

**Economist Intelligence Unit**

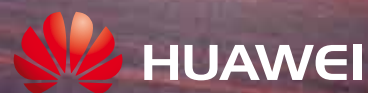
The  
Economist

# Superfast Britain?

Myths and realities about the UK's broadband future

A report from the Economist Intelligence Unit

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## About this report

*Superfast Britain? Myths and realities about the UK's broadband future* is an Economist Intelligence Unit report, sponsored by Huawei. It explores the case for the UK's rollout of superfast broadband over the coming five years, to assess how realistic the hoped-for gains actually are. The views expressed in this report are those of the Economist Intelligence Unit alone.

We would like to thank the following for their time and insights in researching this report (listed alphabetically):

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The report was written by James Watson and edited by Denis McCauley of the Economist Intelligence Unit.

## Executive summary

Looking back, the first generations of Internet connectivity—from dial-up modems to the always-on broadband most of us are familiar with today—delivered clear and significant benefits to the UK. New industries have been created, generating large numbers of jobs. Research from McKinsey, a consultancy, suggests that the Internet accounts for over 5% of the UK's GDP, and a far larger proportion of total economic growth over the past five years.<sup>1</sup> For every job it has displaced, 2.6 new jobs have been created, it suggests.

Given this backdrop, the switch to tomorrow's superfast broadband currently under way should, by some accounts, deliver a sizeable boost to GDP growth and speed up much-needed job creation within the foreseeable future—a godsend to an economy struggling to find its way to recovery. In the view of the government and several experts, superfast broadband will not only deliver jobs and growth, but also fundamentally alter how healthcare, education and other public services are delivered.

Will this next generation of connectivity, however, with its blazing speeds, continue to deliver prosperity in the same way that previous leaps have? The central argument of this report is that, while the gains from significantly faster connectivity will indeed be sizeable over time,

a good dose of reality is also in order. Existing networks are capable of delivering many of the services anticipated over the next few years. Obstacles are also numerous to utilising even the existing technology capabilities to good effect, including a shortage of skills and resistance to change. In this context, some of the expectations about the early returns from superfast broadband rollout in the UK may be overstated.

Our analysis is based on a thorough review of existing research and in-depth discussions with a range of experts, including policymakers, academics and analysts, all with different perspectives and opinions. Not all of these experts will concur completely with our conclusions, so it is important to underline that these are the Economist Intelligence Unit's alone.

The key findings are summarised as follows.

- The shift to superfast broadband will certainly deliver added growth and new jobs, but it is difficult to see how this impact will match that resulting from the earlier switch from dial-up to broadband Internet, at least in the near term.
- A short-term boost to jobs is inevitable, especially as the engineering work to build the networks gains pace. The longer-term, indirect impact on job growth is more difficult to project. Creation of jobs in some industries and regions

<sup>1</sup>"Internet matters: The Net's sweeping impact on growth, jobs and prosperity", McKinsey Global Institute, May 2011.

may very well be partly offset by job losses elsewhere, for example.

- For many anticipated benefits, it is less a case of the pipe needing to change and more that of established systems, processes and skills needing to evolve. This applies across a range of sectors, including healthcare and education.
- In healthcare in particular, many anticipated benefits of telemedicine and remote diagnostics are realistic, but require wider reforms of the

health system itself before they can be realised.

- In many areas, but especially within business, a shortage of skills is at least as big a hindrance to putting technology to good use as constraints on bandwidth.
- In the near term, ensuring pervasive Internet access to all parts of society—rural users, the elderly and others—will be at least as beneficial to society as a whole as upgrading to superfast broadband. ■

## Do superfast broadband definitions matter?

From the first generation of always-on broadband, industry experts have squabbled about what characteristics and speeds define it. Superfast broadband is no exception. Some authoritative studies cited in this report limit the discussion to services delivered over fibre-based networks, while others include 4G mobile broadband. The speed thresholds likewise vary from one place to another. For simplicity's sake, we take the UK's average 2012 broadband speed of 9Mbps as the baseline for today's "basic broadband", while using the

government's stated objective of 24Mbps as the minimum speed for "superfast" broadband. Our discussion also encompasses services delivered over both fibre and 4G mobile networks.

For the purposes of our discussion, however, which focuses on the "downstream" effects of superfast broadband on the economy and society, infrastructure specifics and speed thresholds are less important than the likelihood that UK citizens and businesses should enjoy significantly faster Internet speeds in a few years than they do today. ■



## 1

## The great expectations

Since 2010 the British government has become increasingly convinced about the merits of superfast broadband as a vital tool for kick-starting economic growth, bolstering productivity and providing jobs. It also hopes that by rolling out significantly faster connectivity it can revitalise how education, healthcare and other public services are delivered. To make this a reality, the government has committed to delivering “the best superfast broadband network in Europe by 2015”.<sup>2</sup>

This overall vision, detailed in a speech by then culture minister, Jeremy Hunt, and subsequently developed further, promises a host of benefits.<sup>3</sup> His successor, Maria Miller, believes the same, arguing that superfast broadband is “vital” to securing the country’s future and making UK businesses competitive.<sup>4</sup>

### More jobs, please

The government’s vision draws on a range of research about the potential benefits of a superfast broadband infrastructure, particularly relating to output growth and new jobs. Central to this is a major study from the London School of Economics (LSE), which argues that investing £5bn into superfast networks would create some 280,000 new jobs, both directly and indirectly.<sup>5</sup> Earlier research from Nesta, an innovation-related charity, puts the figure far higher, at up to 600,000 direct jobs, with £18bn added to GDP and potentially “far larger” indirect effects, all within four years.<sup>6</sup>

Other studies cite other powerful gains. One from Arthur D Little and Ericsson (respectively,

a consultancy and a telecoms equipment maker) suggests that a country’s GDP increases by 1% for every 10% increase in total broadband penetration.<sup>7</sup> An updated version of that research suggests that each doubling in speed of broadband connectivity increases GDP by 0.3%, implying that a quadrupling of broadband connectivity speeds would yield a 0.6% boost to GDP.<sup>8</sup> The LSE’s research stresses that broadband makes possible new business models, and argues that shifting to faster broadband would propel the deployment of a host of innovative services and applications.

These studies primarily address the deployment of (fixed) fibre infrastructure. Another study from Capital Economics, a research company, focuses on mobile broadband alone and suggests that 4G mobile networks and services could deliver a boost to national GDP of up to 0.5% per year,<sup>9</sup> although it does not specify a time span for when this would become reality.

Prospective benefits are not limited to the economy and to jobs. The Nesta report highlights that next-generation broadband offers “dramatic” new possibilities for both UK business and society. It cites examples ranging from cloud computing for businesses through to online doctor consultations, especially for the elderly. It argues that better digital distribution for high-quality content opens up “new creative and commercial opportunities” for content owners, while people can better collaborate via social media. In the workplace, higher speeds help ensure increased scope for working from home and other remote locations and new means of collaboration.

<sup>2</sup> “Britain’s superfast broadband future”, Department for Business, Innovation and Skills, December 2010.

<sup>3</sup> “Britain’s superfast broadband future”, Jeremy Hunt, December 6th 2010.

<sup>4</sup> “New UK culture secretary takes an axe to broadband red tape”, ZDNet, September 7th 2012.

<sup>5</sup> “The UK’s Digital Road to Recovery”, Jonathan Leibniz, et al, London School of Economics, April 2009.

<sup>6</sup> “Getting up to speed: making super-fast broadband a reality”, Nesta Policy Briefing, January 2009.

<sup>7</sup> “Broadband in the UK – Faster, higher, stronger”, Jeremy Hunt, August 20th 2012.

<sup>8</sup> “The need for speed”, Ericsson and Arthur D Little, September 27th 2011.

<sup>9</sup> “Mobile broadband and the UK economy”, Capital Economics, April 30th 2012.

In education, the government points to examples overseas, such as virtual learning services in Australia and South Korea, where individuals in remote communities can access high-quality online educational material. In healthcare, faster networks are expected to make possible such services as remote monitoring of patients and video-based consultations with doctors—particularly useful as the British population ages. There are also savings to be had. Thanks to cheaper digital delivery, the Department for Work and Pensions is expected to save up to £100m by 2014-15, for example.<sup>10</sup>

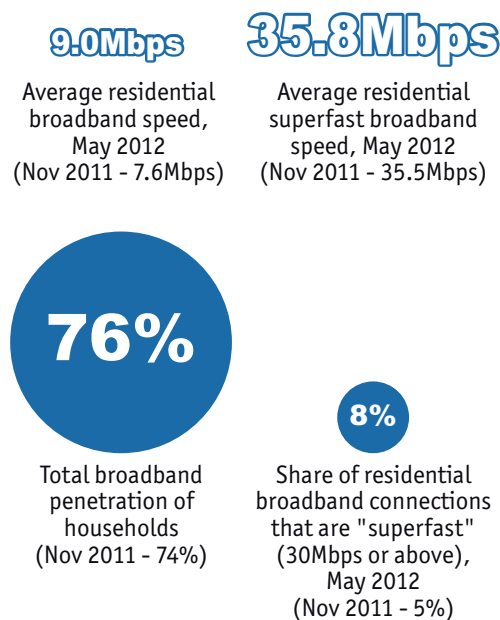
The UK is hardly alone in advancing such goals. Within the EU, the Digital Agenda sets a target of ensuring access of at least 30Mbps to all citizens, with 50% using 100Mbps lines by 2020.<sup>11</sup> And Britain is making encouraging progress towards its goals. In a final speech before switching roles, Mr Hunt announced that average speeds had increased by about 50% between 2010 and 2012, to an average of 9Mbps.

### Reality check

Such gains as outlined above would undoubtedly provide a substantial fillip to the UK's economic growth and the competitiveness of its businesses. But will the gains be as vast as promised, and realised in as little as four to five years, as some of the studies suggest? And even if they are, is superfast broadband required to realise all of them? In short, will this next leap in connectivity offer the same vast gains that previous generations of speed increases have delivered? This report examines a range of issues in turn, to assess how realistic such arguments are.

Chart 1

#### Selected data on broadband in the UK

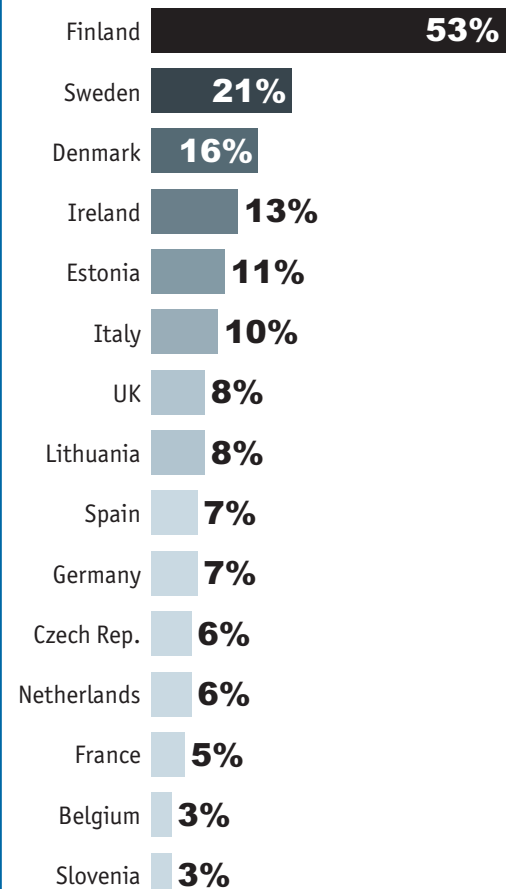


Source: Ofcom, 2012.

Chart 2

#### Mobile broadband penetration, selected countries, 2011

(Active users of dedicated data service cards/modems/keys per 100 people)



Source: European Commission, "Digital Agenda for Europe", 2012.

<sup>10</sup> "Britain's superfast broadband future", Department for Business, Innovation and Skills, December 2010.

<sup>11</sup> "Fast and ultra-fast Internet access", Digital Agenda Scoreboard, European Commission website, last accessed September 24th 2012.

## 2

## Impact on the economy

Some aspects of the potential economic and employment gains from a rollout of superfast broadband infrastructure require little guesswork. To start with, there is the basic job of actually deploying the networks. This so-called construction effect, as Raul Katz, a director at the Columbia Institute for Tele-Information, terms it, is fairly clear. "If you input a certain amount in fibre optics, you're going to create a number

of jobs in construction and digging trenches, in electronic equipment, in steel and plastics, in professional services and civil engineering, and so on."

This is an undeniable boost to employment, but would happen whether the government opted to roll out broadband infrastructure or simply decided to build a new road or another element of infrastructure. And as the LSE study highlights, a large share of the 280,000 jobs it forecasts falls within this construction effect, making them necessarily short-term ones.

To be sure, few would consider any kind of economic prod to be a bad thing right now. William Dutton, a professor of Internet studies at the Oxford Internet Institute, argues that as an infrastructure project, superfast broadband is not especially expensive, especially when compared to projects such as high-speed rail. "It seems like a rational and obvious target of investment when you're trying to stimulate economic growth and development," he says.

### Superfast job growth?

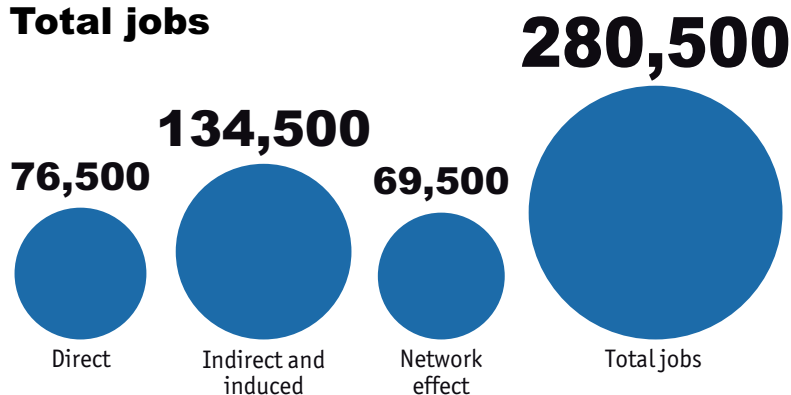
The trickier question is the degree to which longer-term jobs are created as part of the indirect impacts from such investments. The effect of the original switch to basic broadband is clearer to see, and sizeable. By providing an infrastructure that acts almost as a utility, much like electricity, the market has been freed up to develop new firms, services, jobs and careers on the back of it. According to analysis from McKinsey, the Internet contributed 5.4% of the UK's GDP in 2009. The same study suggests that

Chart 3

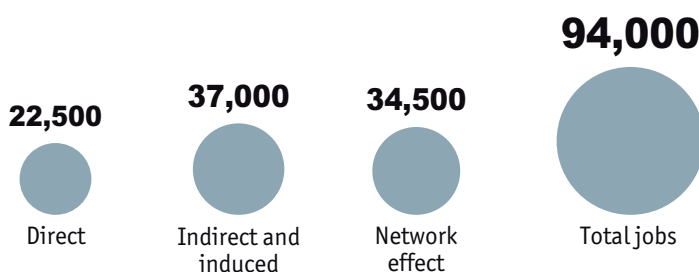
#### Estimated UK jobs created or retained for 1 year by a £5bn investment in fixed-line broadband

(number of jobs)

#### Total jobs



#### Of which, small business jobs



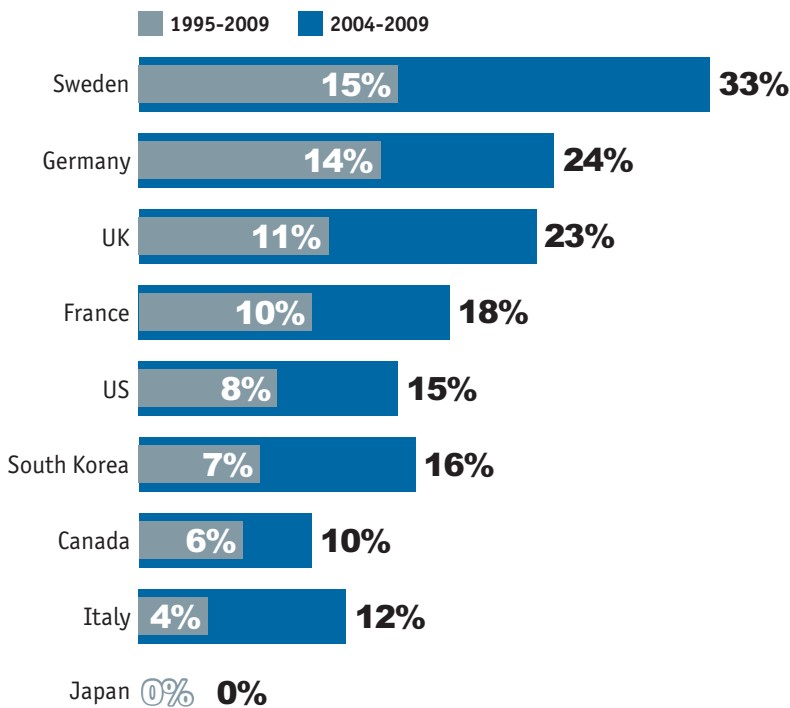
Source: Jonathan Liebenau, Robert Atkinson, Patrik Kärberg, Daniel Castro and Stephen Ezell, "The UK's digital road to recovery", London School of Economics, 2009.



Chart 4

## Internet contribution to GDP growth, selected countries

(%)



Source: McKinsey Global Institute, May 2011.

the Internet accounted for 23% of the country's overall GDP growth between 2004 and 2009.<sup>12</sup>

So far, so good. But while most experts agree that a higher penetration of basic broadband is linked to a rise in economic growth, it is far harder to forecast the effect from a further gain in speed. "This is where it gets tricky," argues Mr Katz, "because there's a school of thought that says we might have a jobless economy. You get more GDP, but you don't need as many workers to produce as much output."

David Dean, a senior partner at the Boston Consulting Group (BCG), a management consultancy, is more optimistic about the likely impact on jobs, but agrees that it is impossible to forecast where they will end up. "Job creation will often come in unexpected places, such as telemedicine, the creative industries or in start-ups," he says, "and it becomes hard to

calculate what can be attributed to broadband investment." Overall, some industries will gain jobs: according to the LSE and other experts, these include financial services, healthcare and trade. Others, such as tourism, will lose them as a result of increased productivity and pressure from new business models.

Pantelis Koutroumpis, a research fellow at Imperial College, London, maintains that if superfast broadband is to succeed in creating new jobs, it must be complemented by strategic policy approaches. "What is critical from a public-policy standpoint," he says, "is whether people have the skills and mentality to adapt to this changing environment. Even if the signs are positive in job creation, one needs to reshape the socio-institutional framework to meet the new needs."

A further variable is geography: some regions of the UK are likely to gain, while others may find it perhaps speeds up the rate of job decline. In rural areas, for example, as consumers get better access to online commerce offerings, local stores may suffer. Mr Dean notes that job losses are inevitable: "Far-sighted governments are trying to understand whether those losses are compensated for by job creation and what policies are necessary to ensure job creation in the longer term."

Part of the challenge is that few regions have so far implemented superfast broadband, and thus been able to measure the effects. One recent study, conducted in Sweden, tried to do so. It explored the impact of superfast broadband on local employment, following the rollout of fibre-to-the-home across 290 municipalities between 2007 and 2010.<sup>13</sup> It found that while there was a statistically valid link between high-speed fibre connections and economic growth, it was relatively weak, at between 0% and 0.2%.

On the other hand, as the study's authors point out, this gain has accrued rapidly. "Two, three, four years is a very short time for effects such as increased productivity and new ways of working to show up," explains Crister Mattson,

<sup>12</sup> "Internet matters: The Net's sweeping impact on growth, jobs and prosperity", McKinsey Global Institute, May 2011.

<sup>13</sup> "Early effects of FTTH/FTTx on employment and population evolution", Marco Forzati and Crister Mattson, et al, 2012.

a senior advisor at the Acreo Research Institute in Sweden and co-author of the study. He also points out that rural municipalities that have been in decline have noticed an increase in population, thanks to people being able to be more connected. One rural entrepreneur even rented an abandoned school on the cheap and set up a company that processes special effects for Hollywood, enabled by the superfast access available. "I know a lot of these small examples that can help us understand why employment improves when fibre is deployed," notes Marco Forzati, a senior researcher at the Acreo Research Institute and the study's co-author.

### Thinking faster

In the Swedish example cited above, many communities went directly to high-speed fibre, skipping basic broadband. The benefits of such a switch are incontrovertible, but arguably some of the outcomes would have resulted from switching to basic broadband. "People say broadband is good, which I would certainly agree with, therefore superfast must be proportionally better, and that's not sensible," argues Robert Kenny, the founding director of the telecoms consultancy Communications Chambers and author of a study examining the merits of investing in superfast broadband.<sup>14</sup> "There is a lot you can do with basic broadband. The set of things that will require superfast is actually not that big."

Indeed, much of the research into the link between broadband rollout and economic growth considers the leap from dial-up to broadband, but not from broadband to superfast. This will come, but as yet it is not immediately clear that the same gains will be generated. Mr Katz notes that the impacts on productivity and job creation are curves of declining effects. "Going from dial-up to a 10Mb connection is one thing, but going from 10Mb to 50Mb—is that proportional?" he asks. "When I switched from 5Mb to 15Mb, it was obviously more pleasant to work, but I cannot say I became more productive, because the bottleneck was my capacity to think."

As important as any consideration of speed is extending access to those who are not yet online. For the newly connected, as anyone with basic broadband access can attest, the services that will prove most vital—online shopping, accessing healthcare information or simply being able to stay in touch with friends and relatives—are all perfectly accessible. "There has to be a consistent push to make sure it's much more widespread and accessible. If you think about the network effect, the more people are connected, the greater the implications for everyone," says Mr Dutton.

Stephen Howard, head of the global telecoms, media and technology research team at HSBC, a bank, also argues that today's applications are all perfectly capable of running at today's broadband speeds because they've been designed to do so. "The question is, in essence, what services do we foreclose upon in future if we don't have the infrastructure available?"

### The skills check

Building infrastructure is only part of the picture. A big challenge in maximising its impact lies in ensuring that the necessary skills are available to make use of it. If local skills in, say, digital gaming or animation are in short supply, companies will find it easier to look elsewhere to have those tasks performed. Job leakage is thus a concern, in that faster broadband will make it easier for firms to outsource specific jobs, such as bandwidth-heavy application development. "Now that a connection is very fast, a games developer might say it will develop its video games in Asia. Jobs will be created in Asia, but leaked from Britain," argues Mr Katz.

This skills gap is a serious challenge for anyone hoping to benefit from the rollout of high-speed connectivity. BCG's Mr Dean says his firm has found that for small to mid-size companies operating on the web a lack of sufficient digital skills is often seen as the biggest barrier to growth, not the cost of broadband access, nor its speed.

<sup>14</sup> "Superfast broadband: Is it really worth a subsidy?", Robert Kenny and Charles Kenny, February 2011.

“What’s holding firms back on the Internet,” explains Mr Dean, “is access to talent—people who understand digital marketing, how to do e-commerce, who understand big data and analytics, and all the things that can be done

on the web.” As he points out, currently much Internet usage in the UK centres on e-commerce activity, “for which you need a network, but not necessarily the highest-speed network”.

## Expert view

### Steve Unger, group director - strategy, chief economist and technology, Ofcom

#### **Q. Are the hoped-for benefits associated with superfast broadband realistic?**

The short answer is yes. We’re going to have to build a knowledge economy in order to compete globally. If our broadband infrastructure isn’t up to it, we will be unable to do that. This is difficult to quantify, however. One reason is that [the knowledge economy] is characterised by innovation, and you just can’t predict what’s going to happen. The other is that it’s only once a large number of people have access to higher speeds that the content will be produced which justifies the network. It’s inherently difficult to forecast from current levels of usage what would happen when there is a faster network.

#### **Q. Some argue that it is unrealistic to expect the transition to superfast broadband to have the same impact as the shift to basic broadband. What is your view?**

I think it is astonishing how much innovation has taken place

around the Internet. Of course, that doesn’t mean you can assume that going from 10Mbps to 100Mbps will generate the same level of innovation. But to continue the virtuous circle between investment in infrastructure and service innovation, I do believe we need to move beyond where we are now. There are things that can be done with the existing infrastructure, and there are obviously reasonable questions about how far that can be pushed. But that doesn’t mean we should not be thinking in parallel about what the future infrastructure should be.

#### **Q. What about the challenge of developing skills to tap into these hoped-for innovations?**

There are two issues. One is that to remain competitive, the infrastructure is critical, but we also need people who can develop the new applications. If we want to build the next Google, what we need are people with a profound understanding of the mathematics that underpin [search engines], so we need a technologically capable workforce. The second issue is about digital literacy more generally, for consumers as well as producers; this is a different type of educational challenge for the UK, but it’s also an important one.

## 3

## British competitiveness and innovation

When asked about the case for superfast broadband, Constantijn van Oranje-Nassau, deputy head of the cabinet of Neelie Kroes, vice-president of the European Commission, is emphatic in his reply: "The most important thing is the competitiveness of the European economy."

HSBC's Mr Howard sees three large arguments in favour of faster infrastructure. One is about making consumers' lives better and easier. The second relates to the competitiveness of all industries. A third element is about boosting the ICT (information and communications technology) industry itself. "Where is our Facebook, or eBay or Google?" asks Mr Howard. "A lot of the growth in the US has come from the technology sector, whereas Europe's hasn't contributed nearly as much. The view is it's less likely to do so as long as it lacks the relevant infrastructure."

Europe's competitiveness challenges, however, go beyond a question of mere infrastructure. America's high-tech sector, after all, thrives without a world-leading broadband network. Rather, for the UK—and for the rest of Europe—the challenges come down to a more diverse set of issues, including a culture that does not promote risk-taking; a shortage of venture capital and the associated network of support services; and, in Europe at least, diverse languages and cultures which make it difficult to rapidly scale up a business in the same way that American firms can.

A few clusters of entrepreneurial technology firms do, of course, exist in the UK, notably in

London's "Silicon Roundabout". A 2010 article in *The Economist* highlighted the area's sustained growth as a source of high-tech innovation, while conspicuously failing to mention broadband at all, barring a side note that the area did not yet have superfast access.<sup>15</sup> Even so, the region was then already home to numerous firms specialising in digital content, multimedia and 3D design.

### Awaiting the killer app

Outside of high-tech, it is difficult to find good examples where superfast would in the next four to five years make a striking difference to a firm's ability to compete. "If you're an animator and you've been working away on files for the next episode, and you want to upload them quickly, superfast will be useful, but that's pretty niche. Most commercial activity gets very little value from it," argues Mr Kenny. The clearest application relates to the sharing of HD (high-definition) video, which largely surpasses the capacity of basic broadband. But while this is undoubtedly important for the UK's content sector, it is also difficult to see that HD alone will unleash a major new set of applications or economic capabilities.

Oxford's William Dutton argues that this ignores the network effect, where a big enough base of high-speed users is needed before relevant applications start to emerge. "People are not going to design for users of a system that is not yet widespread," he says. "Most of us cannot visualise that anyone would want something very different from today, and the same argument about a lack of a killer application was made when moving from dial-up to basic broadband. I think

<sup>15</sup> "Silicon Roundabout: London's high-tech start-ups", *The Economist*, November 25th 2010.

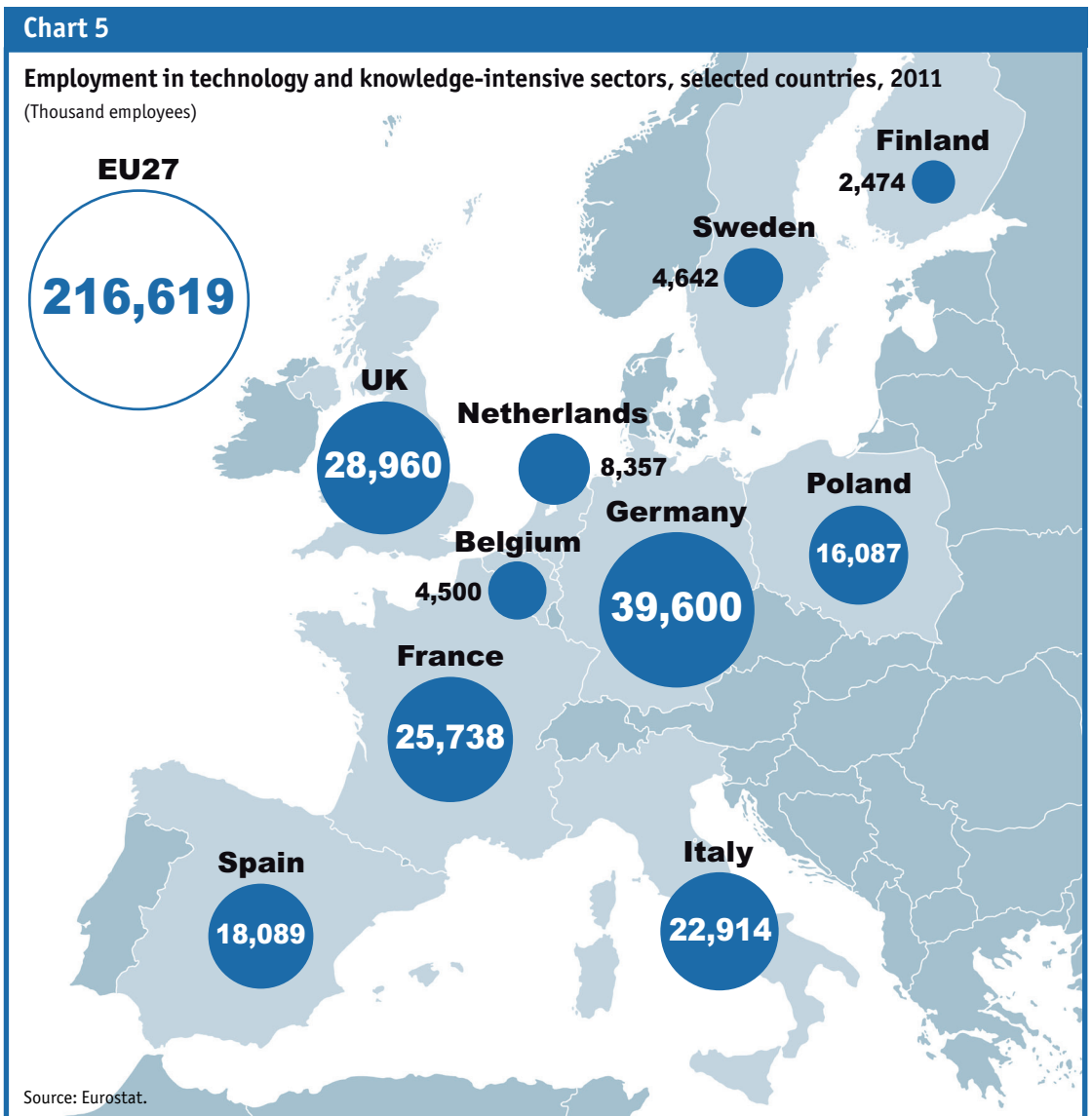
this will extend to faster speeds, with innovations that we haven't thought of as yet."

### The hunt for productivity gains

What of greater productivity? One of the few studies that specifically examines the impact of higher broadband speeds on business comes from New Zealand.<sup>16</sup> By assessing the productivity impacts from businesses that had adopted differing connectivity speeds, it found that while basic broadband clearly boosted productivity, there was zero observable difference for higher speeds thereafter. The majority of companies' needs today, and probably for at least the next

four to five years—e-mailing, sending proposals, making online purchases, collaborating via video conference, accessing cloud-based services—all work over existing broadband. "There is a plethora of fantastic things that broadband does to help make businesses more efficient; they do not require superfast," says Mr Kenny.

Business will of course adapt and make use of superfast broadband over time. Mr Howard argues that the benefits will accrue steadily: they may not appear crucial from one year to the next, but after several years "you will suddenly realise you can't really live without it". This may



<sup>16</sup> "The need for speed: Impacts of internet connectivity on firm productivity", Arthur Grimes, et al, Motu, October 2009.



## What about the smart grid?

Beyond superfast broadband, the UK is also shifting towards a “smarter” electricity grid. As some argue about broadband, the existing infrastructure is creaking, while power generation is shifting from a centralised approach to one that is more distributed, tapping into more diverse power sources. At the same time, home-based smart electricity meters help consumers manage their usage and help power suppliers to better manage demand.

Nevertheless, the data demands of the smart grid are hardly daunting. A recent paper by the Institute of Electrical and Electronics Engineers (IEEE) forecasts data rates to describe the instantaneous status of the grid at 2.5Kbps for a substation through to 250Mbps for the entire grid—with a peak data transfer rate of 8.1Mbps at a vicinity level.<sup>17</sup> This certainly requires a solid, highly reliable network, but speed is not really a barrier today. ■

especially apply to video-based collaboration, with the ability to communicate over high-quality links with colleagues in any location, with no lag. For teleworkers, this may be part of the response to overcoming the challenge of being disconnected from colleagues, perhaps by permitting always-on video connections.

### The innovation to come

What about tomorrow's innovations? This is an inherently difficult thing to forecast. Looking ahead, experts point to various possibilities that seem likely from today's perspective. One is the steady rise of 3D printing, where network speed and reliability in downloading large three-dimensional renderings will help boost this technology's take-up (see the “Expert view” from Malcolm Harbour).

Another is cloud computing. Mr Oranje-Nassau cites a study of CIOs which showed the negative effects of large variations in broadband speeds between different business sites, suggesting that a challenge in adopting more cloud-based services is slow broadband. “For some applications speed is critical, especially those involving work with real-time information, when you need assurance that the quality of the

transmission is continuous and reliable,” he says. But other challenges must be overcome, too, such as legal question marks over how data are protected, especially for cloud providers outside of a national or European jurisdiction.

Of course, it is always dangerous to bet against the unforeseen innovations of future generations. “The total private and public benefit of next-generation access is hard to measure or model,” asserts Mr Oranje-Nassau. “But if we believe that the future will depend much more on digital, it is likely that the benefits are high and the cost of not investing even higher. This is not hard science and we need to sometimes also dare to believe.” Mr Dutton agrees: “One of the most exciting areas of Internet innovation is the flurry of new business models about how people make money from online services. People gave up on search, thinking it didn't have a business model, before Google figured it out.”

Over time, powerful new applications will emerge. But in getting there, other things will be needed beyond faster networks: new skills, regulations that make the business environment more competitive, capital to support business growth and more. ■

<sup>17</sup> “Smart Grid – A reliability perspective”, Khosrow Moslehi and Ranjit Kumar, IEEE, January 2010.

## Expert view

### Malcolm Harbour, Member of the European Parliament and vice-chairman of its Science and Technology Options Assessment Panel

**Q. You had a long history in manufacturing. How do you see connectivity affecting the competitiveness of that sector?**

Services delivered through broadband are clearly shown to have a massive capability for transforming the way that businesses operate, reinventing them but also opening up new possibilities. In manufacturing, we're already seeing a complete transformation of the way that new products are developed and brought into production. What is really interesting is the huge amount of development work—on cars, for example—being done by simulation, with engineers sharing information and doing huge amounts of test work virtually, cutting down the number of prototypes needed.

**Q. Much of this is feasible with today's broadband. What innovations do you believe faster connectivity will permit tomorrow?**

This could be done through basic broadband, yes, but information is the driving commodity for the future of the

economy. Take 3D printing. This essentially enables you to create a three-dimensional model of your design far more quickly than you could before. You can now even print in metal, so you can make a prototype part on site. In the case of Formula One racing, these tools are being used all the time, making parts that can be installed in a car within 24 hours. In other areas, car manufacturers might start to send you the precise design for a replacement part via broadband. You will get the file and then you can either print your own part yourself, or do it via a local supplier. This is the future, and we need to gear up for it. Britain is rather good at these sorts of things, and we need to be looking at the entire training and development set-up in order to develop these skills.

**Q. What skills are likely to be needed?**

We will need a very wide range. The new Range Rover that launched in September has a completely new all-aluminium body structure, with everything laid out and defined using computer simulation. All the body-panel joints are robotically done. So of course we need people with the capabilities to do such work. Some of the more technology-savvy universities are working on that now, and of course they need support.

# 4 Faster, better-quality healthcare?

There are clear benefits to be seen in the healthcare domain in terms of what a faster broadband infrastructure might feasibly permit. For example, medical professionals in a remote location can use high-speed connectivity to exchange digital X-rays, mammograms and other medical information with specialists anywhere in the world, instead of having to ship physical scans off and await a reply. In other applications, this can permit patients to continuously transmit their vital signs to their GP (general practitioner) rather than come in for periodic check-ups.

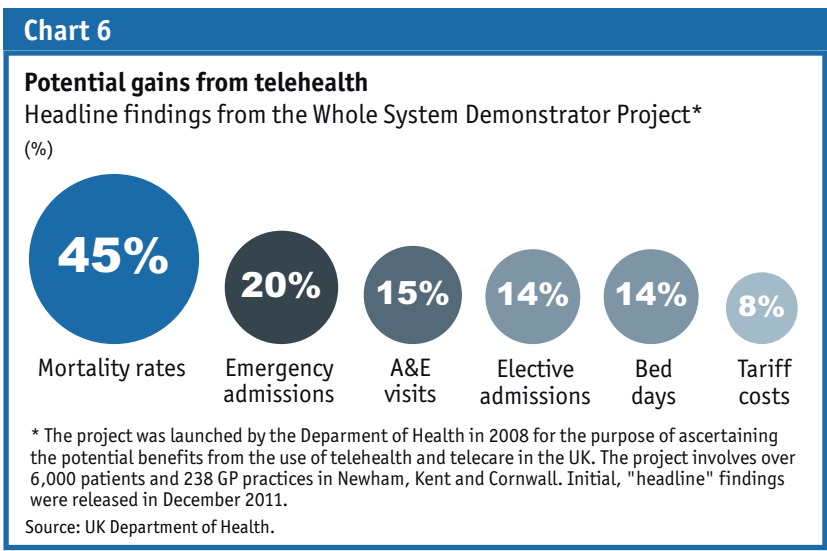
<sup>18</sup> In this report we use the terms “telemedicine” and “telehealth” interchangeably, while recognising that these and other terms, such as “telecare” and “m-health”, can also refer to specific applications.

Externally, there is the promise of rural or elderly patients having online or video-based consultations with a GP, saving time and money for all parties. More importantly, experts suggest that telemedicine can deliver better patient outcomes.<sup>18</sup> James Ferguson, the clinical lead at the Scottish Centre for Telehealth, cites a study

undertaken in England showing a potential decline of up to 45% in mortality rates thanks to telemedicine (see Chart 6). And the latter is hardly niche: Chris Wasden, a managing director within PricewaterhouseCoopers’ healthcare practice, points to Mayo Clinic research which indicated that at least 40% of primary healthcare delivery could be carried out without a visit, while doctors he has spoken to put the figure at well over 50%.

Professor Detlev Ganten at Berlin’s Charité University Hospital has been involved in wide-ranging research and trials for telemedicine and sees a range of benefits from it. “First of all, you connect directly to the patients,” he says. “The latter don’t have to go to the doctor any more, while they still get direct interaction, and this is most cost-effective. Second, telemedicine saves lives, because in an emergency patients can communicate and obtain advice fast.”

While the potential is clear and significant, however, there is a question as to why such services are not already more widely available. After all, there is little telemedicine that cannot be supported with existing speeds. In one remote heart-monitoring application that Mr Ganten has been involved with, for example, a simple mobile phone can be adapted to help act as a remote electrocardiogram (ECG). Most remote monitoring only requires limited amounts of data being transferred each day. Even video consultations could be handled on today’s bandwidth, agree those experts interviewed for this report.



## A prescription for change

If technology is not the barrier to a larger role for telemedicine, what is? The biggest challenge, according to experts, is getting doctors to change how they work—a very slow process.

“Getting doctors to change will take at least a decade,” argues Mr Wasden. He cites several factors that need to be in place before telemedicine can take off. These encompass greater freedom and better standards to share healthcare data and information; educating clinicians about how to work this way; basic reform of medical training and education; financial incentives and penalties to stimulate change; consideration of the liabilities and risks, especially if a remote consultation fails to spot a warning sign; and guidelines on the clinical

and economic efficacy of telemedicine, to better understand this.

“I think we’re expecting too much from doctors if we just say, ‘Here’s some technology, go figure out what works best with patients,’” says Mr Wasden. In the UK, this has been more than evident with the troubled rollout of electronic medical records—originally due for completion in 2006, but now likely only by 2015. A range of factors have plagued the implementation, but one has been the thorny challenge of trying to convince doctors to accept and adopt new processes. Overall, it is quite feasible that the main barrier to tomorrow’s video links to doctors will not so much relate to the pipe, but rather the healthcare system itself.

## Expert view

### James Ferguson, clinical lead at the Scottish Centre for Telehealth

#### Q. Which kinds of outcomes are you targeting for patients?

There are several, but the big one is home monitoring. We are sending far too many patients to hospital, especially people aged over 80 with chronic disease. This is becoming a quality issue, because if a hospital is overloaded, its mortality rates increase by anything up to 20%. But there is evidence that monitoring patients at home or via mobile technology can reduce the need to admit these people to hospital and in turn sharply reduce the associated mortality rate, by up to 45% [see chart 6]. This results partly from reducing hospital overload, but also from being able to intervene earlier.

#### Q. To what extent is superfast broadband necessary for what you can do?

For certain specialised conditions we fit video cameras directly into patients’ homes, and it’s been quite challenging to get connectivity in some of the rural areas, whereas in the

bigger cities it’s not such a problem. We basically use the technology we need to achieve an outcome, but the more connectivity you have, the more advanced interventions you can make. With a simple phone connection you can do things such as daily blood-pressure monitoring, while at the higher end you can have a high-quality video-conferencing link and start to perform remote diagnostic examinations.

#### Q. Where is this all headed, and how quickly are things moving?

We can make the system far more efficient for the customer, with better care and healthcare outcomes. The problem is that telehealth is treated as an add-on to everything else. We need to stop and completely redesign how we do things. Interestingly, the recession has been the best thing for this, because it’s changing how people think. There is no alternative; we cannot build endless hospitals for the elderly patients we’ll have. The major challenge lies in getting medical professionals to accept that telehealth works and is effective.

## 5

## Education in the digital age

Almost all schools in Britain now have broadband connectivity, and teachers regularly incorporate the Internet into their work in the classroom. There are technical limitations, however. A typical primary school has 200 children and, as Miles Berry, a senior lecturer in ICT Education at the University of Roehampton and chair of NAACE, an ICT association, points out, a typical 10Mbps connection is impractical for every child to go online at the same time.

Schools generally accommodate this problem by limiting Internet use to one class at a time, and by restricting access to bandwidth-heavy content, such as video. Thus one clear benefit of superfast broadband in schools would be to enable multiple pupils to access the Internet at the same time. Of course, this would need to be complemented with an increased investment in devices for children to use to go online. Internet usage, however, could more feasibly become an integral part of every lesson, rather than an occasional extra when available.

### Driving on Mars

This opens up numerous possibilities. Schools could make better use of both cloud-based educational software and collaborative office tools such as Google Docs. As well as helping schools reduce the burden of technical administration, cloud solutions can encourage collaborative learning, says Mr Berry. There is also scope for high-definition, immersive video-conferencing to help enable British schoolchildren, for example, to test their foreign-language skills with children overseas, or to carry

out joint projects with schools elsewhere. Long-distance tutoring is also possible: Mr Berry cites Ashford Primary School in north London, which uses maths graduates in India to provide one-to-one tutoring over the Internet.

Superfast broadband could also enable school and university students to work on large datasets, believes Rose Luckin, professor of learner-centred design at the London Knowledge Lab. "People can work together on complex tasks using the kind of high-definition information that only broadband speed can give," she says. Stephen Hilton, director of the Futures Group at Bristol City Council, believes that science lessons could be transformed by giving schools real-time access to data from the Hubble telescope or the Mars Exploration Rovers.

In theory, then, superfast broadband opens up the possibility of radically changing the education landscape, by helping children access educational content and experts anywhere in the world, allowing them to learn anywhere, at any time, without the physical restrictions of a classroom or the time constraints of a school day.

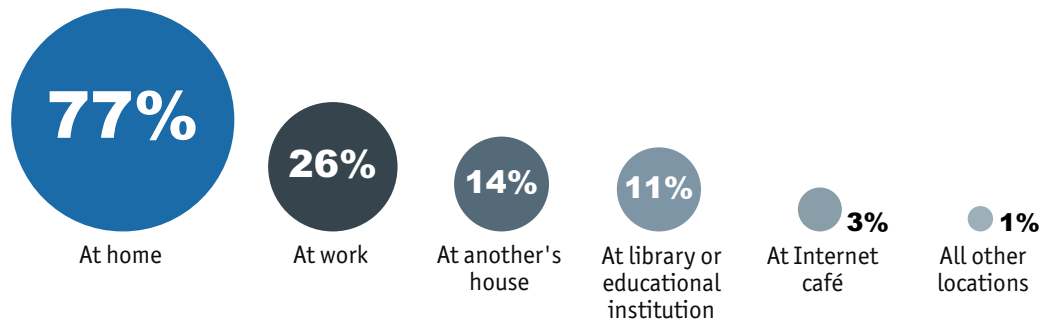
Jon Crowcroft, Marconi professor of networked systems at Cambridge University, urges caution, however. The "any time, anywhere" model of distance learning hardly requires superfast broadband to work, he argues. "Most of the really cool things one can do in higher education—that places like Stanford, MIT and Harvard have recently rediscovered—have been done extremely well by the Open University in the UK over the past 40 years." Furthermore, the free distance-



Chart 7

**Locations of Internet access, UK adults (age 16 and over), Q1 2012**

(% of adults)



Source: Ofcom, "Communications Market Report 2012".

learning materials, such as podcasts and recorded video lectures available from a growing number of top universities, can easily be accessed using today's basic broadband. As Columbia's Mr Katz pointed out earlier on, the bottleneck is not the pipe, it is the brain's ability to absorb information.

**Repeat after me**

The numerous technological advances of recent years, such as interactive whiteboards and Internet access in the classroom, have made little difference to pedagogical approaches. For the most part, children attend school for a fixed period of time each day and sit in groups of about 30, where they face a board and listen to a single

teacher. Technology has made certain aspects of teaching and learning easier, but the basic model has remained unchanged for more than 100 years.

Although some trials being explored around the world—such as models where children watch lectures online for homework and then focus on practical exercises in class—might be eased by faster access, speed alone is unlikely to significantly reshape education. Ms Luckin argues that rather than asking how superfast broadband can improve education, we should ask: "What kind of an education system do we really believe would benefit our learners, and how can superfast broadband help us to get that?"

**What about science and research?**

When it comes to the furthering of scientific research, the case for superfast broadband is easier to see. Take as one example the Large Hadron Collider (LHC) at CERN, in Geneva. It produces some 25m gigabytes of information each year. To cope with this, scientists in the UK and other countries have had to develop a specific data-distribution infrastructure, dubbed the Worldwide LHC Computing Grid, which has created fibre-optic links to key research centres capable of handling 10Gbps transfer rates.

Looking ahead, the upcoming Square Kilometre Array (SKA), the world's biggest radio telescope, is expected to generate one exabyte—about 100 times more than the LHC, or more than twice the volume of data sent over the Internet each day. As it stands, scientists are still working out how to cope with this. In short, as science explores the boundaries of knowledge, there is no upper data speed limit yet in sight.

The current evidence suggests that it is more important to focus on the quality of teachers and pedagogical approaches than technology. For example, research by the Sutton Trust, an educational charity, tested different approaches to improving educational outcomes and found that one of the most effective was the use of peer-assisted learning, which offered an improvement in achievement comparable to six months of additional coaching by a teacher.<sup>19</sup> Overall, superfast broadband can be used to support educational transformation, but will not bring it about on its own. ■

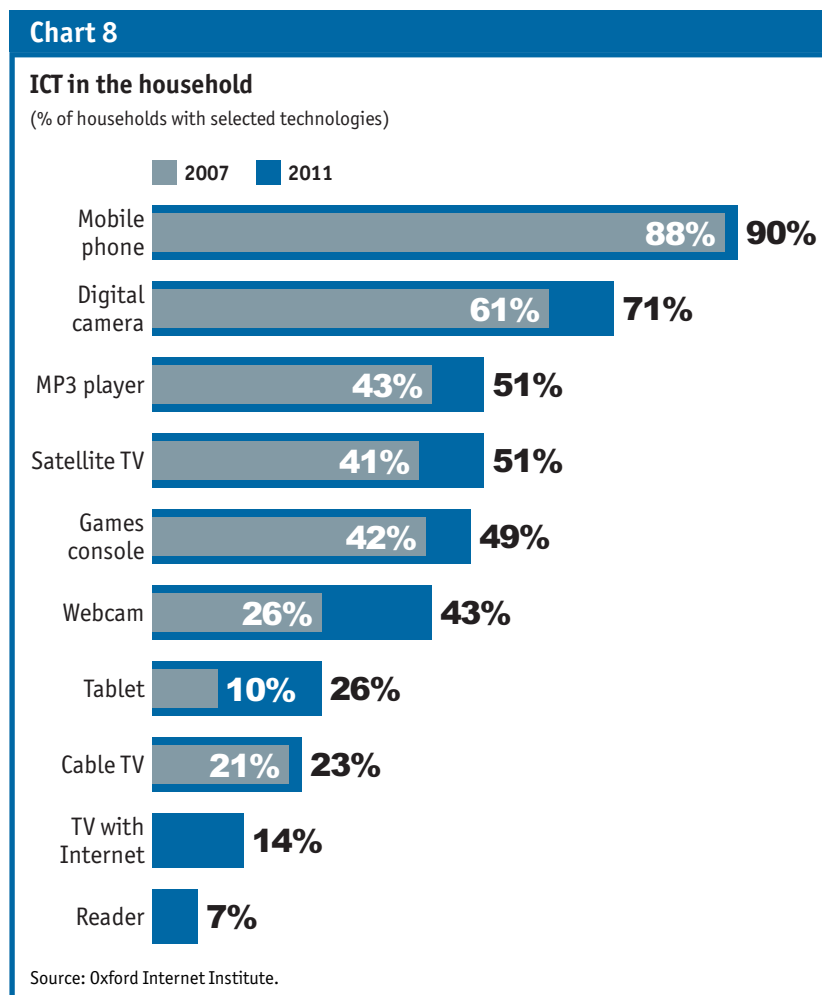
<sup>19</sup> "Toolkit of strategies to improve learning", The Sutton Trust, May 26th 2011.

# 6 Tomorrow's home today?

When looking for gains from superfast broadband, the home is a good place to start, given steadily evolving usage patterns. As a report from the Oxford Internet Institute highlights, some 44% of Britons—spanning men and women and all age groups—now conform to a profile that the study dubs “next-generation Internet users”, up from just 20% in 2007.<sup>20</sup>

Although there are differences among these users, their key defining trait is their ownership and use of multiple devices—including various computers, game consoles, tablets and laptops, as well as smartphones—to access the Internet. Overall, these individuals are much more likely than others to listen to their music online, play games, download and upload videos and other multimedia, generate and post a variety of content, including blogs and social media, and use the Internet as a default source of information.

<sup>20</sup> “Next generation users: The Internet in Britain”, William Dutton and Grant Blank, 2011.



Ian Andrews, a telecoms expert at PA Consulting Group, sees major changes in the way that many households now use their broadband connection, with a multi-user, multi-device and multi-tasking environment now common. A parent may be working from home, phoning colleagues and accessing e-mail, while a child is streaming video or music and updating its social media accounts at the same time. “These demands can severely draw down a broadband account and can interrupt services, given that household lines are not managed in the same way that corporate connections are,” says Mr Andrews.

For these reasons, many experts see a clear argument in favour of faster speeds in the home. “We’re seeing a lot of change in the sector, from Internet TV options to film services like Netflix,” says Mr Andrews. “It’s all bursting into people’s living rooms, driving a need for superfast broadband.” He firmly believes that infrastructure improvements are required, “else we will reach a point where networks are not

performing and holding back the innovations we're seeing on the consumer side."

### Who's buying this round?

But while the case for more speed is easy to see, other questions remain. The first is why consumer adoption of superfast services is slow. By June 2010, when nearly 50% of all UK households were in an area where they could sign up for speeds of up to 50Mbps, only 74,000 subscribers had actually done so. By May 2012 a total of 8% of residential connections were classified as superfast, according to Ofcom.

This relatively slow uptake appears to be due to the fact that while consumers are happy to pay for the switch from slow access to broadband, their willingness to pay a further premium for superfast is more questionable.<sup>21</sup> This may change over time, as the case becomes clearer, but if consumers are willing to express their access preferences through their spending patterns, the result is not yet clear.

This concern also shows up in something economists term "consumer surplus"—the

"gain" that consumers feel they make by getting access to a service at a certain price point. A study from Vodafone and Ingenious Consulting in 2010, which looked at the potential benefit derived from various types of further incremental broadband rollouts, argues that the greatest consumer benefit for every pound of government subsidy given accrued to the further rollout of standard broadband to 100% of households.<sup>22</sup> This generated a consumer surplus of €2.25 for every €1 invested. By comparison, faster broadband connection options showed limited benefit. For example, the rollout of superfast broadband to 64% of urban areas showed a consumer surplus of €0.34 for every €1 invested.

A cost-benefit of various rollout options is beyond the scope of this research, but it does suggest that ensuring pervasive access to basic broadband is at least as important as it is to get superfast connectivity to key users. "We need inclusiveness; we need to make sure everyone comes along with us," maintains Mr Andrews. It is not just about the pipe, but also about providing support to those who remain digital novices.

<sup>21</sup> In the US, a survey by the Federal Communications Commission (FCC) noted that the average household was willing to pay about US\$45 per month to shift from "slow" to "fast" access, but just US\$3 more per month to move to "very fast" speeds. Cited in "Overselling Fibre", Charles Kenney and Rob Kenney, 2011.

<sup>22</sup> "Developing government objectives for broadband", Vodafone policy paper series, No 10, March 2010.

## Expert view

### Stephen Hilton, director of the Futures Group, Bristol City Council

#### Q. To what extent do you need superfast broadband rather than existing speeds?

Current speeds allow you to do what you need to, but more slowly. About 36% of businesses in Bristol are classified as being within the knowledge economy. They represent the knowledge-rich sector that has an implicit need for high-speed connectivity, as timeliness of transactions and data analytics is critical. So while other businesses where broadband is used for basic e-mail and ordering supplies can do with current broadband speeds, specialist companies would benefit greatly from higher speeds.

#### Q. Where do you see this going in Bristol?

I want everybody in the city to at least be able to access speeds of 20Mbps, but we aspire to a network that can support gigabit transfer of files. We may not get that, but we

want to push the market to see how high the delivered speeds can go, and to challenge business and academic partners to find uses for them. We think that by creating that headroom, by giving people more bandwidth than they know what to do with, we will start to see innovation. We've got lots of creative industries, lots of university activity and lots of high-end users. This should then lead to new products and services that will in turn drive the demand for higher speeds.

#### Q. How will faster speeds change the way Bristol does business?

Wide availability of broadband is changing the way people do business these days. In Bristol we are moving from a workforce that is primarily office-based to a scenario where, in the next three to five years, a vast majority will be mobile or home-based, or working from a much smaller number of office hubs. A number of people in Bristol are also starting their own businesses and relying heavily on digital networks to market themselves and create a customer base.

# Conclusion

## Patience, please

If the British government keeps to its stated ambitions, much of the UK will have access to speeds well in excess of 24Mbps—almost three times the average of today—by 2015. Implementing this will act as a short-term stimulus, providing jobs and much-needed economic activity.

Over time, this platform will surely be the basis for a wide array of changes in the life of the nation. Superfast broadband will help foster new ways of working and better collaboration within businesses. It will supercharge home entertainment, allowing individuals to access a wide range of multimedia services across a growing array of devices. It should make the lives of patients (especially the elderly) and their doctors easier, and ultimately save lives. It will give students and teachers access to an array of learning opportunities previously closed off to them. At some point, society will look back at 2012 and wonder how it ever coped with the clunky speeds of the day.

As this report argues, however, a good dose of reality is also in order. Many of the hoped-for

services are already eminently feasible using today's networks. Instead, what too often blocks progress is a shortage of suitable digital skills, institutional resistance to change, unreformed processes and a lack of pervasive basic broadband access, among other things. Deploying superfast networks will not by itself resolve these problems.

In this context, some of the projections cited at the start of this report—especially those regarding the superfast broadband impact on the British economy and jobs over the next five years—appear fanciful. Government and business in the UK naturally wish to embrace any technology-driven boost to an otherwise weak economic growth outlook. The rollout of superfast broadband, both the mobile and fixed variants, will help, but it would be unwise to expect early returns.

Some patience is required. "In the short term, most of these things do turn out to be hype," notes Ofcom's Steve Unger. "But in the long run, things that you couldn't imagine before do actually start to happen, and quite often the hype almost turns out to be understatement."



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