

Connected Nations 2019

Wales report



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Overview

This annual report measures progress in broadband and mobile services in Wales and sets out the role Ofcom plays in helping to further improve them.

Alongside this report, we also provide an [interactive dashboard](#), allowing people to see data for different areas, services and coverage levels. This includes coverage data for all Welsh local authority areas, Westminster and National Assembly for Wales constituencies. Further reports are available at a [UK-wide level](#) and for the other [Nations of the UK](#).

We are also making it easier for people to access our data, so they can create their own interactive services. We have two application programming interfaces (APIs), which allow others to use our data creatively to develop services, such as apps and widgets to benefit consumers and businesses. More than 50 organisations are now looking to exploit this capability.

This report highlights the work Ofcom is doing, alongside the UK Government, Welsh Government and communications companies, to improve the availability of fixed and mobile services across Wales. Ofcom wants people in Wales, and the rest of the UK, to be able to easily access good broadband and mobile connections wherever they live, work and travel.

What we have found:

- 165,000 homes in Wales (12%) now have access to full-fibre broadband connections; over 90,000 more premises than last year. These connections can deliver much higher download speeds, of up to 1 Gbit/s and are also much more reliable than older, copper-based broadband.
- The number of homes with access to superfast (at least 30 Mbit/s) broadband in Wales now stands at 93%, With ultrafast speeds (at least 300 Mbit/s) available to 31% of homes in Wales - a three percentage point increase from last year (28%).
- The deployment of wireless home broadband from BT/EE on their mobile network further reduces the number of premises that cannot get a decent broadband service. We now estimate that as few as 189,000 homes (18,000 in Wales) should be unable to access a decent fixed broadband service, subject to confirmation of individual premises coverage. From March, those homes unable to get a decent connection will be able to request one from BT¹².
- 5G services have been launched by all four mobile network operators over the past year and are now operating in over 40 towns and cities across the UK.
- 4G coverage from all four operators now extends to 58% of Wales' landmass However, indoor 4G coverage by all four operators extends to 73%. The proposed Shared Rural Network programme being negotiated between the operators and Government, with support from Ofcom, will aim to extend coverage for all operators well beyond this.
- 90% of homes and businesses in Wales should be able to get good 4G indoor coverage from all operators. We estimate that 9,514 premises cannot access either a decent fixed broadband service or get good 4G coverage indoors (from any operator).

Work continues to improve service availability

Ofcom initiatives

Ofcom supports investment in full fibre networks to make sure the needs of consumers and businesses continue to be met. We support this through measures designed to encourage investment from Openreach and make it cheaper and easier for other providers to build their own networks. This has helped to support faster growth in full fibre over the past year. We will publish proposals on this as part of our forthcoming consultation on the Telecoms Access Review, which will also include a number of other regulatory measures to encourage new network investments.

We have also worked to encourage early investment in 5G mobile networks, and this is already bearing fruit.

¹ Or KCOM in the Kingston-upon-Hull area.

² Subject to eligibility criteria

Working with the UK and Welsh Government

Alongside the work we do as a regulator, there will continue to be a role for government to help improve access to mobile and broadband, including by investing public money in networks in areas which are unlikely to be covered commercially. We will work closely with the new UK Government as it develops plans to invest £5bn in full fibre and gigabit capable broadband and as it works towards an agreement with the mobile operators on a Shared Rural Network (SRN). We will also continue to work closely with the devolved governments as the implementation date for the Broadband Universal Service Obligation approaches. More detailed information about publicly funded schemes in Scotland and Northern Ireland can be found in the individual nations reports.

Fixed broadband services

In this report, we also focus on the availability of services for decent (10 Mbit/s and above), superfast (30 Mbit/s and above), ultrafast (300 Mbit/s and above) and full-fibre broadband, which can offer speeds of 1 Gbit/s. Our report shows that coverage of faster broadband networks, particularly full-fibre networks, is increasing, and consumers are increasingly taking up the faster broadband services.

Decent broadband coverage is improving but more remains to be done

Coverage from conventional fixed line networks continues to improve but around 50,000 homes and businesses in Wales are still unable to receive a decent broadband service. Increased coverage from fixed wireless networks, including those of the mobile operators, provides an alternative to a fixed line connection but we estimate this still leaves approximately 18,000 premises in Wales without any decent broadband service at all.

In March 2018, the UK Government introduced legislation for a Broadband Universal Service Obligation (USO), which will give eligible homes and businesses the right to request subject to eligibility criteria a broadband connection that delivers a decent broadband service of at least 10 Mbit/s download speed and 1 Mbit/s upload speed. Ofcom is implementing this, and it will come into force in March 2020.

Superfast and ultrafast broadband rollout continues

In addition to full-fibre rollout, investment in superfast and ultrafast coverage continues, but at a generally lower pace than previously reported. This is because most of the country now has access to superfast broadband. The total number of premises able to get superfast broadband in Wales now stands at 93% of premises able to access superfast broadband with a download speed of at least 30Mbit/s.³ Coverage of ultrafast broadband, with download speeds of at least 300Mbit/s, has also increased from 10% of premises in 2017 to 31% of premises in Wales (a two percentage point increase from last year from 29%)

Mobile services

Mobile coverage across Wales is gradually improving but some parts of the country still struggle to get a good mobile connection. Good reception is easier to achieve outdoors than inside because mobile signals are weakened by obstacles such as walls and the glass used in cars and trains. Because of this, we report separately on outdoor and indoor coverage. We also report on in-car and out-of-car coverage on roads.

Mobile coverage

89% of Wales' landmass (91% of the UK) now has good outdoor 4G coverage from at least one mobile operator. Only 58% of Wales' landmass (66% UK) has good outdoor 4G coverage from all four operators. The proposed Shared Rural Network should further reduce the areas without good 4G coverage.

Indoor call coverage from all four operators is available to 90% of premises in Wales. Indoor 4G coverage from all four operators has increased to 73% of premises in Wales. EE provides the highest level of good indoor data (92%) and Vodafone provides the highest level of good outdoor geographic voice coverage (91%). O2 has the highest voice call coverage covering 91% of the Wales' landmass, around 4 percentage points above Three and Vodafone and 6 percentage points above EE.

11% of the landmass in Wales does not have good outdoor 4G coverage from any operator, again, largely unchanged from last year.

There are a small number of premises that do not have a decent fixed line or good 4G mobile network connection

As with last year this report looks at those premises unable to get a decent fixed (at least 10Mbit/s download speed) or a good 4G mobile broadband service. We estimate that around 9,524 premises in Wales (53,000 UK premises) are unable to access a decent fixed broadband service or a good mobile broadband service. The broadband USO, which we are implementing, and the proposed SRN for improved mobile coverage should reduce the number of premises that are unable to receive either a decent fixed or good mobile service. However, there might be some premises that will require an alternative technology solution.

5G

As of October 2019 EE, O2, Three and Vodafone were offering mobile and/or fixed 5G services. They have launched 5G in more than 40 cities and towns in the UK. Initial offerings are focused on densely populated areas.

As well as providing improved broadband services for consumers via public networks, future 5G networks could provide specialist services to organisations and businesses. We expect our new spectrum sharing framework announced in July to provide support for organisations and businesses to deploy such private wireless networks.

Network security and resilience

As people and businesses become more reliant on fixed and mobile networks, and the threat from cybersecurity risks increase, companies must manage security risks and safeguard the availability of their services. We are working closely with the UK Government and its agencies to improve security and resilience, for example by contributing to the work initiated by the [Supply Chain Review](#) being led by DCMS.

In previous Connected Nations, we reported on the significant incidents that we have been informed about by fixed and mobile phone companies. This year, we have found:

- Network problems and outages continue to occur with roughly the same frequency, root causes and level of impact.
- Fixed telephone networks tend to be the most reliable, with the worst being unavailable for five hours during the year. Fixed broadband networks reported up to 24 hours of unavailability. Mobile networks tended to perform somewhat worse with reported unavailability ranging from seven hours to two days.
- The few large-scale outages that do occur can have a major impact on users.

So, Ofcom is increasingly focused on how networks could be designed and operated to minimise the risk of widespread failures and mitigate their impact. We are working with industry and Government to achieve this. We are also continuing with our increased focus on cyber security through our Security and Resilience Assurance Scheme, with initiatives such as a penetration testing programme. We continue to work closely with Government and the National Cyber Security Centre (NCSC) on a set of technical security requirements for the telecoms sector.

Contents

Fixed broadband and voice.....	7
Mobile voice and data	21
Glossary	36



Fixed broadband and voice

Key highlights for Wales

Fixed broadband networks	Wales	UK
Coverage of broadband faster than:		
>=10Mbit/s	97%	98%
Premises that don't have access to decent broadband	3%	2%
Superfast broadband coverage (% of premises with >=30Mbit/s)	93%	95%
Superfast broadband coverage in rural areas (% of premises)	78%	79%
Full fibre (residential)	12%	10%
Superfast lines delivering superfast speeds (% of premises – indicative of superfast take-up)	46%	57%
Average broadband speed (download)	49Mbit/s	60Mbit/s
Average broadband speed (upload)	8Mbit/s	9Mbit/s
Average broadband download speeds by settlement type:		
Urban	54Mbit/s	64Mbit/s
Rural	32Mbit/s	43Mbit/s
Data use (monthly average)	338GB	315GB

Introduction

A key priority for Ofcom is to [encourage investment in full-fibre](#), which provides greater speed and reliability than copper-based telecoms networks. The UK and devolved governments are also supporting the move to improved connectivity for the country.

For this report, we have expanded the number of companies contributing data to our analysis, incorporating coverage information from fixed wireless access providers and smaller full-fibre network providers.

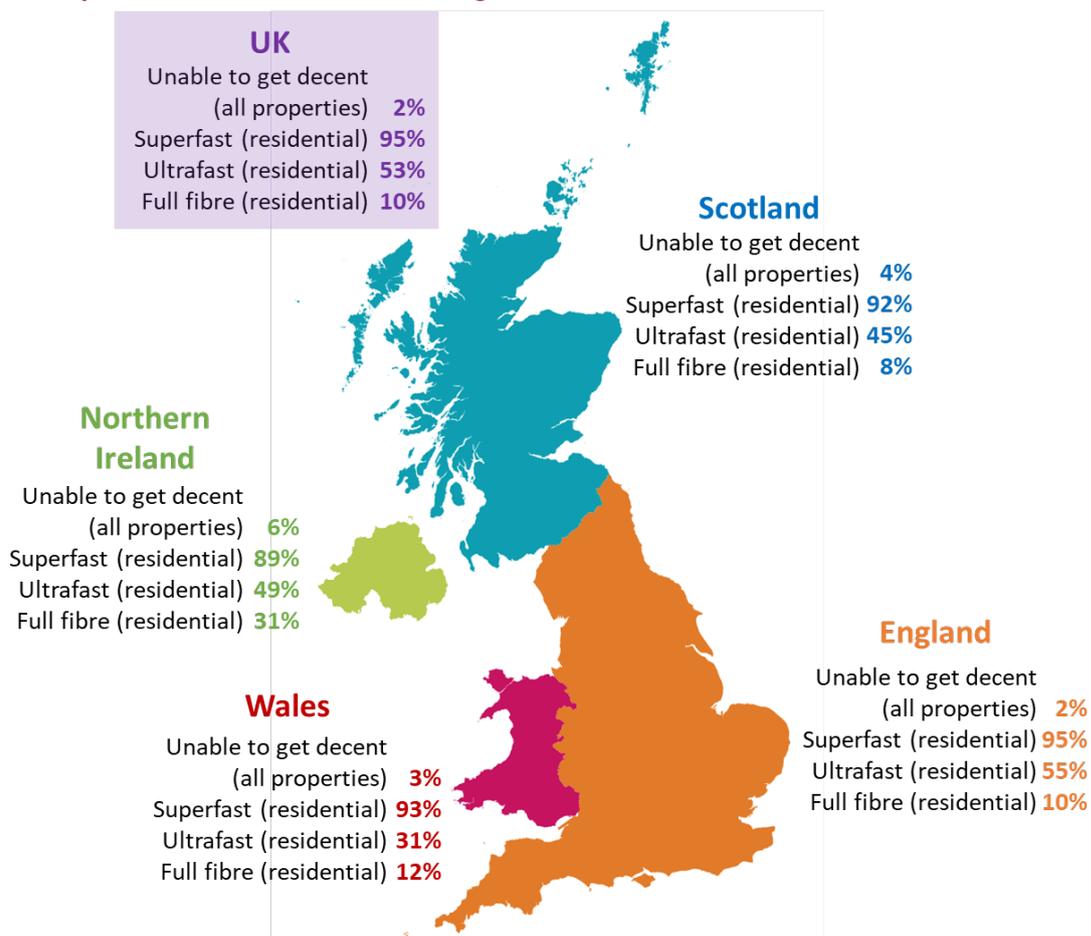
We also highlight some of the developments in the preparation for migrating voice services to be delivered over fibre broadband connections.

Key highlights:

The most important points for fixed broadband in Wales are:

- Superfast broadband coverage to residential properties stands at 93%. This relates to the availability of fixed broadband with a download speed of at least 30 Mbit/s.
- 12% of premises (165,000) now have access to a full-fibre connection, capable of delivering much higher download and upload speeds. 15% of these premises are in urban areas and 8% in rural areas.
- Around 50,000 (3%) homes and businesses in Wales are still unable to access a fixed broadband service that delivers a decent broadband connection, that is one that delivers a download speed of at least 10 Mbit/s and an upload speed of at least 1 Mbit/s.
- Factoring in the coverage from other fixed wireless networks that can deliver a decent broadband service, up to 189,000 homes and businesses in the UK (18,000 in Wales) may be eligible for the Broadband USO when it launches in March 2020

Summary of fixed line broadband coverage across the UK and Nations



Fixed broadband coverage has increased across the UK

There has been continued investment in fixed networks resulting in improvements in the availability of superfast, ultrafast and full-fibre broadband. Consequently, the number of premises that do not receive decent broadband has also declined.

Access to a superfast broadband service continues to increase although at a slower pace than for previous years

Ofcom defines superfast broadband as a service which delivers a minimum download speed of at least 30 Mbit/s. The Scottish Government and Welsh Government also use this definition in their schemes to extend broadband coverage.

Over the past year the coverage of superfast broadband to residential homes across the UK stands at 95%, broadly similar to last year.

Nation	Residential superfast coverage
Scotland	92%
Wales	93%
Northern Ireland	89%
England	95%

Superfast availability for UK business or commercial properties is somewhat lower (86%) than for residential premises. This may be due in part to lower availability in business parks, due to the costs involved in rolling out technology these areas and the higher use of business broadband services to such areas (such as private lines).

There is also a significant difference between the availability of superfast broadband in urban and rural areas, with 97% of residential premises in urban areas having access to superfast broadband compared to 79% in rural areas.

We expect superfast broadband coverage to continue to increase as a number of public sector interventions are currently underway:

- As part of the Autumn 2018 Budget, the Chancellor announced that £200m would be made available to pilot innovative approaches to the deployment of full-fibre via the Rural Gigabit Connectivity Programme. The programme aims to deliver gigabit capable connections to key public and business buildings, including schools, as well as encouraging broadband providers to create additional connections to local homes.
- Building Digital UK (BDUK) has extended 24 Mbit/s coverage to 95% of the UK and estimates that by 2020 this coverage will be extended to at least a further 2% of UK homes and businesses.
- The Local Full Fibre Networks Programme ('LFFN') is allocating £200m to local projects to incentivise and accelerate commercial investment in full-fibre broadband. As part of the LFFN programme, a £67m Gigabit Broadband Voucher Scheme was launched to help small businesses and the local communities around them to contribute to the installation cost of faster connections using gigabit-capable infrastructure.

- The Scottish Government has committed to extending superfast broadband access to 100% of premises in Scotland as part of its 'Reaching 100%' (R100) programme. Contracts for the £600m programme are being finalised, with BT Group plc named as the preferred bidder for all three geographical lots across Scotland.
- The Welsh Government has announced that BT has won all three lots of the new Phase 2 Superfast Cymru programme. This will initially provide access to fast broadband to 26,000 premises by March 2021 with the majority of these premises being served by FTTP connections. In Northern Ireland, the Department for the Economy has identified 97,000 premises that will be eligible for a broadband boost under **Project Stratum**. The £165m project seeks to improve connectivity for those unable to access broadband services of 30 Mbit/s or greater. Procurement was launched in July 2019 and contract award is anticipated in mid-2020.

Superfast Cymru, its successor scheme and rollout

Superfast Cymru delivered superfast broadband access to around 733,000 homes and businesses in Wales (at >24 Mbit/s), of which 717,000 can achieve speeds of at least 30 Mbit/s. The project was delivered with a public sector investment of over £220m. The technology rolled out by Openreach was primarily Fibre to the Cabinet (FTTC) with some Gigabit-capable Fibre to the Premises (FTTP) technology. This roll-out finished in 2018.

The Welsh Government awarded its Superfast Cymru successor scheme contract to BT which is expected to provide 26,000 premises, in three lots across Wales with access to FTTP technology by March 2021. This will be achieved with £26m of public subsidy from the Welsh Government and EU funding.

Next Generation Access Broadband

In November, the Welsh Government published a consultation on its recent Open Market Review (OMR) of existing and future superfast broadband coverage over the next three years. The purpose of the consultation is to confirm the premises in Wales which do not have Next Generation Access (NGA) broadband infrastructure, capable of delivering at least 30 Mbit/s to premises and/or Gigabit services, or where there are no plans to provide such infrastructure over the next three years. The OMR revealed that 96,111 premises have been classified as *white* and in need of future intervention to help improve their connectivity.

The Welsh Government is expected to publish a map of the proposed intervention area following the consultation.

Premises and postcode breakdown

Consultation status	Premises (info provided at postcode level)	Premises (info provided at premises level)	Total Premises
Black	379,324		379,324
Grey	22,271	1,119,640	1,141,911
Under Review	128	27,750	27,878
White	-	96,111	96,111

Source: Welsh Government Next Generation Access Broadband – public consultation 2019 [document](#)

The number of White premises within each Local Authority in Wales is shown below: -

Local Authority	Number of White Premises
Blaenau Gwent	1,488
Bridgend	2,684
Caerphilly	1,372
Cardiff	1,028
Carmarthenshire	12,838
Ceredigion	7,181
Conwy	3,794
Denbighshire	4,689
Flintshire	3,730
Gwynedd	8,969
Anglesey	3,466
Merthyr Tydfil	900
Monmouthshire	5,590
Neath Port Talbot	1,941
Newport	1,751
Pembrokeshire	9,819
Powys	13,188
Rhondda Cynon Taf	3,237
Swansea	2,440
Torfaen	998
Vale of Glamorgan	2,213
Wrexham	2,785

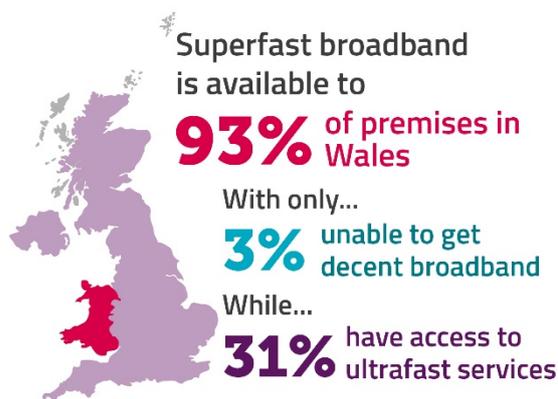
⁴ G.fast is a fixed line technology that reuses the existing copper connection to a cabinet, and makes use of a greater frequency range to deliver

Welsh Premises listed in England	
Cheshire West and Cheshire	3
Gloucestershire	1
Shropshire	6
Total	96,111

Source: Welsh Government Next Generation Access Broadband – public consultation 2019 [document](#)

Ultrafast broadband deployment continues to increase

Ultrafast services are defined as being able to deliver broadband speeds that are greater than or equal to 300 Mbit/s. This definition includes G.fast⁴, cable networks and full-fibre technologies. G.fast services deliver very high speeds over very short telephone lines, so only premises close to the serving cabinet will be able to receive ultrafast broadband from this technology.



Ultrafast broadband coverage in Wales stands at 31% (53% in the UK). Virgin Media has continued to upgrade its network, increasing its fastest residential broadband service to 300 Mbit/s for the majority of its network. In addition, Openreach has deployed G.fast technology in many areas. We also expect ultrafast coverage to increase as a result of growth in full-fibre networks.

faster services than current fibre to the cabinet services that use VDSL technology.

Although we have observed an increase in ultrafast coverage due to these factors, this figure is lower than the one quoted in our summer update due to changes in the way that we identify premises, which is discussed further in our [Methodology Annex](#).

Full-fibre investment and roll out continues to increase

In a 'Full-fibre' or Fibre-to-the-Premises network, fibre optic cables are connected all the way from the local exchange to the home or small business, and can reliably deliver speeds of 1 Gbit/s or more.⁵ This contrasts with technologies that are a combination of fibre and copper, like Fibre to the Cabinet, where the quality and distance of the copper to the premises can impact on both the reliability and speed of the service.

Around 3 million UK premises now have access to a full-fibre connection. This is an increase of 1.5 million premises compared to last year and represents over 10% of UK premises

In Wales, 165,000 premises (12%) now have access to a full fibre connection. This is an increase of over 80,000 premises compared to last year. Full fibre coverage to rural premises in Wales stands at 8% and 15% in urban areas.

Full-fibre broadband is available to **12%** of premises in Wales



Coverage of commercial properties with "full-fibre" broadband access services⁶ stands at around 12% (10% Wales), which is likely to be

⁵ We define full-fibre coverage as where the network has been rolled out to a "lead-in" that will serve the consumer end premise and where the customer would expect to pay a standard installation charge for that connection.

⁶ "Full-fibre" broadband access services are those delivered to the mass market primarily to deliver

the result of operators selecting areas for deployment that contain a larger number of businesses to maximise take-up.

A recently published report by the [Centre for Economics & Business Research](#), Cebr) – "[Full fibre broadband: A platform for growth](#)" has estimated that the Welsh economy could benefit by almost £2 billion as a result of connecting everyone in Wales to full fibre broadband by 2025.

The report claims that almost 25,000 people could be brought back into the workforce through enhanced connectivity. This could include roles within small businesses and entrepreneurs – as well as allowing thousands more people to work remotely.

The Cebr research also highlights the positive impact full fibre broadband would have on rural towns and villages where people have traditionally moved away in search of work. Being able to work from home or set up a home-based business would make these areas more appealing to workers, boosting the local economy alongside reducing transport and housing pressures in cities.

Capability for access networks to meet consumer demands for service

In addition to physical coverage, to ensure that consumers can access the services that they want, the networks need to be able to meet new demand. This capability varies from location to location and from time to time as demand emerges and operators upgrade

internet connectivity and have some degree of contention in the network. Uncontended "leased line" services over fibre are also available at higher price points for corporate networks and other applications.

equipment and install new capacity to meet this demand. We have examined the capacity of fixed access networks to meet additional demand and estimate that across the UK for 99% of the time access networks can meet additional demand. We shall use this as a baseline to monitor how operators are ensuring that networks remain open and available to new customers as network coverage expands.

A full list of the providers who contributed coverage data can be found in our Methodology Annex.

To encourage investment in building full-fibre networks and to provide investors and companies with long term regulatory certainty, Ofcom has proposed several [changes in our regulatory and policy approach](#). They include:

- Allowing competing companies to use Openreach's ducts and poles for both people and businesses. In June this year, we set out our decision on regulation to allow all telecoms providers to [access the ducts and poles operated by Openreach](#) to promote competition and make it easier to build high-capacity connections to homes and businesses.
- A flexible approach to regulation by deregulating in areas where there are competing fibre providers.
- Increasing the periods between major reviews of the telecoms market from 3 to 5 years.

Openreach's provision of access to ducts and poles to other telecoms providers was a remedy put forward in Ofcom's Digital Communications Review (2016) to promote competition in the telecoms access network. We found that telecoms providers were beginning to use this product, however, at the time of data collection (September 2019) volumes were low as this was a relatively new product and responses were provided in a way that we were unable to report take-up in a comparable manner.

We expect these issues to be resolved allowing us to report on total full-fibre network and duct and pole access in the Connected Nations 2020 report.

The number of premises unable to access decent broadband has fallen

While superfast coverage continues to improve, there remain premises that do not have access to decent broadband. In March 2018 the UK Government finalised the terms of a new Universal Service Obligation (USO) by issuing secondary legislation to introduce a USO for broadband connections and services. The Order states that affordable broadband connections and services must be provided throughout the UK with a download speed of at least 10 Mbit/s and other specified technical characteristics. The technical specification in the Order aims to ensure that consumers can use the digital communications they need today, but it may have to increase over time to meet rising consumer expectations and demands. The Digital Economy Act 2017 includes an automatic review of the USO to ensure it remains relevant.

The USO will apply to the whole of the UK and is intended to help fill the gap left by existing broadband rollout programmes. It will act as an important digital safety net for people who might otherwise get left behind by ensuring every household and business will have the right to request a decent broadband connection and service. The USO aims to improve broadband coverage to households and businesses in hard to reach areas and it is an important building block to improving access to broadband services across the whole of the UK.

Ofcom is responsible for implementing the Broadband Universal Service Obligation (USO). We have designated BT and KCOM as the broadband Universal Service Providers and from March 2020 consumers can start to request USO connections.

We will be working with the Universal Service Providers and public bodies to raise consumer awareness of the USO in time for consumers to start requesting connections in March.

Coverage of decent broadband also varies across the nations in both rural and urban areas. The following table highlights the differences between the nations and the urban/rural divide.

Figure 1: Premises unable to receive decent broadband from a fixed line

Nations	All	Rural	Urban
England	2% (412,000)	9% (274,000)	1% (138,000)
Northern Ireland	6% (50,000)	19% (44,000)	1% (6,000)
Scotland	4% (98,000)	19% (89,000)	0% (9,000)
Wales	3% (50,000)	12% (42,000)	1% (8,000)
UK	2% (610,000)	10% (449,000)	1% (161,000)

Source: Ofcom analysis of operator data

Around 610,000 premises (2% of all premises) cannot get decent broadband from a fixed line connection. Of these, we estimate that around 189,000 (0.5% of the total) are likely to be potentially eligible for the broadband USO. 18,000 of these premises are predicted to be in Wales.

This is because the launch and substantial expansion of 4G fixed wireless services has meant that a decent broadband service can be delivered over a wireless connection (see further detail below). Ofcom will continue to analyse the coverage and performance of these providers to ensure that they are robust and likely to give homes and businesses the connections they need.

Figure 2: Premises unable to receive decent broadband by nation and likely to be eligible for the broadband USO

Nation	Premises unable to access decent broadband
UK	189,000
England	111,000
Scotland	40,000
Wales	18,000
Northern Ireland	21,000

Source: Ofcom analysis of operator data

Data at National Assembly for Wales constituency level

National Assembly for Wales constituencies with the largest percentage of premises with less than 10Mbit/s

Looking at availability of broadband at the more granular constituency levels reveals the ongoing disparity across Wales. Figure 3 shows the number and percentage of premises unable to access services of 10Mbit/s or more in the constituencies with the highest percentage of premises unable to access decent broadband.

Four mid and west Wales constituencies each have double digit percentages of premises in this category.

Figure 3: National Assembly for Wales constituencies with the highest percentage of premises unable to access services of 10Mbit/s or more

Constituency	Residential Premises	% Residential Premises	All Premises	% All Premises
Brecon and Radnorshire	4,708	14%	5,080	14%
Montgomeryshire	3,670	13%	3,961	12%
Ceredigion	4,275	12%	4,534	12%
Carmarthen East and Dinefwr	4,061	12%	4,286	12%
Preseli Pembrokeshire	3,293	9%	3,705	9%
Dwyfor Meirionnydd	2,869	8%	3,371	9%
Monmouth	2,593	7%	3,001	7%
Carmarthen West and South Pembrokeshire	2,378	6%	2,570	6%
Clwyd West	2,010	6%	2,134	6%
Aberconwy	985	4%	1,111	4%

Fixed Wireless Access as a means of delivering broadband

Fixed Wireless Access (FWA) networks use a wireless link for the final connection to a home or business, avoiding the installation of a line into the building. The capacity in the wireless access network is shared between multiple users. The service needs to be managed appropriately to ensure there is sufficient capacity to meet user needs, especially in areas with capacity constraints.

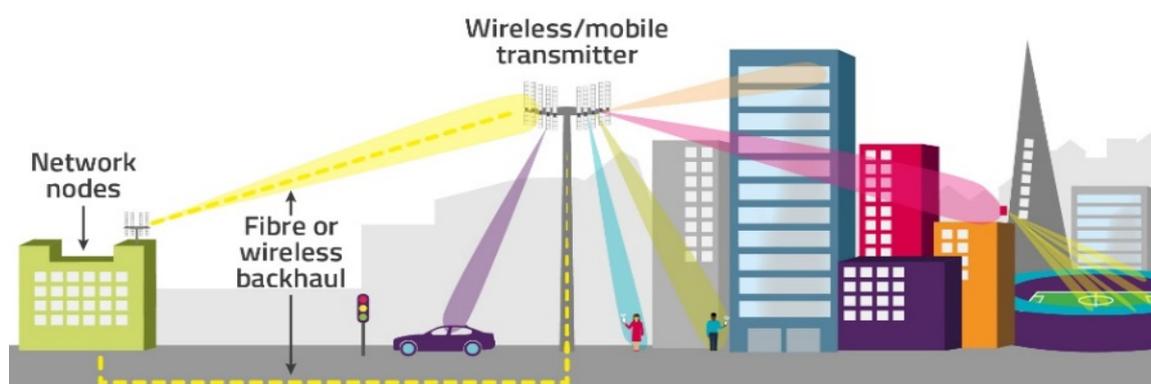
FWA services can be delivered on networks that only serve customers at a fixed location, by Wireless Internet Service Providers (WISPs). In the UK, these networks most commonly use licence exempt or light licensed spectrum such as the 5 GHz band. They can also be delivered on mobile networks, where the capacity of the network is shared with mobile users, using 4G and 5G technologies.

This section initially focuses on the FWA services provided by licence exempt or light licensed systems offered by WISPs and then considers the FWA service delivered by mobile networks.

Fixed Wireless Access by WISPs

The majority of these services are delivered over wireless networks that communicate via a wireless link between a provider's mast site and an external antenna fixed to a customer's premises. The speeds and services delivered will depend on a number of factors including, but not limited to: the number of premises being served from the same transmitter, the location of the premises, line-of-sight issues, consumer equipment and available network capacity. We intend to work with FWA providers to better understand the performance of these services.

Schematic of Fixed Wireless Access network



Ofcom's work with WISPs

We have applied a modelling method to data we have received from a number of providers in order to predict the number of premises that have coverage from these providers via existing infrastructure. The modelling method provides an estimate only and does not account for network capacity constraints, interference or other external factors.⁷ We would note that, for all coverage estimates based on such predictive modelling tools, localised issues may mean that particular premises may not be able to receive an adequate service despite being predicted to do so.

We estimate that up to 1.6 million premises could receive decent wireless broadband on licence exempt or light licensed spectrum.

The results of our modelling show that, in principle, as many as 1.6 million⁸ homes and businesses in the UK (403,000 in Wales) could have a medium or high chance of being able to receive a decent broadband service from a WISP.⁹ Of these, 53,000 (6,000 in Wales)

currently do not have access to a decent fixed broadband service. This provides an additional 0.17% of decent broadband service coverage to the UK. Around 1% of premises that have coverage from a WISP have taken up a service from one of these networks.

Figure 4 shows the total number of premises covered by one or more WISP networks. It also shows the number of premises which are unable to access a decent broadband service but can be covered by a WISP. This is labelled WISP USO in the table below.

Figure 4: Number of premises which can receive decent broadband from WISP by nation

Nation	WISP coverage	WISP USO
UK	1,588,000	53,000
England	1,126,000	39,000
Northern Ireland	26,000	6,000
Scotland	33,000	3,000
Wales	403,000	6,000

Source: Ofcom analysis of operator data

⁷ More detail on the methodology used to determine WISP coverage can be found in Annex A.

⁸ The network infrastructure that is currently deployed by the providers we have obtained information from would need to be extended significantly to support any larger proportion of

this total nominal capability beyond the current level.

⁹ This consists of data from 13 providers, of which 5 provided updated data for this year. The increase in the number of premises compared to last year is due to data from one additional provider.

There are many more WISPs who have not given us their coverage data, so coverage from these providers could be higher. We intend to continue to collate and analyse data from these providers and monitor changes to the sector.

In July this year, we announced our decision to introduce a new local licensing approach to provide localised access to spectrum bands. We have already issued a license for access to licensed mobile spectrum and we have recently opened up [access to the shared spectrum bands](#). We expect this could help extend the provision of FWA networks in hard to reach places.

Fixed Wireless Access via mobile technologies

Over the past year, mobile network operators (MNOs) have launched new FWA services, in some cases making use of the increased capacity of their 5G networks. Some MNOs have also continued to offer FWA services on their 4G networks. Of the four MNOs, only O2 does not currently offer 4G or 5G FWA services.

Mobile FWA services are mainly delivered directly to an indoor router. For areas with poor indoor coverage, EE offers an external antenna for its 4G FWA service. Three offers an external antenna to customers of its 4G FWA service in parts of Swindon. There are currently no providers offering an external antenna for their 5G FWA service.

In the majority of cases, these services share the network capacity with mobile users and MNOs do not market the services based on speed. We intend to carry out more research into the performance of these services.

We estimate that EE has FWA coverage over 401,000 premises that do not currently have access to a decent broadband service from a fixed line or a WISP. Our research has shown that the 4G EE service is capable of delivering USO level broadband.¹⁰ Taking this and the WISP coverage into consideration means that we estimate that there are currently only around 189,000 premises that could be eligible for the Broadband USO.¹¹

Figure 5: Breakdown of the number of premises unable to get decent broadband from fixed, WISP or mobile FWA connection

Nation	No decent broadband from a fixed line	No decent broadband (no fixed, WISP or mobile)
UK	610,000	189,000
England	412,000	111,000
Northern Ireland	50,000	21,000
Scotland	98,000	40,000
Wales	50,000	18,000

Source: Ofcom analysis of operator data

We are in discussions with Vodafone and Three about collecting information about the performance of their services and understanding how they plan to manage the capacity of their network for FWA customers.

¹⁰ In 2018 we conducted research into the [performance of the EE FWA service](#). We found high levels of variation in the performance of FWA connections. Overall, five of the 58 panellists did not receive our benchmark 9.5Mbit/s downstream

speed and 0.95Mbit/s upstream speed during peak hours.

¹¹ Subject to the individual premise network coverage variations noted earlier.

As we explain in the next section, the initial rollout of 5G has been focussed in areas of higher population density, where capacity demands are likely to be the greatest. In the near term, operators are likely to continue to rollout in areas where 5G will deliver significant quality of service. As roll out continues, MNOs might consider whether to offer 5G FWA; this could help extend the reach of broadband services.

Satellite

There remain 6% of premises that are unable to access superfast broadband coverage from a fixed network, of which 2% are unable to access decent broadband. For the most remote premises, which do not have suitable coverage from a mobile network, broadband services may be provided using satellite broadband. Like with mobile networks, capacity is shared between premises served by the same spot beam.

Until now, the most common of these are services from geostationary satellites. These offer broadband with speeds up to 30 Mbit/s but, unlike fixed broadband services, have data caps to manage the demand on the network. In addition, broadband services from geostationary satellites have higher latency than fixed broadband services, due to the round-trip time for data packets to travel between the earth and the geostationary orbit (some 36,000 km above the Earth's surface).

In the past few years, there has been a renewed interest in Low Earth Orbit (LEO) satellite constellations. These satellites are deployed at an orbit much closer to the Earth. This means that they can provide lower latency services. However, the closer to Earth they orbit, the greater the number of satellites required to ensure a continuous connection.

Two constellations have started to deploy satellites:

SpaceX's Starlink constellation will operate at around 500km and will comprise at least 4,425 satellites. At the time of writing, 120 satellites have been launched into orbit. SpaceX has announced that an initial broadband service is to be offered over Canada and the US by mid-2020 and this service will be available in other countries from 2021.

OneWeb will operate at an altitude of between 900 and 1100 km, deploying an initial constellation of between 650 and 900 satellites. They have already launched four satellites and plan to launch 30 satellites a month in 2020. Onweb has announced that an initial service will be available from 2021.

Not all constellations will provide direct-to-home broadband services. Some operators may opt to provide backhaul for more traditional mobile or broadband providers. The types of services offered may partly depend on the final cost of satellite receivers for LEO constellations, which are currently more expensive compared to customer premise equipment for fixed and other wireless services. Despite this, they could still be less costly than the total costs of a installing a fixed or wireless connection in hard-to-reach premises, and therefore could help to connect those premises.

Future of voice

As companies move away from deploying copper-based to fibre broadband technologies, the traditional telephone network will also have to change. Traditionally most landline services are delivered to people over the Public Switched Telephone Network (PSTN), using copper. With a reduction of technical knowledge on such copper dependent systems and the unavailability of spare parts, companies are already preparing to move to an all IP world where telephone services will be delivered over the broadband connection, often referred to as Voice over IP (VoIP).

Openreach and Virgin Media are planning to migrate voice services to VoIP. Sky and TalkTalk already carry voice calls as IP traffic within their core network.

We are gathering information about the technology used by companies to provide voice services so that we can track the migration to VoIP in the coming years. The majority of services are still being supported by the traditional PSTN network, with around a fifth of them being supported by a modern IP-based network that imitates the characteristics of the traditional PSTN (known as 'emulation').

Managed voice services over broadband or fibre to replace the PSTN completely still constitute a very small part of the total number of lines (around 1%), but we expect this to increase rapidly in the coming years as part of the PSTN migration. We will continue to monitor this in future Connected Nations reports.

Some services that rely on the analogue characteristics of the current PSTN may be affected by the migration to IP, for example some types of fire alarms and telecare services and monitoring equipment used in the energy, water and transport sectors. As a part of their plan for migration, [BT](#) and Virgin Media¹² are offering a test facility for providers of such services to test the impact of this transition.

Ofcom has also engaged with the UK and devolved governments and other regulators to help raise awareness about the migration and potential impact for services they or their stakeholders use so that they can make sure appropriate measures are being taken to protect critical services.

There are a number of other regulatory and operational implications of the change to VoIP that Ofcom is addressing through a work programme that will continue through 2020 and beyond:

The technology change brings new challenges – for example, it has become easier to hide or change callers' identity information presented through phone numbers, and therefore more difficult to trace and prevent nuisance or scam calls.

We work closely with the Information Commissioner's Office (ICO) which is the organisation with lead responsibility for tackling unsolicited sales and marketing calls. Together with the ICO, we have published a Joint Action Plan which sets out a number of initiatives on dealing with the problem of nuisance calls and how to prevent them occurring in the first place.

¹² For further information email: IPvoice@virginmedia.co.uk

Ultimately, we believe that addressing nuisance or scam calls will require a mechanism for providers to authenticate callers' identity for each call. We are working with industry to understand the significant changes to communications systems that will be necessary and to implement a common numbering database that can be used for authentication. We believe a common database could be in place by 2022, which could then be progressively used to verify that the identity of a calling number is genuine for calls made on these networks.

A common database could also support more efficient processes for porting numbers and routing calls to these numbers when customers switch between competing providers, as well as support improvements and efficiencies in number management.

The move to IP will also need changes to how calls are passed between networks. Our main regulation in this area is in setting the maximum charge that operators can levy for calls handed over to them. With PSTN on BT this means calls that are handed over to BT at each of its 800 local exchanges. With IP calls will be handed over centrally with the number of different points of connection largely determined by the need for resilience. Our regulation will also shift to focus on the charges for calls handed over using IP.



Mobile voice and data

Mobile networks ¹³	Wales	UK
Indoor voice premises (coverage by all four operators)	90%	93%
Geographic voice (coverage by all four operators)	77%	79%
Indoor 4G premises (coverage by all four operators)	73%	80%
Geographic 4G (coverage by all four operators)	58%	66%
Indoor voice premises (complete not-spots)	1%	0.2%
Geographic voice (complete not-spots)	5%	5%
Indoor 4G premises (complete not-spots)	2%	1%
Geographic 4G (complete not-spots)	11%	9%

Introduction

People expect to be able to make calls and get online where they live, work and travel. In this chapter we provide an update on coverage both outside and inside premises, across the UK's landmass and on roads. We also describe the measurements we are making available to

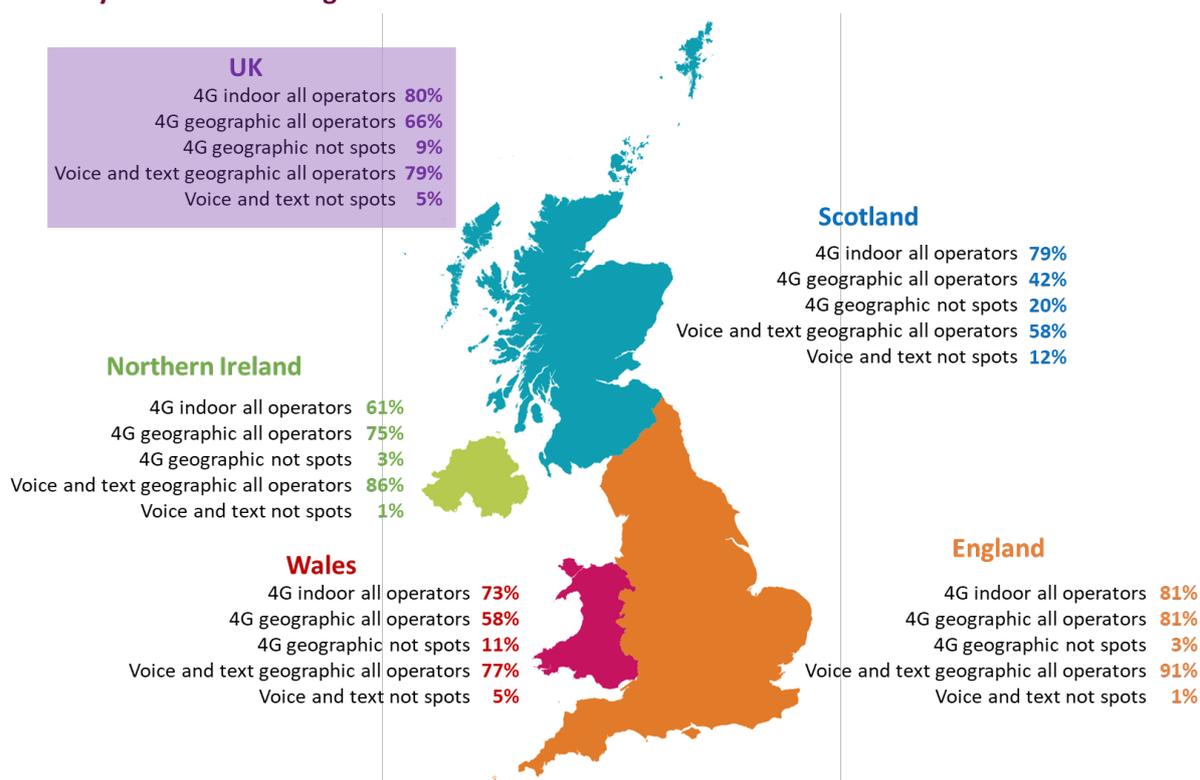
policy makers, train operators and others to improve their understanding of the coverage available along selected railways in England, Wales and Scotland. 'Internet-of-Things' services are also becoming increasingly important, and in this chapter, we are reporting on their availability in the UK.

¹³ Coverage thresholds are: 2G indoor (-71dBm), 2G outdoor (-81dBm), 3G indoor (-90dBm), 3G outdoor (-100dBm), Good quality 4G voice and data services indoor (-95dBm), Good quality 4G voice and data services outdoor (-105dBm), Lower speed 4G data services indoor (-105dBm) and Lower speed 4G data services outdoor (-115dBm).

Key highlights for Wales:

- Good 4G services from all four operators are available (outdoor) across 58% of Wales' landmass.
- Voice services from all four operators are available (outdoor) to 77% of Wales' landmass.
- 73% of premises in Wales have good indoor 4G coverage from all four operators.
- Voice services (indoor) from all four operators are available in 90% of premises in Wales
- All four MNOs have launched 5G services.
- The commercial rollout of 4G is approaching completion and MNOs are focussing further investment to deliver improvements where demand is concentrated. As a result, both UK premises coverage and outdoor geographic coverage show small improvements. Outdoor coverage is now available in the majority of places where people live and work.
- However, coverage of the UK landmass remains patchy, especially in rural areas. The UK Government has announced its in-principle support for the network operators' proposed Shared Rural Network, which would deliver new coverage in many rural areas.

Summary of mobile coverage across the UK and Nations



5G is here

This year marked the launch of 5G in the UK. The UK is a 5G leader in Europe, because it is one of the first countries where all the Mobile Network Operators (MNOs) have started 5G deployment.

These initial 5G networks target mobile broadband services, providing several enhancements over 4G networks, including higher speeds and the capability to deliver extra capacity where needed, such as in urban areas or sports stadiums. Future evolutions of these initial 5G networks will enable additional services that rely on a near instantaneous network response (a latency of the order of only a few milliseconds) and need high reliability, with applications in sectors such as manufacturing, logistics, agriculture, transport/automotive, energy, media & entertainment, and healthcare¹⁴. Examples of applications include controlling vehicles at distance, e.g. in mines, or enabling robots in automated factories to communicate with each other.

All UK MNOs have launched 5G this year

EE, O2, Three and Vodafone are offering 5G in some form in more than 40 UK cities and towns in the UK, from Plymouth to Edinburgh and from Lisburn to Norwich. Rollout has so far focused on areas with higher populations, where capacity demands are likely to be greatest. In the near term, operators are likely to continue rollout in areas where 5G will deliver significant quality of service improvements needed to meet consumer demand.

¹⁴ https://www.ofcom.org.uk/_data/assets/pdf_file/0022/111883/enabling-5g-uk.pdf

5G will also benefit organisations and businesses

Public mobile networks, in addition to providing broadband services for consumers, could also be used to provide specialist services to organisations and businesses.

Organisations and businesses could also decide to access 5G services via a local private 5G network, either self-deployed or deployed by a third party. This option guarantees a high level of security and full control on data ownership. In February 2019¹⁵ we outlined a range of technological approaches and business models to support organisations and businesses in developing their digital infrastructure. We expect the new [spectrum sharing framework](#) to provide support for organisations and businesses interested in deploying wireless services via private solutions using 4G or 5G. From December 2019, it has been possible to apply for a local licence.

4G coverage growth has been slowing but the SRN is designed to change this

Introduction

During 2017 and 2018 we saw significant growth in 4G rollout as MNOs deployed 4G by upgrading existing infrastructure, spurred on by the coverage obligations that fell in December 2018. Since then, 4G coverage has continued to improve, but at a lower rate than in previous years. Generally, MNOs focus has more recently been on targeted rollout and capacity enhancement to deliver key improvements to meet consumer demand.

¹⁵ <https://www.ofcom.org.uk/spectrum/spectrum-management/supporting-role-wireless-innovation-uk-industry>

However, in October 2019, the UK Government announced that it had reached an in-principle agreement with industry to fund a ‘Shared Rural Network.’ The Shared Rural Network proposal would see mobile operators sharing existing and new infrastructure to provide significantly improved and extended coverage in rural areas, as is explained later in this section.

Additional public investments

The Scottish Government is investing up to £25 million in the Scottish 4G Infill Programme (S4GI) to provide, future proofed 4G infrastructure and services in selected notspots. However, S4GI will not resolve every notspot in Scotland. S4GI aims to deliver to up to 49 sites currently in the programme but, crucially, no site will go into build unless the programme has firm commitment from at least one mobile operator (MNO) to use the mast.

In parallel, the Scottish Government has welcomed the UK Government’s in-principle announcement regarding the Shared Rural Network (SRN) which could, if final agreement is reached, deliver an improvement to the availability of 4G across Scotland’s rural and island communities. The Scottish Government has said it will look for opportunities for alignment of S4GI with SRN and that it intends to work with the UK Government and the MNOs on its implementation plans.

Methodology

In this section we report on coverage both outside and inside premises, on geographic coverage and on coverage along roads. We report on the availability of voice services, via either 2G, 3G or 4G, and on the availability of 4G data connections. Our definition of 4G coverage reflects a level of service that supports nearly all 90-second telephone calls being completed without interruption and

data connections that deliver a connection speed of at least 2 Mbit/s (fast enough to browse the internet and watch glitch-free mobile video).

The mobile coverage figures provided in this report rely on the accuracy of coverage prediction data supplied by the mobile operators. We note that operators continue to update and improve their prediction models, which is welcome. The data used in this report includes predictions provided to us by EE using a newly developed coverage prediction model, which has seen some changes in the coverage it predicts for landmass and premises. EE has provided us with information on the validation work it has undertaken to date.

We take the accuracy of the data supplied to us seriously given its importance to policy making and to ensuring people are well informed about available coverage. We will continue to monitor, through drive testing, the accuracy of all operators’ coverage predictions.

Coverage outside premises

People expect good mobile coverage inside and outside their home, and coverage that is only present outside a home does not provide consumers with a comprehensive experience. Coverage outside premises, however, provides a good indication of the availability of coverage in the kinds of places where people typically live, work and travel.

Mobile telephone calls outside premises are available from all operators at 97% of premises in Wales, while almost all premises have telephone call services from at least one operator.

There are substantial differences between urban and rural areas in Wales. For example, 97% of premises in urban areas have outdoor mobile telephone services from all operators while in rural areas services are available only outside 75% of premises. However, we note that in rural areas mobile services from at least one operator are available outside almost all premises.

Moreover, in urban areas of Wales 4G data services are available from all operators outside 98% of premises while in rural areas 4G services from all operators are available outside only 76% of premises. In rural areas 4G data services from at least one operator are available directly outside 98% of premises

Indoor coverage

The coverage people receive indoors will depend on a range of factors including: the thickness of walls, building materials used in construction and where in the building you are. Due to these factors, in some premises there may be differences between our predicted indoor coverage data and the actual coverage available. Our online coverage checker provides additional information on the likelihood of there being indoor coverage in buildings in different locations, which takes into account some of the factors that can affect a mobile signal.

Based on an average building loss model¹⁶ (i.e. the model we use to estimate the amount of signal loss from outside to inside the building), indoor mobile calls are predicted to be available from all operators in 90% of premises in Wales while in almost all premises mobile call services are available from at least one operator. 73% of premises in Wales now

receive 4G data services indoors from all operators (up 4 percentage points from last year), while in 98% of premises 4G data services are available indoors from at least one operator.

Indoor coverage remains poor in many rural areas in Wales. For example, in urban areas mobile services are available from all operators in 96% of premises while in rural areas services are available from all operators in only 69% of premises (up 3 percentage points from last year). However, we note that in rural areas mobile services by at least one operator are available in 98% of all premises (in line with last year).

Moreover, in urban areas 4G data services are available from all operators within 83% of premises (up 4% from last year) while in rural areas 4G services are available from all operators in only 38% of premises (up 2% from last year). In rural areas good 4G data services by at least one operator are available inside 92% of premises.

There are a number of alternative options for people who struggle to get reliable indoor mobile coverage, such as broadband-based calls on services such as Skype, femtocells¹⁷ and mobile repeaters. Moreover, all the MNOs in the UK make Wi-Fi calling services (the ability to make and receive a call over a Wi-Fi network) available to their customers (although not all the mobile phones support them).

¹⁶ We determine indoor coverage by applying an average building entry loss of 10dB across all buildings.

¹⁷ Femtocells are small base stations that can be plugged to a home broadband connection.

There are two types of Wi-Fi calling solutions: “cellular preferred”, where the devices use Wi-Fi calling only if there is poor cellular coverage, and “Wi-Fi preferred” where all the calls are made via Wi-Fi, when Wi-Fi is available. The percentage of calls made using voice over Wi-Fi by the MNOs ranges from 0.22% to 12%. We note that this percentage is usually higher for MNOs using “Wi-Fi preferred solutions”.

Geographic coverage

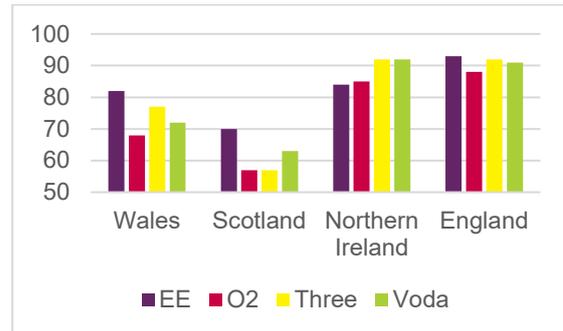
4G geographic outdoor coverage growth is slowing, with small increases in individual operator coverage, but no substantial change to coverage overall. There is still considerable difference between the coverage offered by individual operators, with good consumer experience limited by the presence of enduring ‘partial not spots’ (i.e. areas not covered by all operators). These partial not spots are predominantly located in rural areas.



Mobile voice coverage from all four operators extends to **77%** of Wales

4G mobile coverage extends to **90%** of Wales

Figure 6 – Differences in 4G data geographic coverage in Wales, Scotland, Northern Ireland and England



Source: Ofcom analysis of operator data

77% per cent of the Wales’ geographic area is now covered by all four operators for mobile calls (up from 75% in September 2018¹⁸). As last year, the area covered by at least one operator for mobile calls is 95% of Wales’ landmass, with a maximum difference of about 6% between operators. O2 has the highest voice call coverage covering 91% of the Wales’ landmass, around 4 percentage points above Three and Vodafone and 6 percentage points above EE.

58% of the Wales’ geographic area is covered by all four operators for 4G data services. As last year, the area covered by at least one operator for 4G data services is 89% of Wales’ landmass.

¹⁸ These figures include voice calls over 4G LTE services.

Figure 7: Coverage of mobile services in Wales by network operator September 2019

	O2	Vodafone	EE	Three
Indoor voice premises	98%	97%	95%	94%
Indoor data premises	89%	88%	92%	85%
Geographic voice	91%	87%	85%	87%
Geographic data	68%	72%	82%	77%

There are considerable variations between the coverage provided by the individual operators in Wales. EE provides the highest level of good indoor data (92%) and Vodafone provides the highest level of good outdoor geographic voice coverage (91%). The greatest variation between operators occurs in relation to geographic coverage of good data services where EE provides the highest level of coverage (82%) and O2 the lowest (68%). 11% of the landmass does not have good outdoor 4G coverage from any operator, again, largely unchanged from last year.

There continue to be differences in coverage between urban and rural areas.

In urban areas of Wales 4G data services are available from all operators in 90% of the landmass (1% up from last year), while in rural areas 4G data services are available in only 54% of the landmass (1% up from last year). 4G data services from at least one operator are available in 88% of rural landmass.

The challenges in Wales

The topography and the density of its population poses particular challenges in improving mobile coverage in Wales. Providing comparable levels of coverage with other nations of the UK will inevitably require the construction of more masts and in many cases the height of those masts will have a beneficial effect on the coverage levels achieved.

While the ongoing roll-out of 4G services has led to improvements, mobile coverage is still worse in Wales, Northern Ireland and Scotland than it is in England. Coverage varies considerably among MNOs and remains poor in many places, with only 58% of geographic area covered by good 4G services from all operators in Wales compared with 42% in Scotland, 75% in Northern Ireland and 81% in England. There is considerable variation in the levels of good 4G coverage that is available from each operator:

There remain areas in Wales with no good mobile coverage from all four of the network operators as well as complete not-spots where there is no coverage at all. In geographic terms, 11% of Wales is not covered by a good 4G service from any operator and 5% not covered by a voice service by any operator.

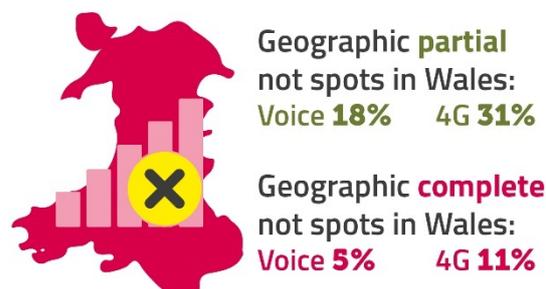


Figure 9: Ten local authorities with the lowest coverage by all operators for 4G outdoor geographic coverage

Devolved Constituency UK	% Coverage
Isles of Scilly	0%
Argyll and Bute	19%
Na h-Eileanan an Iar	24%
Highland	25%
Stirling	42%
Gwynedd	42%
Moray	43%
Conwy	44%
Copeland	45%
North Ayrshire	48%

Source: Ofcom analysis of operator data

Of the 10 local authorities with the lowest good 4G outdoor geographic coverage Gwynedd is sixth from bottom (42%). When looked at by local authority, Gwynedd is ninth from bottom (42%) and Conwy tenth (44%).

Welsh Government policy on mobile communications

In October 2017, the Welsh Government published its Mobile Action Plan which sets out how it will work with the mobile phone industry and Ofcom, to provide connectivity to meet the needs of people and businesses in Wales. Although telecommunications policy is not devolved to Wales, the action plan focused on key areas where the Welsh Government could use its powers to improve mobile connectivity and capacity.

The Welsh Government subsequently published draft proposals for the creation of a number of mobile action zones across Wales. Within these zones the Welsh Government, mobile network operators, infrastructure providers and local authorities would work together to improve mobile connectivity. Depending on the circumstances of each zone either the public sector would work with the mobile industry to create the right conditions for commercial investment or where commercial investment in capital costs is not viable under any circumstances, then publicly funded mobile infrastructure would be considered.

In January 2019 the National Assembly for Wales' Economy, Infrastructure and Skills Committee published a [report](#) on the Welsh Government's Mobile Action Plan. The Committee called on the Welsh Government to allow MNOs to erect masts of up to 30m under the permitted development planning regime and supported the principle of shared infrastructure in rural areas. It added that the role the Welsh Government's Action Plan had

played in the improvement in coverage was "unclear". The Committee called for the Welsh Government to use its devolved levers "to potentially tip the scales of commercial viability in favour of further investment in some areas".

In February 2019 the Welsh Government published a prior information notice to commence a market engagement exercise to explore the range of possible solutions/strategies prior to embarking on a competitive bid process to appoint contractor/s to deliver the project. It said that between £10m and £20m might be available to fund the work. No further announcements have been made in relation to the project.

Later in the month, the Welsh Government also announced that it would relax planning restrictions on mobile masts. The change which came into force in April allows 25m masts (20m in restricted areas) to be built without having to go through the full planning process bringing Wales in line with practice in England and Scotland since 2016.

The Shared Rural Network proposal aims to improve rural coverage

Following detailed discussions between the MNOs and the UK Government (supported by Ofcom), in October 2019 the UK Government announced in-principle support for the MNOs' proposed 'Shared Rural Network'. The Shared Rural Network would expand each operator's outdoor 4G coverage to 92% of the UK landmass by 2025, with specified increases in each of the UK nations. 4G outdoor coverage from at least one MNO is expected to increase to 95% by the same date. The Shared Rural Network proposal is subject to final agreement by the mobile operators and the UK Government. The UK Government's intention is to reach a formal agreement in early 2020.

Should final agreement be reached, these promised improvements will make a real difference to mobile customers across the UK, enabling consumers to get a continuous coverage experience in areas where there is at least one provider, but, as of today, not their provider of choice. Operators have committed to entering into legally binding licence variations which will allow Ofcom to hold them to these commitments. We will monitor and report on the MNOs' progress in achieving better coverage via our Connected Nations reports.

The proposal has three key elements:

- Existing masts would be shared by all four MNOs, at their own cost, in areas where some, but not all, MNOs have coverage.
- Up to 292 mobile infrastructure sites built as part of the Government-owned Emergency Services Network would be made available to all four operators, delivering additional coverage in some of the most remote, rural locations.
- New sites would be built in a number of areas where there is no coverage from any operator. These sites would host all MNOs and would be funded by Government.

Emergency calls

Mobile phones can use signals from other mobile networks to make emergency calls. As the mobile networks have slightly different coverage footprints this means that 95% of the UK geographic area, and almost all premises indoors, are covered for mobile emergency calls. This is in line with last year.

Premises that do not have a decent fixed or good 4G mobile network connection

As with last year this report examines those premises unable to get a decent fixed or a good mobile broadband service. Premises are considered to have access to a decent fixed connection if the broadband speed is above a download speed of at least 10 Mbit/s and an upload speed of at least 1 Mbit/s and to have good mobile coverage if indoor 4G mobile coverage is available. We estimate that 97% of UK premises can receive both decent fixed and good mobile broadband services, while 53,000 UK premises, of which, 9,514 are in Wales are unable to access either. As with last year, more premises currently have good indoor 4G coverage from at least one operator than a decent fixed broadband service.

As with last year, it is rural areas in Scotland (3%) and Wales (3%) that have the highest percentage of properties that have neither decent fixed nor good (indoor) 4G mobile services. Premises in the Scottish Highlands and Islands and rural areas of Wales are most likely to be unable to access either a decent fixed or good mobile service available.

Figure 10 shows the areas of the UK that have outdoor 4G coverage from all operators, the areas that have coverage from some operators (partial not spots) and the areas that have no coverage at all (not spots).

Figure 10



Source: Ofcom analysis of operator data

Coverage on the roads

Mobile coverage on roads has remained stable over the last year.

Within vehicles, mobile voice services from all operators are available on 81% of Motorways and A roads and on 68% of B roads. Mobile voice services along motorways (outside vehicles) are available on 95% of Motorways and A roads and on 90% of B roads. For emergency calls, where mobile calls can be made on any network, voice coverage within vehicles increases to 99% of Motorways and A roads and 96% of B roads. Outside vehicles there is coverage for emergency calls in 100% of Motorways and A roads and in 99% of B roads.

Within vehicles, 62% of Motorways and A roads and 46% of B roads have 4G data coverage from all four operators. We note that there is a decrease in coverage with respect to last year and this might be in part due to EE's new coverage model. Outside the vehicle, 88% of motorways and A roads and 80% of B roads have good 4G data coverage from all operators.

Similarly, to outdoor and indoor coverage, mobile coverage on roads has remained stable over the last year.

Within vehicles, mobile voice services from all operators are available on 76% of motorways and A roads in Wales (as last year). Mobile voice services (outside vehicles) are available on 92% of motorways and A roads (up 1 percentage point from last year). For emergency calls, where mobile calls can be made on any network, voice coverage increases to 97% of Motorways and A roads within vehicles (as last year) and 99% outside vehicles (as last year).

Within vehicles, 52% of Motorways and A roads in Wales have 4G data coverage from all four operators (compared to 53% last year). We note that this decrease in coverage might be in part due to EE's new coverage model as EE's reported coverage along motorways and A road has decreased more than 4 percentage points with respect to last year.

Outside the vehicle, 81% of Motorways and A roads have good 4G data coverage from all operators (up 1 percentage point from last year).

Internet of Things

The Internet of Things (IoT) is a term used to describe the aggregate network of devices and sensors, which is able to collect and share data with people or with other devices, and to take actions based on this data. IoT has applications in different sectors, such as healthcare, utilities, manufacturing, consumer electronics, and smart cities among others.

This year's report provides some qualitative and quantitative insights into public and private wide-area IoT networks in the UK.

Low-power wide area networks

Wide area IoT connectivity can be [delivered via several technologies](#): traditional cellular (2G, 3G and 4G) and Low-Power Wide Area (LPWA) networks such as Narrowband IoT (NB-IoT), Long Term Evolution for Machines (LTE-M), Long Range Wide Area Networks (LoRaWAN) and Sigfox. NB-IoT and LTE-M have been [standardised by 3GPP](#) and they are now part of the 4G standard. 3GPP is further evolving these technologies as a part of 5G.

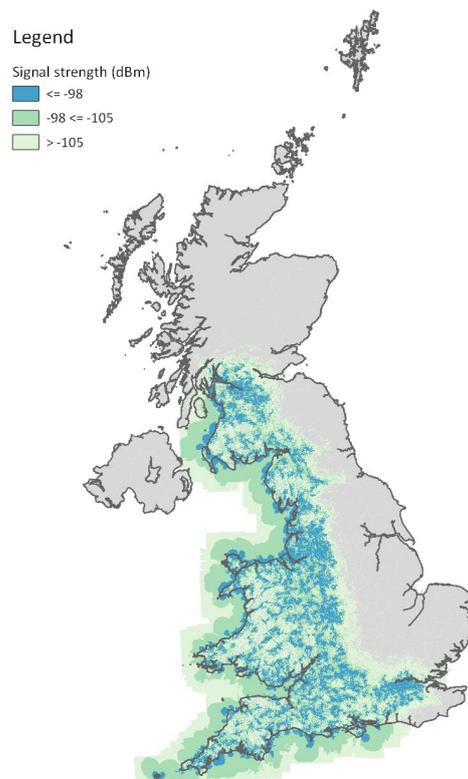
LPWA technologies are designed for IoT applications and services that have low data rates, require long battery lives and can operate in remote and hard to reach locations. Furthermore, their extended range makes them better suited for in-building applications such as smart meters and smart car parks which may be located underground or in basements.

IoT Connectivity available from non-mobile network operators

Today all four UK MNOs have commercial IoT deployments using traditional 2G, 3G and 4G cellular technologies. IoT traffic is a very small portion of the total MNO data traffic: less than 1% of the total.

Vodafone has commercially deployed NB-IoT using the 800 MHz band in the UK, and has a network covering the west part of the UK.

Figure 11 - Vodafone's NB-IoT Coverage map.



Source: Vodafone

BT is currently [deploying a LoRaWAN proof-of-concept](#) in Newcastle and Sunderland as part of a collaboration with Northumbrian Water to analyse network information to reduce costs and improve overall network performance.

Three UK [recently launched its LPWA](#) network pilot network based on LTE-M and NB-IoT. The pilot is a collaboration between Three UK, Northern Gas Networks, Newcastle University, Northern Powergrid, Northumbrian Water and Siemens. It aims to help utilities to improve service reliability, detect faults and reduce emissions.

IoT Connectivity available from non-Mobile Network Operators

SIGFOX

Sigfox is a global network¹⁹ deploying the technology in various countries or territories. In the UK, WND UK is the sole Sigfox network operator. Its network includes 1900 base stations with a population and landmass coverage of 90% and 60% respectively. Figure below shows the coverage of WND UK's network. The figure also shows areas with more than one base station for increased reliability.

The network supports very low bandwidth applications with infrequent transmissions. Examples of applications utilising this technology include smart metering (where usage data is sent once a day), gas and water leakage detection and asset tracking.

Figure 12 - Map of WND UK Sigfox coverage.



Source: WND UK

LoRaWAN

There are several LoRaWANs in the UK, supporting both public community and/or private deployments. The public community networks are open-source and free to use^{20,21}. They allow users to connect devices to existing gateways (base stations) within the network or add new gateways to increase coverage. In essence they are decentralised, and collaborative networks driven by the user community. The private networks offer service level agreements and guaranteed availability on a paid basis to organisations.

¹⁹ Several partners may be affiliated to Sigfox but it generally has one operator in each country/territory. <https://partners.sigfox.com/>

²⁰ They are usually bound by fair use policies which restrict data rates, packet sizes, transmit time, number of gateways/devices, etc.

²¹ The network servers are hosted by not for profit institutions like the Digital Catapult (UK) or companies which also offer private networks.

Public community LoRaWANs

Providers of public community LoRaWANs allow users to connect to their open network. In this capacity, they support developers, businesses (particularly where prototypes are being tested), government and public initiatives across the UK Local Authorities.^{22,23} The Things Network (TTN), that recently partnered with the Digital Catapult's Things Connected network, is the major LoRaWAN in the UK. It has **over 600 base stations** (gateways) and about 90 communities (cities, counties or groups of hobbyists with deployments in close proximity). Applications include smart irrigation, smart parking, cattle tracking among others. The **TTN Mapper** provides a crowd sourced coverage map of the network.

Private LoRaWANs

We are aware of several private LoRaWAN providers operating in the UK, such as Comms365, Connexion, The Things Industries (TTI), Boston Networks and Pinacl Solutions Limited. These private networks provide services such as smart metering, flood detection, street lighting and air quality detection.

Menter Môn

Menter Môn is a social enterprise delivering a range of projects across North West Wales. These range from business support, renewable energy, conservation and the most recently digital technology. Wherever possible the company seeks to add value to local resources for the benefit of rural communities.

The Year of IoT

Rural areas often lag behind when it comes to the adoption of new technology. However, IoT technology lends itself to remote geographical areas and therefore there is every reason for them to take a lead. Therefore in April 2019 organisations in North West Wales came together to launch the 'Year of IoT' to raise awareness of the technology and encourage collaboration between different sectors and specialists. Among those involved are Menter Môn, North Wales Tech, M-SParc, Gwynedd and Ynys Môn County Councils and Grwp Llandrillo Menai.

Over the course of the year a programme of events, site visits, clinics and workshops were arranged across the region to explore the potential uses of IoT. An important outcome from the activity has been the identification of potential use cases for IoT within specific sectors, including tourism, agriculture and public services. Local digital specialists and enthusiasts have been taking this information in order to develop and trial solutions.

IoT in the care sector

IoT technology has significant potential to improve the quality of service and reduce costs in the care sector, especially in remote communities. Sensors can be deployed to monitor homes and alert carers if there is something unusual or out of the ordinary. An example could be an alert informing the carer that the resident has switched on their kettle for the morning cup of tea.

²² <https://www.suffolk.gov.uk/business/suffolk-norfolk-long-range-wide-area-network/>

²³ <https://thingitude.com/2018/11/digital-playground-in-wales/>

In June 2019 Menter Môn arranged a workshop focusing on IoT in the care sector and invited speakers from across the UK to share their knowledge and experience. Among those present were Age Cymru Gwynedd & Môn, Canllaw (Eryri) Cyf and Ynys Môn and Gwynedd Country Council. Following on from that event Menter Môn is trialling of two types of IoT based care services in Gwynedd and Ynys Môn in order to learn lessons and share best practice with all care providers in the region.

IoT in agriculture

The potential value of remote monitoring on farm is significant and could lead to greater efficiencies, improved safety and security, and protect the environment. As part of the Year of IoT a range of devices have been installed on Glynllifon College Farm near Caernarfon to trial the technology and provide an opportunity to show the technology in situ. Among the devices installed are a depth meter for the slurry pit, a moisture and temperature sensor for the calving shed, and several gate sensors to monitor whether they are open or closed. Each of the sensors are able to send a text message to the farmer if the sensors are triggered.

As well as providing a living laboratory for the IoT in an agricultural setting, the site has been visited on several occasions by Welsh Government Ministers, Ofcom, DCMS, Farming Connect and Farming Unions eager to learn more about the technology.

On the back of the work in Glynllifon, Menter Môn and a group technology experts are installing a network of IoT Gateways on 18 farms on behalf of Farming Connect. This will provide important infrastructure to develop the use of IoT in Agriculture across Wales.

The future

The activity around IoT has dramatically increased over the last 12 months and North Wales has a reputation for leading the way, especially within a rural setting. With so much going on it is important that organisations and business share best practice and learn from each other. To facilitate this Menter Môn have established the Rural Wales Digital Forum.

The first meeting was held in December and was attended by Local Authorities, Housing Associations, Bangor University, Grwp Llandrillo Menai, Welsh Government and various specialists. The next meeting is scheduled for March and already several other groups have expressed an eagerness to attend.

Moving forward the Forum will also encourage collaboration and highlight commercial opportunities that could be developed within the local economy..

Coverage Comparison table

Coverage by all four operators of voice and 4G services across the UK and Nations, September 2018

		Indoor premises		Outdoor geographic		Major roads	
		4G	Voice	4G	Voice	4G	Voice
UK	Total	80% (3↑pp)	93%	66% (1↑pp)	79% (1↑pp)	62% (↓2pp)	81% (↓1pp)
	Urban	86% (3↑pp)	97%	96% (1↓pp)	99%	82% (1↓pp)	94% (1↓pp)
	Rural	42% (1↑pp)	68% (2↑pp)	62% (1↑pp)	77% (2↑pp)	51% (2↓pp)	74% (1↓pp)
England	Total	81% (3↑pp)	93%	81% (1↓pp)	91%	68% (2↓pp)	87% (2↓pp)
	Urban	87% (3↑pp)	97%	97% (1↓pp)	99%	83% (1↓pp)	95% (1↓pp)
	Rural	42%	68% (1↑pp)	78% (1↓pp)	90%	57% (3↓pp)	81% (2↓pp)
Northern Ireland	Total	62% (4↑pp)	80% (1↓pp)	75% (4↓pp)	86% (1↓pp)	52% (8↓pp)	72% (6↓pp)
	Urban	72% (7↑pp)	88%	90% (3↓pp)	96%	65% (3↓pp)	84% (3↓pp)
	Rural	36% (3↓pp)	58% (1↓pp)	74% (4↓pp)	85% (2↓pp)	47% (10↓pp)	67% (7↓pp)
Scotland	Total	79% (4↑pp)	92% (1↑pp)	42% (3↑pp)	58% (4↑pp)	48% (1↑pp)	68% (2↑pp)
	Urban	87% (5↑pp)	97% (1↑pp)	96%	99%	85% (2↑pp)	96%
	Rural	49% (5↑pp)	71% (6↑pp)	41% (3↑pp)	58% (4↑pp)	42% (1↑pp)	63% (3↑pp)
Wales	Total	73% (4↑pp)	90% (2↑pp)	58% (1↑pp)	77% (2↑pp)	52% (1↓pp)	76%
	Urban	83% (4↑pp)	96% (2↑pp)	90% (1↑pp)	97% (1↑pp)	77% (1↑pp)	93% (1↑pp)
	Rural	38% (2↑pp)	69% (3↑pp)	54% (1↑pp)	75% (2↑pp)	42% (2↓pp)	69%

Source: Ofcom analysis of operator data

Interactive dashboard

The publication of this report is accompanied by an interactive dashboard. This allows more flexibility to interact with the data of most interest. The additional features introduced enables users to view the data in a granularity that is most useful to them.

The user will have the option to choose from the following levels of geographical detail on most pages.

- Nations
- Local Authorities
- Westminster Constituencies
- Devolved government constituencies (NI, Scotland and Wales only)

Furthermore, for each level of detail, the user can always compare selected figures with the equivalent UK figures. These features have been introduced to meet the demand that has been observed from previous years, to access local figures and compare them against UK average.

Glossary

2G Second generation of mobile telephony systems. Uses digital transmission to deliver: voice, text services and very low-speed data services.

3G Third generation of mobile systems. It can be used to deliver: voice, text and lower speed data services. It supports multi-media applications such as video, audio and internet access, alongside conventional voice services.

4G Fourth generation of mobile systems. It can provide download speeds of over 10 Mbit/s, and is used to deliver: voice, text and higher speed data services.

5G will be the fifth generation of mobile technology. It is expected to deliver faster, lower latency mobile broadband, and to enable more revolutionary uses in sectors such as manufacturing, transport and healthcare.

Access network An electronic communications network which connects end-users to a service provider; running from the end-user's premises to a local access node and supporting the provision of access-based services. It is sometimes referred to as the 'local loop' or the 'last mile'.

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

Backhaul The part of the communications network which connects the local exchange to the ISP's core network

Base station This is the active equipment installed at a mobile transmitter site. The equipment installed determines the types of access technology that are used at that site.

Decent Broadband A data service that provides download speeds of at least 10 Mbit/s and upload speeds of at least 1 Mbit/s.

Broadband A data service or connection generally defined as being 'always on' and providing a bandwidth greater than narrowband connections.

Broadband USO Broadband Universal Service Obligation. This will give consumers and businesses the right to request a broadband connection capable of delivering a download sync speed of 10Mbit/s and an upload sync speed of 1Mbit/s.

Core network The central part of any network aggregating traffic from multiple backhaul and access networks.

DOCSIS Data Over Cable Service Interface Specification. It is a standard for the high-speed transmission of data over cable networks.

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

FTTC Fibre to the Cabinet. Access network consisting of optical fibre extending from the access node to the street cabinet. The street cabinet is usually located only a few hundred metres from the subscribers' premises. The remaining segment of the access network from the cabinet to the customer is usually a copper pair.

FTTP Fibre to the Premises. A form of fibre optic communication delivery in which the optical signal reaches the end user's home or office. Also known as full-fibre broadband.

FTIR Future Telecoms Infrastructure Review. This document sets out the government's ambition for digital connectivity published in July 2018.

Full-fibre coverage Where the network has been rolled out to a "lead-in" that will serve the consumer end premise and where the customer would expect to pay a standard installation charge for that connection

HD or HDTV High-definition television. A technology that provides viewers with better quality, high resolution pictures.

IP Internet Protocol. This is the packet data protocol used for routing and carrying data across the internet and similar networks.

IoT Internet of Things. Embedded connectivity in everyday things, enabling them to send and receive data.

LTE Long Term Evolution. This is 4G technology which is designed to provide faster upload and download speeds for data on mobile networks.

M2M Machine to Machine. Wired and wireless technologies that allow systems to communicate with each other.

MNO Mobile Network Operator, a provider who owns a cellular mobile network.

Not-spot An area which is not covered by fixed or mobile networks.

PSTN Public Switched Telephone Network. The network that manages circuit switched fixed line telephone systems.

SIM Subscriber Identity Module. A SIM is a small flat electronic chip that identifies a mobile customer and the mobile operator. A mobile phone must have a SIM before it can be used.

Smartphone A mobile phone that offers more advanced computing ability and connectivity than a contemporary basic 'feature' phone.

Superfast broadband A data service that delivers download speeds of at least 30 Mbit/s.

UHD Ultra High Definition television, providing a resolution of 3840 x 2160 pixels (4K).

Ultrafast broadband A data service that delivers download speeds of greater than 300 Mbit/s.

Usage cap Monthly limit on the amount of data that users can download, imposed by fixed and mobile operators for some of their packages.

VDSL Very High Speed DSL. A high speed variant of DSL technology, which provides a high headline speed through reducing the length of the access line copper by connecting to fibre at the cabinet.

VoIP Voice over Internet Protocol. A technology that allows users to send calls using internet protocol, using either the public internet or private IP networks.

wifi A short range wireless access technology that allows devices to connect to a network through using any of the 802.11 standards. These technologies allow an over-the-air connection between a wireless client and a base station or between two wireless clients.

xDSL The generic term for the Digital Subscriber Line (DSL) family of technologies used to provide broadband services over a copper telephone line.