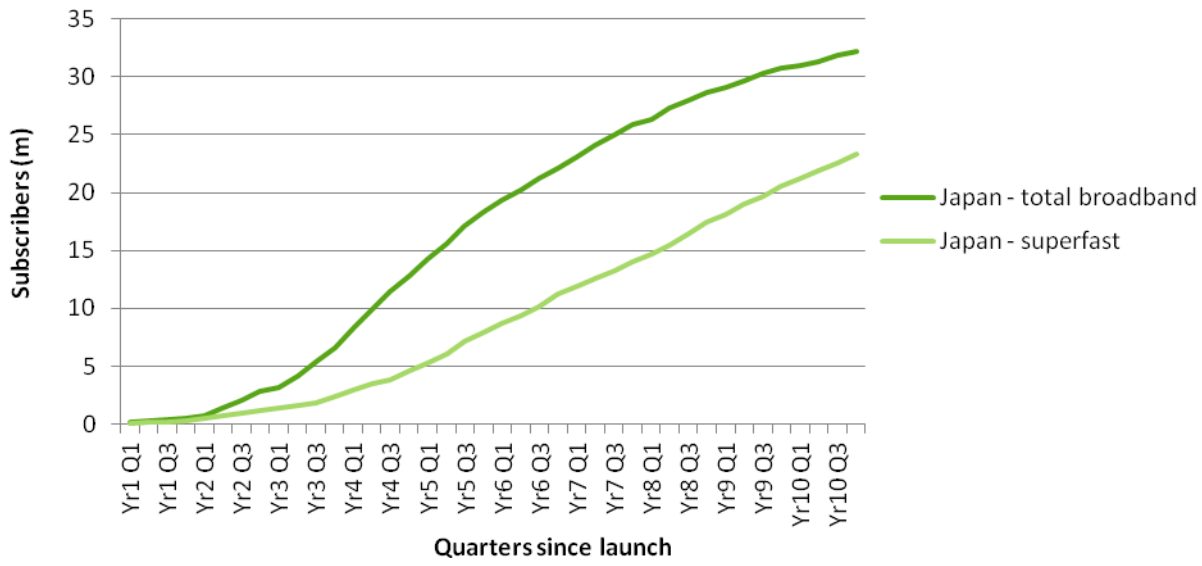


Source: Operators, Ofcom

Although this might suggest that superfast broadband could see a growth rate similar to, albeit slightly slower than, first generation broadband, this would not necessarily be accurate. Around this period of first generation broadband's development, the introduction first of a wires-only product, and then of fit-for-purpose local loop unbundling (LLU), dramatically increased the level of competition amongst broadband providers, reduced prices, and encourage take-up to grow more rapidly. In the superfast market there is at present less chance of this occuring. Wires-only is being developed, but at present unbundling is not practical from the exchange and not commercially feasible on the sub-loop. Furthermore, whether a competitive environment will develop for superfast services beyond BT and Virgin Media remains to be seen.

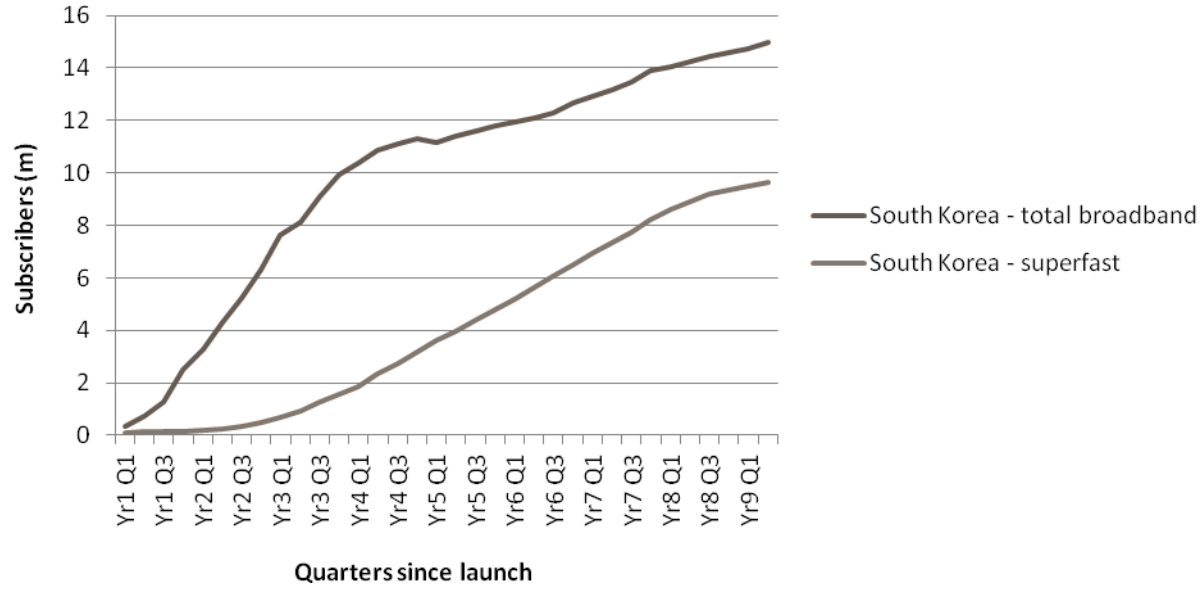
When we examine other markets, we see that this trend of superfast broadband growth being behind first generation growth is the same in each of the markets that we have looked at, including Asia – and even allowing for the caveats involved in comparing data from South Korea.

Figure 45: Japan, total broadband subscribers v superfast broadband subscribers



Source: Operators, MIC

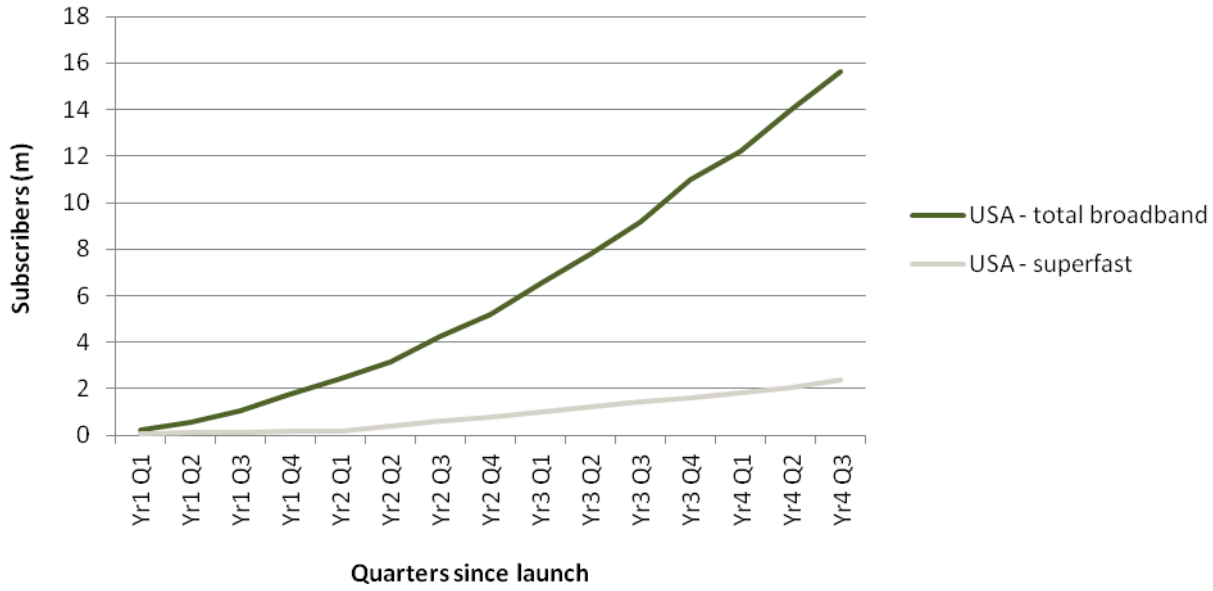
Figure 46: South Korea, total broadband subscribers v superfast broadband subscribers



Source: Operators, KISA

(NB: the numbers for total broadband in both South Korea and Japan will include superfast broadband subscribers part way through their growth – in these markets these services came online during the initial adoption of broadband, and so the number of first generation broadband subscribers is difficult to break out, and would be largely meaningless in any event.)

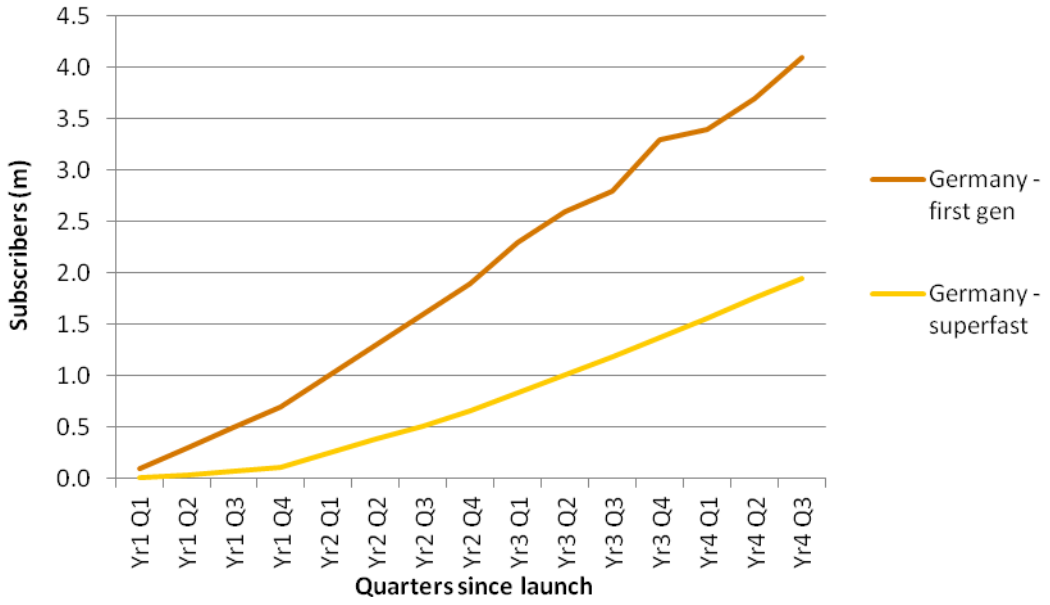
Figure 47: USA, first generation broadband subscribers v superfast broadband subscribers



Source: Operators, FCC

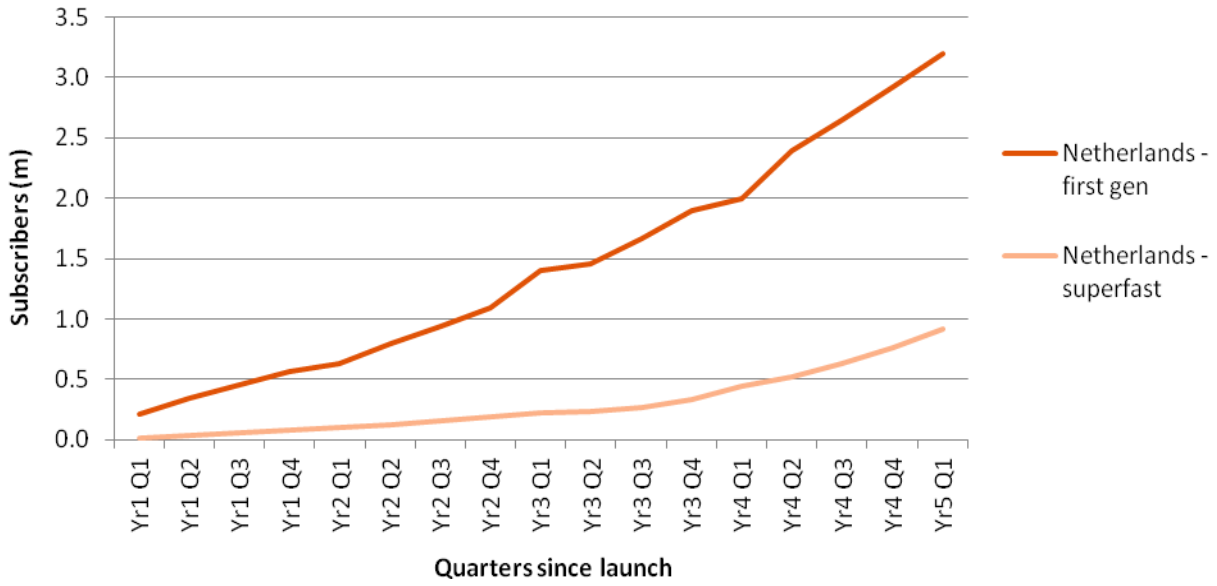
In Europe we see the same story.

Figure 48: Germany, first generation broadband subscribers v superfast broadband subscribers



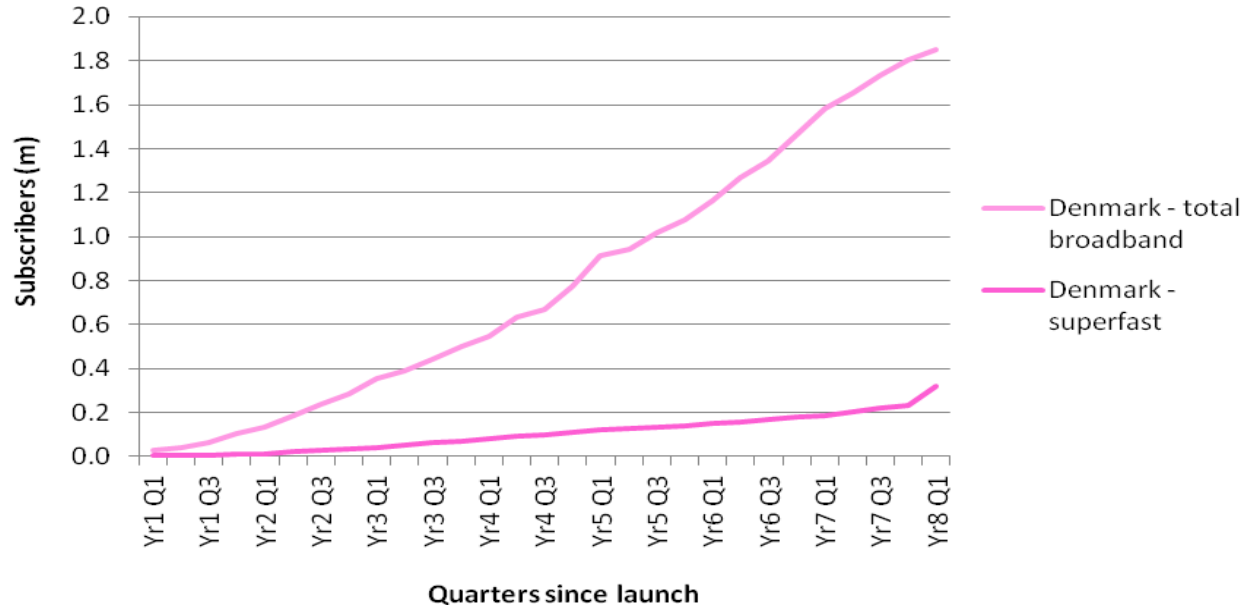
Source: Operators, BNetzA

Figure 49: Netherlands, first generation broadband subscribers v superfast broadband subscribers



Source: Operators, OPTA

Figure 50: Denmark, total broadband subscribers v superfast broadband subscribers



Source: Operators, NITTA

In each market the take-up curves for superfast broadband are much flatter, and almost linear, in comparison to the more traditional demand s-curves that first generation broadband saw. The only exceptions to this are Portugal and Spain, where much faster rates of adoption have been seen, most likely due to uplifting that we have not been able to account for. This would suggest that the UK's experience to date is typical, and that a slower, more

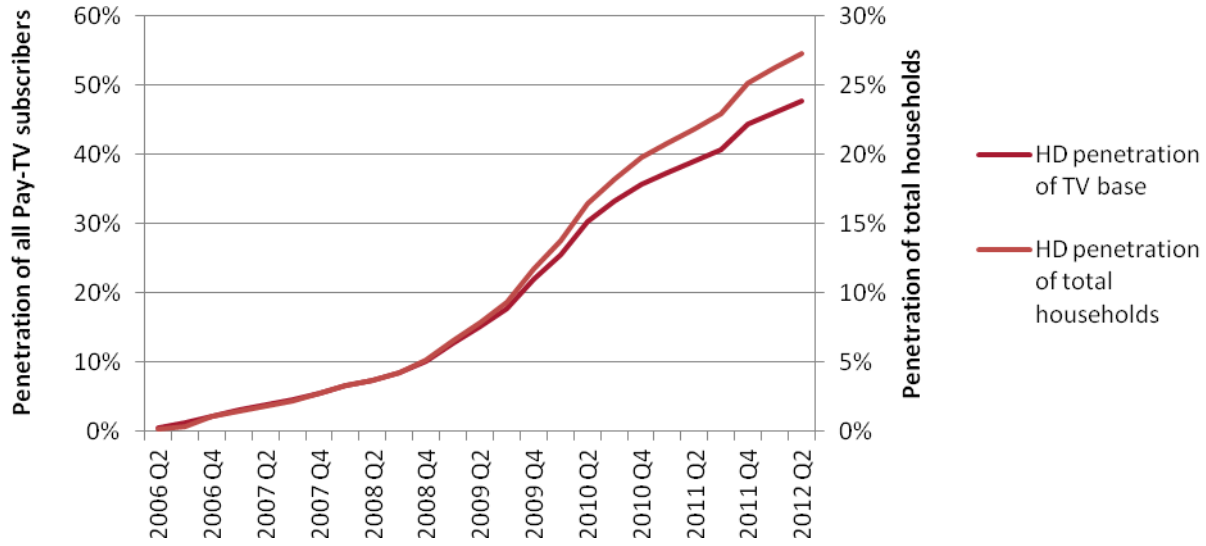
gradual subscriber growth for superfast services can be expected than that which was seen for first generation broadband.

5.2 HDTV

HDTV provides an interesting comparison for superfast broadband. In terms of its proposition to consumers, it is of the same essence: subscribers are paying a premium to receive a better version of a service to which they already subscribe. In the absence of a killer app that requires superfast connectivity, the value proposition for superfast broadband is to do the same things you currently do, but do them faster.

In the UK, consumers have been able to subscribe to HD services through Sky and Virgin Media – we will focus on these two providers as there is a subscription charge involved, and therefore a willingness to pay has been revealed. The graph below shows how subscriber numbers for HD services have grown over time. Available in 2006, the growth was slow in the early years before increasing after two years, maintaining a steady growth rate.

Figure 51: HD penetration of Pay-TV subscriber base - Sky, Virgin Media combined



Source: BSkyB, Virgin Media

This in some ways mirrors the experience of many of the more mature superfast broadband markets that we have examined. The slow penetration of HD TVs in UK homes will at first have constrained adoption, as would the lag caused by the time required to deploy superfast broadband networks. Once coverage of HD TVs reached critical mass, however, the service grew more quickly, albeit at a steady rate rather than with a more apparent s-curve that first generation broadband saw. The comparison with HD suggests that consumers in the UK are willing to pay a premium for a better service, and that these services will gradually gain traction and take-up over time.

(It is also worth noting that this take-up occured despite the prevailing economic conditions, notably the recession of 2009, but also the continuing uncertainty since. This highlights the relative resilience of communications products for households, even when household expenditure may need to be cut back – indeed, even premium products such as HD have remained a fixture in household expenditure.)

6. Conclusions

Given the available evidence, we can draw some views as to how demand for superfast broadband has developed, how this might continue, and what this might mean for the UK.

1. Comparisons are difficult to draw conclusions from, given the non-homogeneous nature of the markets under review

   For this study we have reviewed a number of the leading markets for superfast broadband deployment, and in most cases these have been chosen because they are similar to the UK market – whether this is in terms of market structure, regulatory environment, or consumer behaviour. However, even on this basis there is still much that is unique to each market, and in particular factors that impact on the deployment and take-up of superfast broadband. Factors such as geography, adjacent market structure, competitive dynamics, and even the economic environment within each country make it difficult to compare results, and in particular minor differences between markets.

   This is additionally so given the early stage of deployment in a number of the countries we are looking at, particularly within Europe. With deployments not yet completed, it is in many cases perhaps too soon to say with any certainty exactly how the take-up story will unfold. Certainly, contrasting minor differences between levels of take-up in markets that are at an early stage is likely to lead to a false analysis; longer-term trends are of greater use, but in many countries are yet to fully reveal themselves.

2. Superfast broadband demand builds slowly in every market – even in Asia.

   Despite the caution in the first conclusion, it is clear that in every market we have looked at superfast broadband take-up grew quite slowly. Even in Japan and South Korea, where they now have very high levels of take-up, their rate of growth has still been gradual; it has taken over a decade for them to reach the levels of penetration we see today, and it is likely that other markets will require similar time frames to achieve similar results. Indeed, the UK's early experience is relatively similar to that of Japan – though this is not to say that the UK is necessarily headed towards where Japan is today.

3. The UK's early evidence has growth broadly in line with other markets, and slower than for first generation broadband in the UK.

   Comparisons of the initial period of service availability for both superfast broadband and first generation broadband made above suggest that superfast services are experiencing a similar slow start to that which first generation broadband saw.

   Over time, first generation took off and became widely adopted. However, in the UK there were developments that led to a faster growth of first generation broadband take-up – specifically the development of a wires-only solution, and then the availability of LLU. Although some developments in this direction are expected for wholesale superfast services in the UK – wires-only is currently under discussion in the relevant standards body – there is unlikely to be the same step-changes for superfast broadband that encouraged innovation and competition and led to lower

prices and increased take-up in first generation broadband. Therefore, it is unlikely that superfast broadband will see the same level of take-up growth as first generation broadband from this point – as is suggested by the more mature markets, where take-up for superfast grew more slowly than for first generation broadband.

4. Adjacent markets, such as Pay-TV, have played a significant role in some operators' strategies – and this may create an advantage for the UK

   In some of the markets we have looked at Pay-TV has played an important role in driving the take-up of superfast broadband. This is especially true in the US, but also in some European markets such as Germany and Portugal. In the UK, although BT has a Pay-TV service it has likely played less of a role in the commercial case for deploying NGA, as it has been less able to grow market share than other IPTV services in the countries we have examined.

   The case of the US, however, might suggest that an innovation gap will occur for services utlising superfast broadband speeds. The US market was home to most of the successful innovations in first generation broadband. However, it cannot necessarily expect to replicate this for next generation broadband, as its consumers cannot or do not take services that deliver superfast speeds, despite widespread NGA deployments. This may leave an opportunity for innovations in other markets to play a more prominent role in driving the next wave of Internet-based services.

5. Demand in rural areas may be higher than in urban areas

   There is some evidence to suggest that network quality impacts on the demand for superfast broadband. This suggests that more rural areas with poor current broadband might see higher levels of demand for superfast broadband than urban areas. However, the caveat to this is that in many rural towns and villages existing ADSL services are actually better than average, as the local exchange has shorter line lengths. A more detailed view on what speeds can be achieved in different geographies – rural town, remote hamlet, urban centre etc – may help to better understand whether rural areas will in fact see greater demand than urban areas.

6.1 What does this mean for the UK?

The early data to emerge from the UK shows a rate of growth that is broadly in line with European peers and other markets. It is still early days, but this is a solid start. However, it is important that this relative success is set against realistic expectations – no market has seen huge take-up occur rapidly, and it is unlikely that the UK will reach very high levels of take-up by 2015.

The UK has a potential upside over many of its peer markets, however, due to the level of competition in the market. Of the markets reviewed, only France and the Asian markets are likely to experience competitive provision of fibre-based services as well as competition from the cable operator – and in Asia the incumbent operators remain dominant, creating a less competitive environment. In the UK, however, there is the opportunity for the biggest four ISPs (BT, Sky, TalkTalk and Virgin Media) to all be retailing a superfast broadband service.

How take-up of superfast develops, however, will depend on a number of factors. While there is a potential upside from the competitiveness of the UK broadband market, how the

available wholesale products develop, both in terms of features, process and pricing, will be an important factor in how ISPs in the market are able to differentiate their superfast services and to compete with each other. We have noted how the introduction and development of wires-only and LLU services helped strengthen competition and drive the growth of first generation broadband in the UK. It is unlikely that the same step changes will occur in next generation broadband, although some developments are expected that could provide further support to competition in the market.

A related issue is how pricing for superfast, and for alternative broadband options, evolves – both in terms of fixed and wireless services. The level of retail pricing compared to ADSL services, and how it is impacted by the availability of new and competing services such as LTE, are uncertainties at this point; whether superfast continues to be marketed as a premium service will impact on the level of take-up that can be expected. This will also be impacted by the strength with which non-BT ISPs market superfast services, and will likely reflect the take-up momentum that superfast builds up in the early years of availability.

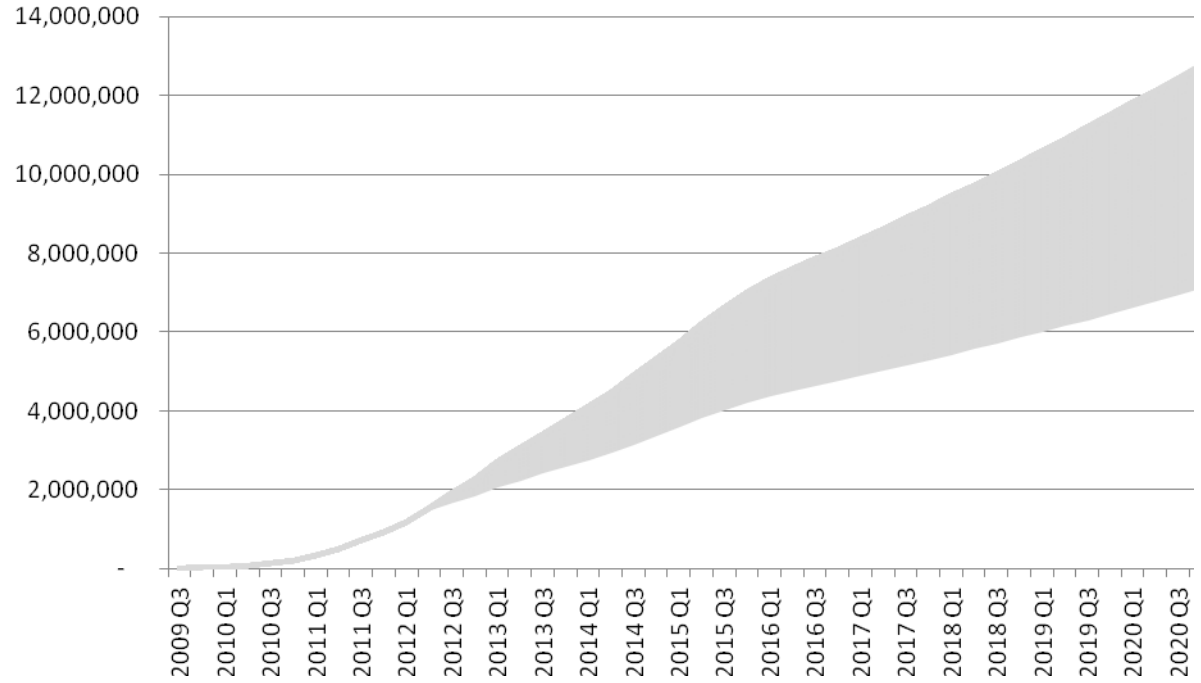
The level of take-up will also be impacted by whether the consumer appetite for superfast services goes beyond early adopters and zero-premium migrations. One view of take-up could be that once the early adopters have been captured, there is a relatively slow movement of subscribers from first generation services to superfast. At this time, given that rollout in the UK has not yet finished, there is no clear answer to this question.

This could also be influenced by the development of the over-the-top service environment, and whether IPTV becomes a mainstream service. If services continue to be developed, and utilised by end users, that require, or perform better over, superfast broadband then consumer demand may become stronger than it would otherwise have been.

Finally, the speed of the BDUK projects coming online will also impact the rate at which demand grows. These projects will account for nearly one quarter of households in the market, almost all of which will not have access to superfast broadband through the cable network. How rapidly these projects come online will impact the speed at which superfast broadband take-up grows in the UK.

Given these significant uncertainties, below is an estimate of the likely range within which we expect superfast broadband take-up to grow. It is necessarily broad; as just discussed, there are many factors that will influence how rapidly take-up grows, and these are largely unresolved at present.

Figure 52: Superfast broadband subscriber estimate to 2020 - UK



Source: Operator data; BSG estimates

Understanding how demand for superfast broadband is developing will be crucial for policymakers in this next period of the development of the broadband market. Many governments are investing in superfast broadband infrastructure themselves, and have ambitious goals and targets to achieve, placing bets with scare resources that superfast broadband will be an important enalbing infrastructure for economic growth. Understanding how these networks will be utilised will be important in order that they can develop appropriate policy responses as the market develops; understanding how these networks are likely to perform for investors is equally important, in order to understand the investment environment for future infrastructure development.

We have set out to get underneath the headline data, in order to explore what the actual demand is. We have noted that for a number of operators willingness to pay is lower than the reported subscriber numbers; similarly, we have seen that the picture in some markets that lead the global rankings may not be as simple as those rankings suggest, with slower growth and lower profitability. We have also noted the relationships between broadband and other adjacent markets, such as Pay-TV, and how these existing market structures can play a role in the adoption of superfast broadband. In each of these areas, there are lessons for policymakers and others. BSG will continue to monitor demand for superfast broadband and to inform future policy debates.

Glossary of terms

4G: Fourth-generation wireless data communications; usually classed as WiMAX, WiMAX2, HSPA+, LTE and LTE-Advanced technologies, superseding second (2G) and third (3G) generation wireless.

ADSL (Asymmetric Digital Subscriber Line): A digital technology that allows the use of a standard telephone line to provide high speed data communications. Allows higher speeds in one direction (towards the customer) than the other.

ADSL2+: An improved version of ADSL, offering high speeds, especially on shorter telephone lines. In the case of ADSL2+, up to 24Mbps can be delivered towards the customer.

Broadband: A service or connection generally defined as being 'always on', providing a bandwidth greater than narrowband.

Broadband speed: The speed at which data are transmitted over a broadband connection usually measured in megabits per second (Mbps).

Dial-up internet services: A form of internet access that uses the facilities of the public switched telephone network (PSTN) to establish a dialled connection to an internet service provider via telephone lines.

DSL (Digital Subscriber Line): A family of technologies generally referred to as DSL, or xDSL capable of transforming ordinary phone lines (also known as 'twisted copper pairs') into high-speed digital lines, capable of supporting advanced services such as fast internet access and video-on-demand. ADSL, HDSL (high data rate digital subscriber line) and VDSL (Very high data rate digital subscriber line) are all variants of xDSL.

DOCSIS3.0 (Data Over Cable Service Interface Specification 3.0): An international telecommunications standard for sending data over a cable network. It is employed by many cable operators to provide internet access over their existing hybrid fiber-coaxial (HFC) infrastructure. DOCSIS 3.0 supersedes DOCSIS 1.0, DOCSIS 1.1, and DOCSIS 2.0. DOCSIS 3.0 offers channel bonding, for a minimum of four channels.

Download speed: Also downlink or downstream speed. Rate of data transmission from a network operator's access node to a customer, typically measured in Megabits per second (Mbps).

Exchange: The local telephone exchange is the building where all consumers' copper telephone lines are connected to enable telephone calls to be switched, and where network equipment is installed which enables consumers' data traffic to be routed via an operator's core network to its destination.

Fibre optic cable: Flexible, transparent fibre made of very pure glass which permits transmission of high data rates over longer distances with l ess loss than metal cables.

Final third: The Final Third refers to an estimated third of all UK homes and businesses where there is no business case for the market alone to serve with next generation broadband.

First Generation Broadband: The first 'always on' internet service, providing a bandwidth greater than narrowband. This predates next generation broadband, which provides a significant upgrade from first generation broadband, offering a step change in speed and quality of service.

FTTB (Fibre-to-the-building): A form of fibre-optic communications delivery in which an optical fibre is run into the basement of a building and another cable type is used through the building (common in high rise living accommodation in South Korea).

FTTC (Fibre-to-the-cabinet): An access network consisting of optical fibre extending from the optical distribution point at a handover point (telephone exchange) to the street cabinet, a radial distance of typically 25Km. The street cabinet is usually located only a few hundred metres from subscriber premises. The remaining segment of the access network from the cabinet to the customer is usually a copper pair but could use another technology, such as wireless.

FTTH (Fibre-to-the-home): A form of fibre optic communication delivered in which the optical signal reaches the end user's home. Typically it uses the same optical distribution frame as FTTC and uses the same duct access as FTTC, however rather using the existing copper, it takes fibre all the way to the customer's premises.

FTTP (Fibre-to-the-premise): A form of fibre optic communication delivered in which the optical signal reaches the end user's living or office space. Typically it uses the same optical distribution frame as FTTC and uses the same duct access as FTTC, however rather using the existing copper, it takes fibre all the way to the customer's premises.

FTTx (Fibre-to-the-x): Fibre-to-the-x is a collective term for various optical fibre delivery topologies that are categorized according to where the fibre terminates. I.e. FTTP, FTTB, FTTH, FTTC.

GHz (GigaHertz): A measurement of frequency in radio spectrum.

Gb (Gigabit): A measure of digital information storage, 1000,000,000 bits (see bytes and bits).

Headline speed: The speed at which a broadband service is marketed, usually expressed as 'up to' (for example, in January 2012 all of BT's nationally available ADSL broadband services were advertised as "up to 20mbps").

HDTV: High-definition television.

HFC: Hybrid fibre-coaxial. A broadband network which combines optical fibre and coaxial cable.

IPTV: Internet Protocol television. The delivery of television services via the internet protocol suite over a packet-switched network such as the internet, instead of being delivered through traditional terrestrial, satellite signal and cable television formats.

ISP (Internet Service Providers): A company that provides retail access packages to the internet.

Killer App: A killer application is a feature, function, or application of a new technology or product that is presented as virtually indispensable and is so desirable that it demonstrates the core value of some larger technology.

LAN: Local area network. A computer network covering a small physical area such as a school, office or home.

LLU: Local loop unbundling is the process whereby incumbent operators (in the UK this means BT and Kingston Communications) make their local network (the lines that run from customer's premises to the telephone exchange) available to other communications providers. This process requires the competitor to deploy its own equipment in the incumbent's local exchange and to establish a backhaul connection between this equipment and its core network.

Local loop: The access network connection between the customer's premises and the local telephone exchange, usually a loop comprising two copper wires.

LTE (Long Term Evolution): A 4G wireless broadband technology. 4G supersedes second (2G) and third (3G) generation wireless, and is engineered to reflect the growing reliance on the need for carrying large volumes of data.

Mbps (megabits per second): A unit measuring the bit-rate. 1Mbps is the equivalent of 1,000kbps.

Multi-room HD TV service: A high-definition TV (HDTV) service that allows different HDTV channels to be viewed at the same time on multiple television sets throughout the home.

NGA (Next Generation Access): Access to a network providing a significantly upgraded service from first generation broadband, offering a step change in speed and quality of service.

NRA: National Regulatory Authority.

Next Generation Broadband: A broadband service which provides a significant upgrade from first generation broadband, offering a step change in speed and quality of service.

Next Generation Network (NGN): A network providing a significant upgrade from first generation broadband, offering a step change in speed and quality of service.

Pay-TV: Television broadcasting in which viewers pay by subscription to watch a particular channel or group of channels.

PSTN (Public Switched Telephone Network): The traditional international telephone system in which phone calls are switched or routed from origin to destination. This is in contrast to private networks and dedicated point-to-point services.

SLU (Sub-loop unbundling): Like local loop unbundling, sub-loop unbundling is a process whereby incumbent operators make part of their network available to other communications providers. However, with sub-loop unbundling, service providers interconnect at a point between the exchange and the end user, usually at the cabinet.

SME: Small and Medium Enterprise.

SLU (Sub-loop unbundling): Like local loop unbundling, sub-loop unbundling is a process whereby incumbent operators make part of their network available to other communications providers. However, with sub-loop unbundling, service providers

interconnect at a point between the exchange and the end user, usually at the cabinet.

Street cabinet: A box, usually green, on the street that connects a telephone line to the exchange.

Superfast broadband (SFBB): A service or connection generally defined as being 'always on', which is beyond the capability of ADSL technology, i.e. over 24Mbps. This definition excludes services delivered over NGA networks which are not superfast, but captures higher speed services on cable networks[8].

Superfast cable: For all markets except the USA, we understand superfast cable to be a service or connection delivered by cable infrastructure with a headline speed of 30Mbps or higher. We use a headline speed of 25Mbps for the USA, as this is the threshold at which data is available from the Federal Communications Commission (FCC).

Take-up: An acceptance of broadband services by an end user where offered.

Upload speed: Also uplink or upstream speed. Rate of data transmission from a customer's connection to a network operator's access modem, typically measured in Kilobits per second (Kbps).

VDSL (Very-high-bit-rate Digital Subscriber Line): An upgrade to ADSL technology which allows very fast internet access over copper lines. VDSL is capable of transforming ordinary phone lines (also known as 'twisted copper pairs') into high-speed digital lines, capable of supporting advanced fast internet access and video-on-demand. VDSL is often used in FTTC deployments, from the home to the cabinet.

VoIP (Voice over Internet Protocol): VoIP is a communications protocol that allows for telephonic communication via the internet.

Organisations

ARCEP: French National Regulatory Authority.

BDUK: Broadband Delivery UK, a unit within DCMS, is responsible for managing the distribution and allocation of the UK government's broadband funding.

BNetzA: German National Regulatory Authority.

FCC: USA National Regulatory Authority.

KISA: South Korean National Regulatory Authority.

MIC: Japanese National Regulatory Authority.

NITTA: Danish National Regulatory Authority.

[8] This is the definition the BSG use in this study. We are not interested in an academic debate about what a superfast broadband service is; we are interested in capturing adoption of higher speed services that consumers must pay a premium for and that have required investment from operators in order that they can deliver them.

Ofcom: UK National Regulatory Authority.

Ookla: Web-based network testing application.

OPTA: Dutch National Regulatory Authority.

PTS: Swedish National Regulatory Authority.

SamKnows: A web-based broadband measurement resource service.

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About the Broadband Stakeholder Group

The Broadband Stakeholder Group (BSG) is the UK government's leading advisory group on broadband.

It provides a neutral forum for organisations across the converging broadband value-chain to discuss and resolve key policy, regulatory and commercial issues, with the ultimate aim of helping to create a strong and competitive UK knowledge economy. It was established in 2001, and since 2006 has focused on next generation broadband issues.

The BSG's diverse network includes telecoms operators, manufacturers, investors, ISPs, mobile network operators, broadcasters, new media companies, content producers and rights holders, as well as central and local government, devolved administrations, Ofcom and others.

The BSG is based in the offices of Intellect, the trade body for the ICT, telecommunications and electronics industry.

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