

Section 4

Fixed broadband services

- 4.1 Superfast broadband is available to more consumers than ever before, with both industry and Government investments driving improvements in coverage. However, almost 5 million (or 17% of) consumer households and small and medium-sized enterprises (SMEs) remain unable to take advantage of these services. While that number will reduce over the coming few years, a significant proportion of homes and businesses are still unlikely to be able to receive superfast broadband without further action.
- 4.2 This section explores the coverage, performance and take-up of broadband, and highlights the divide between those with access to the best and worst broadband. Given the potential for this divide to exclude citizens, consumers and businesses from full participation in internet-based services that are now vital for many aspects of economic and social activity, we discuss various current and possible future initiatives to improve broadband access for all.
- 4.3 The most important messages are:
- 4.3.1 **The coverage of superfast broadband continues to increase.** Around 24 million (or 83% of) UK premises are now able to receive superfast broadband, up from 75% in 2014. Coverage of superfast in rural areas has increased significantly, from 22% in 2014 to 37% (over 1.1 million premises).
 - 4.3.2 **Many consumers and SMEs are still unable to receive even standard speed broadband.** In the UK as a whole, around 2.4 million (over 8% of) premises cannot receive a speed greater than 10Mbit/s, with around 1.5 million (or 48% of) premises in rural areas being affected.
 - 4.3.3 This divide between the best and worst performing services suggests that intervention may be required to ensure that everyone has access to broadband. **We believe that a download speed of at least 10Mbit/s is necessary to deliver an acceptable user experience.**
 - 4.3.4 Evidence is now emerging that **consumers who opt for higher speed services (greater than 40 Mbps) on average consume more data** as a result of using their service more intensively.

Coverage and speed of superfast broadband services continue to increase

- 4.4 Superfast broadband is now available to 83% of UK premises, up from 75% in 2014. Download speeds¹⁶ have also increased, with superfast broadband users in the UK

¹⁶ The download speeds represented here are known as *line speeds*. For services based on the traditional telephone network, they are the stable speed of the link between the consumer's home or office and the street cabinet/exchange and are sometimes referred to as *sync speeds*. For cable networks broadband, or all-fibre networks based on FTTP, they are the speeds configured in the network equipment that are determined by the service the customer has contracted for. They are a

receiving, on average, 63Mbit/s. The average upload speed of superfast broadband in the UK has remained the same as last year, at 8Mbit/s.

- 4.5 Coverage and speed of superfast broadband in the constituent nations of the UK have also seen similar improvement, as shown in Figure 7. Coverage has improved most in Scotland and Wales, as a result of investment in new and upgraded networks by industry and governments. However, coverage in Northern Ireland has remained unchanged over the past year; we would expect coverage to increase again in coming years as a result of a current Government investment programme, intended to improve services for consumers living in rural areas.

Figure 7: Coverage and speed of superfast services have improved across the UK

	Coverage of superfast broadband, premises		Average download speed of superfast broadband	
	2015	2014	2015	2014
UK	83%	75%	63Mbit/s	54Mbit/s
England	84%	77%	63Mbit/s	56Mbit/s
Northern Ireland	77%	77%	56Mbit/s	50Mbit/s
Scotland	73%	61%	67Mbit/s	54Mbit/s
Wales	79%	55%	59Mbit/s	52Mbit/s

Source: Ofcom analysis of operator data

How is superfast broadband delivered to homes and small businesses?

Broadband that supports download speeds of 30Mbit/s or more is known as superfast broadband. In order to deliver these speeds, service providers need to install fibre optic cabling, which supports higher speeds than the copper cables used in traditional networks.

The current generation of superfast broadband is typically delivered by replacing the copper cable between the local exchange and the street cabinet with a fibre optic cable. The cable between the street cabinet and the consumer's home or business is still made of copper. The replacement of copper with fibre in the connection enables higher speeds for the consumer. It is also possible to use fibre optic from the exchange all the way to the consumer's premises. This offers speeds that are even higher than superfast: ultrafast broadband.

Some common terms used to describe broadband services include:

Fibre to the cabinet (FTTC): This describes a superfast broadband connection that uses a fibre optic connection from the exchange to the street cabinet and a copper cable to connect the cabinet to the home or office, as described above. Providers such as BT, Sky and TalkTalk offer FTTC services.

better indication of the performance actually experienced by consumers than *headline speeds*, which are theoretical maximum speeds that are often not achieved in practice.

Cable: This is a similar concept to FTTC, but the connection between the cabinet and the home or office is made of a particular type of copper cable that can offer very high speeds. Virgin Media offers this kind of service, delivering superfast broadband and television services over its cable network.

Fibre to the premises (FTTP): This describes a service that uses fibre from the exchange directly to the consumer’s home or office. FTTP can deliver superfast or ultrafast speeds and is offered to different extents by BT, KCOM in and around Kingston-Upon-Hull, and several smaller providers such as B4RN in rural Lancashire, Hyperoptic, CityFibre and Gigaclear.

Wireless: This describes a service that uses a wireless connection between the consumer’s home or office and the provider’s network. This kind of service is often based on similar technologies to those used in mobile networks, can deliver superfast speeds and is offered by providers such as Relish in London.

4.6 Coverage of broadband services is generally better in urban areas than in rural areas. This is mainly because it is easier and cheaper to provide services to consumers in more densely populated, urban areas. Figure 8 shows the coverage of superfast broadband in rural areas.

4.7 This year we have used a new approach, based on standard government definitions, to categorise whether a consumer’s property lies in an urban or rural area. This change makes it difficult to make meaningful comparisons of changes in coverage in rural areas between 2014 and 2015¹⁷. However, we estimate that coverage of superfast broadband has increased most in Wales¹⁸ and Scotland¹⁹, albeit from a relatively low level of coverage in previous years.

Figure 8: Rural areas have seen large increases in the availability of superfast broadband

Availability of superfast broadband in rural areas, premises			
	2015	2014 (est.)	Approximate estimated year-on-year increase
UK	37%	22%	1.7×
England	36%	23%	1.6×
Northern Ireland	40%	38%	1.1×
Scotland	31%	8%	3.9×
Wales	50%	17%	2.9×

Source: Ofcom analysis of operator data

¹⁷ We estimate that rural premises make up around 11% of the total number of premises in the UK. See paragraph A1.27 for more information.

¹⁸ The growth in Wales has been largely due to the Superfast Cymru programme, which began in 2013 to provide access to fibre broadband in areas where the commercial sector has no plans to invest.

¹⁹ The Scottish Government’s ambition is to enable 85-90% of Scottish premises to receive broadband speeds of 40-80Mbit/s by March 2016, extending to over 95% by the end of 2017.

- 4.8 There are two main factors behind the increase in the coverage of networks capable of supporting superfast services:
- 4.8.1 **Investment by broadband providers** in an effort to deliver faster services to more customers. For example, BT and Virgin Media have announced plans to further increase their superfast coverage.
 - 4.8.2 **Investment by Government, industry and local authorities** in order to deliver broadband to those areas unlikely to be served by purely commercial deployments, such as rural areas. The UK Government aims to deliver superfast broadband to at least 95% of UK premises by 2017²⁰.
- 4.9 In summary, many consumers are benefiting from the continuing increase in the coverage and speeds of superfast broadband. However, these services are not available everywhere, and there is the potential for consumers who have access only to standard broadband services to become excluded from important online services. In the following section we explore the reasons why superfast broadband is not available everywhere.

Many are still unable to experience superfast broadband

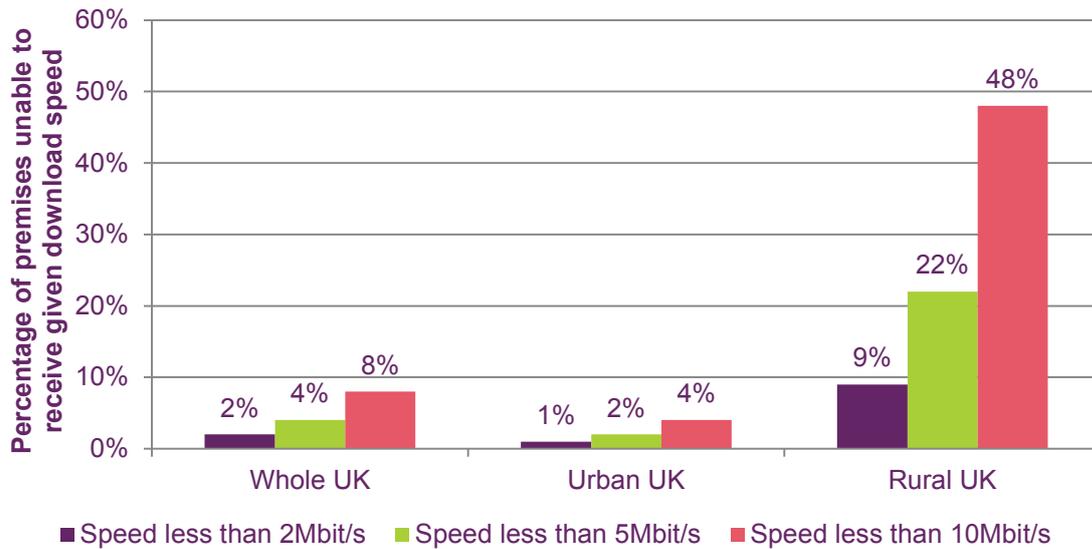
- 4.10 While the coverage and speeds of superfast broadband continue to increase for many, a significant number of consumers are still unable to access these services.
- 4.11 For some consumers, the local infrastructure has been upgraded, but for specific technical reasons their lines cannot receive superfast speeds. Around 2 million (or 7% of) UK premises are connected to upgraded networks but cannot currently receive download speeds of 30Mbit/s; on average, their download speeds are around 18Mbit/s.
- 4.12 Many of the affected consumers are in rural areas, where the relatively long copper cables between premises and street cabinets result in poorer performance, compared to the shorter cables used in urban areas.
- 4.13 A further group of consumers (almost 5 million premises) are unable to receive superfast speeds because superfast broadband roll-out has not yet been extended to their area.

Nearly half of all premises in rural areas across the UK are still receiving speeds of less than 10Mbit/s

- 4.14 These consumers have to rely on slower broadband. This continues to be a particular problem for many consumers in rural areas; around 1.5 million, or nearly 50% of, rural premises are connected by lines that are unable to receive speeds higher than 10Mbit/s and one in five rural premises are unable to receive speeds higher than 5Mbit/s.

²⁰ This commitment is with respect to a definition of superfast as having a download speed greater than 24Mbit/s, used in the BDUK procurement and subsequent contractual framework.

Figure 9: Many UK premises are connected by lines that are unable to support fast speeds



Source: Ofcom analysis of operators’ data

4.15 Of the nations, Scotland has the highest proportion of rural premises (57%) that are unable to receive more than 10Mbit/s. This is largely because coverage of superfast-capable networks in Scotland’s rural areas is relatively low compared to the other nations. However, given the recent increase in the coverage of superfast broadband in Scotland’s rural areas, and ongoing Government programmes across the UK more broadly, we would expect the proportion of premises that are unable to receive at least 10Mbit/s to drop over time.

Why are broadband speeds lower in rural areas?

The distance between the premises and the exchange has an impact on the quality of service received, and in particular the speed of a consumer’s connection. Consumers who live in less densely populated parts of the UK are more likely to live further from the exchange, and therefore achieve lower broadband speeds.

The resistance of copper wire increases with the length of the wire, so speeds decay as the distance between the premises and the exchange increases. Speeds typically start to decrease between 1 and 2km from the exchange and are reduced considerably at distances more than 3.5km.

FTTC-based broadband uses optical fibre to the cabinet and therefore the length of copper wire is reduced. It can currently support superfast speeds up to 80Mbit/s. However, as some copper wire remains between the cabinet and the premises, there can be some decay in speeds for customers located a long way from a cabinet. Customers further than 300m from a cabinet can expect their speeds to be less than half the maximum possible.

However, most consumers who live too far from the cabinet to receive superfast broadband may still benefit from the upgrade at the cabinet, as the reduction in the length of the copper access line will improve their broadband speeds.

Slow broadband is also a significant problem for many smaller businesses across the UK

- 4.16 The UK’s 5.4 million small and medium enterprises (SMEs)²¹ constitute 99.9% of UK businesses, account for 60% of private sector employment and 47% of business revenue. High quality telecommunications services are essential to their ability to participate in and drive the digital economy. In June 2015 we published a report²² which considered how well the broadband market is serving SMEs. This report updates some of that analysis.
- 4.17 We have analysed the availability of superfast broadband delivered to the approximately 1.3 million SMEs with at least one employee (i.e. not including sole traders). We have compared coverage of SMEs against the average, split by geography, shown in Figure 10.
- 4.18 Superfast coverage for SMEs has increased to around 890,000 (or 68% of) premises, up from 56% in 2014, although SMEs still experience lower coverage of superfast services than the population as a whole. We note, however, that some SMEs may have access to alternative sources of connectivity, such as shared facilities within incubator centres.

Figure 10: Coverage of superfast broadband for SMEs compared to all premises

	Superfast coverage for different sized SMEs, premises				
	Total superfast coverage, premises	1 or more employee, premises	Micro (excl. sole traders)	Small	Medium
UK	83%	68%	69%	62%	59%
England	84%	69%	71%	62%	59%
Scotland	73%	55%	56%	53%	50%
Wales	79%	66%	66%	66%	62%
Northern Ireland	77%	66%	64%	71%	75%

Source: Ofcom analysis of operator data

- 4.19 There are broadly similar levels of superfast broadband coverage for SMEs in England, Wales and Northern Ireland. Coverage is lower in Scotland and reflects the lower availability of superfast broadband overall. More generally, the relatively low levels of superfast coverage for SMEs throughout the UK reflects the fact that many SMEs are based in rural areas or business parks, which to date have not been targeted for network upgrades.
- 4.20 Given the relatively low coverage of superfast services for SMEs, we would expect download speeds to also be slightly lower than for the wider population. On average

²¹ Defined as businesses with fewer than 250 employees – around 3.7million of these are sole traders.

²² *Broadband services for SMEs: Assessment and action plan*, <http://stakeholders.ofcom.org.uk/market-data-research/other/telecoms-research/smes-research-jun15/>

the download speed in UK postcodes with at least one SME is 28Mbit/s, compared to 29Mbit/s for the UK as a whole.

Coverage for SMEs in business parks

- 4.21 The data in Figure 10 are based on an analysis of SMEs throughout the whole of the UK, including in residential areas. However, around 290,000 (or 25% of) all SMEs are located within SME-only areas, or business parks, that include no residential or large enterprise postal properties.
- 4.22 To date the deployment of superfast-capable networks has been driven by demand from the private consumer market. As a result, superfast coverage is greatest in residential areas, with non-residential areas often having no superfast coverage at all. Our analysis confirms that there is poorer coverage of superfast broadband in these SME-only areas, and that as a result average speeds are significantly lower, as shown in Figure 11.

Figure 11: Broadband performance and superfast broadband coverage in business parks

	Average download speed (all broadband products)	Availability of superfast broadband, % premises	
		In a postcode with any superfast coverage	In a postcode with 100% superfast coverage
All UK postcodes	29Mbit/s	95%	81%
Business parks	15Mbit/s	92%	56%

Source: Ofcom analysis of operator data

- 4.23 We estimate that, as of August 2015, 46% of premises in SME-only postcodes had broadband connections with a maximum speed of less than 10Mbit/s, 24% had maximum speeds of less than 5Mbit/s and 12% had maximum speeds of less than 2Mbit/s.

18% of SMEs are still unlikely to have access to superfast broadband beyond 2017

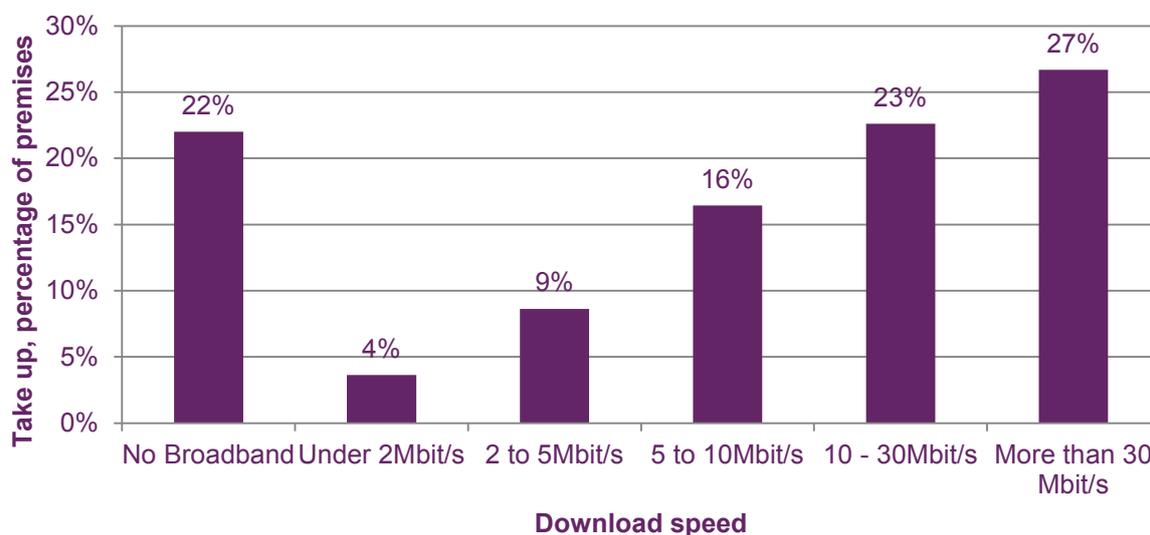
- 4.24 To conclude, SMEs across the UK experience poorer coverage of superfast broadband than the population as a whole. There have been some improvements in coverage over the last 12 months and we expect further improvements as commercial and publicly-funded deployments continue. However, many SMEs are still unlikely to be able to access superfast broadband.
- 4.25 In our report²³ in June 2015 we estimated that by 2017, when 95% of all UK premises are likely to have superfast broadband, around 18% of SMEs (over 230,000) will still not have access to superfast broadband. We have updated this analysis for this report and have found that this conclusion remains valid.

²³ *Broadband services for SMEs: Assessment and action plan*, <http://stakeholders.ofcom.org.uk/market-data-research/other/telecoms-research/smes-research-jun15/>

Increased take-up of superfast services is driving growth in data use

4.26 Superfast broadband has now been taken up by almost 8 million, or 27% of all premises in the UK, up from 21% in 2014, as shown in Figure 12. The percentage of premises not taking up broadband is now 22%, down from 27% in 2014.

Figure 12: Take-up of fixed broadband



Source: Ofcom analysis of operators' data

4.27 Consumers with superfast broadband services will be better able to take advantage of the range of multimedia services that are available, including:

- video streaming of films and TV programmes such as those offered by the BBC, Netflix and Amazon onto TVs and mobile devices;
- seven-day catch-up services streamed via the electronic programme guide on YouView and Freeview Play;
- libraries of downloadable content offering box sets and films, e.g. from Sky and Virgin Media;
- high-definition video calling through Skype and Viber; and
- cloud-based services for the storage and sharing of photos and videos.

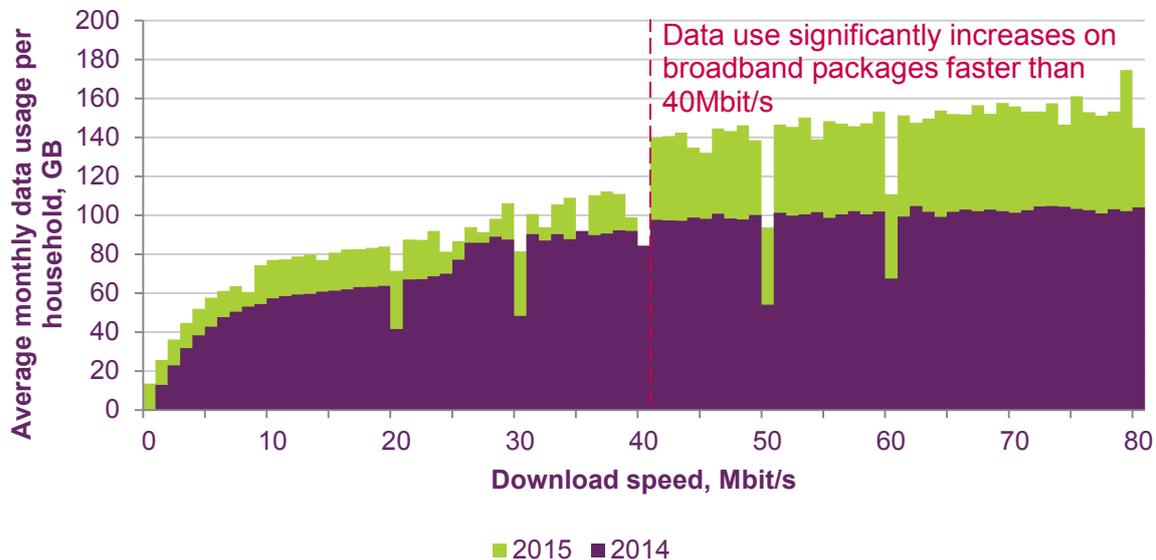
4.28 A combination of higher broadband speeds and the wider use of multimedia services is resulting in increased volumes of data being downloaded and uploaded by consumers. The average amount of data used²⁴ by consumers per month is now 82GB, an increase of 41% since 2014.

4.29 Figure 13 shows how users with broadband connections faster than 40Mbit/s are driving the increase in monthly data use, with an average increase of around 47%

²⁴ A combined figure of the volume of data downloaded and uploaded.

over the past year. This increased use of data by consumers on the fastest packages could be clear evidence of demand for superfast services.

Figure 13: Users with the fastest broadband connections are driving the increase in data use



Source: Ofcom analysis of operator data

4.30 While high-speed connections are important for the delivery of these multimedia services, a range of other factors can also affect the user's quality of experience. We return to these issues from 3.52 below and they are analysed and discussed further in Section 6.

Ultrafast services are beginning to appear

4.31 Alongside the continuing roll-out of superfast broadband services, a range of new services are beginning to emerge that offer even faster speeds. These services are enabled by new technologies, such as:

- 4.31.1 Fibre optic networks connecting premises directly to local exchanges, without the need for slower, copper-based cabling. A range of large (e.g. BT, KCOM) and smaller (e.g. CityFibre) companies are beginning to offer these fibre-to-the-premises (FTTP) services.
- 4.31.2 Improved computational power and technology development, which is enabling the more efficient encoding and transmission of data across network links. For example, Virgin Media periodically updates its network equipment, including home routers, to enable faster speeds over its existing network.
- 4.31.3 In those areas where FTTP services are not economically possible, G.fast, an emerging technology capable of delivering speeds in excess of 100Mbit/s, is being deployed. It takes high-speed fibre connections closer to the consumer's premises and uses a short copper cable to complete the link.

4.32 There is not yet a consensus on a definition for these ultrafast services, with views on the minimum download speed ranging from 100Mbit/s to 1Gbit/s. Figure 14 shows the current coverage of broadband services in UK with download speeds of 100Mbit/s and 300Mbit/s.

Figure 14: Coverage of faster broadband services with download speeds of 100 and 300Mbit/s

	Coverage of premises, %	
	Download speed is 100Mbit/s	Download speed is 300Mbit/s
UK	46%	2%
England	49%	2%
Scotland	38%	2%
Northern Ireland	27%	0%
Wales	26%	5%

Source: Ofcom analysis of operator data

4.33 For this report, we have defined ultrafast services as those delivering a download speed of 300Mbit/s or more. We will continue to monitor the coverage of these faster services and may, if appropriate, refine our definition as the market evolves.

Smaller providers are extending the reach of broadband to new areas

4.34 As we reported last year, a number of small, or non-major, providers are continuing to deploy networks offering superfast or ultrafast services. Recognising the important role played by these providers in improving the availability of superfast broadband services to consumers, we collected data from a sample of five of the providers from across the UK²⁵.

4.35 The combined coverage of the five providers is 1.3% of all the premises in the UK, or over 370,000 premises. As a result of this coverage, about 71,000 premises are able to receive superfast broadband and over 174,000 premises are able to receive ultrafast broadband that would otherwise not receive a broadband service.

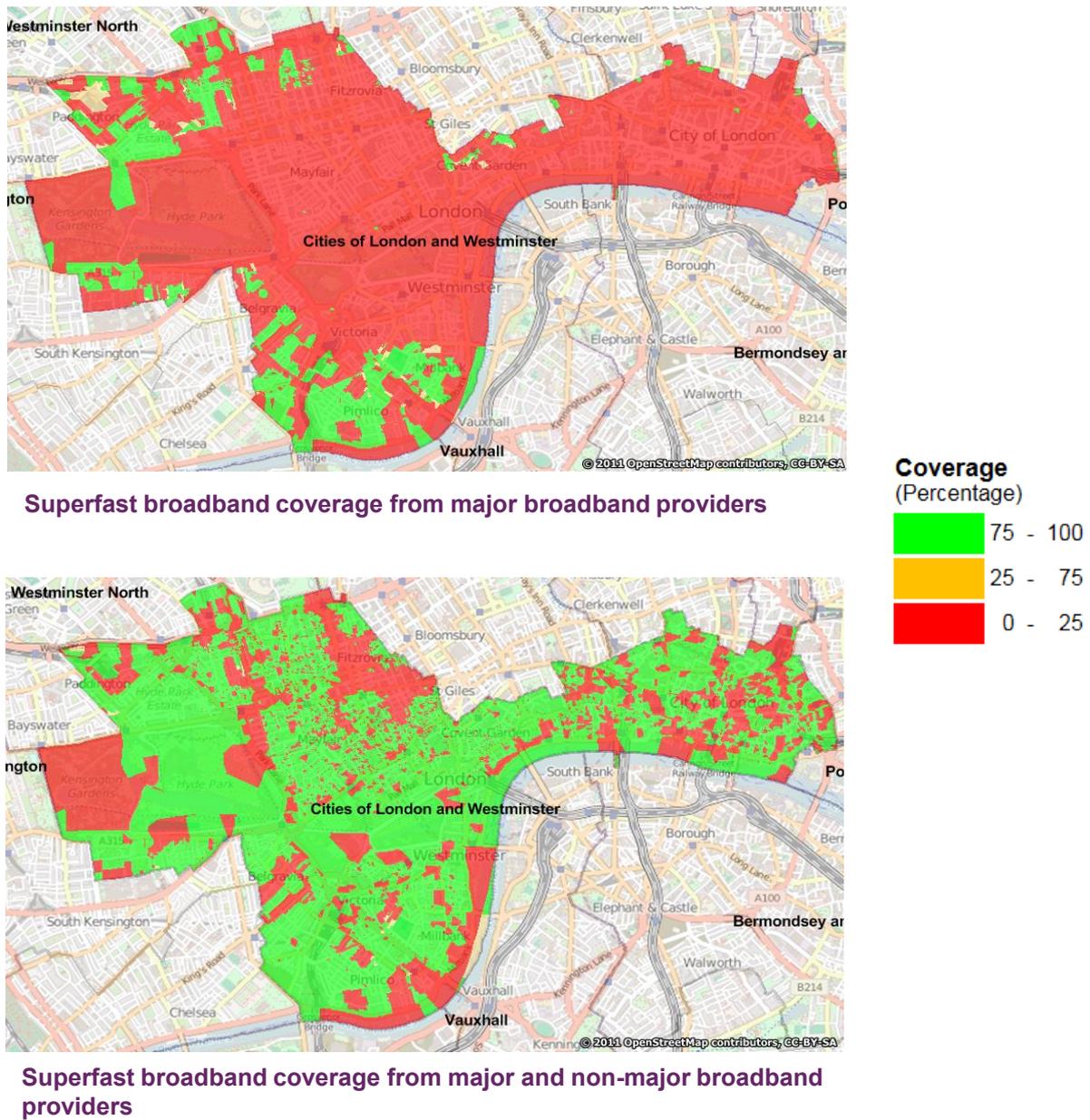
4.36 These providers often operate in areas where there is little or no existing provision of superfast broadband. As an example, Figure 14 compares the improvement in superfast broadband coverage due to the presence of non-major broadband providers in the Cities of London and Westminster constituency.

4.37 We have chosen this constituency as it is a good example of an urban “not-spot”. Although it is in the middle of a large city, it has low superfast broadband coverage due to a high number of “exchange-only lines”, which are unable to be upgraded easily, and limited cable rollout.

4.38 Due to the rollout of networks by non-major providers in this area, there has been significant improvement in coverage of superfast broadband, with 46% more premises having access to superfast broadband.

²⁵ We aim to collect and analyse data from a wider set of non-major broadband providers in the coming years.

Figure 15: Illustration of the improvement in superfast broadband coverage due to the presence of non-major network providers



Source: Ofcom analysis of operator data
 Contains Ordnance Survey data © Crown copyright and database right 2015
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The focus should now be on delivering better broadband to all, so everyone can benefit

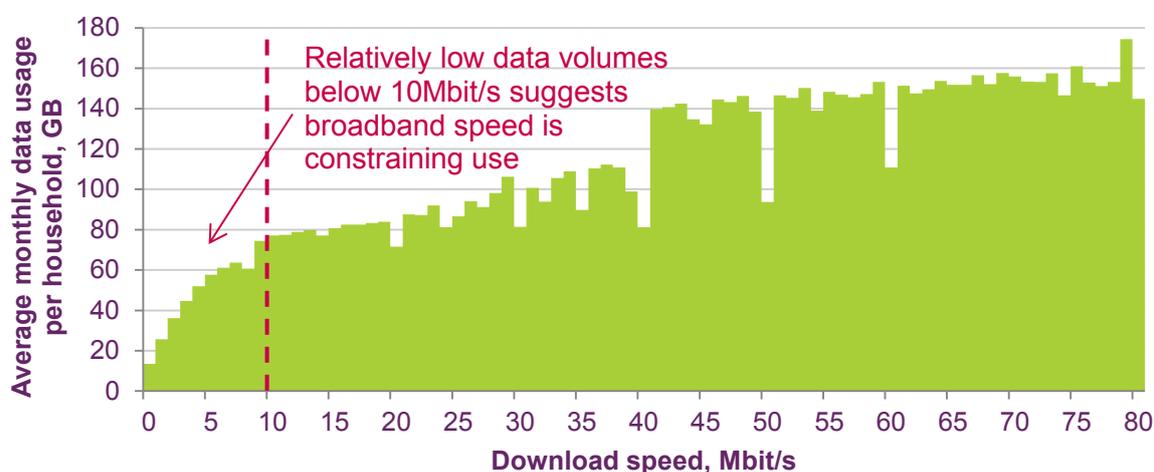
- 4.39 As we have seen, a significant proportion of households and small businesses still cannot access standard broadband services, particularly in rural areas. Almost half of all rural premises cannot get broadband that delivers more than 10Mbit/s. There are also problems in urban areas, where 4% of premises cannot get 10Mbit/s broadband.
- 4.40 There have been a number of UK Government interventions under the Broadband Delivery UK (BDUK) initiative to improve broadband access:

- 4.40.1 **Rural Broadband Programme (Phase 1):** A £530m scheme aimed at rural areas to achieve 90% coverage of superfast broadband (in this case defined as having a download speed faster than 24Mbit/s).²⁶
- 4.40.2 **Superfast Extension Programme (Phase 2):** A £250m scheme aimed at extending superfast coverage to 95% of premises by 2017.
- 4.40.3 **Competitive Fund (Phase 3 pilots):** A competition for a pot of £10m of funding to pilot potential solutions for the final 5% of premises not covered by phases 1 or 2.
- 4.41 The current universal service commitment (USC), set by the Government in 2009, specifies that every household should have broadband access of at least 2Mbit/s. The Government aims to meet this target by the end of 2016 through its Rural Broadband Programme.
- 4.42 The Government is now beginning the process of implementing a broadband universal service obligation²⁷. Its ambition is that this will give all users – consumers and small businesses – in the UK a legal right to request a broadband connection delivering speeds of 10Mbit/s or higher.

Broadband use is constrained by download speeds lower than 10Mbit/s

- 4.43 As we have already seen, the amount of data that consumers download and upload each month has increased over the past year. Figure 15 shows that the volume of data used increases with download speed, and also suggests that the volume of data used is constrained by broadband speed.

Figure 16: Average monthly data use increases with download speed



Source: Ofcom analysis of operator data

²⁶ In practice, since this intervention is based on a ‘gap funding’ model, with industry intervention partners providing additional investment, the actual funding supporting the programme is considerably higher. Indeed, since contracts were awarded on the basis of only 20% take-up, which is in many cases already being exceeded, ‘claw-back’ mechanisms are being invoked, channelling the higher-than-anticipated revenues and consequent profits into further network deployment.

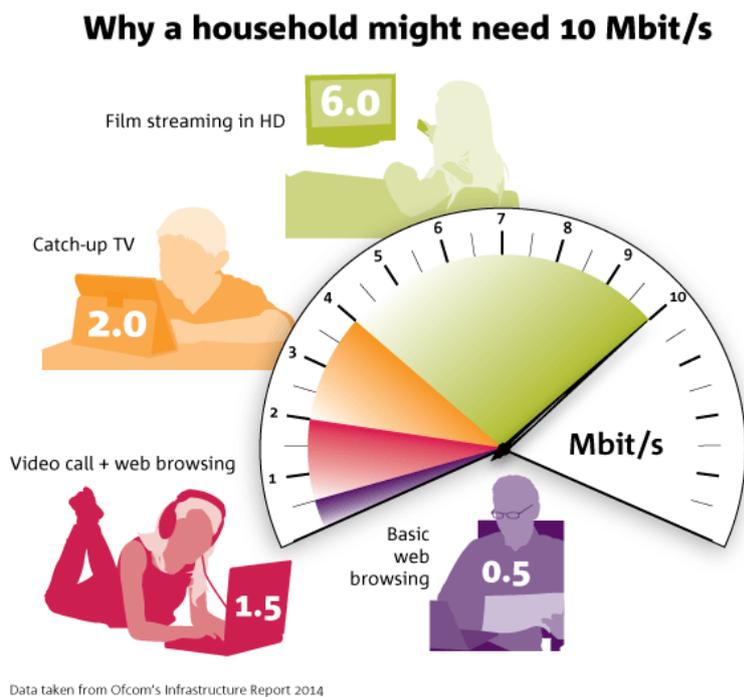
²⁷ <https://www.gov.uk/government/news/government-plans-to-make-sure-no-one-is-left-behind-on-broadband-access>

4.44 Those selecting superfast broadband (over 30Mbit/s) are likely to have done so in order to download more and use the internet more actively than those who have not chosen to, or been able to, upgrade. Below 20Mbit/s, there appears to be a restriction on the amount that households download. As the download rate falls below about 10Mbit/s, the volume of data used decreases rapidly. This may be evidence that users would use more data if their connections were faster.

Connections faster than 10Mbit/s deliver a better quality of experience to the consumer

4.45 The types of service that should be achievable with download speeds of 10Mbit/s are shown in Figure 16 below. At peak time, some of these services may be being used simultaneously, in some cases requiring a download speed greater than 10Mbit/s.

Figure 17: Data rate requirements for household use



Source: Ofcom

4.46 The continued improvement in the efficiency of video transmission is likely to mean that the speed required for streaming video will fall over time. However, higher-quality video, such as 4K, will require higher data rates than high-definition video. Upload speeds are also important, particularly for voice and video internet calling.

There is a requirement for a minimum download speed beyond the 2Mbit/s that is due to be available to all by the end of 2016

4.47 The current universal service obligation²⁸ (USO) provides a legal right for consumers to request a connection to a fixed location that provides voice, fax and functional (i.e.

²⁸ <http://stakeholders.ofcom.org.uk/telecoms/ga-scheme/specific-conditions-entitlement/universal-service-obligation/designation-of-bt-and-kingston/>. Other universal service obligations relate to,

non-broadband) internet access. It was introduced in 2003. At the time, it was intended to ensure the provision of narrowband services; the majority of those connected online at the time were using dial-up internet.

- 4.48 Since 2003, broadband has been taken up by almost 80% of households in the UK. The current USO has no provision for broadband. Some member states in the European Union have implemented broadband USOs, commonly at speeds of 1Mbit/s.
- 4.49 Broadband USOs are set at a specified download speed. This speed reflects the speeds available to the majority of users in the country. As illustrated by Figure 16, a minimum of 10Mbit/s enables an improved user experience with the capacity to operate numerous applications across the household, e.g. voice and video calls, video streaming and faster downloading of programmes and documents.
- 4.50 The Government has announced its intention to consult on the establishment of a 10Mbit/s USO early in 2016, and Ofcom will be continue to work with the Government to ensure that this target is implemented effectively.

A variety of technologies could serve the final 5%

- 4.51 Regardless of what form the intervention takes, there will be a need to consider which technologies might be suitable for deploying high-speed broadband to remote rural areas.

Fixed technologies

- 4.52 **Fibre to the cabinet** will continue to play an important role in upgrading the speeds of those in the final 5%. In areas where there are existing cabinets, the issue in the final 5% will be the number of households connected to the cabinet. The average BT cabinet in the UK will serve between 200-300 premises. In the final 5%, this can fall dramatically, making the economic case for installing a fibre-enabled cabinet difficult.
- 4.53 **Fibre to the remote node** is a newer technology that will deliver faster speeds by bring fibre connections even closer to the premises, and is likely to be a key element of G.fast deployment. The fibre line is deployed to a manhole or a pole outside the property, dramatically reducing the length of copper used. The key challenge will be to ensure a power supply to the remote node: reverse powering, where electricity is drawn from the premises rather than the exchange, could achieve this.
- 4.54 **Fibre to the premises** involves the deployment of fibre directly from the exchange to the property. There are two deployment options. The first involves a dedicated fibre connection to each property, which offers the fastest speeds but is expensive to deploy. The second option, which is cheaper and more commonly used in the UK, is for a single fibre connection to be shared by neighbouring properties. However, speeds may be limited, particularly at peak time, compared to the dedicated approach.

among other things, directory services, public payphones, billing, payments and tariffs, and specific services for disabled users, as well as the public provision of telephone services

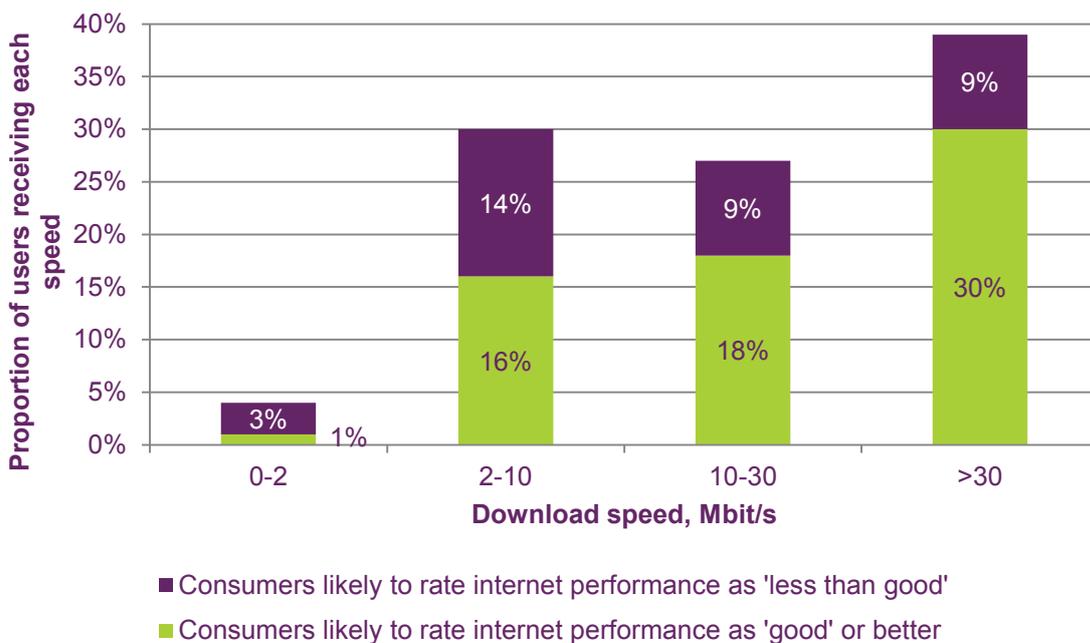
Wireless technologies

- 4.55 **Fixed wireless** includes various options using wireless technology to connect to consumer and business premises. Wi-Fi and LTE can be used in these scenarios. However, although these are useful in reaching a group of premises that do not have adequate fixed infrastructure, it could still be costly to roll out to individual isolated premises.
- 4.56 **Satellite** broadband has the advantage of being able to cover large parts of the country with a small number of satellites. This effectively means that satellite broadband can offer a variety of speeds (including superfast) to anywhere in the UK. However, the number of users that can be supported at a given time is relatively limited, compared to other broadband solutions. Satellite broadband is one of the applications being considered in our strategic review of satellite and space science use of spectrum.
- 4.57 Each of these technology options has advantages and disadvantages, so it is likely that any intervention for these locations will involve a mix of technologies. This reflects the variety of technical and economic challenges faced when upgrading broadband in these areas.

Connection speeds provide a relatively good but incomplete picture of broadband performance

- 4.58 While there is a strong link between connection speeds and the likely consumer broadband experience (see Figure 17), factors such as data congestion in in-home broadband connections, the ISP’s network or the wider internet, mean that speed does not always provide a full picture of broadband performance.

Figure 18: Consumers with faster broadband speeds are more likely to rate their internet experience as ‘good’ or better



Source: Actual Experience for Ofcom

- 4.59 Connections between the broadband home router and consumer devices using Ethernet, powerline or wireless (e.g. Wi-Fi) can affect the quality of internet services when accessed on consumer devices.
- 4.60 Over the past two years we have been conducting research into a new measurement method capable of assessing the effects of these additional factors²⁹. The results of this work in relation to the in-home connection are described below, and those for the ISP network and wider internet in Section 6.

The quality of in-home network connections plays a significant role in about 20% of homes with poor broadband performance

- 4.61 Our research has identified that for most households, most broadband performance problems occur in the access and ISP's network, but the quality of in-home network connections also plays a role in many households. In particular we have found that:
- 4.61.1 the quality of home-network connections plays some role in over 75% of households with poorly performing broadband connections (i.e. likely to be rated as 'less than good' by consumers); and
 - 4.61.2 the quality of home-network connections is responsible for more than 25% of the connection problems in 20% of households with a poorly performing broadband connection.
- 4.62 Given the role played by the in-home network on broadband performance, and the increasing use of Wi-Fi to connect to consumer devices, Ofcom has made an app available to help consumers identify whether their Wi-Fi may be limiting the performance of their broadband connection and hence their experience of using online services.
- 4.63 The app can be installed on smartphones and tablets and works by testing both the in-home Wi-Fi connection and the connection to the wider internet. Using these tests the app determines the extent to which the Wi-Fi network may be the source of any performance problems. The app also provides consumers with advice on how to potentially resolve these issues. Our website³⁰ provides links to the Apple and Google app stores, from where the app can be downloaded.

²⁹ <http://stakeholders.ofcom.org.uk/binaries/research/infrastructure/2015/downloads/qoe-analysis.pdf>
http://stakeholders.ofcom.org.uk/binaries/research/infrastructure/2015/downloads/qoe_uk-analysis.pdf

³⁰ <http://stakeholders.ofcom.org.uk/market-data-research/market-data/infrastructure/connected-nations-2015/WiFi-checker-app/>