Capitalising on Convergence 2
The little red light

Intellect is writing a second report on convergence following on from 2005's 'Capitalising on Convergence', to analyse and discuss how the converged market place has changed over the past three years and make recommendations about the way forward. The report will be written in nine chapters, with each chapter being published on Intellect's website, focusing on the nine topics the Department for Business Enterprise and Regulatory Reform (BERR), and the Department for Culture Media and Sport's (DCMS) Convergence Think Tank will be looking at over the year.

The third instalment of the report looks at prospects for the market to deliver investment in the development of high quality platforms and on the importance of interaction between them.

Capitalising on Convergence Chapter 3

1. Netgear is a US technology manufacturer offering high end networking products for the home. One of the features a Netgear broadband router offers is the accurate monitoring of your home internet connection.

If your connection fails, appropriately enough, a little red light appears on the device and blinks a warning. Sales of these devices in the UK have increased steadily over the last two years due in no small part to this facility, as consumers have become frustrated with fluctuating internet access inhibiting the flow of text, pictures, music and now - the killer application - streamed video content into their homes. They want to know who and what is to blame. In this the little red light is a satisfying piece of technology; inherently binary (the only permutations are yes or no), clear in message and symbolic, it tells the consumer that the problem is not with something tangible like their computer or their modem but somewhere out of sight and intangible: the problem is in the network.

Now this is where the real confusion begins. Whereabouts in the network is the bottleneck that is causing this problem? The network is not a monolith structure but a complicated chain divided into different segments: we have in no particular order of significance, the exchange, the Digital Subscriber Line Access Multiplex (DSLAM), the back haul, and the last mile. The bottleneck that is causing the little red light to flash could be at any one of these particular pressure points at any given moment and is affected by a number of factors including consumer usage and demand, contention rates and legacy technology. However - and this is the crucial point - the consumer doesn't care; all they know is that the little red light is on and the internet is off.

What is clear is that the network is under increasing amounts of pressure: in many ways this is an unexpected consequence of success, but it is important to put this pressure in some sort of context. Current talk of an internet 'crunch' is misplaced. More people are using the Internet to access bandwidth intensive products and services than ever before in the UK. The BBC's iPlayer is an obvious success story here with some 42 million downloads since its introduction on Christmas day 2007. Last year it was claimed that YouTube consumed as much bandwidth in a year as the entire internet took up in 2000. If more people are using the network, there are bound to be congestion and slow downs – the analogy with roads here is well made. There's more and bigger
traffic out there, things will slow down. What we are seeing and what the little red light demonstrates is the first 'squeeze' or 'pinch' of this increased traffic. However this is not solely an access crunch that can only be alleviated by a fibre solution to the home or the kerb, it is a squeeze in the back haul. To tackle this specific pinch requires investment in a different section of the network, one that is regulated in a different fashion to other points. What needs to happen and is happening - with investments like BT's £10bn spend on one of its biggest upgrades, turning its old networks into a single '21st-century network' that is due to be completed in 2011 – are investments made to increase the capacity of the back haul and not, at this particular moment, investment directed at improving the capability of the access network.

The little red light is a harbinger of things to come though: the growth curve of internet usage continues on its steep incline. This pinch is an episode on that growth curve but indicative of what is to come as the pressure points become more apparent and the little red light doesn't blink but beams.

'So what?' you might say. Whilst this is obviously an inconvenience and disruption to the way people are choosing to spend their leisure time and consume their media, does it matter any more than that? There are two responses to this, firstly that consumers are currently being promised a level of service and speed of broadband connection that are simply not being delivered. This should be a concern to communications providers as dissatisfied consumers mean more churn and insecure revenue streams. Secondly, the pressure currently found in the back haul but that will eventually move to other parts of the network as the back haul capacity is increased does a have wider policy implication for government: what does it mean for the future prosperity and competitiveness of the UK economy? In particular what does it mean for the productivity and efficiency for SMEs and home workers who are unable to access higher speed and more reliable networks? **The blinking of the little red light may be considered a warning that first generation broadband, the crucial enabling infrastructure of the UK knowledge economy is under pressure and needs attention.**

So what to do? What are the prospects for the market to address these pressure points and deliver investment in the development of high quality platforms? Indeed what are the platforms? Fibre based technologies, what we will call, 'super fast broadband' is clearly a vital one but what of cable and satellite and the possible interplay between all three? In this paper, in seeking to answer these and other questions, Intellect will begin with an analysis of the market, continue with a look at why broadband matters to the UK, before comparing the UK's current situation with some other countries. It will then look at the commercial, regulatory and policy challenges that are facing the market before concluding with some recommendations for next steps.

2. Analysis of the current state of the market

First generation broadband delivery in the UK, which can service over 97% of homes, has been a success by any measure. From the latest Ofcom statistics over 17.5 million homes are now using broadband services from a number of different service providers and over a range of delivery platforms. The total penetration represents over 58% of homes in the UK. While broadband prices continued to fall during 2006 and 2007, headline connection speeds continued to increase. At the end of 2006 the average blended headline broadband speed across all residential and SME connections was 3.6Mbit/s, more than twice the figure of 1.6Mbit/s at the end of 2005, and by the end of June 2007 this had risen to 4.6Mbit/s. Headline speeds are continuing to rise during in 2008 as BT is upgrading the speed of its basic broadband connection up to 8Mbit/s, and some LLU operators are offering speed of up to 24Mbit/s. There are now over four million lines unbundled from BT's network. This is a considerable achievement and has passed benefits on to the consumer in price and choice very quickly.

On the cable side Virgin Media is in the process of upgrading its cable network and is already offering broadband download speeds of up to 20Mbit/s. Although the coverage is not as extensive as BT's the combined Virgin Media network, formed from the integration of the ntl and Telewest cable networks, pass close to around 13 million homes in the UK and by the end of 2008, Virgin Media will be ready to offer their higher speed broadband services to nine million of them. From late 2008/9, BT's 21CN will use ADSL2+ technology to potentially provide speeds of up to 24Mbit/s.

Virgin Media are looking at VDSL2 technology on the Siamese copper pairs in their cables in the North West to provide speeds of up to 50MBit/s down and 10 MBit/s up for business applications. This move, depending on how it is marketed has the potential to spur other players in the market into action: if consumers are willing to pay more for a reliable, faster broadband service a competitive offer from other market players becomes less of a choice and something approaching a necessity.

This effectively then is the limit of evolution of the copper networks. Demand above that will require new technology: it is important to acknowledge that efficiency gains made from the copper network will have to end at some point.

3. Why broadband matters

By the shrill tone of many reports in the media you would be forgiven for thinking that the internet, and by association broadband, is at crisis point. Not so, and it's important to say that relatively, compared to the UK market five years ago and the international market currently, the UK is in a solid position. The real impasse at the moment is around the business case for the deployment of next generation access and why it hasn't happened yet. The answer is that consumers are not prepared to pay for it. The demand for higher bandwidth is not yet at a significant volume and remains immature: as the average household telecoms spend declines rapidly in a competitive UK market there will have to be a cultural change before the quality of broadband, based around speed and reliability, is recognised as a valuable and marketable proposition to consumers.

Along with this are the technical efficiencies that are still being eked out of the existing copper infrastructure. The biggest strains that new streaming services have been exerting is on ISP's 'all you can eat' business models, not on the network itself. How to deploy NGA itself is also deeply problematic as there is no one technological solution that offers itself as the outstanding choice. The regulator is likely to have to privilege one technological solution over another to suit its competitive agenda, particularly if it is minded to continue with local loop unbundling.

So in this context why should anyone do anything? The policy instinct in a situation where there is market confusion, competing and contradictory forces attempting to exert influence, and a number of possible scenarios and outcomes, is to do nothing until a best case of action becomes clear. **And so the questions remain: does next generation broadband actually matter enough to try and force the status quo to change and what does it allow us to do that we are not already doing?**

Unfortunately the answer is not a simple one. The case for broadband infrastructure is unequivocal: it allows us to live and work better. Broadband's role as the key underlying infrastructure that enables the global knowledge economy to function is well established and understood. Since the start of this decade, it has accelerated technology diffusion into both residential and business markets and stimulated a huge amount of innovation across the public, private and third sectors. It has transformed the way people live their lives.

The case for the deployment of 'super fast broadband' is not so straightforward and raises a host of difficult and presently unanswered questions. Firstly, just what is 'super fast'? This could be a number of permutations from 24Mbit/s, 50Mbit/s, 100Mbit/s, and this ignores the question of whether this provision is symmetrical, with equal capacity both up and down the pipe, or asymmetrical where what can go down the pipe exceeds what can get up it. Even if there were an industry consensus about what this figure is based around some projections on future demand driven by new applications and services - and at present there isn't - a host of questions still need to be addressed. Here are some.

- We know that broadband offers significant efficiency and productivity gains: do these continue to increase commensurate with broadband speeds?
- Is it likely that nations that opt for accelerated deployment will gain sustained competitive advantage over nations that do not?
- Does the UK run the risk of being left behind in the spheres of creativity and innovation, two crucial areas for a burgeoning knowledge economy, if it fails to deploy next generation broadband?
- Can the UK continue to prosper with the extra efficiencies that are currently being developed?
- Can the cost of inaction be measured against the cost of action?

The real shortage of quantative and qualitative analysis on the potential economic and social benefits to the UK of super fast broadband means these questions can not be answered conclusively. This analysis is fundamental to the understanding of the importance to the economy and the potential costs of inaction.

What we can say conclusively is that in modern life speed is a precious and highly valued commodity. Asking consumers if they want faster broadband is like asking if someone wants a faster car; the answer is likely to be yes, as it will allow people to do things more easily and efficiently. The crucial question is how much is the consumer prepared to pay for this quality. The crowded and highly competitive UK market, is currently witnessing a number of operators supplementing and bundling their broadband offer with broadcast and fixed line telephony services that are effectively subsidising their broadband provision. This is part of a discernible 'race to the bottom' as players compete on price alone. **There will need to be a profound change if operators are to persuade consumers of the value proposition of paying more money for faster and more reliable broadband services rather than the current situation where they are paying less money for more services.**

In this section then we will examine the economic and social benefits that high speed broadband may deliver and examine if its deployment is of importance to the continuing economic prosperity of the UK in a global market as well as the strength of its social fabric.

3.1 Economic importance

Broadband is a catalyst for change in industry. A 2006 MIT study concluded that 'communities in which mass-market broadband was available experienced more rapid growth in employment, the number of businesses overall, and businesses in IT-intensive sectors'. It is a force for growth and prosperity.

Broadband will continue to be a key factor in globalisation, enabling knowledge and information to be shared rapidly and at low cost around the globe, changing the way people trade goods and services. Increasing public availability of information has enabled more effective competition and price convergence for traded goods and services. It has also driven the integration of world markets enabling specialisation and fragmentation. The internationalisation of production processes is increasingly feasible and cost effective, for example, enabling a small software company based in Cornwall to exploit international market opportunities and compete globally. Greater capacity and speeds in this underlying infrastructure will best position the UK to exploit these global trends.

Greater broadband speeds also make the internet work more effectively and means that the processing power and storage in PCs can be put to more productive use. That, in turn, means that innovation moves more quickly. **Broadband doesn't just speed up video downloads; it speeds up the pace of change across the global economy and acts as a catalyst for innovation.**

It also offers enormous productivity benefits to industry. According to an Institute of Directors (IoD) survey of its members in 2004, 84% said they had seen improvements in their businesses productivity since installing broadband and 61% said it had delivered cost savings. In all, 64% reported a link between broadband and increased profits. According to the IoD: "Broadband has established itself as an indispensable part of our business infrastructure. It is difficult to think of a comparable recent development in business equipment or techniques that has been so widely identified as a positive factor in terms of business performance."

Due to a severe lack of data what is difficult to identify or quantify are the economic benefits of super fast broadband for industry in the UK. There is likely to be significant process efficiency, and time-savings made and the ability to transfer information quickly and reliably to all sections of the country would clearly be of benefit. However most large businesses that depend on their communication infrastructure to transfer information and data will already have broadband packages that guarantee certain speeds and reliabilities. Where it appears super fast broadband could have a significant impact in industry is for the SMEs or entrepreneurs based in rural areas who are reliant on and frustrated by consumer packages. The real driver of super fast broadband is still likely to be entertainment rather than business needs though, as the consumer demand for video content and online gaming continues to grow.

3.2 Socially

The provision of broadband access at a certain quality is now seen as a pretty fundamental right and necessity for many people in the UK. Around 40% of households still do not have broadband access, but there does seem to be a discernible move, particularly in state sector education towards children being provided at the earliest age possible with broadband access to the internet as an important learning and socialising tool. That the internet is going to play some role in most people's lives, even if only as a utility like electricity or water, is incontestable and as such young people need to have the access and the opportunity to use it.

There are also the potential public uses to consider. Broadband is the biggest driver of digital convergence which offers government a more efficient way to reach, interact with, and serve its citizens in the areas of public service delivery, information sharing and citizen engagement. As such, universal, or as near universal coverage as possible at some basic level of quality is already a political issue, and one that is only going to increase in importance.

For government though, the potential of online public service delivery is something of a double-edged sword and has the potential to both create and solve problems in equal measures. Government cannot discard any current public service provision and replace it with an exclusively online one for fear of abandoning those without the access or skills to interact with this new platform. Here we come to the digital divide, the term commonly used to refer to the gap between those people with access to digital and information technology, and those without. Broadband is at the very sharp end of this debate: it offers people the chance to do to so much - professionally, socially, logistically - but requires certain educational and financial assets. This knowledge and cost barrier can mean that the privileged are paying for and enjoying the benefits of broadband, be it in the shape of experiencing digital media or better interaction with public services, whilst the less well off are excluded from these advantages. This debate needs to be broadened to beyond merely an analysis of the access to technology - an area particularly with schools that is in the process of being solved by targeted investment - to the imbalances in resources and skills needed to effectively participate as a digital citizen.

The demographic categories where the digital divide can be seen to have a negative effect span age (young/old), the socioeconomic (rich/poor), the educational (tech savvy/tech illiterate), and the geographical (urban/rural).

The potential for further social and economic division, based around the access to and participation with converged broadband enabled services has serious implications for UK plc's ability to continue to function as a leader in the knowledge economy. How this divide is managed and addressed is going to be a key policy issue for any government and places broadband front and centre as an enabling infrastructure. An enormous amount of public service broadcasters content is already available online, what if public services were to increase their shift of delivery mechanisms to online services? The importance of broadband infrastructure would escalate by orders of magnitude, not simply as a way of accessing entertainment and information but as a way of receiving fundamental services like public health care.

Broadband is often cited as a panacea for government in its ability to personalise and be responsive in its service, but it poses as many difficulties, particularly with regard to access and skills, as it may solve. The real question is how best to maximise the potential benefits of broadband for as many citizens as possible.

4. International comparisons

International comparisons in telecommunications are notoriously difficult to make. The reasons for this are numerous and range from the different designs, layouts, and ages of the existing infrastructure, to the amount of competition in the market. Other differences in making meaningful comparisons stem from the regulatory and governmental attitudes to new technology, the country's economic well being as well as social and cultural differences. In spite of these limitations there are a number of lessons that can be learnt from what is happening in other parts of the world. **With the rollout of first generation broadband we saw countries make significant step changes in their speeds and market penetrations. This is true again, in the early stages of next generation broadband access deployment.**

The early leaders in next generation fibre deployment are Korea, Hong Kong, Japan and the US. The driving reason for deployment is different in each market. In Japan for instance, a country that had to rebuild its telecommunications infrastructure after the second World War, the move to fibre has been more easily achieved. The government has incentivised operators in respect of their CAPEX obligations. Hence Japan is leading the way with fibre to the home where 50% of new fibre deployed is used for Fibre To The Premises (FTTP) and has a penetration of over 21% of homes and is growing at 90,000 per month. 2007 figures show over 10 million homes are now connected. Tough competition fuels this market. When customers sign for FTTP services, it is difficult for competitors to regain the customer and so the race is fierce for initial signatures.

The Japanese incumbent provider (NTT) faces competition from USEN, Yahoo BB and KDDI as well as the utility companies Tokyo electric and Kansai electric (K-OPT). In Japan there is a 50:50 share between Passive Optical Network (PON) and point-to-point.

The choice of PON or point-to-point is partly influenced by historical familiarity with existing technology (the media converter solution is very well known in Europe), but Japan's experience shows that deployment and maintenance costs can be reduced with PON networks. It is not just deployment costs that are saved; PON allows lower maintenance costs, and takes up less exchange space allowing fewer exchanges to cover a wider area.

What is driving this rollout of fibre services? The motivation to deploy infrastructure exists whilst peer-to-peer file sharing, on-line gaming and voice over IP fuels consumer demand. Currently there is speculation that the new Nintendo WiiWare service titles will be potentially huge which will require an external hard drive for the Wii. Alternatively Nintendo expects users to download individual games every time they need them. Downloading large files quickly encourages users to sign up for next generation broadband and a 100MBit/s service is on offer in certain areas.

Korea is the world leader in FTTP penetration with approximately a third of all households connected. However the deployment in Korea is based on fibre to the building with a Local Area Network reflecting the large numbers of people in flats. This high penetration is the result of a large government backed initiative to deliver high-speed broadband access to Korean homes.

The high density of housing has made the job of the Korean operators easier in this respect. Service is currently offered by KT, Hanaro Telecom and LG Power com with prices around $30-35 per month.

Hong Kong is deploying a similar architecture to Korea and is slightly in front of Japan in terms of home penetration. Rates of up to 100MBit/s are available from both HKBN and PCCW. PCCW has also recently started to offer 1000MBit/s for $280 a month.

In the US Verizon has been building the Fios all fibre networks since 2004 throughout its territory. The network takes fibre directly to the side of people's homes and provides near-limitless bandwidth that can be used to deliver a 'triple play' of services including high-speed internet connectivity, telephone service and TV. The company already offers internet service that runs at 50 Mbit/s. It is testing the service at 100Mbit/s. However these services are costly but show that wealthy customers are prepared to pay the price for fast download speeds.

The largest phone company in the US, ATT took a more conservative approach to broadband-network deployment-taking fibre only into the neighbourhood and using existing copper lines to deliver service to homes. This is similar to the European FTTC approach. In 2004, when Verizon started deploying Fios, many said that the budgeted $18 billion it would take to dig up streets and hang fibre from utility poles made the initiative too expensive and too risky to be profitable. But now these doubters are being proved wrong, according to the analysts. The Fios service has transformed Verizon's business.

Five years ago, Verizon had 1.6 million broadband customers Today, they have over seven million broadband customers, hundreds of thousands of video subscribers and for the first time in a long time, consumer revenue is growing again.

Much of this growth has been fuelled by the success of Fios. Subscriber rates for the service have exploded as the company ramped up deployment during the past several months. At the end of the first quarter of 2007, Verizon reported that it had signed up 864,000 Fios customers, with a penetration rate of 16%. Now it has hit the one million subscriber mark. More important, Verizon is also selling video to almost 50% of those subscribers.

Although deployment is different and prices and offering are different in each of the markets described what is clear from these international comparisons is that there appears to be a consumer demand for higher speed broadband services and in the more prosperous countries a willingness by some customers at least to pay a significant premium for these services.

5. Alternative platforms

Fixed line broadband is not the only platform available. There is also the opportunity for the satellite provision of high definition broadband access in the UK.

Satellite infrastructure is the prime example of a high tech low carbon ICT solution. Satellites are powered by sunshine and a launcher such as Ariane 5 produces less CO2 than a jumbo flying to New York.

The technology has advanced to the point that it can outperform terrestrial infrastructure in terms of cost and performance in certain key sectors (such as broadcasting) despite the barriers that are currently in place. If barriers were to be replaced by technology neutral procurement policies and regulation then, with some encouragement of the private investor, the industry would deliver a better and more widely available ultra high-speed broadband infrastructure by 2012 at lower cost to the investor – and to the environment.

Satellite is the cheapest distribution means for broadcast TV. It provides greater coverage and more choice, especially when users access multiple orbital positions from a single dish. Importantly satellite DTH uses a transparent communications channel, making it easy to upgrade to HDTV and other anticipated developments such as 3D TV. Satellite is future proof, whereas DTT is regenerative and significant infrastructure investment is required for each upgrade (eg HDTV requires DVB-T2 and doubling of transmitter power).

Whilst satellite is currently strong in TV broadcast it plays only a minor (last resort) role in telecommunications (voice and internet). Most satellite capacity has been general purpose covering a wide area (eg CONUS, Europe) rather than specifically designed for national or local coverage. Whilst this has provided operators with greater flexibility to market the wholesale capacity, it has slowed the growth of the broadband satellite market because of the high cost, forcing service providers such as Aramiska into bankruptcy.

Operators have been slow to deploy the frequency reuse satellites, which would have made wholesale satellite capacity more affordable for broadband, largely to avoid undermining their position in the lucrative TV market.

This has now changed in the US where some 670,000 satellite broadband connections were operational at the end of 2007, up 50% on the previous year. The same broadband satellites have been used to transmit local TV content including HD.

Europe is starting to follow suit with HYLAS and KaSat in manufacture at Astrium and both are due to come into service before or during 2010. Whilst these satellites should reduce by a factor of three the wholesale cost of bandwidth, they will not be able to provide the capacity required for NGA.

They provide a stepping-stone towards the requirements of NGA, which will require a constellation of small GEO satellites with large antennas to provide a full, or part solution to serve the UK Notspots, which will be more widespread in this new digital divide.

With a further twenty fold increase in performance and capacity from these modest steps, satellite technology is particularly well suited to play a greater role in a converged ICT value chain in the UK. Satellite can provide by 2012 a green and resilient NGA network covering the whole of the UK. If sized to provide around 2Tbps, shared equally between forward and return, this would be sufficient for all of the most rural 15% of the population. Since the coverage would be close to 100% this could be used anywhere it is needed.

This would enable the distributor/ aggregator to access advertising, content and telecoms revenues for a consumer service package.

The satellite proposition is twofold:

- to take advantage of Freesat to roll out an NGA class network, providing HDTV, local and on demand content as a Freesat plus offer taking customers from the obsolescent Freeview platform in advance of DSO.
- and to provide users with an NGA equivalent service by ADSL2+ or cable where available and by satellite or FTTH where not.

Together these steps can provide a fibre equivalent NGA network for all of the citizens of the UK, wherever they may choose to live and work and at a cost less than fibre alone.

The satellite solution has a capital cost including user terminal of around 730€ per user including installed terminal. The key positives for satellite solutions are immediate coverage of remote regions, an environmentally friendly solution with light carbon footprint and no street works (80% of the cost of terrestrial solutions will be in civil works).

The satellite element of the proposed solution has many other benefits:

- fully complementary to ADSL2+, DOCSIS 3.0 and FTTP deployment
- opportunity to provide Freesat plus additional local or national TV channels
- positive environmental impact through low carbon footprint, zero street works and very limited ground infrastructure
- full national coverage with no delay for green field building sites
- mobile and transportable terminals for terrestrial backup and disaster recovery
- future proof solution with ever larger satellite antennas providing higher data rates and capacity (factor of 50 improvement per decade)

6. Commercial Challenges for Next Generation Access deployment

With the increases in speed and availability of first generation broadband, the case for upgrading to Next Generation Access is not obvious. The change from dialup to broadband had an easier business case to make. First Generation Broadband doesn't require so much exchange equipment yet uses the same copper pair from the exchange to the customer's premises. That is not the case with Next Generation Broadband. There will soon become a time when the copper network is no longer capable of supporting any further increases in line speed. The combination of crosstalk between the pairs and the distance from the exchange to the customer all conspire to limit further increases of speed without compromising data error rates.

The use of fibre, the logical delivery method for NGA has long been used by Communication Providers (CPs) to service the needs of their business customers. However the quality and capacity that businesses require are reflected in the prices charged and as previously discussed these are not currently considered marketable features to consumers. Also there is not currently a sustainable business case for fibre access as a replacement for copper. Changing out the current copper network with the latest gigabit ethernet access product delivered over a generic passive optical network (currently being trialed at Ebbsfleet by BT) is variously estimated at costing between £10-20Bn depending on the final network architecture.

This is one of a number of different options that could be deployed but is one that does address some on the needs described below. This investment would be a major undertaking and not one that will be contemplated lightly unless a number of regulatory factors are confirmed, and would remain stable for the duration of any upgrading project, which is likely to take at least 10 years to complete.

Included in these uncertainties are the needs of the consumer. They are used to a copper or a hybrid fibre coax network delivering a plethora of voice services and a broadband service. Some of the more specialised services cannot be supported over the current fibre access networks. How will these legacy services be provided in the future? Do consumers want higher speeds and what are they prepared to pay? The correct technology to choose is a difficult one for the CPs to make. It needs to be relatively future proofed and be upgraded easily. It is unlikely the network provider or the consumer will be able to afford a 'fit and forget' solution so frequent upgrades to the service package is inevitable. Then a regulatory framework that allows a reasonable return on investment is vital as well as an understanding of which of the traditional 'copper products' do not have to be provided over the fibre. In other words what service mix will be supported? The questions of quality of service, availability, jitter, latency also need to be defined and agreed.

Customer behaviour is changing. In the past internet usage could be characterised as surfing the internet and sending a few emails, but now the downloading and streaming of content, once the preserve of the internet savvy, has become a mainstream activity.

The launch of the BBC's iPlayer and 4OD services as well as other data streaming services has increased people's download traffic. These services rely on peer to peer delivery for TV on demand which means that not only is the customer using up their download entitlement, but that they are supporting other users by allowing their computer to upload the content to others as well. In addition on the uplink side, people are increasingly posting pictures and video clips to social networking websites. This is causing many ISPs to review customer's fair usage policies as this behaviour is putting severe strains on the capacity of the internet. Two one hour downloads of popular programmes can easily exceed a customer's monthly 1GB download allowance. Even customers with unlimited download limits can find their download speeds restricted during peak times. With the adoption of IPTV services and the greater availability of High Definition TV content this will eventually force other delivery solutions to emerge or result in heavy restrictions on internet access.

The current business models are predicated on a vigorously contested market place where prices have been forced down by competition, which has been good for the consumer. However this cannot continue if major investments are to be made to upgrading the networks to support higher speed access. Also many of the CPs have invested in the local loop unbundled market and could face heavy write downs of their equipment if fibre rollout were to proceed aggressively. Also for the full benefit of larger access pipes to be realised more capacity is required in the backhaul networks to carry the extra traffic. These investments must all go hand-in-hand.

To help finance increased investment the customer will have to pay more. The question is 'will they'? Between 2002 and 2006 (the latest Ofcom figures available) the total telecommunications cost per household per month has fallen from £102 to £69. That is made up of fixed access, fixed call charges, broadband and mobile the latter now being £30 of the £69 in 2006. These costs include VAT and are all at 2006 prices.

Moving the customer towards paying more will be an interesting development. Currently most users are unaware when their internet access slows down or becomes unavailable unless their browser freezes or the email they are sending fails to upload. With the new generation of broadband routers a red light on the front can alert users to Internet congestion. The user won't know where the congestion is occurring in the network but if it happens frequently it is likely to force the user to seek redress from the ISP or go elsewhere. Thus if red lights come on all over the UK for significant periods of time then this more then anything will help to orchestrate a move towards customers preparing to pay more and ISPs improving their quality of service. In the short term this may mean no more than investing more in the back haul networks or reducing contention ratios at the local exchanges but eventually it will lead to customers paying more thus allowing network operators to invest in next generation access networks. Cost versus quality will then become centre stage in the arguments for upgrading. However for it to be economical to upgrade to fibre significant numbers in an area need to agree to price increases and a willingness to take the services on offer before the investments can be made. The model that was used for first generation rollout where people declared an interest thus allowing the local exchange to be 'broad banded' could be used again.

7. Regulatory challenges

Regulation in the UK has developed over many years and has had mixed success. In some markets such as wholesale broadband, the market is thriving with competition leading to a range of different packages available to the end users. So too has the voice services market where a range of over 400 communication providers (CPs) offer literally thousands of differently priced packages. In other areas such as the access network success has been more limited. In 50% of the country there is no infrastructure competition at all and in the other 50% there is only cable to compete with BT. Whether this is important is a moot point. Economists argue that it is but there isn't competition in gas, water or electricity infrastructure so why is the telecommunications market any different? There are over 400 CPs in the UK and many of these offer both voice, data and broadband services: at the service level the UK has one of the most competitive markets in the world.

Moving to next generation access demands a whole new set of regulations and it is important that these new regulations do not constrain the investment for fibre unduly. In the current copper environment, the accepted approach to promoting competition is to mandate access on cost based terms. This is almost certainly not appropriate for next generation access networks. While these new investments may also constitute an enduring economic bottleneck, there is significant risk involved in their deployment, including demand side uncertainty as detailed above. In this environment, it may not be appropriate to support the existing regulatory approach to these new networks. Regulators across the world are increasingly focused on how to address this issue.

Regulation has a key role to play in clearly setting a framework that strikes a balance between investment incentives and retaining consumer protection.

Market intervention or regulatory holidays are often quoted as solutions to the problem but in practice these may be of benefit in some markets they are not the answer in the UK with its history of service competition. What is important is the need for a continuation of service competition in all telecommunication services capable of being delivered by fibre access. This clearly excludes services that require a metallic pair where other solutions are required.

Because there is also a significant degree of supply side uncertainty investors have different opinions about which technologies should be used in different locations and how these technologies will develop over time. Some operators are considering fibre to the cabinet deployments, maximising the re-use of existing copper access networks. However, utilising copper in this way may ultimately limit bandwidths delivered to customers. This solution brings its own problems of cabinet congestion and competition issues. Many believe that the longer-term evolution of access networks may be fibre to the premises. Some operators are going straight to this option, thus avoiding cabinet upgrades. Inevitably in the longer term there will be changes to network architectures. The most important of these is the introduction of long-range passive optical networks (PON), allowing many local exchanges to be removed. This in turn will require solutions to handle CP's stranded assets.

The European Commission has not been idle during this period with the recently published proposals for a revision of the EC Recommendation of Relevant Markets. This provides details and guidance on those markets that may be susceptible to ex ante regulation and takes into account technological and market developments that have occurred since its first implementation, including next generation access deployments. In the document two relevant wholesale markets have been defined.

The new market definitions concede that different technological platforms allowing for the provision of the same services will be included in the same market definition, consistent with the technology neutrality principle. It also means that deployment of a new network or technology does not automatically imply that it will be excluded from regulation on the basis of the 'emerging markets' principle. This requires economic market boundaries to be defined by product substitutability. Quite how you will assess whether buyers and sellers in a market are indifferent towards a set of alternative products remains to be seen. This may make it difficult to assess precisely the substitutability of different products in the same way across Europe. Clearly the regulation has some way to go and will be subject to different interpretations in different markets. Ofcom have yet to pronounce on these proposals.

Whatever regulation is finally decided it should allow operators not to be unduly constrained. For example they should be able to make a reasonable return on their investments and compete with fairly priced copper alternatives. They should not be liable for any consequential impacts upon pre-existing business models or face obligations to provide copper services in fibre-enabled sites. Finally the operators should be free to design efficient fibre network architectures in line with technology neutrality principles.

BT's trial at Ebbsfleet is an example of trialling a solution that meets all of these challenges. In order to meet the needs of both the developer and the residents, two different (but complementary) infrastructures are being deployed at Ebbsfleet, with each able to support a different set of services.

The key to meeting these requirements is the deployment of Generic Ethernet Access (GEA). This enables CPs to develop a range of communications and interactive video and entertainment services. It will enable the delivery of services ranging from a simple voice to products with a range of tiered service offerings through to an up to 100 Mbit/s (downstream) data channel.

In addition satellite, terrestrial TV and digital audio broadcast services will be delivered to homes via a Fibre IRS (Integrated Reception System) service. This will allow the residents of Ebbsfleet to access the same services in the same way as everyone else in the UK – the only difference being that the signals now get to the customers via fibre rather than 'over the air'.

For the network architecture the use of point-to-point fibre links was a credible alternative to GEA and merited careful consideration. Openreach (BT's access line of business) assessed the merits of both of these options and concluded that, whilst point-to-point fibre systems have many attributes that make them very well suited for other deployment scenarios, PON represents the best solution for fibre to the premises. For mass-market deployments, PON-based architectures reduce capital expenditure by reducing the fibre count, duct build and the total investment required at the switch site (exchange) eg by reduced port counts, space and power.

Bending large fibre cable in confined cable chambers is difficult if not impossible. Also for mass-market deployments, PON-based architectures offer lower operational costs by reducing power consumption, accommodation costs and fibre management complexity. Repairing large fibre cables after they've been severed is complex resulting in long outage times and a poorer customer experience.

Point-to-point systems on the other hand potentially enable a higher sustained data rate to be delivered to each customer, the anticipated roadmaps for PON technologies provides a high degree of future-proofing.

The key to the PON architecture from a regulatory perspective is the presentation at the customer's premises of a number of simple ethernet connections, with higher layer voice and broadband services being constructed and supplied by CPs. This means that each customer is supplied with a 4 Port Optical Network Termination (ONT), which includes 2 voice and 2 data ports. This enables two CPs to supply services to each end customer allowing one CP use of up to 4 ports, or two CPs using up to 2 ports each. This allows equivalence of input and hence competition in the service layer.

The situation with Virgin Media is slightly different. There is not a requirement for them to provide an equivalence of input in the same way as BT. The solutions for Next Generation Access being adopted by Virgin Media are a natural evolution of their existing hybrid fibre coax (HFC) network. As a consequence of this HFC architecture, Virgin Media's customers are typically within 500m of its fibre network, and by replacing the coax tail with fibre the delivery of a FTTP solution is relatively straightforward but still expensive.

New optoelectronics, splitters and modems are still required and for the change out to be economical a whole area needs to be covered.

Since the end of 2006, Virgin Media has been trialling new faster broadband services using early implementations of DOCSIS 3, with solutions from Cisco Systems, Motorola and several other suppliers. The trials are aimed at testing 50Mbit/s burst speed services to around 100 homes on the Virgin Media network in the towns of Ashford, Dover and Folkestone in east Kent. The technology can achieve burst speeds of up to 100Mbit/s.

8. Policy Challenges

The issue of NGA is of particular interest to policy makers because of the impact it is already having on the economic and social value in the UK and the influence it will continue to exert going forward. This interest from policy makers should be welcome, given that consumers and the economy stand to potentially gain huge benefits from an NGA network.

In a global market, the UK must be aware of its competitor's movements towards next generation broadband development, and the possibility that many are moving ahead of them. It is essential that the UK is not left behind given these potential gains and the resulting impact that action or inaction may have upon our economy.

Whilst the initial benefits of NGA will be alternative infrastructures for the deliverance of services like TV, the effect of achieving faster services will stimulate innovation by business, public services, and the consumer.

The first reaction of policy makers may then be to sit back and watch the market evolve in order to make an informed decision. However, there is a real danger that whilst we watch, others will not only make huge advancements with regards to NGA, but also corner the market. In this context the UK's national competiveness can be seen to be entwined with the UK's position and readiness to achieve NGA.

Therefore it is not simply a question of whether there is a role for government, but rather what that role should be? Having recognised the significance of broadband for the UK economy, policy makers will have to cover and answer the following questions closely.

- How best to achieve economic benefits from NGA?
- How best to measure our advancement against any international benchmark?
- How best to measure and deal with demand exceeding the capabilities of current technologies?
- What are the possibilities of investment incentives?

Whilst it is important that policy is designed to nurture the advancement of NGA, it is also imperative that any policy does not harm NGA in the UK. Examples of premature interventions show that it is possible to distort the market as seen in Germany and Australia. The politicisation of broadband issues in last year's Australian election may have damaged the advancement of NGA rather than stimulating an interest. Having arguably lagged behind many others in the broadband stakes for years, a tit-for-tat game emerged, with the Howard Government announcing plans to provide broadband to 99% of the population, trumping the opposition promises of 98%.

Germany, having taken the view that strong incentives were needed to enable deployment, is currently subject to a challenge from the European Commission after providing a regulatory holiday for Deutsche Telekom. There is then a real danger of rushing into misjudged and confusing political decisions regarding NGA. Interventions may be justifiable upon the grounds of market failure, but policy must also be aware that by distorting competition, government could in-fact deter future private investment. The UK must then be aware of the mistakes of others, and its own distinct climate.

With regards to the UK broadband climate, it is vital policy helps to facilitate investment where possible. One key element that will hinder investment is the impact of construction and operational costs. The likelihood of a mix of public and private investment to make NGA a reality should be investigated, along with the potential for the market to deliver a mixed economy of platforms delivering broadband. Such an approach will ensure there isn't a patchwork of disproportionate geographical fulfilment of NGA. Given the UK's track record with its quick take up of broadband, the future potential is promising and policy should cultivate this carefully.

Whilst we concede that 'fools rush in', the importance of NGA should be acknowledged now, so that the UK is in a position to foster NGA and ensure that its potential is reached. Intellect therefore welcomes both the Ofcom consultation on potential regulation models for NGA, and the announcement of the independent review to be led by Caio. This review focuses on how government can help to facilitate an NGA friendly environment by considering how policy could help to remove barriers to investment, without actually interfering in the market.

The government must then work with industry to critically assess where improvements can be made with regards to the flow of investment. This may include such examples as reducing rating costs along with the costs of road works to install NGA infrastructure. It must be clear to investors that the potential revenue from NGA makes the investment acceptable.

Given the risks of too much or too little involvement by policy makers, the UK seems to be both on the right track and taking the right approach to government intervention at this stage. It is essential that the public sector remains engaged in the NGA debate with operators in order to understand the prospects and problems that continue to emerge. It is important that the future of NGA is ensured and its growth encouraged, yet we should not rush into an ultimate decision of the issues regarding NGA quite yet.

9. Summary and recommendations

Broadband matters because it has an impact on the UK's long-term competitiveness. To compete in a global knowledge economy, UK businesses and citizens need to have access to a world-class communications infrastructure. The UK has been quick to embrace the potential of broadband. Adoption rates have outstripped many of our G7 competitors and across the economy people are exploiting broadband to innovate and do things differently. The UK has also been successful in ensuring that broadband access is available as widely as possible and leads the G7 in terms of broadband availability. This has been important to ensure social inclusion and the health of the rural economy. However, we should not assume that the UK will maintain this position.

This suggests that a gap is opening up between the 'public value' to society of next generation broadband and the 'private value' available to investors in these services. Evidence of the positive externalities resulting from next generation access has yet to emerge – largely because these networks are only just being built. However, over the next two years as international deployments of next generation broadband accelerate and a new wave of bandwidth intensive services are taken up by the mass market, the requirement for next generation broadband in the UK is likely to become much more transparent.

So the issues involved here are complex and there are few obvious solutions to the impasse at this stage. The lack of sufficient platform competition from cable means that deregulation or regulatory forbearance would not be appropriate in the UK. Ofcom will need to find an alternative approach that provides the right risk/reward balance to enable and, possibly, incentivise efficient investment. At the same time, government should monitor the UK market closely and benchmark progress against our international competitors.

In the short term the public sector should forbear from making premature interventions in the market, but should be prepared to make carefully targeted interventions in the future in areas where persistent market failure is most likely.

Intellect is the trade association for the UK technology industry.

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