



Department
for Culture
Media & Sport



HM Treasury

Digital Communications Infrastructure Strategy

Consultation Document

6 August 2014

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Foreword



Digital technology is transforming all our lives. And as it advances it will continue to offer previously unthinkable options for communications individually and in business.

At the same time we are relying more upon the devices many of us now own and we are demanding more from them. In a world where there is an “app” for everything, we increasingly expect to be connected anywhere at any time and to access our data and content from multiple devices.

The evolution of Big Data and the Internet of Things mean that we can now use digital technology to support our day to day activities, for example by remotely monitoring the health of vulnerable people living alone, helping us use scarce energy resources efficiently and giving easy access to public services from the comfort of home. They are also critical to the development of our economy, driving the way in which we do business within Britain and internationally.

This advance is set to continue at the same relentless pace: In two decades’ time the children of that “digital generation” will be despairing of their parents’ inability to grasp the new technology just as our children are today.

That is why the Government is committed to making the UK the best connected country in the world. It is already delivering a superfast broadband programme where £1.45bn of public money has been invested to produce £20 of economic benefit for each £1 invested by the public sector. In addition to providing 95% of the UK population with access to reliable, superfast broadband by 2017, up to £150 million is being provided to improve mobile coverage in hard to reach parts of the country.

However, if the UK is to remain a leading digital economy it needs the right digital communications infrastructure in place to meet user demand, support economic growth, build a digital society and allow new technology to flourish.

Now is the right time to look at what the strategy should be to follow on from superfast broadband and to address the rapid convergence of the broadcast and telecommunications markets. Investment in communications has to compete for resources against other forms of investment in economic and social infrastructure, so it is becoming increasingly important to

understand the way in which the various infrastructure networks interact with each other – so we can get the maximum benefit from each investment.

In July 2013, the Department for Culture, Media and Sport published Connectivity, Content and Consumers, Britain's digital platform for growth, announcing the Digital Communications Infrastructure Strategy. The strategy will map out what actions Government and industry partners may need to take, what changes might be needed to the regulatory framework and by when to make sure the right digital communications infrastructure is in place to give the UK the best connectivity by 2025-2030. This consultation has been drawn up following discussion with a wide range of industry experts and sets out the current infrastructure landscape alongside some scenarios about future demand and a series of questions that arise from these and other possible developments.

The government will also continue to ensure that infrastructure priorities for the near term are managed to ensure they are steps towards meeting the Government's ambition to become one of the fastest and best connected nations. To achieve these shorter and longer term goals, the Government has established a Digital Task Force, chaired by the Minister for the Cabinet Office. The task force has been asked by the Prime Minister to build on the UK's current position in advancing its digital economy, including ensuring our infrastructure is world leading. The Digital Task Force will therefore play a prominent role in shaping the debate and subsequent strategy.

The development and implementation of a successful long term strategy relies upon all stakeholders in the communications sector and users across a wide range of activity playing a strong active role, so we want to hear your views on how you see future user needs unfolding, and how these might be met.



Ed Vaizey MP
Minister for Culture and Digital
Industries



Lord Deighton
Commercial Secretary to the Treasury

Executive Summary

In July 2013, the Department for Culture, Media and Sport published Connectivity, Content and Consumers, Britain's digital platform for growth. The report specifically identified a need to develop a longer term digital communications infrastructure strategy. The aim of this strategy is to ensure that the UK builds on its strong digital foundations to continue to benefit from world class communication networks, supporting further economic growth and wider social benefits. At the same time, the Digital Taskforce will continue to identify any nearer term issues that are affecting the development and deployment of digital infrastructure and consider how these can be addressed.

The introduction to this document sets out in detail the importance of digital communications in a modern economy. IT and telecommunications generally contribute £105 billion to gross value added in the UK and employ 1.3 million people. The scale of the importance of this sector makes the infrastructure that underpins it a matter for public policy.

We need to plan ahead to make sure the right infrastructure is in place to meet the UK's objectives and this strategy will set out what the UK needs to do over the next 10 to 15 years to achieve this. It is vital that our digital communications infrastructure meets the needs of users in the UK. The UK must also be competitive on a global scale. It is imperative that the UK pays the same close attention as other countries to developing communications infrastructure to maintain the competitive edge essential to retain and attract business. In terms of infrastructure the UK is currently competitive compared to similar nations and we must ensure we remain so.

We envisage the UK's strategy addressing a number of key areas. These were set out in the Terms of Reference published in February 2014. We anticipate that the strategy will cover a high level view of what user demand and international competitiveness might look like in 2025-2030 and how we anticipate we will meet our ambition to provide the infrastructure needed to respond to both these elements.

The strategy will also consider and identify key next steps and action points for delivery in the following areas:

- a) How might the UK take advantage of the growth potential of the communications sector, including boosting innovation and creativity, maintaining global competitiveness and ensuring we realise the benefits of having world class infrastructure;
- b) Facilitation and encouragement of private sector investment in infrastructure;
- c) The regulatory framework;
- d) The role of Government, including coordination of policies, programmes and investment.

This consultation paper and its responses will represent important steps in its development. We are not consulting on a draft strategy or specific options for future action. We are instead asking for views and evidence on the issues set out above, on challenges that might be faced in delivering future world class digital communications infrastructure and how those challenges might be addressed and by whom. Views are welcome on whether there are areas where more immediate action would both improve existing infrastructure deployment and benefit more medium term deployment of digital infrastructure.

The Government will always look to the market first to deliver infrastructure, but realisation of our ambition to be a world leading digital economy will require Government, industry, and

others to work together. It may require changes to the regulatory framework. The introduction to this consultation considers the possible role for Government in future strategy, such as setting the challenge and desired outcome and alignment of government policies that make demands on communications infrastructure or impact on how these are provided.

Given the need for collaboration, this consultation is aimed at gathering the views of a broad range of stakeholders. The consultation document has been written after initial discussions with companies, organisations and individuals from across the communications industry, consumer representatives, the regulator, other government departments and the Devolved Administrations. We are continuing to gather views.

Existing and planned communications infrastructure and the current infrastructure supply market

Section 1 of the paper provides a summary of the existing and planned infrastructure and the current infrastructure supply market. It sets the scene for the following chapters, which look at future demand post 2025.

At present, UK communications networks are mature with:

- Universal provision of fixed telephony services;
- Near universal provision of current generation broadband and plans well advanced to deliver superfast broadband for at least 95% of the population by 2017 through targeted Government intervention;
- A competitive mobile telecommunications market with extensive indoor and outdoor 4G services being rolled out to 98% of the population by 2017 at the latest;
- A thriving broadcast infrastructure providing digital radio and television and other television services, across a number of platforms; and
- A regulatory framework that has supported the development of this extensive and highly resilient infrastructure.

What might future demand look like: Core assumptions underpinning the scenarios

Section 2 of the paper moves on from current and planned infrastructure and outlines some assumptions underpinning our assessment of future demand from 2025 to 2030. This section provides a basis for the detailed scenarios of future demand examined in section 3. Our assumptions were developed through discussion with stakeholders and draw on a review of published reports and articles. The assumptions include:

- Users will need more bandwidth as data consumption continues to rise;
- Expectations to gain access to services and applications on the move will become the norm;
- Technological advances in telecommunications and broadcasting will continue to be rapid;
- We can expect changes in the communications market, potentially including new players and possibly market consolidation; and
- Resilience and reliability will become increasingly important as aspects of what constitutes a good service, alongside availability and speed.

We have looked at how the infrastructure required to meet anticipated demand in 2025-2030 differs from that expected to be in place by 2018. Comparing the two has given rise to questions relating to any future disparity in the provision of communication services, the extent to which greater symmetrical download/upload services will be needed and the basis upon which future communications infrastructure should be compared between nations.

Scenarios of future demand

We said we would take a scenario based approach to developing the strategy. Section 3 of the paper looks at three scenarios of possible user demand in 2025-30 that draw from a workshop held with industry stakeholders. We are describing these scenarios in this document to stimulate discussion on how the UK's digital communications infrastructure may need to develop against a background of differing political, economic, environmental and social factors to meet potential demand from consumers, business and the Government. The Government, industry and the regulatory framework play a role in the development in each scenario and so views on which is most realistic against other varying factors identified will shape the ambition and next steps in the strategy.

Each scenario aims to provide a depth of variety and is summarised below:

- Scenario 1 is based on the premise that demand for services grows up to the period 2025-30, but that the growth is more modest than some of the predictions suggest;
- Scenario 2 is based on the premise that demand is stronger than the first scenario, although there are still factors that dampen demand for certain products and services; and
- Scenario 3 is based on the premise that demand is at the upper end, or exceeds, forecasts. Connectivity is a given and we have moved from an "always on" to an "always available" expectation. The scale of challenge to communication providers (current and future), policy makers and regulators is of a higher magnitude than experienced in the other two scenarios.

Each of the scenarios has a technology commentary that outlines the sorts of changes and challenges that the scenario might present to communication providers in terms of future device and infrastructure requirements. These range from demand being met on the basis of known technological developments and those that are expected to emerge in the coming years, through to a more challenging landscape where some significant changes to existing communications infrastructure might be required. These raise regulatory and policy questions as well as the need to identify other influencing factors that may have to be taken into account when developing the strategy.

Competition and regulation

Competition has helped to drive innovation in communications services and has provided value to the consumer with prices of communications services having decreased over many years. Competition is at the heart of the current regulatory framework set out in the Communications Act 2003. Government intervention has focussed on removing regulatory and other barriers to investment in network deployment as we believe strongly in the power of competition to deliver innovative services providing value to consumers.

Section 4 of the paper looks in more detail at the competition and regulatory aspects of the communications markets and in particular where this might impact on future investment over the duration of the strategy. We would welcome views on how the future regulatory framework might continue to promote effective competition and support efficient investment in infrastructure. We also consider whether any changes are needed to the European Regulatory Framework to encourage future competition or move to a greater focus on competition law.

Facilitating and encouraging investment

Having considered the need for competition and investment in section 4, the next section considers in more detail how investment might be facilitated and encouraged. The

consultation considers and examines the elements that might encourage continuing investment beyond 2018, summarised as:

- A stable regulatory regime which encourages investment;
- Low costs of infrastructure deployment, particularly so called “civils”;
- Revenues; and
- Ongoing certainty of government strategy.

The section seeks views on any additional actions the Government might consider for inclusion in the strategy. Encouraging additional and future investment from now and over the period up until 2030 will be important to maintain the UK’s international competitiveness and ensure the UK can take full advantage of the opportunities offered in the Digital Age.

Section 5 also considers other policy options to support investment that could be reflected in the strategy that might give the UK a competitive advantage, perhaps through investment ahead of demand or through identifying possible technologies that the UK could develop and take a global lead in. Finally the section considers local authorities and Local Enterprise Partnerships and other local bodies and asks what role they might play in the strategy to facilitate the future investment in the delivery of digital communications infrastructure.

Next steps

The consultation questions in this paper are set out in full at Annex C. This consultation will run for an 8 week period and given that the Government will use this to develop the strategy, we do not intend to publish a separate consultation response. Section 6 provides details of how to respond to the consultation.

Introduction

Digital communications are an essential part of everyday life for consumers, citizens and business, although their importance in underpinning economic and social activity is probably not fully recognised and appreciated. There are few aspects of our daily life that aren't dependent in some way on digital communications from the more obvious phone calls and use of the Internet, to a myriad of (literally) invisible uses of wireless communications that, among other things, support the operation of transport and energy networks and control and monitoring systems. These changes will have economic and social implications. The much heralded Internet of Things (IoT)¹ will see billions of devices come into use worldwide that will need to communicate over future communications infrastructure. How we spend our leisure time will change, perhaps radically, fuelled by mobile devices connected through one technology or another to communications networks.

Because of the near ubiquitous use of communications technology, it is very difficult to ascribe a value to the "communications" sector, indeed it is a challenge to define what the sector actually is. In the Information Economy Strategy published in June 2013² the core of the information economy was identified as software, IT services and telecommunications services which between them contributed £105 billion (8%) to Gross Value Added (GVA) and employed 1.3 million people (both figures 2011) in the UK. However as the report stated "its metamorphic nature and transformative impact on other sectors means it may be more clearly thought of as an eco-system.....this means that we may not have an exact picture of the number of businesses in the information economy, or its employment, or the value it brings to the UK economy". In the broader economy, a report for DCMS estimated that take-up of faster broadband speeds would add £17 billion to the UK's annual GVA by 2024³.

In fact every business relies on digital communications infrastructure to function, at a minimum through a mobile or fixed line telephone. Many sectors of course are heavily reliant on communications infrastructure and couldn't function without it. For example, in its report on the creative industries, the CBI highlighted the digital infrastructure as a vital part of the overall infrastructure mix and a key requirement for the creative industries, a sector worth £36 billion GVA and employing 1.5 million people⁴.

For the consumer, already heavily reliant on access to mobile phones, the Internet, digital applications and services to transact their daily lives and to access entertainment, more will be expected in the future. Lack of coverage and network failures, already considered unacceptable by many, will be considered totally unacceptable in the future. Business already expects security and resilience from the networks it connects with. With the growth in data usage and cloud computing this will become essential for all. As technology develops, new providers emerge and consumers become more aware and demanding. We can expect to see services become more bespoke to meet the individual need, rather than packages offered that suit the provider. The expectation will be for "always sufficient" bandwidth, allowing the consumer to do what they want, where they want and when they want to do it.

¹ For the glossary see Annex B

² Information Economy Strategy, HM Government June 2013

³ UK Broadband Impact Study, SQW, November 2013

⁴ The Creative Nation, a Growth Strategy for the UK's Creative Industries, January 2014

The Government has a direct interest in the ability of consumers and business to connect given its Digital Strategy⁵ and its objective of digital by default.

Given the importance of digital communications infrastructure within a modern economy and society, the Government needs to ensure that it is fit for purpose in the future. The Government already has a broadband strategy, which is being delivered through Broadband Delivery UK up until 2017-18. Alongside this Government intervention significant private sector investment, in the billions, continues to be made in both fixed and wireless technologies, for example the current 4G roll out and in the recent past digital television switchover. This private investment, responding to demand and competitive pressures, remains crucial for future infrastructure. The Government has also created the Digital Taskforce with a remit that includes infrastructure and which will be taking action to continue to improve the UK's digital infrastructure. However existing policies and known investment plans run their course by 2017-18, or in the case of the European Digital Agenda by 2020. And so there exists the question – what then?

The creation of a strategy that takes us beyond 2020 and looks ahead ten to fifteen years from today is how we answer that question. Although the Government is taking a lead in developing the strategy, it needs to be a combined effort also involving consultation and input from industry, the consumer (including businesses) and the communications regulator, Ofcom.

The objectives

The Government has an ambition of the UK having communications infrastructure that is comparable with other leading nations, that meets the needs of users, including those who may see the UK as a place in which to do business or invest. Studies⁶ suggest that the UK is currently in a favourable position with respect to other major economies, but we want to continue to compare favourably in the future.

The consultation asks a number of questions that have emerged from discussions with stakeholders, written views and scenario planning and to which the further views of stakeholders are required, which will inform the strategy document.

There are a number of areas which we expect the strategy will address. These include the extent of future coverage, both in terms of capacity and geographic area; whether there should be some minimum level of service requirement and how investment in future communication networks can be encouraged.

In the context of Government intervention in the development of future infrastructure timing is important. Do we seek to build ahead of anticipated demand, a 'build it and they will come' approach favoured by those espousing fibre to all premises as the only future proof solution? Such an approach could stimulate growth and innovation and would position the UK as a leading digital nation, however there remain uncertainties. Alternatively, do we seek to ride the demand curve, so that services are scalable and delivered as and when demand emerges and people are willing (and able) to pay for the level of services required? Are there any benefits to being later adopters of emerging technologies that will meet user need, or is

⁵ Government Digital Strategy November 2012

⁶ See <http://stakeholders.ofcom.org.uk/market-data-research/other/telecoms-research/bbresearch/scorecard-14> or International Benchmark for Superfast Broadband, Analysys Mason, November 2013

this always to be avoided if possible? Are there any actions that would deliver immediate benefits whilst underpinning future infrastructure deployment?

This document

The Government published the Terms of Reference for the strategy in February 2014 and invited initial views from relevant stakeholders. We received eighteen written responses, supplemented by meetings and discussions with industry, consumers and others. A full list of organisations that have provided views, written or oral can be found at Annex A.

Following this introduction, section 1 is a review of the existing infrastructure and known developments along with a summary of the existing market. Section 2 outlines some of the assumptions that were used to inform the demand scenarios and these scenarios are outlined, along with possible infrastructure requirements capable of meeting that demand in section 3. Section 4 is a review of the regulatory framework that currently exists for telecommunications and broadcasting. Section 5 looks at issues around the timing and the financing of the investment required in future networks.

The discussions and the scenarios raise a set of questions about the scale, scope and delivery of future communications networks and the paper draws these out and seeks responses. The questions are not to be considered exhaustive, respondents are welcome to comment on any issues of relevance that they believe have not been addressed in this consultation, including whether any nearer term actions would be beneficial. A summary of the questions is at Annex C.

In this paper we are not suggesting what specific actions might need to be taken to achieve the desired infrastructure; this would pre-empt the answers to the questions. However from a Government perspective, there are some assumptions that have underpinned our thinking to date - these are set out in section 2. We would also make the following high level observations about the Government's role:

- It is Government's role to set the challenge and desired outcome and seek to achieve a level of consensus about that outcome;
- There is scope for Government to act as a facilitator between players where this is appropriate to address the challenges faced. In many cases, this may just involve encouragement to discuss challenges and develop innovative approaches to address them;
- It is Government's role to consider intervention in the event of certain forms of market failure, particularly in the event of failure to invest and thus achieve its policy objectives;
- Government should align its own policies where the consequences of these are to make demands on future communications infrastructure or impact how these are managed or run;
- Any future, or nearer term interventions, should they be necessary, must be well targeted, evidence based and proportionate; and
- The strategy should complement, build on and inform, or be informed by, existing work where relevant e.g. the recently published spectrum strategy or the work on smart cities.^{7 8}

Q1 Views are sought on:

- a) Is this an appropriate role for Government?**
- b) What other high level principles might the Government adopt?**
- c) What resources do you consider the Government should aim to deploy to effectively manage its role?**

Timing

Closing date for responses is: 1 October 2014

Full details on how to respond to this consultation are set out in section 6.

⁸ https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/246019/bis-13-1209-smart-cities-background-paper-digital.pdf

Section 1: Existing and planned communications infrastructure and the current infrastructure market

- 1.1 It is possible that rising levels of demand and the changing nature of demand, alongside different behaviours of users, will have an effect on the architecture and deployment of future communications infrastructure. However whatever needs to be done to achieve that infrastructure by 2025-2030 will have to take account of what is currently available, or will be available in two to three years once the current known investments are complete. This section provides a summary of that position. Pictorial representations of some communications infrastructure are set out in Annex D.
- 1.2 Digital communications are a feature of everyday life, ranging from live television available across satellite, cable and digital terrestrial television (DTT) platforms and on line and the vast array of applications and services accessible via smart phones (and increasingly tablets) and PCs; web browsing, ecommerce, non-linear television⁹; video conferencing or calls and business communications on multiple platforms on the move, at home and in the office. Over 41 million people in the UK use the internet for an average 37.3 hours per month¹⁰ and over half the population use multiple devices to do so¹¹. Devices are becoming ever more intelligent, connected and mobile. Increasingly people expect the right information to be available all the time, to have access to communications services when they want them and where they want them. Health and education are increasingly digital including remote health diagnosis and monitoring, massive open online courses and the cloud storage of records. Government and the private sector are delivering services more efficiently, enabling the development of smarter and greener energy supply and increasingly smart cities and Big Data. Millions of autonomous sensors, machines, gadgets and devices are being connected to a cloud based infrastructure to form the Internet of Things.
- 1.3 Most of these need ubiquitous, secure and resilient infrastructure in terms of networks and data storage. The Government wants digital services to serve the needs of the users and it will work with the information economy sector to address the challenges of improving infrastructure and building on the UK's position as the most advanced on line market in Europe.

⁹ Linear or live television requires the viewer to watch a programme at a determined time and on a determined channel.

¹⁰ Comscore, UK Digital Future in Focus, February 2013.

¹¹ Cultures of the Internet, Oxford Internet Survey 2013.

UK Communications 2013 *Fast facts*

Internet



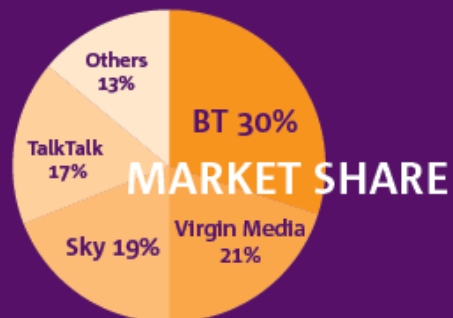
55% of adults with home internet use social networking

No. of home broadband connections:

21.7m

75% of adults have broadband (fixed & mobile)

Average broadband speed **12.0 Mbit/s**



Phones

15%

live in a mobile-only household

24.4m home landlines

33.1m fixed landlines (inc. ISDN)

Mobile subscriptions in the UK: **82.7m**

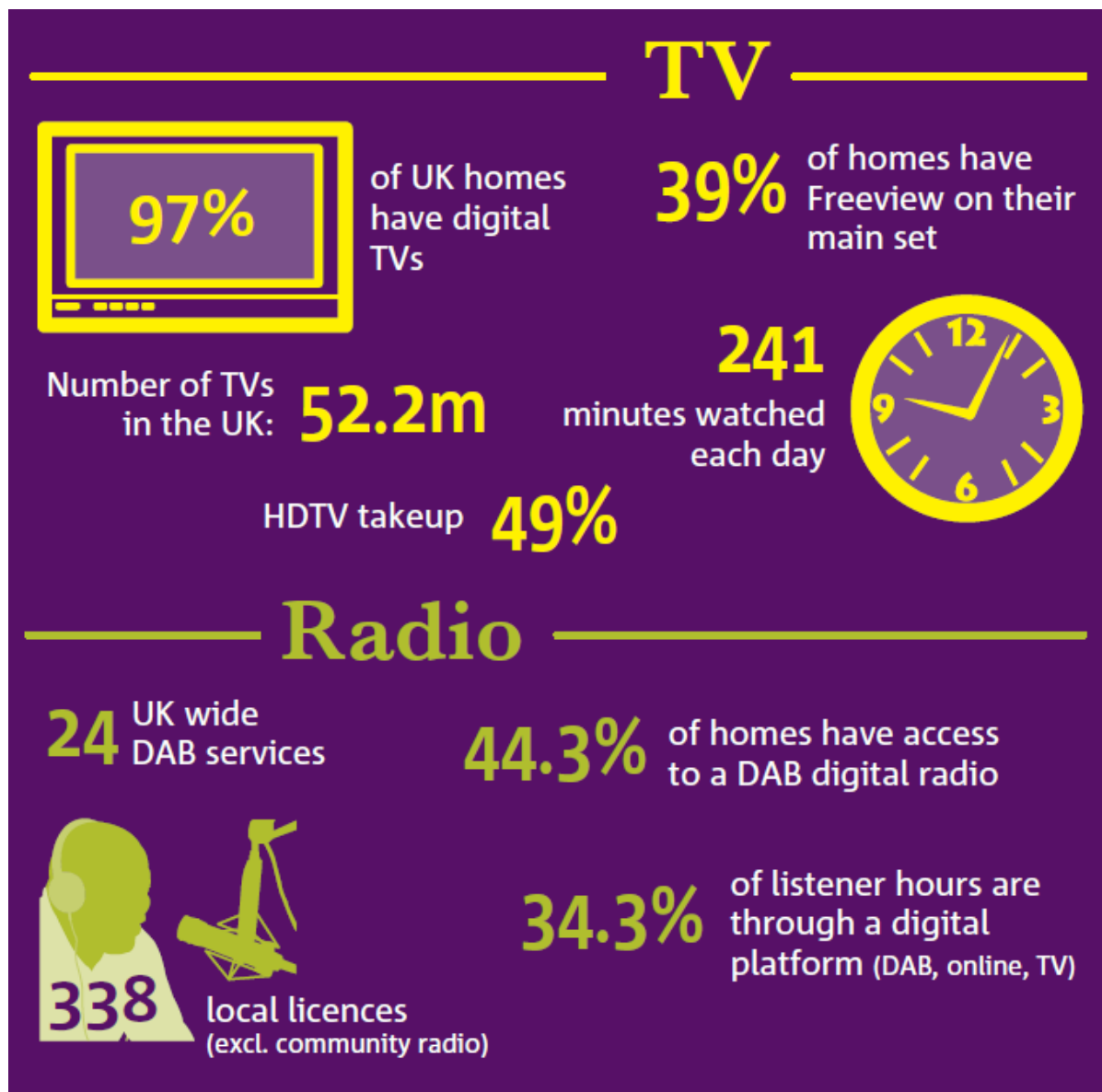


text messages sent per subscriber per month



94% of adults own/use a mobile phone

61% of mobile subscriptions are contract



Note: This data is from 2013. Ofcom has updated a number of the figures in subsequent publications and where relevant, these have been reflected in the text.

Telecommunications Markets

- 1.4 Telecommunications markets in the UK are mature. There is universal provision of fixed telephony services guaranteed by the Universal Service Obligation¹², near universal availability of current generation broadband¹³ and plans in place to make available next generation, or so called superfast, broadband¹⁴ for 95% of the UK population by 2017. There are more mobile subscriptions than people living in the UK and over 50% of people in the UK have smartphones.¹⁵ Consumers have benefitted

¹² Which also includes basic internet access

¹³ Ofcom considers that up to 140,000 lines may not be able to receive broadband

¹⁴ Generally using either fibre to the cabinet (FTTC) or cable networks

¹⁵ Ofcom's Communications Market Reports 2013

from competition in communications markets through low prices. Whilst the UK was later than other comparable countries in rolling out fixed and mobile next generation broadband infrastructure, it has rapidly caught up and is now rising in the rankings.

- 1.5 In fixed networks the UK has a combination of cable companies using fibre and coaxial cable for television and broadband and copper for voice and a growing number of other operators using IP based core and transit networks of fibre optic cables connected to premises with copper or, to a lesser extent, fibre. Openreach¹⁶, a division of BT, operates much of the local loop throughout the UK, other than in Hull where KCOM Group is the sole provider¹⁷. The current generation of broadband is provided over the local loop using ADSL¹⁸ technology. Increasingly Openreach is installing the next generation of broadband with fibre to the cabinet (FTTC) deploying VDSL technology.¹⁹ To a lesser extent Openreach is installing fibre to the premises (FTTP) where the customer is prepared to pay. The largest cable operator, Virgin Media, currently uses a cable specific technology called DOCSIS 3.0²⁰ to provide superfast broadband. Although superfast broadband speeds vary enormously, in this document we are describing speeds in excess of 24Mbps as superfast.
- 1.6 BT is the largest fixed operator in both residential and business markets, with Virgin Media and KCOM also operating in those markets.²¹ Sky and TalkTalk have significant shares of the residential broadband market and have invested heavily in unbundling BT's connections to premises – each unbundling over 90% of local exchanges. Level 3, Colt, Gamma and Vodafone²² are also significant operators in the business market.
- 1.7 The telecoms market is traditionally divided into residential or consumer customers and business customers, with SMEs and the public sector falling into both categories dependent on their particular needs. It is also still separated into fixed and mobile markets, although this is slowly changing with increasing use of bundles of services, including fixed line and broadband being sold with mobile and/or television and with consolidation between mobile and fixed operators. In infrastructure terms television transmitter towers are often used for mobile and radio broadcasting equipment as well as microwave dishes used by both fixed and mobile operators. Backhaul is provided predominantly by BT and Virgin Media to both mobile and other fixed operators. Of increasing importance are content providers, known as “over the top” operators, such as Google and Facebook.

¹⁶Openreach was created following undertakings given by BT to Ofcom under the Enterprise Act 2002 to establish functional and where appropriate, physical, separation of systems and processes.

¹⁷ In Hull KCOM is in the process of installing FTTP.

¹⁸Asymmetric Digital Subscriber Line. Currently most subscribers have ADSL2

¹⁹Very-high-bit-rate digital subscriber line technology

²⁰ Data over Cable Interface Specification, a standard permitting the addition of high-speed data transfer to an existing cable TV system.

²¹ BT has over 80% of the wholesale market

²² Vodafone acquired Cable and Wireless in 2012

- 1.8 The largest mobile operators are EE²³, Vodafone, Telefonica (O2) and Three. As well as operating their own networks, these provide wholesale services to a significant number of mobile virtual network operators (MVNOs). The four main mobile operators have formed two joint ventures to provide the mobile network infrastructure.²⁴ BT has announced its launch of business mobile services with consumer services expected to also be announced in this financial year. These will combine its MVNO arrangements with EE with its WiFi network and its 4G spectrum.²⁵
- 1.9 Several satellite operators, including SES, Eutelsat and Avanti Communications provide wholesale satellite broadband services, using the Ka-band and there are a number of special internet service providers which retail these services. New technology is being tested to increase the uplink capacity of satellite broadband services which should make it more attractive and increase the speeds available. In addition, several over the top (OTT) players are trialling new technology to provide additional internet access, such as satellites, balloons and drones, although deployment is unlikely in the UK except perhaps for special events to supply additional capacity.

Broadcast market

- 1.10 Around 97% of UK homes have digital TV and over 40% have access to digital radio²⁶. Television and radio are currently delivered by satellite, cable and terrestrially, with growing markets in on demand content and live content delivered on line. All television is now digital and a number of channels including the major public service channels are also delivered in high definition.
- 1.11 Broadcast services are provided over two main free to air platforms, Freeview and FreeSat (jointly owned by the BBC and ITV), and three main pay platforms, Sky, Virgin and most recently YouView²⁷. Public service content is available across all of these platforms.
- 1.12 The BBC remains the largest free to air broadcaster with 8 national TV channels and 10 national radio stations. Its commercial public service competitors are ITV and Channel 5, together with the publicly owned Channel 4. Sky is the major provider of satellite services and increasingly is developing its own channels. FreeSat provides access to free to air satellite services. Virgin Media is the main cable provider, covering around half of the country. BT provides IPTV services and is investing in content such as sport. It is also an investor in YouView, alongside TalkTalk and Arqiva and broadcasters. In addition to these national services, we are also now seeing the launch of new local TV services with six services launched to date.

²³ The result of a merger in 2011 between Orange and T-Mobile

²⁴ Mobile Broadband Network Limited provides infrastructure for EE and Three. Cornerstone Telecommunications Infrastructure Limited provides infrastructure for Vodafone and O2.

²⁵ <http://www.btplc.com/Sharesandperformance/Quarterlyresults/PDFdownloads/q414-slides.pdf>

²⁶ Ofcom's Communications Market Report 2013

²⁷ Youview includes BT TV, which is also available on line

- 1.13 Digital terrestrial television (DTT) is delivered through 6 national multiplexes²⁸, the Northern Ireland Multiplex and the local TV network utilising DVB-T technology. The next generation of DVB-T technology, DVB-T2, is being used for the high definition channels and greater granularity of television is coming with 4K (ultra HD) and then 8K definition. The DTT transmitter network comprises 1,156 transmitters with the three public service broadcasting multiplexes available on all transmitters and the three commercial multiplexes only available on the 80 large transmitter sites. The public service broadcasters have a coverage obligation which currently effectively means that they have to reach 98.5% of the UK population. On both satellite and DTT there is a mixture of standard definition and high definition broadcasts. Ofcom manages the multiplex licences which, aside from those for the BBC, expire between 2022 and 2026.
- 1.14 Radio is more diverse: ranging from local community radio, national and local analogue (long-wave, medium wave and FM), digital (DAB) and on line. There are two terrestrial national DAB²⁹ multiplexes: the BBC National Multiplex that the BBC is currently extending from 94% to 97% of UK households by the end of 2015 and the National Commercial Radio Multiplex (D1) which Arqiva is building out to match Classic FM coverage. There is also a network of local DAB multiplexes which can carry local commercial radio services as well as BBC nations and BBC local radio services and which currently reach around 72% of households. The Government announced on 16 December plans to support the extension of local DAB towards commercial FM coverage of around 90% by 2016. The Government has also announced its intention to give Ofcom the power to enable National and local DAB multiplexes to be extended up to 2030. Arqiva provides the entire digital terrestrial television transmission infrastructure and the bulk of the digital radio transmission infrastructure on terms governed by the undertakings which it gave to the Competition Commission in 2008.
- 1.15 There are 3 national commercial radio stations available across AM, FM, DAB, satellite and cable, 24 nationwide DAB services and over 338 local radio stations, aside from community radio, with diversity of ownership. Following the television digital switchover in 2012 there is continuing industry support for a future analogue radio switchover, but the Government has determined that it is too early to confirm that switchover will take place or to set a timetable for a future switchover. Decisions on a future switchover are dependent on the build out of the DAB network to FM equivalence and the majority of all radio listening being digital which on current projections will be in late 2016/early 2017.

Other communications networks

- 1.16 Alongside the publicly offered services there are a range of other communications networks in use in the UK.
- 1.17 The Government's Public Services Networks (PSN) initiative has led to the developments of common standards relating to connectivity and security and procurement frameworks to enable more efficient acquisition of its communications needs. Anyone in government and the wider public sector can use the framework and its use has resulted in an assured network of networks. It is now being updated to

²⁸ A multiplex is a number of concurrent television or radio services which are digitally combined into a single signal to form the transmitted multiplex.

²⁹ Digital Audio Broadcasting

recognise increased use of mobile and of the internet as the main transport network. As part of the National Cyber Security Programme work is ongoing to replace the previous secure core network programme.

- 1.18 There are a number of significant public sector networks, or networks serving the public sector, including Airwave, which serves the police and other public safety agencies. The Emergency Services Mobile Communications Programme will replace the current network provision progressively from 2016.
- 1.19 The Janet network is a high bandwidth network linking high performance computing systems and connecting the UK's research and educational institutions and increasingly private sector research facilities working with such institutions. The NHS also has its own network as do other parts of the public sector such as the Highways Agency and the Ministry of Defence. Network Rail has recently completed the installation of a new digital radio system to allow train drivers to communicate directly with signallers using the GSM-R spectrum. This also included upgrading much of the line side fixed telecoms network which is now being made available for fibre wholesale connectivity. It is also in the course of a request for proposals which may lead to improved mobile connectivity on trains and fixed wireless rural broadband.

Q2 What potential opportunities are there for Government to leverage its combined buying power to support policy objectives?

- 1.20 Almost all UK networks offer connectivity to the internet or products that can be connected, for example SMART TVs and IP enabled DAB radios. The internet is international, a system of self-regulated and self-governed globally connected networks using a standard set of protocols (TCP/IP). The networks include private, public, academic, business and government networks. Internet governance and connectivity is divided between addressing, which is currently the responsibility of the Internet Corporation for Assigned Names and Numbers (ICANN), and core protocols, which is largely the responsibility of the Internet Engineering Task Force (IETF). The UK is well connected in terms of internet connectivity and exchange points with a large number of internet exchanges and undersea cables connecting it to the rest of the world, as well as satellite connectivity. The expansion of the internet and the World Wide Web ("WWW")³⁰ has meant that internet service providers (ISPs) are likely to have to migrate their networks to a new protocol, IPv6, to provide substantially higher numbers of internet addresses.³¹ Ofcom has stated that, generally, the networks of the large retail internet service providers are now able to support both IPv4 and IPv6 traffic.

Q3 If migration to IPV6 is required, are there any barriers to that migration and if so how might these be addressed?

Competitive, Legislative and Regulatory background

- 1.21 Communications networks are regulated by sector specific legislation, primarily the Communications Act 2003 (the Act), which sets out the responsibilities of the regulator

³⁰ The internet is a network of networks connecting computers and devices, whereas the WWW is a way of accessing information over the internet, mainly visually, using the HTTP protocol.

³¹ Internet Protocol version 4 uses 32 bit addressing, allowing for 4 billion addresses to connect directly to the Internet. Its successor IPv6 uses 128 bit addressing allowing a near unlimited amount of addresses

Ofcom, and implements the EU electronic communications framework³². The legislation confers a range of functions on Ofcom in relation to the regulation of the communications sector and the management of radio spectrum. Ofcom's statutory functions make it responsible for authorising all use of spectrum in the UK, except for use by Crown bodies. Increasingly there has been additional regulation of communication operators, especially mobile network operators, in areas such as international roaming and consumer protection. Ofcom also regulates the broadcasting sector, though in the case of the BBC limited to some aspects of content regulation, under the Act, as well as specific broadcasting legislation. Much of broadcasting regulation relates to public service broadcasting which is required to be regional in part, accessible and universal. Regulation is dealt with in more detail in section 3.

- 1.22 Competition in fixed broadband network provision has been encouraged by regulatory intervention such as requiring incumbents to unbundle their local loops (LLU) making them available to competing operators. There are more than 9 million unbundled local loops, with TalkTalk and Sky prominent. Virgin Media competes strongly in those areas where it has its network.
- 1.23 More recent regulation of superfast broadband³³ is still light touch at both a European³⁴ and UK level with BT being obliged to provide a product replicating LLU access on a virtual basis – called virtual unbundled local access (VULA).³⁵ Whilst BT has pricing flexibility in setting the wholesale charges for superfast broadband Ofcom has indicated that it may be required to maintain a sufficient margin between its wholesale and retail pricing to enable other operators to offer competitive fibre products.³⁶ Ofcom has also required access at prices related to cost to be provided to BT's ducts, poles and other access infrastructure, known as physical infrastructure access (PIA), to support the deployment of superfast broadband networks, but not for business connectivity services, such as business leased lines and mobile backhaul. The third remedy applicable to superfast broadband is sub loop unbundling (SLU) which allows competing operators to take over or share existing copper lines between a street cabinet and customers³⁷ so that they can deploy their own FTTC superfast broadband network. The charges for SLU should be related to BT's costs. Generally competing operators have not used PIA and/or SLU to build their own superfast broadband networks, probably due to the challenging economics of doing so. BT also has a general requirement to provide network access on reasonable request as part of its

³² The EU framework comprises a number of directives, regulations, recommendations and decisions, aimed at creating a harmonised framework

³³ Various defined as over 24Mbps or 30Mbps

³⁴ Commission recommendation of 11 September 2013 on non-discrimination and costing methodologies to promote competition and enhance the broadband investment environment.

³⁵ Known as Generic Ethernet Access (GEA)

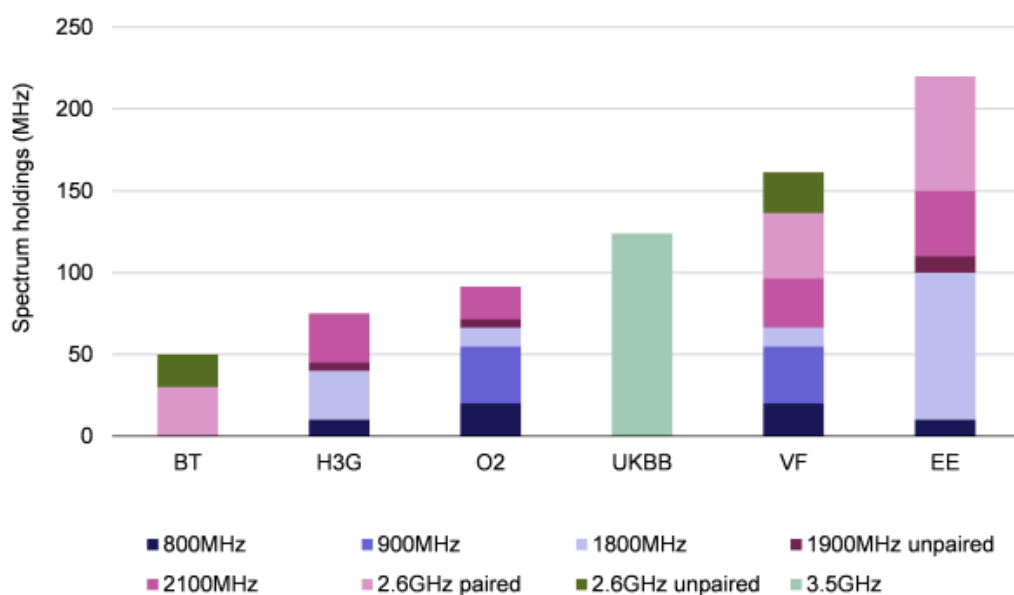
³⁶ Ofcom is now consulting on its proposals for addressing the margin
<http://stakeholders.ofcom.org.uk/consultations/VULA-margin/>

³⁷ Sub loop unbundling has only been used for one deployment, by Digital Region Limited in South Yorkshire.

significant market power status. Ofcom has not imposed any remedies on BT in relation to the supply of dark fibre or naked fibre³⁸.

1.24 The business connectivity market relies on leased lines with competition in that sector being less intense than in access markets. Ofcom has determined that BT has significant market power throughout the UK (outside Hull), in most types of leased lines, although with a greater degree of competition in the London area. The current price controls have applied to such lines since 2013.

1.25 The mobile market is one of the most competitive in Europe. Alongside the four main mobile network operators other operators such as UK Broadband and BT also offer services, as well as a number of mobile virtual network operators (who do not have spectrum holdings themselves) such as Tesco. Mobile network operators require spectrum to provide services and seek to differentiate the services they offer through those holdings. The current allocation of this spectrum is set out below:



Key: BT = Niche Spectrum Ventures (a subsidiary of BT); H3G = Three; O2; UKBB= UK Broadband³⁹; VF =Vodafone; EE. UK. UK Broadband is part of the Hong Kong based PCCW and provides a range of 4G and wireless services, primarily to business and public sector customers.

1.26 Operators are now currently competing to roll out 4G networks, providing faster download speeds to customers. As a result of a condition attached to its licence, O2 is required to provide a sustained downlink speed of a minimum of 2Mbps, to 98% of the UK population by 2017 and at least 95% in each individual nation. Due to its sharing network infrastructure with Vodafone, we can expect at least two operators to meet this obligation. The other two are likely to do so as a result of competitive pressure.

³⁸ Without the competitor also having to take either Wholesale Line Rental (essentially leasing an existing line from Openreach) or MPF/SMPF (Metallic Path Facility or Shared Metallic Path Facility - an alternative provider providing either broadband or broadband and voice over the Openreach copper network from the customer's premises, linked to a distribution frame at the exchange and thence to the alternative provider's network).

³⁹ UK Broadband is a fixed wireless operator

- 1.27 Mobile coverage obligations have been based on population coverage, rather than geographic coverage and this presents challenges in the more sparsely populated rural areas. Around 99% of the population have coverage from at least one 3G network but geographic coverage is lower with around 12.7% of the UK having no 2G coverage and 22.9% having no 3G coverage⁴⁰. There are some challenges around mobile coverage on roads and railways. Whilst most roads are covered by 2G only 35% of A and B roads are covered by all operators for 3G.⁴¹
- 1.28 Continuing competition, and the development of new services in the future, will in part depend on the availability of additional spectrum. The Government's Spectrum Policy⁴² outlines how this will be achieved, including the release of spectrum currently held by the public sector. Ofcom published its Spectrum Management Strategy in April 2014. Three of Ofcom's priorities are considering future mobile data demands, the future of the 700 MHz band⁴³ and DTT, and the expected growth in IoT. It is also considering allocating more spectrum for WiFi. Ofcom is also trialling the use of white space technology allowing sharing of unused DTT spectrum and has stated it will publish a framework as to its implementation using dynamic spectrum access concepts. Ofcom has recognised the importance of DTT to policy objectives such as maintaining universal access to public service broadcasting and its view is that DTT will continue to be an important delivery technology for free to view TV over the next decade. Ofcom does not currently anticipate a full switch off of DTT until post 2030, absent significant policy intervention.

Provision of superfast broadband

- 1.29 Superfast fixed broadband providing speeds in excess of 24Mbps⁴⁴ is now being rolled out to customers throughout the UK. The initial rollout has been undertaken commercially by the private sector and by 2015 around 75% of UK homes are expected to be able to have access to these commercially funded services. In 2013 18% of broadband lines were superfast⁴⁵ with Virgin Media having 56% of the market, with 3.4 million customers and a network covering over 44% of the country. BT had 2.1 million customers and a network currently covering 19 million premises. Virgin Media customers can now get broadband at speeds up to 152Mbps and BT customers up to 76Mbps⁴⁶. The speed usable by customers, other than FTTP, depends on how close their premises are to the fibre component of the network. A number of niche operators provide superfast services in parts of large cities, and in smaller cities and towns. The diagram below illustrates the extent of commercial superfast broadband coverage.

⁴⁰ Predicted coverage by Ofcom in its 2013 UK Communications Infrastructure Report.

⁴¹ On 30 September 2013 the Department of Transport announced measure to increase coverage on trains by 2019, largely by upgrades of the Network Rail network funded by it and the private sector

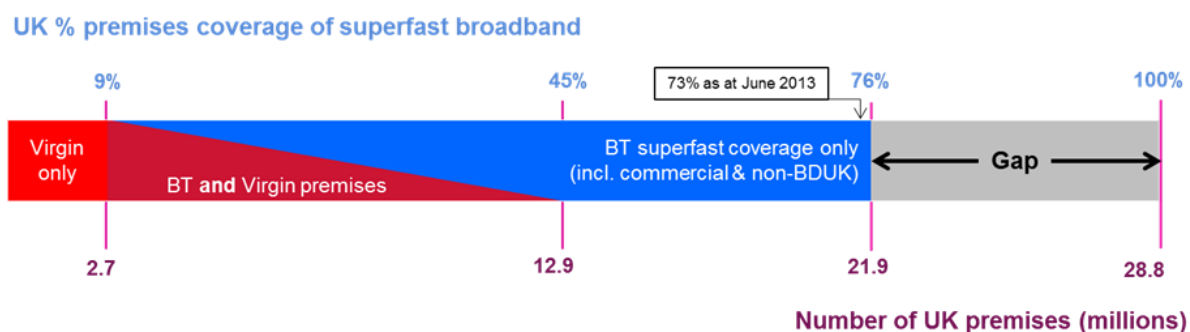
⁴² <https://www.gov.uk/government/publications/spectrum-strategy>, published on 10 March.

⁴³ Ofcom consulted on 28 May on the costs and benefits of using this spectrum for mobile <http://stakeholders.ofcom.org.uk/binaries/consultations/700MHz/summary/main.pdf>

⁴⁴ Ofcom and the EC define superfast broadband as requiring speeds of 30Mbps or more.

⁴⁵ Ofcom fixed access market reviews, July 2013 para 11.6.

⁴⁶ BT customers receiving fibre to the premises can receive speeds of up to 350Mbps.



- 1.30 Business customers are able to obtain faster speeds if required and also to have symmetric connections providing greater uplink speeds, for example where needed for near instantaneous trading and applications like cloud computing. Business customers usually have shorter service levels for provision of lines and repair than consumers and greater security in their service contracts.
- 1.31 The Government's national broadband strategy, "Britain's Superfast Broadband Future" published in 2010 recognised that the uncertain business case for building next generation communications networks in some hard to serve and more rural parts of the UK would result in services not being provided by the private sector. The Government set up Broadband Delivery UK (BDUK) in the Department of Culture, Media and Sport to manage delivery of the UK-wide programme to fund the extension of access to Next Generation Access (NGA) infrastructure in these areas capable of delivering superfast broadband speeds. BDUK's programme will also ensure that everyone in the remaining areas in the UK has access to minimum broadband speeds of 2Mbps (the Universal Service Commitment). Superfast broadband projects currently under way in these areas have public funding of £1.2 billion and the government has announced further funding of £250 million which, with local match funding, will ensure the provision of superfast broadband to 95% of premises by the end of 2017⁴⁷. The Government has also recently announced (June 2014) eight successful bids for a £10 million fund for pilots to explore how to expand coverage in the remaining hard to reach areas of the UK through a variety of technologies and business models, including fixed wireless and satellite technologies, a social investment financial model and an operating model which aggregates small rural networks. The UK's plans are consistent with the EU's Digital Agenda⁴⁸ target that all homes have access to superfast broadband⁴⁹ by 2020.
- 1.32 In addition, the Government has established a separate urban development fund to help to create "Super-Connected Cities". This provides funding to help drive take-up by SMEs of high-speed/high-grade connectivity that will help them to develop their businesses. This demand-side measure, which offers SMEs up to £3,000 in the form of a connectivity voucher, is supported with technology demonstrators that are used to help inform SMEs' understanding of the productivity benefit from upgrading capability. The fund also provides targeted financial support to enable cities to benefit from wide-

⁴⁷ BDUK is already delivering on the Government's earlier target to obtain 90% UK-wide coverage of superfast broadband and to meet its USC, with contracts to support this (that largely serve to support FTTC based solutions) now in the delivery stage.

⁴⁸ Part of its Europe 2020 initiative, <http://ec.europa.eu/digital-agenda/digital-agenda-europe>

⁴⁹ At speeds of 30Mbps.

spread, fast and high-quality wireless connectivity. These interventions serve to provide support for: the deployment of competing wireless services through access to city passive infrastructure (e.g. street furniture); public provision of broadband access in specified spaces, such as museums; and other innovative schemes that help develop the UK's wireless capability, such as wireless mesh networks.

- 1.33 More recently the Government has created a Ministerial Digital Taskforce to focus on a number of areas, including infrastructure that will enable the UK to become a leading digital nation. The Taskforce is chaired by the Minister for the Cabinet Office.
- 1.34 Each of the UK's nations has significant broadband projects. Northern Ireland contracted with BT in 2009 to provide high speed broadband to 85% of its businesses (residential customers were also indirect beneficiaries) and aims by 2015 to deliver the Universal Service Commitment and speeds of 24 Mbps or better to 90% of premises. The Welsh Government has its "Superfast Cymru" programme to complement commercial plans with the aim that 96% of Welsh homes and businesses have access to broadband at speeds of up to 80Mbps by 2015. Enterprise Zones and local growth zones will have access to speeds of up to 330Mbps. Its funding programme is covering over half the population of Wales and will deliver superfast broadband to 96% of Welsh homes and businesses by the end of 2016. The Scottish Government's £410 million Digital Scotland Superfast Broadband programme will extend access to superfast broadband infrastructure to 85% of premises across Scotland by 2015-16 and 95% by 2017-18. This is a vital first step towards achieving the Scottish Government's longer term ambition of having a future-proofed infrastructure that will deliver world-class digital connectivity across the whole of Scotland by 2020.
- 1.35 EU State aid approvals for the various rural broadband projects⁵⁰ require that minimum wholesale access obligations apply to superfast broadband infrastructure, whether these are qualifying fixed or wireless capabilities. In particular, they require the provision of both active⁵¹ and passive⁵² wholesale access products, which must be price benchmarked against those prevailing in comparable competitive broadband markets, to enable alternative operators to compete effectively for retail customers. The type of access is described in more detail in the regulatory section. The Mobile Infrastructure Project (MIP) state aid is structured differently with the aid being provided to the infrastructure provider, Arqiva, and mobile network operators being granted access to the infrastructure on non-discriminatory terms provided they use all of the funded sites⁵³.
- 1.36 Structurally the UK market compares well with other European markets with new entrants in the fixed retail market having a higher market share than other major EU countries and consumers having consistently cheaper fixed and mobile broadband prices.⁵⁴ The UK's position going forward depends on further investment. Other countries have announced plans for further investment, e.g. Germany is promising

⁵⁰ SA.33671 (2012N), 20 November 2012

⁵¹ Such as sub-loop unbundling

⁵² Such as GEA

⁵³ SA.35060 Mobile Infrastructure Project, 5 December 2012

⁵⁴ Ofcom's The Communications Market Report: International, December 2013.

networks delivering a national minimum speed of 50 Mbps by 2018, an infrastructure project which could cost €20bn to €34bn (£17bn-£28bn), and which the country plans to fund in part from mobile spectrum sales. China's Next Generation Internet project is already well advanced and is delivering fibre to the premises, with an investment US\$160 billion by the end of 2015. South Korea, with its urbanised population already has networks delivering 50-100Mbps and is offering incentives to reach 1Gbps with substantial public funding. Australia has a government funded National Broadband Network programme to deliver near universal superfast broadband⁵⁵ as a wholesale product. Whilst the ambition of the programme is being scaled back it is expected to provide very fast broadband⁵⁶ nationally for a budget of Australian \$29.5 billion and to incidentally achieve the structural separation⁵⁷ of the dominant fixed and mobile operator, Telstra.

UK infrastructure in 2018

1.37 In summary, through a combination of competition, private and public investment, and regulatory intervention, the UK can expect to have widespread availability of superfast fixed broadband, in excess of 24Mbps, to the vast majority of the country, with a minimum service of 2Mbps to the remainder provided by a combination of fixed networks, fixed wireless and satellite. Mobile 4G indoor coverage will be available to at least 98% of the population, which should equate to 99% population coverage outdoors. There will be a thriving broadcasting environment with content delivered over a number of competing platforms and continuing innovation. The UK will compare favourably with a range of other competitor nations and will be on track to close the gap on others. Currently for the majority of users this will be sufficient to meet demand. In the next sections we look ahead 10 - 15 years and consider how demand might develop and evolve and the infrastructure that might be required to meet those new levels of demand.

⁵⁵ At speeds of 25 to 100Mbps

⁵⁶ The universal commitment is to 25Mbps with speeds of at least 50Mbps to 90% of the population with an upgrade path.

⁵⁷ Structural separation entails the formation of a separate corporate entity unlike the current functional separation; e.g. Openreach is functionally separated from the rest of BT.

Section 2: What might future demand look like: Core assumptions underpinning demand scenarios

- 2.1 Having outlined the existing infrastructure in the UK and provided a summary of the communications markets in section 1, in this section we look forward to 2025 to 2030. The purpose of the strategy is to identify what needs to be done to deliver the communications infrastructure that will need to be in place in 2025 - 2030 to meet the needs of users - consumers (and citizens), business and the public sector to ensure the UK is a successful digital economy, with the societal benefits that flow from that, and compares favourably with other leading nations.
- 2.2 Looking ahead 10-15 years in the communications space is challenging if not near impossible. Nevertheless, as outlined in the introduction, the importance of these technologies to the wider economy and society means that ignoring its development carries its own risks. Digital communications infrastructure has reached a point where its importance is (at least) on a par with more traditional infrastructures such as transport and energy that have traditionally attracted a strategic approach⁵⁸. For this reason the Government will continue to address nearer term issues and will draw on responses to this consultation where those are relevant.
- 2.3 For this consultation we have, in common with others, adopted a scenario based approach. Working with industry, consumer and business groups and other government departments and drawing on published sources, we have developed a number of outline scenarios that combine possible user demand, by consumers, business (and in particular small business) and Government and the wider public sector.
- 2.4 In developing the scenarios we set out a number of assumptions reflecting existing developments and future projections. In identifying the possible infrastructure requirements to meet the demand scenarios, we have suggested how future infrastructure might meet those needs, without assuming that this could be achieved through the evolution of current network architecture, market structure or business models, although that may well be the case. In other words, rather than looking forward from 2014 and basing the strategy on actions around evolving existing models/technology/network architecture/regulation we have looked at what may be required in 2025 - 2030, how best that could be achieved and then considered how this differs from the infrastructure we expect to be in place in 2018 or thereabouts. Comparing the two has given rise to a number of questions and challenges in moving from one to the other. This consultation invites responses to those questions and how best to address the challenges.

⁵⁸ In this context it should be noted, for example, that digital infrastructure was included in the strategic plans of the Local Economic Partnerships (LEPs)

Core Assumptions

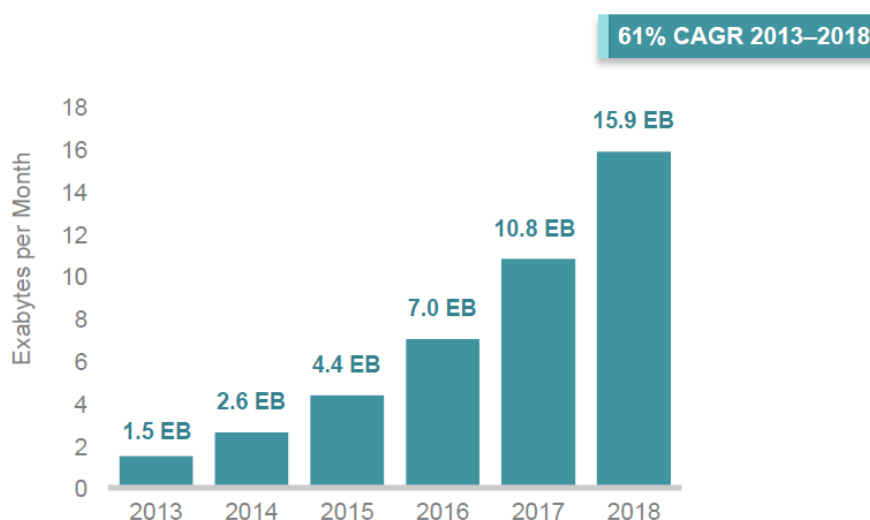
- 2.5 In this section we outline the core assumptions underpinning our work on the scenarios. These have emerged from an analysis of identifiable trends in existing research and studies and the level of consensus around them. As such, we don't believe any of them are particularly contentious as broad statements, although debate continues to be lively around a number of them and the range of possible outcomes.

Bandwidth

- 2.6 More bandwidth will be required as the traffic over fixed and wireless networks continues to rise. Cisco predict that in the United Kingdom, mobile data traffic will grow 11-fold from 2013 to 2018, a compound annual growth rate (CAGR) of 51% and will reach 445 Petabytes per month by 2018, the equivalent of 111 million DVDs each month or 1,226 million text messages each second⁵⁹.

Global Mobile Data Traffic Growth / Top-Line

Global Mobile Data Traffic will Increase Nearly 11-Fold from 2013–2018



Source: Cisco VNI Global Mobile Data Traffic Forecast, 2013–2018

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- 2.7 Similar trends are reported by others, Analysys Mason forecasts that fixed Internet traffic in Western Europe will grow at a CAGR of 42% between 2012 and 2017⁶⁰.
- 2.8 These data predictions are of course at the aggregate level. However the expectation is that the average consumer will require more capacity (in terms of Gigabytes per month downloaded) and higher speeds (in terms of Mbps up and down) into the home and on the move. Business needs will also change and evolve, the distinction between home user and business user will become eroded as home working increases, more businesses are run out of the home and the nature of work changes and work becomes

⁵⁹ Cisco: VNI Mobile Forecast Highlights 2013-18

http://www.cisco.com/c/dam/assets/sol/sp/vni/forecast_highlights_mobile/index.html#~Country

⁶⁰ Analysys Mason: Fixed Internet traffic worldwide 2013-18

a function not a place to go. The need to achieve balanced growth across the country and between rural and urban locations (and super connected cities) has implications for the bandwidth required across the country. Geographical coverage will become as relevant as population coverage.

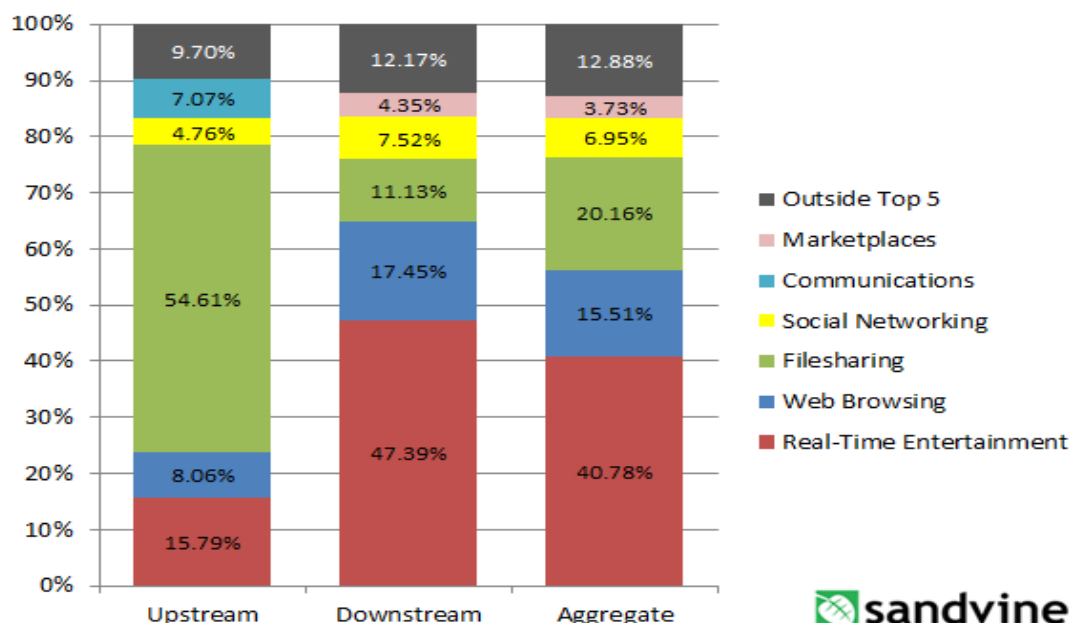
- 2.9 Recent studies⁶¹ looking at the UK suggest that the average household requirements will range from a (median) 19Mbps to a high end 35Mbps (looking out to 2023) or between 15Mbps and 52Mbps⁶² (looking ahead to 2018). These are based on their own sets of assumptions and methodologies, but it is striking that both suggest download speeds well within the capability of existing network deployments across much of the country. Others looking for much higher speeds and capacity continue to argue that fibre to the premise should be the goal to deliver future proofed supply, avoid interim and possibly uneconomic investment in alternative solutions and to maximise innovation and economic activity. A second element of this fibre debate is the provision of adequate backhaul for the mobile networks and how far availability (or lack of it) of backhaul acts as a constraint on their ability to deliver services.
- 2.10 Deployment of LTE (4G) technology will see users experiencing higher speeds. There are a number of factors that affect the level of service users might receive, but speeds between 6Mbps and 25Mbps are typically available now. Further evolution of the technology (e.g. through carrier aggregation) will see those speeds increase, and then 5G technology is expected to be deployed from around 2020 onwards.
- 2.11 Although many will see an improvement in the capacity and connectivity speeds provided by the commercial services they can access, on a purely commercial basis it can be expected that disparities will continue across regions and between urban and rural. Although connectivity may be close to being ubiquitous, the connectivity speeds and capacity may not. Whether these disparities are considered to be acceptable or not, or how far and how they should be addressed needs to be considered from a public policy perspective.
- Q4 Is an ongoing disparity of broadband services inevitable? If so, should this be addressed and how might this be done most effectively?**
- 2.12 We assume video services will continue to consume most bandwidth. Figures for Europe show that real time entertainment (applications and protocols that allow “on demand” entertainment) accounts for over 47% of peak time downstream traffic on fixed networks and the share is on the increase⁶³.

⁶¹ Communication Chambers report for the BSG November 2013 – Domestic Demand for Bandwidth

⁶² Analysys Mason: International Benchmark of Superfast Broadband November 2013

⁶³ Sandvine: Global Internet Phenomena Report 2H 2013

Peak Period Traffic Composition (Europe, Fixed Access)



2.13 Similarly real time entertainment accounts for 36% of peak period traffic composition for mobile access. It is expected that the IoT will increase significantly by 2030. Recent research by Ofcom⁶⁴, suggests that by 2022 between 170 and 530 million M2M devices will be active in the UK generating over 1 billion data transactions a day over a number of connecting technologies. Although the majority of these transactions will consume little bandwidth, they will pose problems for current 2G and 3G networks that are not designed to carry large volumes of small data transactions. The emergence of LTE M2M technology is expected to resolve this shorter term issue. There will be many instances where the issue won't be bandwidth, but the extent to which the data being communicated needs to be secure, how critical it is that data is received, is it tolerant of delay or how sensitive it is to error in communications. Examples might include critical control systems or health applications.

2.14 We expect to see users uploading more content than ever before, both consumers and business. The average (fixed) download speed in the UK in November 2013 of 17.8Mbps is around 8 times that of the upload speeds (2.3Mbps)⁶⁵. Those averages can be expected to continue to rise, but is the current level of asymmetry in networks likely to meet future demand, in particular for business use?

Q5 How symmetrical will digital communications networks have to be in the future? Will this differ across user types? What implications does this have for fixed and wireless broadband provision?

2.15 There are a number of significant technological developments we are currently witnessing that will have implications for the scale, security and reliability of networks.

⁶⁴ http://stakeholders.ofcom.org.uk/binaries/research/technology-research/2014/M2M_FinalReportApril2014.pdf

⁶⁵ UK fixed-line broadband performance Ofcom April 2014

These include Big Data, cloud based services, computing and processing power, education, automation, the environment, transport and verification and identification (to name a few). Government is actively engaged in supporting many of these areas, for example in Big Data⁶⁶ and is working with industry and academia through bodies such as the Information Economy Council and the E-infrastructure Leadership Council.

- 2.16 In addition, the shift to digital Government services, although modest in the overall demand picture, has the potential to bring additional users into the digital space.

Mobility will increase

- 2.17 Around 92% of adults in the UK use a mobile phone⁶⁷ and there are 1.3 mobile subscriptions for each person in the UK. Although the market is now mature and there are signs of market saturation, technological evolution is still causing significant changes within the UK market.
- 2.18 One such change is the move to smartphones. Ofcom reports that over half of adults in the UK now own a smartphone⁶⁸ double the number two years ago, though this is still lower than penetration in the U.S at around 70%⁶⁹ and in South Korea which is approaching 80%, with near total penetration on the 18-24 age brackets. Ericsson⁷⁰ reports that in 2013 worldwide mobile traffic generated by mobile phones will exceed that generated by mobile PCs, tablets and routers. They expect the amount of traffic to increase by a factor of ten to 2019.
- 2.19 Alongside this take up of smartphone use has been an explosion of availability and use of applications or apps. Increasingly people want and expect access to their apps wherever they are and whenever that want. We could move from a world of voice not-spots to apps not-spots. There is a danger of hard to reach rural areas being disproportionately affected – with potential negative impacts on their sustainability. This shift poses significant challenges to existing operators in how they meet this increasing demand.
- 2.20 The use of tablets has grown even faster than smartphones, 24% of households now have one, double the figure of a year ago. Most of these are WiFi enabled rather than using SIM cards⁷¹, although that may change. Even if WiFi remains the predominant means of connectivity for tablet users, the scale, availability and capacity of WiFi networks will be critical in the overall mix of technologies enabling the UK infrastructure.

⁶⁶ See https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/254136/bis-13-1250-strategy-for-uk-data-capability-v4.pdf

⁶⁷ Ofcom: Communications Market Report 2013

⁶⁸ Ofcom: *ibid*

⁶⁹ See https://www.comscore.com/Insights/Press_Releases/2014/3/comScore_Reports_January_2014_US_Smartphone_Subscriber_Market_Share

⁷⁰ Ericsson: Mobility Report, On the Pulse of the Networked Society, November 2013

⁷¹ In its 2012 Infrastructure report, Ofcom reported 1.2 million 3G connected tablets

- 2.21 However attitudes to these evolving technologies are not all uniformly positive. The most recent Oxford Internet Survey⁷² identified a number of Internet Cultures reflecting various levels of engagement with the Internet and related technologies. Although the latest report showed a healthy 78% use of the Internet (and a narrowing of the digital divide), there was a spread of attitudes ranging from the enthusiastic “e-mersives” to the (almost reluctant) “a-digitals”. These differing views and the extent to which people might move between cultures in the future, has implications for future demand.

Technological change within the communications industry will remain rapid

- 2.22 Technological advancement continues to be rapid in telecommunications and broadcasting. These advances are enabling existing technologies to deliver more services more effectively (such as the increased amounts of data that can be delivered over a copper pair, or improved compression techniques allowing greater amounts of data to be delivered over the same bandwidth) or make it cost effective to deliver enhanced services to meet demand, such as the use of smaller cells in mobile networks.
- 2.23 Our expectation is that these technological developments will continue to progress and probably happen quicker or deliver better results than anticipated. Indeed it is possible to envisage a situation where any demand scenario can be expected to be met by advances in technology over next ten years. It may well therefore be a case of understanding what barriers – policy, regulatory, commercial or social – might exist that would stop the deployment of those technologies. There is no shortage of potential technological developments, especially in the wireless space, that might emerge to meet future demand. Prominent among these is the promise of 5G and the prospect of always sufficient bandwidth (or bit rate), densification of wireless networks through the use of small cell technology, the emergence of software defined networks and network function virtualisation. The performance of existing technologies will continue to be enhanced, with the prospect of delivery of 1Gbps over hybrid fibre/copper networks and we can expect further enhancements in the provision of broadband via satellite.
- 2.24 Better use of the radio spectrum will also enable the emergence of new services, improve existing services and support further innovation. The Government published its UK Spectrum Strategy earlier this year, aiming to double the annual contribution of spectrum to the economy by 2025⁷³. The Strategy sets out a series of actions that will enable change of spectrum use over time to the benefit of the UK, including greater sharing of frequencies and dynamic spectrum access.
- 2.25 We expect those technological developments to include further convergence in fixed-mobile or broadcast-mobile technology. The extent of this convergence is unclear and in part will probably be driven by commercial needs to reduce costs and deliver enhanced services. Indeed the majority of technological developments will be driven by these requirements; this takes us to our next assumption.

⁷² Cultures of the Internet: The Internet in Britain, William H Dutton, Grant Blank, Darja Groselj, Oxford Internet Institute, 2013

⁷³ The UK Spectrum Strategy: Delivering the Best Value From Spectrum for the UK, DCMS, March 2014

Communications markets will change

- 2.26 Given the likely challenges over the next ten years, we can expect to see changes across the communications sector. Some of these are already emerging, with challenges from OTT players and applications and a spate of takeovers and mergers between mobile and fixed operators driven by technology convergence or operators seeking scale.
- 2.27 In fixed network provision, there will be continuing pressure to move fibre closer to the customer's premise. Within cities we can expect to see continued competition in the provision of fibre connections between a number of large and small providers. The further extension of fibre networks to less urban areas, at least on a commercial basis, will remain a challenge. More generally, technological advances will continue to deliver improved service delivery and enhance the user experience.
- 2.28 For mobile network provision there will also be major challenges, with the rapid expansion of mobile devices being used to access the Internet and higher bandwidth applications and shifts in demand and expectations of the level of service being delivered. The industry faces continued requirements to invest against a backdrop of flat-lining or declining revenues in voice and messaging services and newer services proving hard to monetise. As noted above, one response to this has been moves to see some consolidation within EU markets, alongside speculation about non-EU companies making acquisitions. At the same time mobile operators are facing direct challenges to their business models from apps operated by OTT players e.g. WhatsApp, which is already challenging the revenues for mobile operators from SMS messages⁷⁴, and has now announced the introduction of voice services. These developments are not only a commercial challenge, they may raise issues for the regulator as well and will have implications for Government policy making to minimise any digital divides such as between rural and urban
- 2.29 The TV broadcast market is still dominated by consumption of linear TV. Ofcom report⁷⁵ that 88% of people watch linear TV on a daily basis. Use of time shifting, catch-up TV and video on demand services remains modest by comparison, although video on demand services such as Netflix are relatively recent in the UK⁷⁶. Competition between platforms will remain strong with DTT, cable and satellite being joined by IPTV. Opinions vary as to how quickly IPTV might grow, it remains to be seen whether the recent announcement by the BBC on moving BBC3 onto iPlayer only will see other linear channels follow. However the arrival of Apple, Google and most recently Amazon in the living room along with the existing installed base of games consoles adds an additional level of complexity and uncertainty about who will provide and manage future content via TV screens. The fact that the main TV screen itself is undergoing a significant change, to become another connected device, alongside the use of second screens, suggests that this area will continue to be dynamic. However given current licences, all the existing platforms will continue to be part of the landscape up to 2026 and beyond if the right investments are made.

⁷⁴ The number of data messages already exceeds the number of SMS messages.

⁷⁵ Communications Market Report, Ofcom 2013

⁷⁶ Netflix reported having 1 million customers in the UK in August 2012 but has released no further figures. Enders Analysis estimate the current customer base at 2.4 million

2.30 Broadcast radio will also continue to be part of the landscape, dominated by live radio but with additional ways of consuming content through smart phones and tablets. The concept of radio as a service will undergo change, affected by streaming services which vie for a share of the audio market, podcasts will gain their share of the “ear” and other new innovations will emerge to meet changing demands or expectations. However the huge installed base of traditional and DAB radios in the home (and car) providing a very personal listening experience, often accompanying other activities, the continued attraction of live radio (with 91% of adults listening at least once a week) and the much slower rate of replacement compared to phones and TVs, will mean any changes in the radio landscape will be in slower time.

Consumers will change

2.31 The UK’s population is growing and aging. There will be more users, in particular in the older age groups, all with greater demand than now.

Resilience and reliability will increase in importance.

2.32 Whilst speed may remain a differentiator of service, it is expected that resilience/reliability will become more prominent. As more mission/life critical applications are developed and deployed, and the technologies become ever more embedded in day-to-day life the need for greater resilience and reliability of the networks will increase accordingly. Latency is also likely to be a factor here.

International Comparisons

2.33 Remaining competitive internationally is a key issue for the UK and a world class digital infrastructure is an important component of that competitiveness.

2.34 Comparing countries is challenging, not least in defining what “world-class” might look like. Comparisons can sometimes be misleading, failing to account for a variety of factors – economic, social and topological – that differ across countries and have a material effect on outcomes.

2.35 There are a multitude of international comparisons covering a range of different measurements, be they penetration of certain technologies, level of take-up, prices and activities. Speed and coverage tend to be a popular basis for measuring progress and it is to be expected that these will still be important indicators in the future, partly because they are currently used and partly because they are (relatively) easy to understand and measure.

2.36 Across an external range of indicators, the UK performs comparatively well. The broadly based Network Readiness Index produced by the World Economic Forum has the UK ranked 9th in the world⁷⁷. The UK’s position is favourable against other major European countries (Germany, France, Italy and Spain) in availability of services (including superfast broadband), take-up of devices and prices⁷⁸. However purely in terms of availability and take up of superfast networks and higher end devices other countries in Europe, notably Sweden and the Netherlands, along with Japan and Korea

⁷⁷ http://www3.weforum.org/docs/WEF_GlobalInformationTechnology_Report_2014.pdf

⁷⁸ The European Broadband Scorecard 2014

in the Far East, tend to score higher. Likewise the US is ahead of us in certain areas, such as the roll out of superfast broadband and 4G LTE networks⁷⁹.

- 2.37 A recent Ofcom report⁸⁰ showed the UK to be leading other major European countries in metrics such as superfast broadband and mobile broadband coverage and standard and superfast broadband take-up and mobile broadband take-up.
- 2.38 There are differences between countries due to history and the type of technology used for network deployment. Regulation and Government investment also have an impact. For example, due to a number of differences between the markets, the US hasn't approached regulation of access networks in the same way as Europe. Japan and South Korea have had strong Government incentives put in place for superfast network rollout. In the Scandinavian countries, local and regional utilities have used existing infrastructure to provide broadband services. Roll-out of cable may be affected by the prevalence of pre-existing analogue television coverage.
- 2.39 Countries vary in terms of the availability of different technologies. Scandinavian countries often have more extensive superfast broadband networks than other countries. The UK does not have as high cable coverage as the US and some other major European countries, leading to less national communications network competition.⁸¹ Some commentators have noted the comparative lack of investment in the UK and rest of Europe compared to countries such as the US⁸². However, consumers in the UK have benefitted from a combination of low prices alongside good levels of investment to provide the services that consumers want, including most recently investment in 4G networks and superfast broadband rollout. On the mobile side EE has announced that it expects to achieve 98% 4G population coverage by the end of 2014 (comparable with US levels),⁸³ while Telefonica (whose spectrum allocation includes a requirement to achieve 98% indoor population by the end of 2017), Vodafone and Three expect to achieve 98% population coverage a year later, at the end of 2015. In addition, the Government expects to deliver 95% superfast broadband availability by 2017.
- 2.40 In common with many countries, the UK has developed a strategic and policy response to enabling the provision of broadband (the UN Broadband Commission has estimated around 119 countries have a broadband plan of some sort). This has included direct investment in the deployment of broadband infrastructure, extending mobile coverage and investment in emerging wireless technologies (5G), and making deployment easier. We have built upon this with the publication of our long term spectrum policy that will deliver greater value from the use of spectrum. We aim to build on the existing strong digital foundations in place with this strategy. But other countries will also be

⁷⁹ OECD Key ICT indicators current updates

⁸⁰ The European Broadband Scorecard, Ofcom, March 2014

⁸¹ The EC's Digital Agenda Scoreboard 2013 states that over 57.4% of high speed lines are cable and that 90% of European cable networks have been upgraded to NGA technologies <http://ec.europa.eu/digital-agenda/en/scoreboard>

⁸² For example see Digiworld Yearbook 2014 and Delivering Digital Infrastructure: Advancing the Internet Economy World Economic Forum April 2014

⁸³ <http://ee.co.uk/our-company/newsroom/britain-love-4g--ee-reaches-one-million-customers-at-superfast-s>

making progress and we need to ensure that we are benchmarking ourselves against the relevant countries over the next ten years.

Q6 Which countries should be our benchmarks on communications infrastructure to ensure that businesses remain in the UK and continue to invest?

2.41 In addition, when making comparisons, speed, coverage and take-up are the metrics currently most commonly used but in the future other metrics may be seen as equally important or valid. These elements may include latency in networks and the degree to which communications require symmetrical networks. We will need to consider appropriate ways of capturing and comparing these measures in the future.

Q7 What metrics do you think should or will become relevant in comparing network performance in different countries? Which metrics should most appropriately be used as the basis to set objectives for government policy?

Section 3: Scenarios of future demand

- 3.1 Determining the future need of communications infrastructure through looking ahead ten to fifteen years is challenging. However it is equally challenging to approach this through extrapolating existing trends forward as a method. On balance, we have decided to take the route of looking at what the UK might look like in ten plus years, what might be desirable and what might be achievable and work backwards towards what is likely to be required by 2025. We have therefore produced a set of three potential scenarios to stimulate debate on what demand may look like in 2025 and the role Government, industry and others could play in response.
- 3.2 Working with a range of stakeholders we looked at some of the factors that will influence demand, sharing with them the assumptions in section 2. We have chosen to approach this on a broader basis than is sometimes the case, so have considered the political, economic, societal, technological, legislative and environmental drivers that might impact on the demand for future communications.
- 3.3 Within each of these categories, we identified which drivers were most critical and used these to develop the scenarios outlined below. The scenarios therefore reflect a common set of influencers, but how these impact differs across the scenarios. Each scenario includes a technology commentary, outlining a possible infrastructure capable of meeting the demand. Some of the anticipated technological developments are depicted in a technology “radar” at Annex D.
- 3.4 It is important to stress that these are not Government forecasts or predictions, nor should these be seen as suggesting any Government policy preference. They are scenarios, possible courses of events that could emerge and impact on how future communications infrastructure needs to develop on which we are seeking comments and perhaps additional scenarios.
- 3.5 There are a number of common questions that have been applied to each scenario as well as a set of questions that apply across the scenarios.

Scenario 1

- 3.6 In this scenario levels of users’ digital competence will have risen, but significant numbers of users’ skills will not keeping pace with technological changes. This will define the digital divide, rather than whether there is access to high speed networks.
- 3.7 Audio visual content will remain the largest consumer of bandwidth in the home and services such as Netflix will continue to increase in penetration. Viewing of linear television will remain strong and increased storage capacity on set top boxes will provide alternatives to downloading content via catch up services. Although 4K services will have arrived, take up will be modest. Whilst there has been some modest increase in the use of IPTV services, the other platforms – DTT, satellite and cable – will remain strong.
- 3.8 Use of smartphones, tablets and other mobile devices will have increased but the rate of penetration will have slowed. There will be a steady movement of people switching from 3G to 4G services as coverage levels reach 98% of the population, but time per day spent on mobile devices will not increase significantly and there is no real movement away from using WiFi rather than the mobile network to connect. Initially as people move onto 4G services data consumption increases, but this will stabilise. 5G services are being planned.

- 3.9 Increased volumes will require greater backhaul capacity and traffic through internet exchanges will also increase but there will be greater availability of fibre services, whether fibre to the cabinet or to the premises. Content service providers will continue to invest in content delivery networks, with the caching of content moving increasingly into the network to meet consumer demand. The use of cloud based services will continue to grow.
- 3.10 The IoT will grow. By 2022 over 350 million additional devices will be connected in the UK. The majority of these devices however consume little bandwidth, although there will be a need for reliability for time sensitive communications.
- 3.11 The use of online public services will continue to grow, with citizen transactions with government moving increasingly online, and with growth in e-health and online education applications and services.
- 3.12 Online users in more densely populated areas will see continued improvements in the level and capacity of services. In other areas the Government's superfast broadband strategy will have delivered a minimum of 24Mbps so that networks are likely to be able to meet the likely demand for consumers and small businesses. Corporate users will be able to obtain the greater speeds, bandwidth, resilience and security they require through known developing or existing products and competition. Mobile coverage has exceeded the coverage obligation on O2's 4G licence as a result of the work of the ESMCP and MIP projects and cover over 99% of the population and all major roads and railways. The other mobile networks will continue to match this coverage.

Scenario 1 Technology commentary

- 3.13 In a world where the majority of devices will be wireless, providers will seek to deploy a heterogeneous infrastructure combining fixed, cellular and WiFi technologies that delivers the lowest cost per bit but is capable of delivering a user experience that will evolve at a pace dictated by access capability.
- 3.14 Devices will be smarter and roaming between access media will be automated but all traffic will pass over the specific radio environment, cellular or other radio. At a device level this will be transparent to the user.
- 3.15 Everyone will have the same minimum level of service but in many areas will be limited to a single access medium. The access network will become more dynamic in nature supported by a suite of software defined network applications that monitor and optimise the network fabric. The benefit of this is predominantly permitting the operator to optimise capital and operational expenditure.
- 3.16 Overall the physical network will not have changed significantly. Retaining the current physical topology results in the building of network silos in order to support key infrastructure investments such as IoT. The capacity provided by these networks will not be available to the broader consumer population.
- 3.17 The access network will be delivered over a common physical layer, used by many operators with competing services housed in the same physical infrastructure. Bundling of services will be provided within the aggregation layer of the network. This will ensure a high level of security in the access domain but limits the ability of the operators to optimise use of bandwidth and other assets resulting in long investment cycles and a reduced pace of innovation.
- 3.18 Quality of content delivery will define the experience for many consumers. Content providers will mandate, and will pay for, deeper caching within the operator domain to

ensure the quality and cost of delivery remains sustainable. Economy of scale will be key in the ability to innovate and deploy new services, operators have delivered a virtualized content delivery network (CDN) capability but this will be limited to the big providers of content. New entrants will be forced to use managed services which offer little or no differentiation or control over user experience.

- 3.19 Ultra High Definition (UHD) video content will be available across all access media. The traditional broadcasting multiplexes will carry a small number of UHD channels leveraging advanced statistical multiplexing techniques and high levels of compression. In this scenario it will not be possible for an all IP broadcast delivery infrastructure to be achieved and DTT and other platforms will continue to be popular.
- 3.20 The core, aggregation and data centre infrastructures will have evolved to a high degree; with levels of dynamic programmability and automation providing agility to the management and provisioning of core bandwidth. User consumption of bandwidth will lack flexibility, with users signing up to a contract and having little ability to control their service level on demand.
- Q8 Do you agree with this scenario or elements within it? Where do you agree/disagree? If you disagree what alternative scenario do you envisage?**
- Q9 What are your views on the technology commentary underpinning this scenario? To what extent might the infrastructure/technology discussed evolve irrespective of demand and how far will it be a direct consequence of the level of demand?**
- Q10 Are there technologies not identified here that you think will have a major impact on the performance of existing infrastructure or the deployment of additional infrastructure in the next 10-15 years?**
- Q11 Are there wider environmental issues not reflected in the scenario e.g. the price or availability of energy that will affect this scenario and in what way?**
- Q12 How likely is any unforeseen disruption to this scenario and what area might it occur?**

Scenario 2

- 3.21 Demand and levels of expectation about what services and applications will be available will have risen. Alongside this there will be an expectation that these services will be accessible wherever and whenever people want and that the user experience will be a good one. This will matter more to the consumer than what maximum speed they might theoretically be able to receive.
- 3.22 There will be a continued shift towards smartphones and tablets, the latter mainly connected through WiFi rather than having SIM cards. The increasing simplicity in the use of these devices will have a noticeable effect on the digital divide as fear of the technology is removed and enables greater levels of digital competence among users.
- 3.23 Audio visual content will remain the most popular type of content and people will expect to be able to access this content wherever they are and enjoy a seamless user experience. Traditional linear television delivery will remain strong, but there will be increased, often complementary, use of catch up services and over the top providers to view content when on the move.
- 3.24 Demand for wearable technologies continues to evolve, but these devices are seen as more luxuries than essentials (although wearable medical devices are becoming more widespread) and so will be the province of the early adopters. Use of these devices will

be concentrated in city centres or other areas of high concentration of people - shopping centres, sports stadia, major tourist sites and transport hubs.

- 3.25 Consumers will expect multiple devices to connect together without fuss and to receive services across devices seamlessly and that the market will have resolved interoperability issues that affect connectivity between different types of devices. Silos across the value chain and existing business models will limit the ability or willingness of the market to respond to these needs, leading to a slower adoption or take up of services.
- 3.26 Home and remote working will have increased, but the majority of demand will still be related to the physical work place. Businesses, the majority of which are small businesses, will increasingly need to engage in the digital world to meet the needs of their customers. They will require more symmetrical networks to allow greater uploading and sharing of files and require a greater degree of security and resilience. Increasingly they will want a service that meets their specific needs, rather than services that have been created for the larger business or the individual consumer. Cloud based services will continue to grow steadily, but uncertainties in areas such as ownership of data will result in uneven progress.
- 3.27 Machine to machine communications will increase the number of connected devices, which significantly exceed the numbers of people connected. In purely enterprise environments growth will be robust and exceeds current estimates. Use in cities has will evolve rapidly fuelled by Government interest in encouraging smart cities. Concerns about over reliance on technology, will spill over into their use in health care and other areas.
- 3.28 The digital divide will have narrowed in terms of availability of high speed connectivity, but will manifest itself in other ways, such as differing levels of confidence in being able to use services.

Scenario 2 - Technology commentary

- 3.29 This scenario has a significant overlap with the first scenario and so these comments deal with the likely differences from a technical point of view. The significant difference between this and the first scenario is a stronger growth in demand and changes in technology led by that demand.
- 3.30 The changes will include the following. Network Investment will be concentrated in some areas. Operators will use the most cost effective access technology. It will be left to the device and application layer to make the best use of the infrastructure available. This approach provides an elevated user experience and will lead to innovation particularly in small cell technology.
- 3.31 Physical access medium such as cellular, cable and FTTX will remain siloed with the subscriber having to choose the type of operator/access provider that best meets their needs, where there is a choice.
- 3.32 Evolution of fibre virtualisation techniques will make optimal use of existing assets. Caching will be the preferred means of improving user experience providing the highest return on investment and most control to the content community. Providers will seek to minimise spend on core capacity choosing to cache content on a per content provider basis.
- 3.33 There will be some convergence between telecommunications and broadcasting with 4G's broadcast capability being deployed particularly in urban areas where networks

are denser. 5G standards will be agreed with 5G networks operating in a number of countries. UK operators will be making plans for deployment of 5G networks, based on their existing shared infrastructure, and rolling out first by utilising and upgrading the heterogeneous networks in urban and other places with significant amounts of people.

- 3.34 The device manufacturers provide handsets or devices that offer an always best-connected experience that exploits the mix of access technologies. Processing and radio management are complex limiting battery life and innovation of device capabilities.
- 3.35 Networks in urban areas are optimised and some network silos are removed to support the significant increase in IoT applications, especially those relating to smart cities and smart non-residential buildings, where there is now a business case for additional investment.

Q13 Do you agree with this scenario or elements within it? Where do you agree/disagree? If you disagree, what alternative scenario do you envisage?

Q14 What are your views on the technology commentary underpinning this scenario? To what extent might the infrastructure/technology discussed evolve irrespective of demand and how far will it be a direct consequence of the level of demand?

Q15 Are there technologies not identified here that you think will have a major impact on the performance of existing infrastructure or the deployment of additional infrastructure in the next 10-15 years?

Q16 Are there wider environmental issues not reflected in the scenario e.g. the price or availability of energy that will affect this scenario and in what way?

Q17 How likely is any unforeseen disruption to this scenario and what area might it occur?

Scenario 3

- 3.36 People's expectations will be that coverage and connectivity are hygiene factors, taken for granted, and that fixed, mobile and WiFi will seamlessly work with each other. Devices will also be simple to use and utilise whichever connectivity is available or best delivers the service required. This will drive convergence and bundling.
- 3.37 Demand will be user specific and not location specific. The distinction between consumer and small business networks will become blurred and with increased home and remote working, demand will drive better quality of service across all networks. The corporate market will continue as a distinct market. Improvement of performance in networks will drive an ongoing expectation for even better networks. Voice traffic will shift predominantly to mobile and this with the IoT will drive network expansion. Fixed lines will only be retained for broadband connectivity with copper being phased out.
- 3.38 There will be continued demand for television in a linear and non-linear form across satellite and DTT but with a high degree of personalisation in addition to demand for IPTV and mobile viewing. It will be immersive and more effective transmission methods will be sought to further enhance the user experience. There will be a move from 4K to 8K standards. Radio will be increasingly delivered by streaming to connected devices. Satellite still will have a role in broadband, especially in the less populated areas and continues to be innovative on the delivery of television services.
- 3.39 Cloud technology will be the norm, with symmetrical and high capacity broadband networks available. Content will be stored on the internet closer to users to meet the

need for instant access to such services. Each home will be a home network with equipment readily available, easy to use and affordable and equipment will automatically connects wirelessly to each new electronic device.

- 3.40 Deployment of connected devices will exceed expectations, driven by smart homes, smart cities, smart energy, e-Health and the growth in the intelligence of machines. And driverless cars will lead to safe motoring requiring ubiquitous road coverage.
- 3.41 A significant increase in demand will require superfast speeds of over 1Gbps applying to both uplink and downlink, and this will be fuelled by ongoing changes in user behaviour, new devices, technology and content. Resilience will be expected, delivered both by having fixed and mobile networks covering the country, with availability or capacity, reliability, low latency and noise levels. This group of service metrics will replace the current emphasis on speeds and be regularly updated. Networks will be more scalable and able to respond more rapidly to demand through virtual network management. SMEs will require these service metrics, together with greater transparency around quality of service and enforceable Service Level Agreements. The majority of businesses will fully embrace working digitally as competitive forces make this essential. This will create additional demand across the board and across the country. Significant differences in service provision across geographies will not be tolerated.
- 3.42 There will be significant convergence of fixed and mobile networks and broadcasting, as well as devices, as both business and consumers will want to consume content whether on the move or not. All broadband prices will be relatively affordable given their interdependence with WiFi and mobile operators will price to encourage high data usage.

Scenario 3 – Technology commentary

- 3.43 Delivering the underlying infrastructure to realize this scenario requires a sea change in the approach to many elements of the telecommunications environment.
- 3.44 In a world where the majority of devices will be wireless, providers will seek to deploy a heterogonous infrastructure combining fixed, cellular and WiFi technologies that delivers the lowest cost per bit but are capable of delivering a user experience that will evolve rapidly over time. By 2025 5G technologies will form an important element of this capability. In order to achieve ubiquitous and consistent connectivity, a denser radio access network will be required regardless of radio type.
- 3.45 Fibre access will be required at a far more granular level than is seen in the current infrastructure. In order to guarantee user experience it should be symmetric and resilient. Building out to this level will provide a number of benefits. In addition to allowing subscribers and business to support the relentless evolution of applications and devices, a more granular access network will expedite and optimise the deployment of other applications and technologies such as 5G, M2M, public safety and smart cities.
- 3.46 The access network will be virtualised or support virtual overlay networks to ensure consumer, business and public service applications can run in parallel with no possibility of cross connection or infiltration through configuration or malicious access by third parties (denial of service attacks, hacking etc).
- 3.47 The IoT will be widely deployed leveraging the very lowest bit rate radio and fixed overlay technologies such as Power Line Technology through to high bandwidth traffic types such as video to support public safety requirements. This connectivity is will be

delivered over the fibre access infrastructure although in many cases reach will be sufficient to allow access at a lower volume of sites.

- 3.48 Whilst the internet will remain international the data centres providing the Internet exchange and peering environment will have devolved to a more regional model which will have evolved significantly to support the federation of CDNs bringing connectivity and content closer to the user. In addition to large managed CDNs which support the caching and processing of data from graphics to telemetry, large content providers will also have created a set of overlay CDNs that are optimised and scaled to ensure a high and measurable level of quality.
- 3.49 UHD content will become the normal delivery medium for video content. The traditional broadcasting multiplexes will carry a small number of UHD channels leveraging advanced statistical multiplexing techniques and high levels of compression. The proliferation of over the top technology and the ability to provide a single viewing experience will allow fast delivery of new channels and content offering over the IP network. In this scenario it will be possible for all IP broadcast delivery to be achieved allowing the release of spectrum to further enhance wireless coverage.
- 3.50 Overall the physical network will have been overhauled with new physical facilities and a set of agreements that provide fast and cost effective access to capability when needed. Traffic profile will have shifted significantly in response to the proliferation of cloud techniques. Technologies such as Terabit Ethernet will be used to connect large Infrastructure providers to the backbone networks. These connections will be virtualised by provider and are defined once again by agreed specification of both physical and logical interfaces.
- 3.51 The fabric of the UK infrastructure will be dynamic. Wireless access requires significant levels of dynamic programmability to cope with heterogeneous access. Capacity will not be dedicated to any one application, access or geographic area. Dynamic capacity management will ensure the optimum use of infrastructure and provision of seamless resilience.
- 3.52 Security of the infrastructure will be embedded at all levels.

Q18 Do you agree with this scenario or elements within it? Where do you agree/disagree? If you disagree, what alternative scenario do you envisage?

Q19 What are your views on the technology commentary underpinning this scenario? To what extent might the infrastructure/technology discussed evolve irrespective of demand and how far it be a direct consequence of the level of demand?

Q20 Are there technologies not identified here that you think will have a major impact on the performance of existing infrastructure or the deployment of additional infrastructure in the next 10-15 years?

Q21 Are there wider environmental issues not reflected in the scenario e.g. the price or availability of energy that will affect this scenario and in what way?

Q22 How likely is any unforeseen disruption to this scenario and what area might it occur?

General

Q23 Are there factors, for example technical or unrelated to the regulatory framework, that could create bottlenecks and delay future infrastructure deployment in the

UK in this timeframe, that would result in demand not being met or the UK not being seen as a leading digital nation?

- Q24 Do you expect commercial providers to deliver future infrastructure and meet demand on a purely commercial basis, or is some form of public intervention likely? If public intervention is likely how might that work with the commercial provision of infrastructure? What form might that intervention take?**
- Q25 Which current or draft legislation might prevent or facilitate the emergence of any of the scenarios?**
- Q26 Do you have views on which scenario (or combination of scenarios) is most likely and should influence the development of future strategy?**

Section 4: Competition and regulation

- 4.1 In the UK, regulation has been used to benefit consumers and citizens through the promotion of competition, or to prevent exercise of significant market power, encourage investment, promote diversity or achieve other public policy goals. In common with other European markets, and based on a common European legal framework, fixed networks have been subject to regulation as they developed from state owned monopolies, Mobile networks are also subject to regulation and spectrum management. Competition has been of great value to the consumer by providing choice, driving investment and innovation and ensuring value for money.
- 4.2 In broadcasting public service broadcasting obligations are grounded partly in the benefits of education and uplifting entertainment and with a strong bias against political interference. Before Ofcom was formed, competition in television was subject to a strong government control through the Independent Television Commission and its predecessors and the legacy of this control is the UK's ubiquitous television transmitter network.
- 4.3 This section looks at current regulation of communications infrastructure and where relevant at the application of competition law, for which regulation is a proxy. This consultation is considering whether the regulatory framework and the framework for competition law will encourage investment in the infrastructure the UK will need in the period from 2025 to 2030. To the extent that they do not provide sufficient incentive we would welcome views on possible changes to legislation or the regulatory framework which might have that effect to inform the new strategy.
- 4.4 Ofcom is responsible for the regulation of all digital communications infrastructure. It is the UK's independent national regulatory authority under the European regulatory framework⁸⁴. The Communications Act 2003 outlines all of its overarching duties⁸⁵. Ofcom must have regard, among other things, to encouraging investment and innovation⁸⁶, and encouraging the availability and use of high speed data services.⁸⁷ Ofcom has concurrent competition powers with the newly formed Competition and Markets Authority (CMA) in relation to communications matters, other than mergers, and can make market investigation references under the Enterprise Act 2002.⁸⁸ Ofcom also advises the CMA on Phase 1 mergers and has a specific role in relation to public interest tests in media mergers and has oversight of some of the remedies imposed in merger cases.
- 4.5 The Digital Economy Act 2010 modified Ofcom's duties to include an obligation to report to the Secretary of State every three years on UK communications infrastructure, the availability of networks and their ability to respond to emergencies. The first such

⁸⁴ See Framework Directive 2002/21/EC, art 3. See paras 4.19-4.23 below in relation to the European regulatory framework

⁸⁵ S3(1) of the Communications Act 2003.

⁸⁶ S3(4)(d) *ibid*. Also included in the EU framework

⁸⁷ S3(4)(e) *ibid*.

⁸⁸ The way in which the concurrent competition powers are exercised are dealt with in more detail in a Memorandum of Understanding between Ofcom and the CMA of 17 June.

report was published in 2011 and it has been updated on an annual basis. It also covers network resilience and, in the 2013 report, the migration from IPv4 to IPv6, to ensure the availability of internet addresses. The promotion of efficient investment in infrastructure is a key concern for Government and it is keen to understand what the obstacles to investment in communications infrastructure might be.

Q 27 How might efficient investment in communications infrastructure be supported, for example by changes in the regulatory framework?

Investment in Superfast broadband

- 4.6 In making its decisions Ofcom takes into account all its duties. It has particularly taken encouragement of investment into account in recent regulatory decisions related to superfast broadband. On 26 June 2014 Ofcom published its final statement in its Fixed Access Market Review⁸⁹. This does not propose setting prices for active wholesale access to the BT superfast broadband network (the GEA or VULA product) and notes that it was concerned not to undermine the investment case for rolling out fibre. It also recognises the importance of switching in creating competitive markets by proposing to make switching between providers of superfast broadband cheaper and to reduce the minimum length of the wholesale contract between BT and the other retail suppliers from a year to one month.
- 4.7 Ofcom's policy since its Strategic Review of Telecoms in 2004/5 has been to encourage competition at the deepest level in the network where it is efficient and sustainable to do so. For superfast broadband Ofcom concluded that physical or passive network access was unlikely to support efficient and sustainable competition and accordingly introduced VULA (as the access product that would support efficient and sustainable competition). As investment in superfast broadband networks is continuing Ofcom has also introduced PIA, which allows competitors to install fibre between the customer and the local exchange using BT's duct and pole infrastructure to provide broadband, telephony and cable TV, to permit contestable investment in network infrastructure.
- 4.8 Ofcom looked at the issue of extending PIA to leased lines in its Business Connectivity Market Review⁹⁰. Ofcom concluded that the risk of introducing PIA into this market could result in a net detriment to consumers. This issue is being revisited by Ofcom in its next Business Connectivity Market Review⁹¹.
- 4.9 Some in the industry have expressed concerns about whether the current PIA remedy is effective because the charges are too high for consumer superfast broadband services, that its supply is not yet industrialised and that the provision of additional communications infrastructure would result from allowing the use of BT's ducts and poles for non-consumer networks and mobile backhaul is not permissible. PIA is available for mobile backhaul and leased lines in a number of other member states including Italy, Spain and Portugal.

⁸⁹ <http://stakeholders.ofcom.org.uk/telecoms/ga-scheme/specific-conditions-entitlement/market-power/fixed-access-market-reviews-2014/statement/>

⁹⁰ <http://stakeholders.ofcom.org.uk/consultations/business-connectivity-mr/final-statement/>

⁹¹ Consultation published on 1 April 2014.

- 4.10 Industry also has concerns that an alternative remedy, SLU is expensive and has technical limitations. SLU connects the customer's premises with a concentration point or other intermediate access point in the Openreach local network allowing other operators to provide this final drop to the customer. Instead of using these passive remedies some of BT's competitors are partnering on a trial basis with alternative fibre to the premises providers, such as Cityfibre Holdings.

Mobile broadband

- 4.11 Although investment in mobile markets has been driven extensively by competition, it has also been required by the imposition of coverage obligations on 3G licences and one 4G licence. As part of its work on the recent 4G auction Ofcom undertook a competition assessment which was used to determine the number of national wholesalers owning spectrum required to provide consumers with better services at lower prices. Ofcom determined that it was important to structure the auction so as to sustain at least four national wholesalers. In fact a new entrant to the mobile market, BT, acquired spectrum as did the existing four operators⁹².
- 4.12 Ofcom also considers that competitive pressures will drive an increase in the coverage of mobile networks which is why only one 4G licence contained a coverage obligation, traditionally all mobile spectrum licences have contained coverage obligations. Of the 4G licences only the O2 800 MHz licence has a coverage obligation; indoor reception of at least 98% of the UK population and at least 95% of the population of each of the UK nations, to be met by the end of 2017 at the latest. Competition in the provision of M2M services, which do require ubiquitous geographical coverage, may drive coverage further as might the Government's emergency services ESMCP⁹³.
- 4.13 Expansion of mobile networks requires both spectrum and sites, with spectrum particularly important for bandwidth. The government's spectrum strategy is discussed further in section 5.20. Ofcom has set out its strategy for managing spectrum⁹⁴ which sets out how it proposes to manage its priorities over the next 10 years. The priorities are future mobile data demand, the future of the 700 MHz band and free-to-view TV, public sector spectrum release, programme making and special events, IoT applications and the emergency services.
- 4.14 Industry⁹⁵ has suggested to us that authorised spectrum access is also a useful means of increasing the availability of spectrum, whilst also providing certainty and quality of service. Mobile networks can be expanded through densification of sites and integration of WiFi. We expect this to happen in the future. The infrastructure being used is likely to be small or pico cell infrastructure utilising buildings or street furniture. We have dealt below with the impact of the Communications Code on the acquisition by mobile operators of sites, and clearly in less populated areas the business case for additional masts is more challenging than in populated urban areas

Q28 Are any further regulatory measures necessary to incentivise the rollout of future mobile infrastructure in currently underserved areas?

⁹² BT owned what is now O2 until its demerger in November 2001.

⁹³ Ofcom consulted in December 2013 on these issues in relation to its mobile data strategy.

⁹⁴ Spectrum management strategy, Ofcom, April 2014

⁹⁵ This comment has particularly come from equipment manufacturers.

Universal Service Obligation

4.15 BT and KCOM are both subject to a universal service obligation (USO), which relates to the provision of, inter alia, a basic voice line and functional internet access (narrowband) available at an affordable price and at uniform prices throughout the UK. Currently this is self-funded but the European framework makes provision for third party funding, if appropriate. The European Commission has looked several times at including broadband in the USO but rejected it given the differences between member states in the existing provision of broadband networks and current progress on superfast broadband rollout. It has though specifically permitted member states to define functional internet access to include broadband in the USO and several have done so.⁹⁶

Universal Service Commitment

4.16 Currently the Government has a Universal Service Commitment (2Mbps to everyone) which is limited to current generation broadband and is not legally binding. This is being delivered by BDUK. In the event that some areas might be underserved in the future, a similar approach might be a consideration.

Q29 Is there a role for a revised USO or USC to ensure that minimum consumer demand requirements are met and to reduce the potential for a new digital divide? What might this look like?

Broadcasting

4.17 Ofcom licenses all commercial and local television and commercial radio services and the spectrum each uses. Its duties include securing the availability of a wide range of high quality and varied television and radio broadcasts throughout the UK⁹⁷. Ofcom has a statutory obligation to review public service broadcasting and also has responsibility, shared with the Competition and Markets Authority for competition issues. It also has sector specific competition powers.⁹⁸

4.18 The current multiplex licences, aside from the initial multiplex licence granted to the BBC⁹⁹ were issued under the Broadcasting Act 1996 and expire either in 2022 or 2026.¹⁰⁰ Under existing legislation they cannot be extended any further without a competitive process. Unlike telecoms, the EU does not have any comprehensive broadcasting legislation although the European Regulatory framework covers some aspects of broadcasting infrastructure.

Q30 In terms of supporting future innovation and long-term investment in infrastructure, what areas of broadcasting regulation may have served its purpose by 2025 -2030 (or indeed earlier)? What future technical developments may also have longer term implications for regulation and wider public policy?

⁹⁶ Recital 5 of the Citizens' Rights Directive (2009/136/EC). Spain, Malta and Finland have done so. The speeds specified in the USO need to reflect average broadband speeds.

⁹⁷ S3(2)(c) of the Communications Act.

⁹⁸ Under s316 of the Act.

⁹⁹ Its renewal is part of the BBC Charter renewal.

¹⁰⁰ The 2 multiplex licences expiring in 2022 are those granted to ITV and channels 3&4.

EU Communications Law

- 4.19 The regulation of the communications sector and spectrum is heavily based on EU law. This limits the changes which can be made at a UK level without changes being made to EU regulation. The EU Communications Framework together with its Recommendation on Relevant Markets set out the duties of regulators, and the basis for undertaking periodic market reviews by regulators in accordance with the Recommendation where regulation is needed to supplement competition in communications markets, as well as licensing of spectrum and the imposition of ex ante regulation. The Framework aims to complete the single market in communications. The Universal Service Directive¹⁰¹, part of the Regulatory Framework, is the basis of the USO applicable to BT and KCOM.¹⁰² The Framework also regulates switching between communications services, spectrum licensing, and the mobile roaming market. It specifically provides that regulation may be rolled back and be replaced by competition law once there is effective and sustainable competition in particular markets.¹⁰³ Ofcom considers this question as part of its regular market reviews.
- 4.20 The Framework prescribes a system of consultation on market reviews and other regulatory action to ensure consistency throughout the EU, involving both the European Commission and the Body of European Regulators for Electronic Communications (BEREC) which was established in 2009. Ofcom is a member of BEREC. The European Commission has additional powers of veto on decisions of national regulators on market definition and designation of an operator as having significant market power. The Framework is periodically reviewed and the next formal review is expected in mid-2016.
- 4.21 The European Commission has also proposed changes to the Framework, separately from any required periodic review. The so called Connected Continent proposals¹⁰⁴ are a wider package of draft measures described as an intermediate step towards the goal of a single market in telecoms. Amongst the proposals is an end to intra-EU roaming charges, spectrum harmonisation, harmonised virtual access to fixed networks for business, as well as consumer protection measures including a harmonised switching process. These proposals are likely to be amended prior to adoption and are unlikely to be adopted before the end of 2014. At the same time the Commission issued a Recommendation on Costing Methodologies and Non-Discrimination¹⁰⁵ aimed to encourage investment in superfast broadband networks and create more regulatory certainty. Its Recommendation on Relevant Markets is also likely to change this year¹⁰⁶ to simplify the number of markets which must be reviewed by European regulators.
- 4.22 There is EU legislation relevant to digital communications infrastructure which will come into force prior to the Connected Continent proposal. The Directive on Broadband Cost

¹⁰¹ Directive 2002/22/EC.

¹⁰² The Electronic Communications (Universal Service) Order 2003.

¹⁰³ Recital 5 of the Better Regulation Directive, 2009/140/EC.

¹⁰⁴ <http://ec.europa.eu/digital-agenda/en/connected-continent-single-telecom-market-growth-jobs>

¹⁰⁵ <http://ec.europa.eu/digital-agenda/en/news/commission-recommendation-consistent-non-discrimination-obligations-and-costing-methodologies>

¹⁰⁶ <http://ec.europa.eu/digital-agenda/en/news/draft-revised-recommendation-relevant-markets>

Reduction¹⁰⁷ will come into force in 2016. Measures include the right to request access for superfast broadband providers to the infrastructure of telecommunications and other utilities providers, other than those providing drinking water, and inclusion of broadband access in building regulations.

- 4.23 The European Union's current 2020 Strategy is designed to deliver smart sustainable and inclusive growth, and the Digital Agenda for Europe is one of the major initiatives forming part of this strategy. The Digital Agenda aims to help European consumers and businesses to get the most out of digital technologies. One target of the Digital Agenda is broadband coverage providing services with speeds exceeding 30Mbps for all by 2020¹⁰⁸. This is reported on annually by the Commission.

Q 31 Are there changes to the EU Regulatory Framework that the UK might seek to encourage more competition in UK markets?

Q 32 Should Government seek changes to the European regulatory framework which put more reliance on competition law and how might this be done?

UK Competition Law

- 4.24 Competition law is important to digital communications, particularly areas such as potentially anti-competitive agreements and mergers. Competition law too has a European and UK dimension. The UK Competition Act 1998 essentially replicates the basic competition principles of European law in relation to the general prohibition of anti-competitive agreements and abuse of dominance¹⁰⁹. The Enterprise Act 2002 applies to mergers and market investigations. Either the Commission or the national competition authorities can apply EU competition law. There is specific EU law dealing with mergers which sets out when the Commission deals with particular mergers¹¹⁰. In relation to anti-competitive conduct and abuse of dominance in practice the Commission deals with major cases involving more than three member states, where the decision is linked to other questions of EU law or is important as a matter of competition policy or the effective application of EU competition law. Market investigations, to determine if competition is not working as it should, can be conducted by the Competition and Markets Authority (CMA)¹¹¹ or the European Commission, but under a different legislative framework, although when it conducts a market study the CMA must apply EU law. The CMA is required to promote competition, both within and outside the United Kingdom, for the benefit of consumers. Most UK regulators have concurrent competition powers with the CMA other than in relation to mergers¹¹². Ofcom is a member of both the UK Competition Network, which is intended to ensure closer working on competition issues by the sectoral regulators with competition powers and the CMA, and the UK Regulators Network (UKRN). The UKRN has the

¹⁰⁷ http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:JOL_2014_155_R_0001&rid=4

¹⁰⁸ <http://ec.europa.eu/digital-agenda/digital-agenda-europe>

¹⁰⁹ Articles 101 and 102 of the Treaty on the Functioning of the European Union.

¹¹⁰ Council Regulation (EC) No 139/2004 of 20 January 2004 on the [control of concentrations between undertakings \(the EC Merger Regulation\)](#) as amended.

¹¹¹ Formed on 1 October 2013 under the Enterprise and Regulatory Reform Act 2013.

¹¹² The Enterprise and Regulatory Reform Act gave the CMA the right to exercise powers in relation to anti-competitive conduct in preference to the sectoral regulators and the Secretary of State the right to remove concurrent powers.

aim of improving co-ordination across regulated sectors to enhance investment and efficiency for the benefit of consumers. Two of the initial areas of focus for the UKRN are facilitating efficient multi-sector investment projects, and assessing cross-sector resilience and cyber-security. Both areas are relevant to the strategy we are consulting on.

Market convergence and consolidation

- 4.25 Changes in technology and networks are creating ever more opportunities for convergence. We are seeing convergence in consumer products, consumption habits and business practices. In particular, we are seeing an increasing trend towards the bundling of services. The regulatory framework may need to adapt to reflect these changes, including in relation to the regulation of bundled services and how competitive pressures between related markets can be recognised.
- 4.26 Market consolidation is another area for future consideration. Historically, evidence considered by competition authorities at an EU and UK level has continued to support looking at consolidation in an individual market manner, for example considering mobile and fixed markets and pay TV separately. For example, in the Vodafone/Kabel Deutschland merger¹¹³ in which both parties were active in the fixed and mobile markets, those markets were considered separately, as was the Pay TV/IPTV market. The ability to bundle different services was also considered in that merger and not held to be a competitive problem. However, the approach to considering mergers may develop over time as convergence develops and as bundled products become increasingly prevalent.
- 4.27 In relation to investment, a number of analysts and, more recently, the French Government, have suggested that consolidation might be needed in communications markets, particularly mobile markets¹¹⁴. It remains the UK Government's view that competition has served the customer well and that competition itself can, along with innovation, stimulate investment. Network sharing can be an effective means of realising efficiencies of scope and scale without losing market players. The general approach is to allow network sharing amongst operators to the extent that it increases efficiency and delivers savings which can be enjoyed by consumers, but not to the extent that competition might be threatened.

Q 33 In what ways can you see competition driving technological change in the UK in the future?

Q 34 How can the regulatory framework keep up to date with new business models and changes in technology?

State Aid

- 4.28 State aid considerations are relevant presently because of Government intervention in superfast broadband. The issue is whether Government support for the deployment of infrastructure qualifies as State aid¹¹⁵ and if so what compatibility conditions apply¹¹⁶.

¹¹³ COMP/M.6990, 20 September 2013

¹¹⁴ French Economy Minister Montebourg on 9 April confirming that a reduction in the number of mobile operators was Government policy

¹¹⁵ For a measure (intervention) to constitute State aid it must fall within the meaning of Article 107(1) of the Treaty for the European Union (TFEU).

State aid is a grant by the state which distorts or threatens to distort competition by favouring certain companies. The compatibility conditions serve to ‘balance’ the presence of funding that serves to competitively advantage a particular company with the benefits of the aid. State aid measures can only be implemented following approval by the European Commission or where they are otherwise subject to exemption¹¹⁷.

- 4.29 There are a number of policy objectives for which State aid can be used, one being public investment in broadband infrastructure development¹¹⁸, to support the objectives set out in the EU’s Digital Agenda. European Commission guidelines have been published which cover the application of State aid rules in relation to the rapid deployment of broadband networks, including qualifying basic and superfast broadband networks (‘the Guidelines’)¹¹⁹. Under the Guidelines, public sector interventions to support the deployment of broadband infrastructure are permitted in either ‘white’¹²⁰, ‘grey’¹²¹, or ‘black’¹²² areas. BDUK’s interventions under its National Broadband Scheme are limited to interventions in non-urban ‘white’ areas. Whilst in principle State aid can be used to support ‘grey’ and ‘black’ area interventions where there is evidence of persistent failures Member States are required to undertake a more detailed analysis and compatibility assessment and the European Commission would apply stronger conditions to compensate for the granting of aid.
- 4.30 State aid that is used to support broadband deployments in non-urban white areas must meet a minimum set of compatibility conditions¹²³.
- 4.31 The UK’s National Broadband Scheme is capable of meeting not only the minimum requirements but ensures that, inter alia: (a) the minimum wholesale access conditions required by BDUK go beyond those required by Ofcom in areas such as PIA and provide a clear route for alternative providers to obtain alternative forms of wholesale network access; and (b) places universal ‘open access’ obligations on suppliers

¹¹⁶ TFEU applies a negative presumption to all forms of State aid, declaring those measures incompatible with the common market. However, the European Commission may derogate to the incompatibility and declare the proposed measure as compatible with the internal market under the terms of either Article 107(2) or Article 108(3) TFEU.

¹¹⁷ The Commission is able to declare certain categories of aid as compatible with the internal market and can make block exemptions including for certain broadband infrastructure.

¹¹⁸ The first guidelines were adopted in 2009 (IP/09/1322) and revised in 2013 (IP/12/1424)

¹¹⁹ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2013:025:0001:0026:EN:PDF>

¹²⁰ ‘White areas’ are those in which there is no broadband infrastructure and it is unlikely to be developed in the near future (i.e. next three years).

¹²¹ ‘Grey areas’ are those in which only one network operator is present and another network is unlikely to be developed in the near future.

¹²² ‘Black areas’ are those in which there are or there will be in the near future at least two basic broadband networks of different operators and broadband services are provided under competitive conditions (infrastructure-based competition).

¹²³ The Guidelines distinguish interventions that occur in areas of lower population density where the imposition of all types of access product (e.g. allowing the use of duct and pole infrastructure solely for the purpose of providing of leased lines) might disproportionately increase investment costs, without delivering significant benefits in terms of increased competition. By contrast the Guidelines recognise that in more densely populated areas where infrastructure competition is expected to develop the State aid subsidised network must satisfy all types of network access, including the provision of passive assets on an ‘open access’ basis.

deploying new duct and new pole infrastructure meaning that infrastructure can be used for any purpose (e.g. supplying business connectivity etc.)¹²⁴

- 4.32 While the objectives of the MIP intervention are different (i.e. to extend mobile voice coverage and basic data service where coverage is poor or non-existent) the terms of the State aid approval ensure compatibility with the EU State Aid rules. In MIP the State aid in question is being paid to the infrastructure operator or MIP provider – Arqiva. Mobile network operators have been granted access by the MIP provider on non-discriminatory terms for a minimum of 10 years. Each existing mobile operator has committed to use all of the MIP sites. The approval contains no discussion of open access, merely non-discrimination. Given that the services provided by the operators are national there is also no specific obligation to provide MVNO access. In the past state aid approval was obtained for the roll out of 900 MHz 2G mobile services in the Highlands and Islands¹²⁵.
- 4.33 The current state aid broadband guidelines apply from January 2013 and it is possible that they will be reviewed prior to 2020. The EU regulatory framework is also likely to be reviewed prior to that time, depending on the fate of the Connected Continent proposal. As for the UK obtaining further state aid approval for superfast broadband the terms for such approval may differ from those currently applying. The strategy will therefore need to bear in mind the scope for change at the EU level.

Common regulatory issues

- 4.34 The ability of customers to switch suppliers is fundamental to competitive markets. The issue is common across all regulated industries. It has received less publicity in the communications sector than in areas like energy with 20% of consumers switching between 2012 and 2013¹²⁶ but remains an issue particularly in the fixed broadband market¹²⁷, where there is much less switching than in mobile markets. Clear information is necessary to enable consumers to make informed choices and then the actual process has to proceed smoothly. Ofcom is working with industry to implement a harmonised switching process on the Openreach copper network by summer 2015 and is also looking to see whether its work should be extended to other technologies, such as cable. The Government is also planning to legislate in relation to switching of bundles.

Other legislation relevant to communications

- 4.35 Decisions on whether to invest in communications infrastructure depend on legislation other than communications regulation and competition law. Government has available to it many means of encouraging competition, innovation and investment. This document is not addressing means outside its terms of reference such as increased on

¹²⁴ "New duct" is defined as that subsidised physical infrastructure located underground with an individual length of at least 1.0km and have deployment costs of £50,000 or greater. "New poles" are defined as that subsidised physical infrastructure located overhead where the poles will be deployed over a distance of 1.0km and have deployment costs of £50,000 or greater. Both new ducts and poles include that physical infrastructure deployed for the purposes of providing both access and backhaul.

¹²⁵ Announced in 1996 and jointly funded by Highlands and Islands Enterprise, the EU, Cellnet (now O2) and Vodafone.

¹²⁶ Ofcom Consumer Experience 2013. 15% of mobile switchers change networks for coverage reasons.

¹²⁷ 13% of respondents to Ofcom's survey found it difficult

line availability of government services and digital literacy. Stakeholders have emphasised to us the importance of the Electronic Communications Code, which has applied since 1984. The Code gives operators designated by Ofcom the right to enter onto land and erect and maintain infrastructure. Even though in most cases operators and utilities only obtain wayleaves, or licences, over land the payment principles differ from those applicable to utility companies which are based more closely on compulsory purchase powers and/or compensation for loss or damage. By way of contrast the Code currently provides that to secure wayleaves an operator effectively has to pay the landowner a market rent, including compensation for loss or damage¹²⁸. If there is a failure to agree then the amount is determined by the County Court. The Law Commission was asked to review the Code in 2011 and produced a report in February 2013. It recommended redrafting of the Code, including a clearer definition of the market value landowners could charge and that disputes should be referred to the Lands Chamber of the Upper Tribunal, which would produce a more expert and faster decision than the County Court. The Government is considering the impact of the recommendations on network rollout and impact on consumers, particularly those recommendations around providing a clearer definition of the market value, to give operators a better idea of what their network is likely to cost. In January 2014 it published the Nordicity report, an economic analysis of the impact of various wayleave valuation regimes¹²⁹. Communications infrastructure operators are beginning to be regarded more as utilities as digital communications become more important and it has been suggested that this should be reflected in the Code.

- 4.36 Designated code operators have additional rights of permitted development under planning law¹³⁰. Planning is a devolved responsibility. In 2013 to support the rollout of superfast broadband the Government implemented a package of planning relaxations in England by removing the need to seek planning permission for specific communications deployments. In summary in June 2013 for a period of 5 years the requirement for the local planning authority to sign off the prior approval requirement in protected areas for telegraph poles, cabinets or wires for fixed broadband on land other than Sites of Special Scientific Interest was removed. In August 2013 changes were made to support 4G rollout in non-protected areas¹³¹ including extending and widening existing masts, permitting larger and taller antennas and small cell antennas. Specific changes for protected areas saw the addition of an allowance of 3 antennas to masts

¹²⁸ Licence holders under the Electricity Act 1989 are only required to pay compensation for economic loss, including any damage and for loss of enjoyment of the land to landowners. Gas and oil companies pay compensation on the basis of a compulsory purchase. Water companies have absolute rights on notice to lay pipes over land and pay on a compensation basis. There is a statutory compensation code which applies to all these utilities which is used in the absence of individual agreements. The Nordicity report https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/270165/Wayleave_Economic_Analysis_2013_10_23.pdf estimates that the costs of communications wayleaves would decrease by 40% under the energy regime and 62% under the water regime.

¹²⁹ The Nordicity report https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/270165/Wayleave_Economic_Analysis_2013_10_23.pdf

¹³⁰ Part 24, Schedule 2, General Permitted Development Order 1995 (as amended)

¹³¹ Protected areas are Sites of Special Scientific Interest, national parks, conservation areas, areas of outstanding natural beauty, World Heritage sites and the Broads (Norfolk and Suffolk).

and dish antennas to existing masts, as well as small cell antennas¹³². The Department of Communities and Local Government is consolidating existing permitted rights, including the new freedoms introduced in 2013 for fixed and mobile telecommunications operators, with new regulations in place by April 2015.

- 4.37 Another suggestion made by operators is that some public sector sites should be made available at low rentals on an open access basis to encourage the further rollout of networks and infrastructure upgrades. Fixed operators have also suggested that Codes of Practice used by local authorities and the Highways Agency in relation to streetworks should be amended to include more innovative deployment of infrastructure so that cheaper means of deployment are available¹³³.
- 4.38 Network operators pay business rates on their network assets which are valued by the Valuation Office Agency. It has been suggested to us that the assessment of network assets may not incentivise the rollout by those operators paying business rates on the basis of the length of their fibre networks and the number of lit fibres. The government is separately carrying out a review of the administration of business rates after 2017 and is considering the responses to its consultation.

Q35 Are there any changes to legislation other than the Communications Act 2003 that would incentivise the provision of communications infrastructure?

VoIP

- 4.39 In addition to network access there is another regulatory issue which operators have drawn to our attention. This is whether changes should be made to UK regulation to make it easier for VoIP to be treated as a publicly available voice service so that consumers need only have a broadband connection without also requiring a separate voice service.
- 4.40 The European Framework¹³⁴ implemented by General Condition 4 requires that users can access the emergency services and that the emergency services receive caller location information. Ofcom has produced guidance on what VoIP operators should say about emergency access to customers and how emergency location information is supplied¹³⁵. If there is a power cut at a VoIP user's location, a VoIP telephone will not work without some alternative source of power. Unlike the public switched network, which derives its power through the copper lines from the telephone exchange, VoIP telephones require connection to a reliable local power source in order to function. This requirement is common to other services, e.g. mobile customers using a femto cell and fixed customers using a DECT cordless phone. Currently back up power is required for an hour.¹³⁶

¹³² The changes for mobile operators are in the Town and Country Planning (General Permitted Development)(Amendment)(No.2) (England) Order 2013 and for fixed operators in the Town and Country Planning (General Permitted Development) (Amendment) (England) Order 2013 and the Electronic Communications Code (Conditions and Restrictions) (Amendment) Regulations 2013.

¹³³ For example the Specification for the Reinstatement of Openings in Highways (SROH) Code of Practice

¹³⁴ Universal Service Directive, art 26

¹³⁵ Annex 3 to General Condition 14.

¹³⁶ http://stakeholders.ofcom.org.uk/binaries/consultations/superfast-broadband/statement/Battery_Backup_Statement.pdf

4.41 All publicly available operators have to provide number portability, but if a number is ported from an ADSL provider to a VoIP provider the line will cease and the customer will lose all services (including broadband connectivity). Attempts have been made to change Openreach systems so when numbers are ported, the line provisioning the broadband service is renumbered so that the connectivity would not cease/be lost on porting to a VoIP supplier. Some claim that naked DSL¹³⁷ would also solve the problem but Openreach do not offer naked DSL.

Q36 Would there be benefits to investment from a focus on broadband only services? Are there any barriers to the emergence and adoption of broadband only services, whilst still providing necessary access to emergency services?

¹³⁷ A digital subscriber line without an associated analogue, voice, line

Section 5: Facilitating and encouraging investment

Investment and revenues

5.1 Encouraging investment in infrastructure over the next 10-15 years will be a key consideration of any strategy to deliver world leading digital communications infrastructure. Private sector investment in communications in the UK increased by 4% in 2011 and 5% in 2012. Figure 1 below sets out private sector investment in telecommunications over the period 1995 – 2012. Previously there was a peak in investment at the end of the 1990s/early 2000s and a lower peak in 2006¹³⁸. Total investment can be expected to increase in the period up to 2017 as mobile network operators invest in the rollout of 4G infrastructure, and Broadband Delivery UK public funding in the rural broadband programme, urban broadband and the MIP proceeds. The strategy will need to consider what action may be needed to facilitate investment beyond 2017.

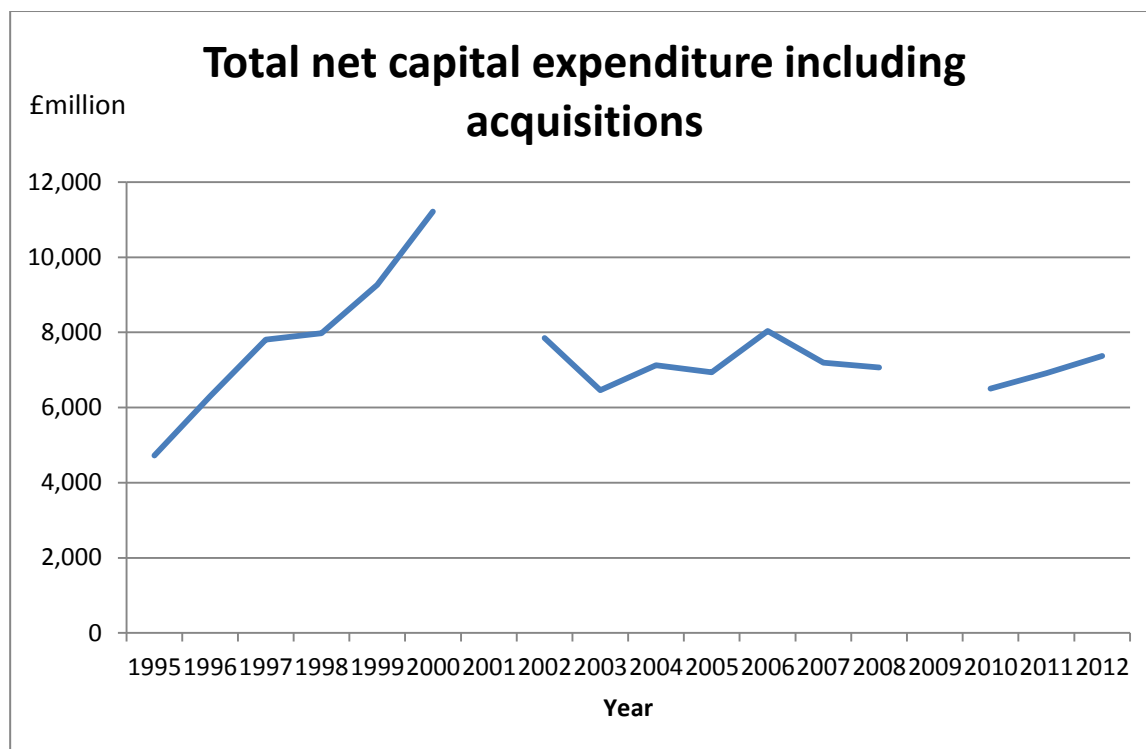


Figure 1 - Source: Office of National Statistics Annual Business Survey.

Note: Data for 2001 and 2009 was suppressed by ONS to avoid disclosure of survey respondents

5.2 Investment in recent years has taken place in an environment where telecoms revenues have been on a downwards trend. Revenue for telecoms in the UK has declined by 8.7% over the period 2008 – 2012 with a 1.8% decline in 2012, although the 5 year compound annual growth rate (CAGR) is -1.6%. Figure 2 below sets out telecoms revenues over the period 2007 – 2012.

¹³⁸ Factors influencing the investment included intensified 3G rollout and to a lesser extent the formation of Virgin Media.

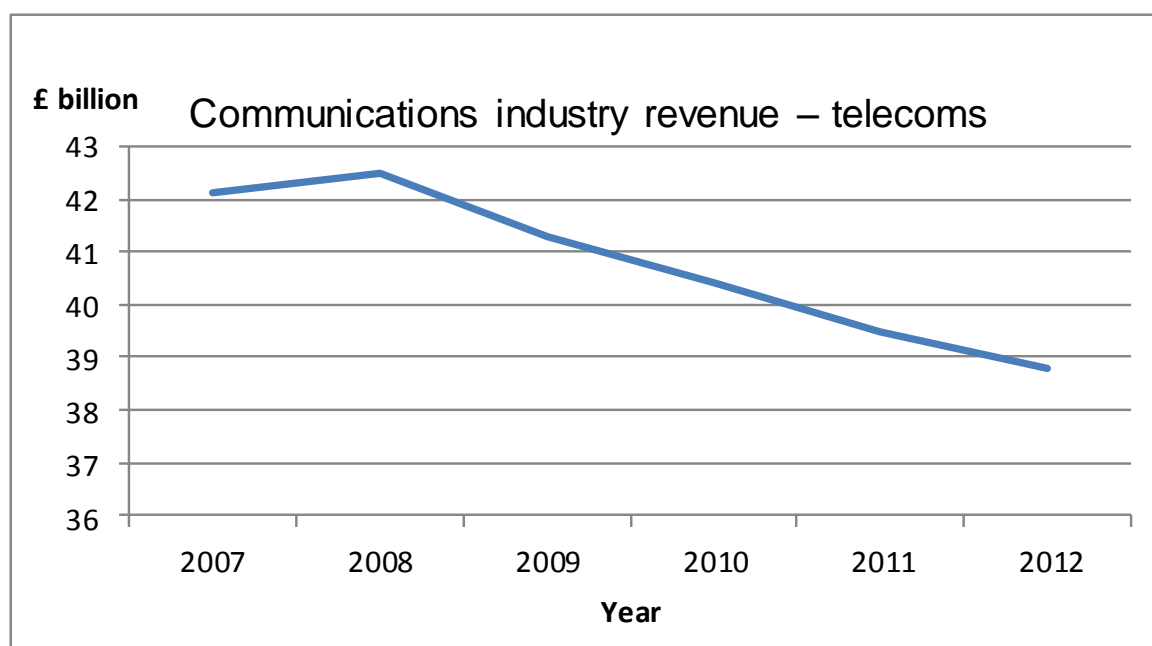


Figure 2 - Source: Ofcom Communications Report 2013 p.21

5.3 The World Economic Forum comments¹³⁹ that in Europe “current industry economics constrain investment in telecommunications infrastructure”. As an example, the report compares estimated levels of investment in mobile infrastructure between Europe, the United States and Japan as shown in the table below:

Mobile infrastructure purchases (\$ – Annual spend per subscriber)	2007 – 2013	2014 – 2016
Western Europe	14.5	8.5
United States	25.5	18.7
Japan	27.9	24.3

5.4 The World Economic Forum report notes that “Europe’s digital health requires many things, but without infrastructure investment, it is difficult to see rapid digital growth taking off”.

5.5 A separate report by the World Economic Forum¹⁴⁰ notes that “Low investment in telecommunications puts at risk not only future consumer benefits but also the [European] region’s overall competitiveness.”

¹³⁹ Delivering Digital Infrastructure – Advancing the Internet Economy, World Economic Forum, April 2014

¹⁴⁰ The Global Information Technology Report, 2013

Private sector investment

- 5.6 Funding is about who ultimately bears the cost of infrastructure. In the UK end users currently fund communications infrastructure investment, other than the taxpayer and television licence fee funded investments through Broadband Delivery UK.
- 5.7 Financing is about the source of the flow of funds to undertake capital investment projects. In the communications sector, private firms typically use their balance sheets, i.e. corporate finance, to fund capital investment. Project finance has been used for telecommunications infrastructure projects in developing countries.
- 5.8 The private sector investment case for digital communications infrastructure projects will depend on the level of return for that investment, the timing of cash flow, the relative attractiveness of alternative investments (including overseas), and the availability of finance.
- 5.9 The level of return for an investment will depend upon:
- The cost of investment;
 - Ongoing operational costs;
 - Revenues accruing to the investment;
 - Risks affecting the level of costs and revenues; and
 - The impact of regulation on any activities or inputs.
- 5.10 For telecommunications providers with international activities, their potential investments in the UK may be compared against returns from investing in other countries including the extent to which those returns are affected by the extent of competition and regulation¹⁴¹ when considering the allocation of available financing.
- 5.11 Revenues are driven by the demand and willingness to pay for broadband services. These are affected by:
- The level of take-up for services;
 - The structure of the value chain for services, e.g. revenues for mobile network operators for voice and SMS messages particularly are declining as the use of OTT applications increases; and
 - The level and nature of competition between communications service providers.
- 5.12 Much of the debate in the UK in recent years has been about ensuring investment in 4G mobile infrastructure and in superfast broadband infrastructure. Telecommunications investment also includes investment in core networks, internet exchange points, research networks, business to business networks, IoT networks (where separate), public sector communications (such as the PSN) and broadcasting infrastructure.

¹⁴¹ For example, mobile call termination and international roaming revenues. Consumer protection measures can also contribute to overheads for operators

- 5.13 This consultation and the forthcoming strategy presume that the first call for investment in digital communications infrastructure should be undertaken by the private sector. Only in the event of market failure to invest where this would result in government policy objectives not being achieved should a contribution of public sector investment be considered.
- 5.14 The remainder of this section considers the potential factors required to facilitate and encourage large scale future private sector investment in increasing the capability and capacity of fixed access networks, mobile networks and complementary networks (e.g. fixed wireless).

Encouraging investment

- 5.15 The following key factors are required to encourage and facilitate investment in digital communications infrastructure:
- A stable regulatory regime which encourages investment;
 - Low costs of infrastructure deployment, particularly so called “civils”;
 - Revenues; and
 - Certainty of government strategy.
- 5.16 **A stable regulatory regime which encourages investment.** A key factor influencing investment is the nature of the regulatory regime. Investors will require that the regulatory regime is sufficiently stable that it does not create external shocks which can abruptly affect revenues and/or costs. This does not mean that regulation should be fixed, as regulators need to respond to market developments both in terms of industry and technologies, as well as government policy and consumer needs and expectations. Section 4 describes the UK regulatory framework. This Framework currently mandates assessments of markets every three years and this timescale is generally regarded as not sufficient for investment certainty.
- 5.17 **Low costs of infrastructure deployment.** Section 4 describes some of the areas where there are issues affecting the costs of the deployment of networks. These include the effectiveness of the PIA remedy, the Electronic Communications Code, access to public sector sites at lower rentals, business rates on network assets, and the use of alternative construction methods such as micro trenching.
- 5.18 **Revenues.** The market for residential consumers for broadband services in the UK is competitive. This can be seen in terms of lower consumer pricing where the UK performs well compared to its major European counterparts¹⁴².
- 5.19 As noted in paragraph 5.2 above, telecoms revenue has been falling in the UK for several years. One view of this¹⁴³ is that industry has been competing to the extent that consumers have benefitted in the short term but that it has left industry with lower revenues to support business cases for substantive longer term investment. However, as the number of consumer subscriptions to superfast broadband increases, which are priced higher than current generation broadband, then there is the opportunity to

¹⁴² European Broadband Scorecard, Ofcom, March 2014

¹⁴³ For example in Delivering Digital Infrastructure, Advancing the Internet Economy: World Economic Forum April 2014 and National Fibre Strategies, Arthur D Little 2013

increase average revenues per user. The level of take-up therefore is important to future investment considerations, as it demonstrates that there is a consumer market willing to purchase services, as well as to reduce the risk that revenues will be insufficient to repay investment costs.

Certainty of government strategy

5.20 Availability of spectrum. Radio spectrum is a key input for the delivery of elements of digital communications infrastructure. For example, mobile services, digital television and radio broadcasting services, microwave links, satellite links and WiFi all require spectrum. The Government's spectrum strategy¹⁴⁴ sets out the government's intentions in the years to 2025 and beyond. This includes making available new spectrum, such as the goal of releasing 500MHz of spectrum below 5GHz from public sector use by 2020.

5.21 The future of copper networks. As the coverage and level of service available on non-copper networks increases the government is likely at some point to need to consider with operators and the regulator whether switching off copper networks is desirable from a commercial and a policy objective. This may need to take into account how best to encourage consumers to switch to non-copper based broadband services prior to this. The benefit of switching off copper networks is that this may further incentivise investment by operators to increase coverage of non-copper networks, and also act as a spur to replace last mile copper networks, or allow substitution with mobile or fixed wireless services. It should be noted that existing copper networks are privately owned assets.

5.22 The government would need to be sure that any switch off of copper networks would not leave any consumers without the availability of communications services, including access to the emergency services and also that any other critical systems (e.g. for monitoring and reporting on other utilities networks) could be migrated to non-copper networks. In addition, the setting of a date would need to be sufficiently far in the future that it would not act as a disincentive to current planned investments, and would minimise the cost of stranding any existing investments in the copper network, including where investment has been made in LLU exchanges.

Q37 How might copper access networks evolve over time alongside other access technologies? Is there a role for policymakers in helping manage any transition from copper to other access networks?

Additional actions

5.23 This section describes a range of incentives and barriers that the government could consider to seek as part of a strategy to address in order to stimulate future investment in digital communications infrastructure. There is a risk that, whilst these should be helpful to investors and the communications industry, they do not lead to a step change in investment in the long term in accordance with the Government's policy objectives of maintaining and improving the UK's trend rate of economic growth in a competitive global marketplace.

¹⁴⁴ The UK Spectrum Strategy – Delivering the best value from spectrum for the UK, Department for Culture, Media and Sport, March 2014

5.24 Future investment needs at a micro level should be determined by the market place and, where appropriate, encouraged at a macro level by Government, and supported and facilitated by a suitable regulatory regime under an independent regulator. The future investment challenge for the UK includes how to deliver, for example:

- Infrastructure that provides for the speed, coverage, capacity, resilience and quality of service that users will demand;
- Moving from the current largely FTTC based infrastructure to the majority of buildings having an access to an internet connection offering FTTP like speeds;
- Greater symmetry in broadband connections to meet the evolving delivery of services across the internet, particularly cloud technology;
- Ubiquitous mobile coverage offering fibre-like speeds and resilience, delivered through 4G and 5G wireless infrastructure, which may require the densification of mobile networks supported by backhaul capacity; and
- Underpinning the areas set out in the Government's Information Economy strategy.

Q38 Views are sought on whether there are any additional actions the Government should consider to ensure:

- a) That the provision of all areas of the UK's digital communications infrastructure remains competitive in order to ensure that the UK can take full advantage of growth opportunities in the Digital Age;**
- b) Aside from legislation and adapting the regulatory framework in the broad sense which other actions should the Government take to encourage investment in communications infrastructure?**
- c) That potential investment in the provision of digital communications infrastructure offers a suitable risk and reward profile to ensure that they can be financed by the private sector.**

Contributing to economic growth

5.25 It is important not to lose sight of the benefits of competition in leading to disruptive conduct which refreshes technology and leads to further investment. The emergence and role of smartphones and their app environment is a perfect example of this.

5.26 Digital communications infrastructure is a vital enabler of other activities that contribute significantly to economic growth as well as supporting a number of major government programmes, including digital by default, the integration of health and social care and supporting people back into work.

5.27 The Government's economic policy objective is to achieve strong, sustainable and balanced growth that is more evenly shared across the country and between industries.

5.28 In particular digital communications infrastructure will directly help the following growth ambitions of the government :

- To make the UK the best place in Europe to start, finance and grow a business;
- To encourage investment and exports as a route to a more balanced economy; and
- To create a more educated workforce that is the most flexible in Europe.

- 5.29 The UK is competing in a global environment. Many sectors rely on digital communications, including the high technology and creative sectors to name just two. The quality of our infrastructure has a significant bearing on how we compete and how we attract investment into the UK.
- 5.30 The UK is not standing still. Our current investments in digital communications infrastructure should allow the UK to share in the proceeds of growth. But do we just want to maintain our trend rate of growth in line with other mature economies? Or should the UK be more proactive and seek to capture more of the available proceeds of growth through acting in advance of demand to get ‘early mover advantage’? Can we improve the trend rate of growth for the UK by investing in and improving our digital communications infrastructure? This encompasses:
- Providing the high quality infrastructure that UK businesses need to successfully compete in a globally competitive environment;
 - Providing businesses with employees able to exploit digital communications infrastructure (this rates highly in many of the surveys);
 - Providing businesses with access to a market of consumers who are able to access and consume the latest digital services;
 - Ensuring an operational environment and marketplace that is highly competitive in attracting foreign direct investment into the UK; and
 - Reducing costs for consumers and making it easier to participate in the digital society.
- 5.31 This approach is not without risks. Investment returns may be uncertain if the UK invests ahead of demand. But not to invest perhaps give rise to the greater risk that the UK will forgo the opportunity to be a leading economy in the digital age.

Q39. Views are sought on:

- a) The case for the UK to invest to gain ‘early mover advantage’;**
- b) In what areas in particular the UK should aim to see investment;**
- c) Are there any actions not covered elsewhere in this report that the government should consider to ensure digital communications infrastructure is in place before it is needed and such that it helps generate need.**

- 5.32 Major initiatives are already underway that, combined, will help inform the country’s future communications technology choices. The Government’s Digital Task Force has recently been created to ensure that the UK is at the forefront of digital and the taskforce will have a prominent role in shaping the strategy. The Information Economy Council’s Future Technologies and Infrastructure work group has committed to doing further exploratory work on the IoT, whilst the recently launched Spectrum Policy Forum will be looking at how to handle future spectrum allocation. The ICT KTN¹⁴⁵, in a study for the Connected Digital Economy Catapult, also published a paper in early 2014 on the issue of future technology choices.

- 5.33 The UK should take into account the potential future opportunities presented by communications infrastructure and, as such, we are keen to get stakeholders' comments on the following issues.
- Q40 How can we maximise the current R&D and innovation UK landscape to help take advantage of the opportunities provided by future technologies? What needs to be done by Government and its agencies, and industry to tackle any gaps?**
- Q41 In which future communications technologies do you consider the UK has, or could achieve, an international leadership position?**
- Q42 What more could government and industry do to exploit future technologies, associated new applications and emerging business models?**

Information Economy Strategy

The Information Economy was selected as one of the eleven sectors for an Industrial Strategy to provide a long term strategic view for government and industry working in partnership to create the conditions for growth. There were over 30 actions in the strategy, mainly focusing on sector skills issues, barriers to growth (particularly for small business), and to provide the framework to enable the UK to harness the commercial opportunities from the use and analysis of data. The Industrial Strategy One Year On Progress Report, published in April 2014 reported on the progress of all eleven sectors, see https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/306854/bis-14-707-industrial-strategy-progress-report.pdf

Information Economy Council

The Information Economy Council, chaired by Ed Vaizey and Victor Chavez, CEO of Thales UK, and President of techUK brings together government, industry, academia, an angel investor and techUK, the trade association. It was set up to provide a vehicle to deliver actions from the Strategy and to set strategic direction for the sector. There are three industry-led working groups on Business Environment and Confidence; Skills and Capability; and Future Technologies and Infrastructure delivering on the actions.

The Business and Environment and Confidence working group's actions are on how to scale up tech companies; to better understand the supply chain; and, to agree a set of data principles for the use and sharing of data. The Skills and Capability working group's actions are: to develop a pipeline of new tech talent; to attract new recruits; to develop the skills for new markets; and as an enabler for citizens and small businesses to trade online. The Future Technology and Infrastructure working group is focusing on how to realise the commercial opportunities from the Internet of Things.

- 5.34 Local bodies (such as Local Authorities and Local Enterprise Partnerships) have a key interest in ensuring that local plans for economic development and growth are enabled by the provision of the appropriate digital communications infrastructure. This infrastructure also supports their work to deliver services digitally to local residents and business, as well as enabling their workforce to operate more efficiently. Local bodies have been working with BDUK, including leading on projects in their own areas and providing local funding alongside central government funding to develop existing broadband projects.
- 5.35 Local Authorities also have assets including sites, buildings and street infrastructure (e.g. lampposts) that can be used as inputs for the provision of network infrastructure. An example of how these can be made available is the collaborative arrangement

developed across 16 London boroughs involving making available local infrastructure under concession contracts supporting the deployment of WiFi and 3G/4G small cells.

Q43. What role might local bodies in have facilitating the future delivery of digital communications infrastructure?

Q44 How can councils maximise the digital communications infrastructure in their local area to support their work on economic regeneration?

Section 6: How to respond

- 6.1 This consultation will run for **eight weeks** from **6 August 2014, closing at midnight on 1 October 2014**. This is a public consultation that is open to all. The extent of this consultation is UK wide.
- 6.2 The full list of questions is set out in Annex C. We would welcome your responses to these questions and any other issues you think relevant. Views are welcome on where action may deliver near term impact whilst contributing to more effective or earlier longer term deployment.
- 6.3 You can email your responses to: dcisconsultation@culture.gsi.gov.uk
- Or write to:
- Digital Communications Infrastructure Strategy Team
Department for Culture, Media and Sport
4th Floor
100 Parliament Street
London
SW1A 2BQ
- Or complete a simplified online survey on our website:
https://dcms.eu.qualtrics.com/SE/?SID=SV_8xq9W5D9afbdDOI
- 6.4 If you have any questions about this consultation or require the consultation document in an alternative format please email dcisconsultation@culture.gsi.gov.uk or write to us at the above address.
- 6.5 When responding, please state if you are doing so as an individual or representing the views of an organisation. If you are responding on behalf of an organisation, please make clear whom the organisation represents and, where applicable, how you consulted your members.
- 6.6 We do not intend to enter into correspondence with individual respondents, but do commit to reading and considering all responses.

How the Government will respond to this consultation

- 6.7 We intend to include a response to this consultation in the document setting out the new Digital Communications Infrastructure Strategy.

Disclosure of responses

- 6.8 The Government intends to publish responses received from organisations to this document on www.gov.uk following closure of the consultation period.
- 6.9 However, all information provided in response to this consultation, including personal information, may be subject to publication or disclosure in accordance with the access to information regimes (these are primarily the Freedom of Information Act 2000 (FOIA), the Data Protection Act 1998 (DPA) and the Environmental Information Regulations 2004).
- 6.10 If you want information that you provide to be treated as confidential, please be aware that, under the FOIA, there is a statutory code of practice with which public authorities must comply and which deals, among other things, with obligations of confidence.

- 6.11 In view of this it would be helpful if you could explain to us why you regard the information you have provided as confidential. If we receive a request for disclosure of the information we will take full account of your explanation, but we cannot give an assurance that confidentiality can be maintained in all circumstances. An automatic confidentiality disclaimer generated by your IT system will not, of itself, be regarded as binding on the department.
- 6.12 The department will process your personal data in accordance with the DPA and in the majority of circumstances this will mean that your personal data will not be disclosed to third parties.



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