CONNECTED NATIONS
**2017**

Report

# About this document

This is Ofcom's annual, in-depth look at the coverage of broadband and mobile networks of the UK and its Nations.

As communications play an increasingly critical role in our lives, the supporting infrastructure must keep pace with the needs of people and businesses.

Part of Ofcom's role is to help ensure that people across the UK can access a decent internet service, and make phone calls where and when they need to.

This annual report tracks communications providers' progress in increasing the availability of good communications, and how the UK's networks are responding to changing needs of people and businesses.

# Contents

**Section**

# 1. Summary of key findings

1.1     This report outlines the main developments in coverage and performance of fixed broadband and mobile networks, as well as network security and resilience. Alongside this report, we have published reports summarising the findings for the four UK nations. We have also updated our mobile coverage checker app for smartphones and tablets, and our online visualisation tool, to help people find out more about the availability of fixed broadband and mobile services.

1.2     Since we published our first report on these services in 2011, coverage has grown and people and businesses are better connected. But in too many areas coverage is still poor, broadband speeds are slow, and mobile services are unreliable or not available. Ofcom's Strategic Review of Digital Communications led to a number of policies[1] aimed at addressing these problems; our Connected Nations reports help us to monitor progress.

## Fixed broadband

1.3     **Broadband coverage to people's homes and businesses has continued to improve.** Superfast broadband – which Ofcom defines as providing a minimum 30Mbit/s download speed – is now available to 91% of premises in the UK, up from 89% last year. Coverage of broadband with a minimum of 24Mbit/s download speed, the Government's definition of superfast broadband, was 92% of premises as of May 2017[2].

**Figure 1: An indication of what you can do with different download speeds**

| | Download speed | | | |
|---|---|---|---|---|
| | **10Mbit/s** | **30Mbit/s** | **300Mbit/s** | **1Gbit/s** |
| **Streaming music** | Yes | Yes | Yes | Yes |
| **Downloading an album** | 1 – 2 min. | 30 – 60 sec. | < 10 sec. | < 5 sec. |
| **Streaming an HD movie** | Yes | Yes | Yes | Yes |
| **Downloading an HD movie** | 1 – 1½ hours | 30 min. | < 5 min. | < 2 min. |
| **Streaming an ultra HD movie** | No | Yes | Yes | Yes |
| **Downloading an ultra HD movie** | 5 hours | 1½ - 2 hours | <15 min. | < 5 min. |

Estimates assume exclusive use of the broadband connection. If others are using the connection at the same time, content may take longer to download or may stream at a lower quality.

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[1] https://www.ofcom.org.uk/phones-telecoms-and-internet/information-for-industry/policy/digital-comms-review/conclusions-strategic-review-digital-Communications

[2] These statistics for coverage of services with download speeds of 30Mbit/s and 24Mbit/s both relate to May 2017, which is when our fixed coverage data was gathered. Throughout the remainder of this document we use our definition of superfast (i.e. with a download speed of at least 30Mbit/s) unless otherwise stated.
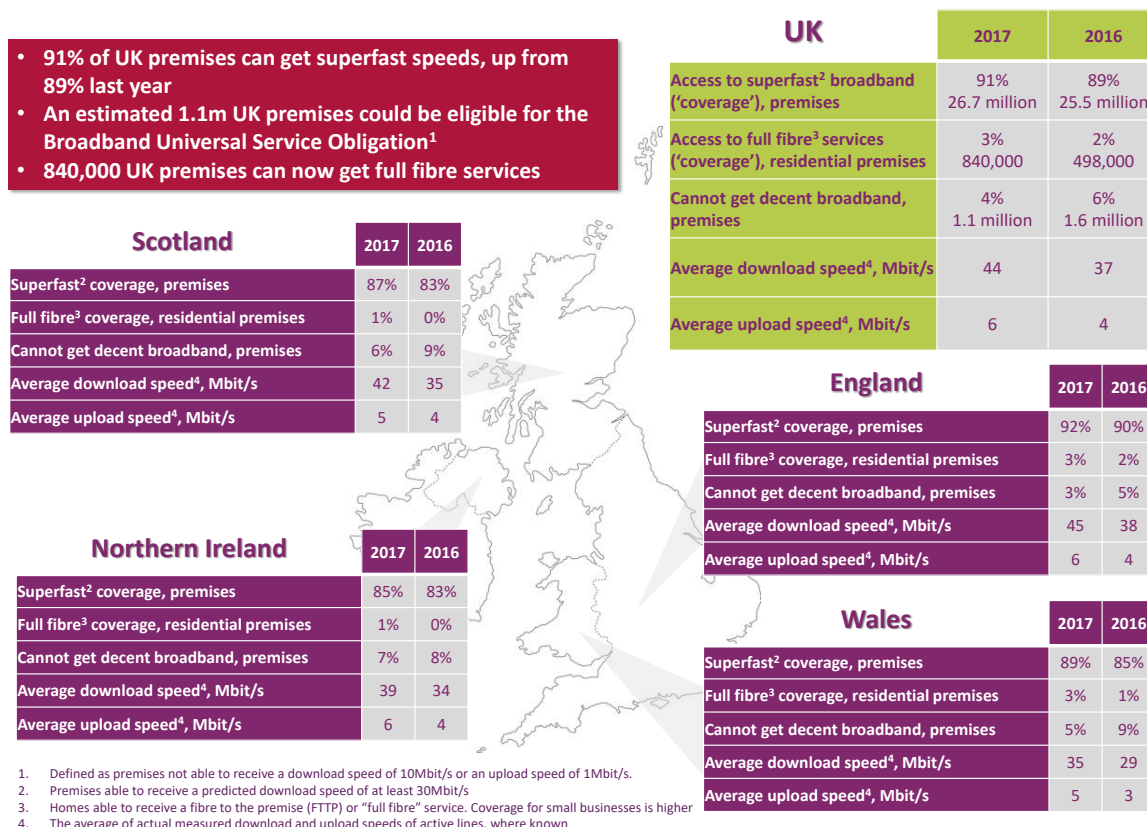
*Source: Ofcom analysis*

1.4    **But too many premises lack access to decent broadband.** We estimate that around 1.1 million UK premises (4%) cannot access decent broadband[3]; that means a connection capable of delivering a download speed of at least 10Mbit/s and an upload speed of at least 1Mbit/s. This is the specification for the Government's proposed broadband Universal Service Obligation (USO). The inclusion of a minimum upload speed reflects the growing importance to people and businesses of services such as videoconferencing and video sharing, which need good upload, as well as download, speeds.

1.5    **Lack of decent broadband is a particular concern for small businesses**.  Small businesses increasingly rely on broadband, but a disproportionate number cannot access even a basic service. We estimate that almost 230,000 small businesses (7%) cannot receive decent broadband. A key benefit of the USO will be to address this concern. We see a similar pattern for superfast broadband, where around 500,000 small businesses (16%) do not have access, compared to 9% of premises as a whole.

1.6    **The picture varies across the nations**. Generally, premises in England have better access to broadband than those in Scotland, Wales and Northern Ireland. While superfast broadband coverage in England is 92%, the equivalent figure for the other nations varies between 85% and 89%. Similarly, 3% of premises in England do not have access to decent broadband, while the equivalent figure for the other nations varies between 5% and 7%.

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[3] We consider that this is the minimum level of broadband performance required for internet access to services such as web browsing, email and certain video services.

**Figure 2: The state of fixed broadband across the UK**

- 91% of UK premises can get superfast speeds, up from 89% last year
- An estimated 1.1m UK premises could be eligible for the Broadband Universal Service Obligation[1]
- 840,000 UK premises can now get full fibre services

| UK | 2017 | 2016 |
|---|---|---|
| Access to superfast[2] broadband ('coverage'), premises | 91%<br>26.7 million | 89%<br>25.5 million |
| Access to full fibre[3] services ('coverage'), residential premises | 3%<br>840,000 | 2%<br>498,000 |
| Cannot get decent broadband, premises | 4%<br>1.1 million | 6%<br>1.6 million |
| Average download speed[4], Mbit/s | 44 | 37 |
| Average upload speed[4], Mbit/s | 6 | 4 |

| Scotland | 2017 | 2016 |
|---|---|---|
| Superfast[2] coverage, premises | 87% | 83% |
| Full fibre[3] coverage, residential premises | 1% | 0% |
| Cannot get decent broadband, premises | 6% | 9% |
| Average download speed[4], Mbit/s | 42 | 35 |
| Average upload speed[4], Mbit/s | 5 | 4 |

| England | 2017 | 2016 |
|---|---|---|
| Superfast[2] coverage, premises | 92% | 90% |
| Full fibre[3] coverage, residential premises | 3% | 2% |
| Cannot get decent broadband, premises | 3% | 5% |
| Average download speed[4], Mbit/s | 45 | 38 |
| Average upload speed[4], Mbit/s | 6 | 4 |

| Northern Ireland | 2017 | 2016 |
|---|---|---|
| Superfast[2] coverage, premises | 85% | 83% |
| Full fibre[3] coverage, residential premises | 1% | 0% |
| Cannot get decent broadband, premises | 7% | 8% |
| Average download speed[4], Mbit/s | 39 | 34 |
| Average upload speed[4], Mbit/s | 6 | 4 |

| Wales | 2017 | 2016 |
|---|---|---|
| Superfast[2] coverage, premises | 89% | 85% |
| Full fibre[3] coverage, residential premises | 3% | 1% |
| Cannot get decent broadband, premises | 5% | 9% |
| Average download speed[4], Mbit/s | 35 | 29 |
| Average upload speed[4], Mbit/s | 5 | 3 |

1. Defined as premises not able to receive a download speed of 10Mbit/s or an upload speed of 1Mbit/s.
2. Premises able to receive a predicted download speed of at least 30Mbit/s
3. Homes able to receive a fibre to the premise (FTTP) or "full fibre" service. Coverage for small businesses is higher
4. The average of actual measured download and upload speeds of active lines, where known

*Source: Ofcom analysis of operator data, May-June 2017*

1.7 **More people are upgrading to superfast services**. As superfast broadband coverage reaches 91%, almost four in ten premises (38%) now take a superfast service. This has increased from 31% last year. As a result, the total amount of data carried by UK fixed access networks in a month has increased by 52% over the last year, to 4.17 exabytes[4].

1.8 **'Full fibre' investment is starting to happen.** Full fibre broadband delivers a predictable and reliable service, with speeds as high as one gigabit per second. It is now available to 840,000 UK premises (around 3%, up from 2% last year). We expect this to increase in the coming years, as a number of network operators have recently announced plans to extend their full fibre networks:

a) Virgin Media is extending its ultrafast broadband network to an additional four million premises, of which two million are expected to be full fibre[5];

b) City Fibre, in partnership with Vodafone, recently announced plans to roll out full fibre to five million premises by 2025[6]. Hyperoptic has also announced plans to provide full fibre coverage to five million premises by 2025[7]. Gigaclear, targeting more rural areas, aims to

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[4] 1 Exabyte = 1 billion Gigabytes = 1 quintillion bytes
[5] http://www.libertyglobal.com/pdf/press-release/Virgin-Media-Fixed-Income-Q3-2016-FINAL.pdf
[6] https://www.cityfibre.com/news/vodafone-cityfibre-bring-gigabit-speed-fibre-uk/
[7] https://www.hyperoptic.com/press/posts/hyperoptic-secures-100million-to-accelerate-full-fibre-rollout/

cover 150,000 premises by 2020[8]. KCOM has also announced it plans to have full fibre coverage across all of its network area by March 2019, providing coverage to 200,000 premises[9]; and

c) Openreach has outlined its ambition to roll out full fibre services to two million premises by the end of 2020[10], and indicated that it may be possible to extend this to 10 million premises by the mid-2020s. [11]

# Mobile telephones and broadband

1.9     **We are making sure that the way we measure mobile coverage reflects the actual experience of today's mobile users.** Our expectation of mobile services is changing as we become more dependent on mobile services and need to access them wherever we are – indoors, outdoors or on the move. At the same time the devices we use to access mobile services have changed, with increasing take-up of smartphones and tablets, which require stronger signals than older, simpler phones. Our engineers have therefore carried out an extensive programme of practical tests to ensure mobile coverage information reflects the actual experience of today's mobile users.

1.10    The Government and the National Infrastructure Commission (NIC) have supported this approach, asking Ofcom to set out how reporting of mobile coverage might reflect the quality of service experienced by consumers[12] [13].

1.11    We define mobile coverage in a way that is likely to deliver a decent experience to smartphone users:

a) **Telephone calls:** Nearly all 90-second telephone calls should be completed without interruption;

b) **Data services:** Nearly all connections should deliver a speed of at least 2Mbit/s. This is fast enough to allow users to browse the internet and watch glitch-free mobile video.

1.12    We have used crowdsourced[14] data from consumer handsets to identify the signal levels needed to meet these targets at least 95% of the time. We have also checked the signal levels predicted to be available from mobile operators are provided in practice.

1.13    The headline findings on the state of coverage of the UK's mobile networks in 2017 are:

a) **Most, but not all, people have coverage in their home or at their offices:** 90% of UK premises have indoor telephone call coverage from all four mobile networks, while 85%

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[8] https://www.ispreview.co.uk/index.php/2017/05/gigaclear-raise-111m-1gbps-rural-broadband-150000-uk-premises.html
[9] https://www.kcomhome.com/news/articles/kcom-full-steam-ahead-for-fibre-broadband/
[10] http://www.btplc.com/Sharesandperformance/Quarterlyresults/Investormeetingpack.pdf
[11] https://www.homeandbusiness.openreach.co.uk/news/industry-has-welcomed-our-ambition-to-build-a-large-scale-fttp-broadband-network
[12] https://www.gov.uk/government/publications/next-generation-mobile-technologies-a-5g-strategy-for-the-uk
[13] https://www.gov.uk/government/publications/connected-future
[14] Crowdsourcing is the use of data from a large number of people and, in this particular case, their mobile phones. This data is automatically collected and made available for analysis.

have indoor coverage for mobile data services. These figures are up from 85% and 80% respectively last year. Our coverage figures take into account the reduction of mobile signal levels indoors because signals can struggle to travel through walls. However, those people who do not have indoor coverage may still be able to access mobile data over wifi, and are increasingly able to make telephone calls over wifi[15];
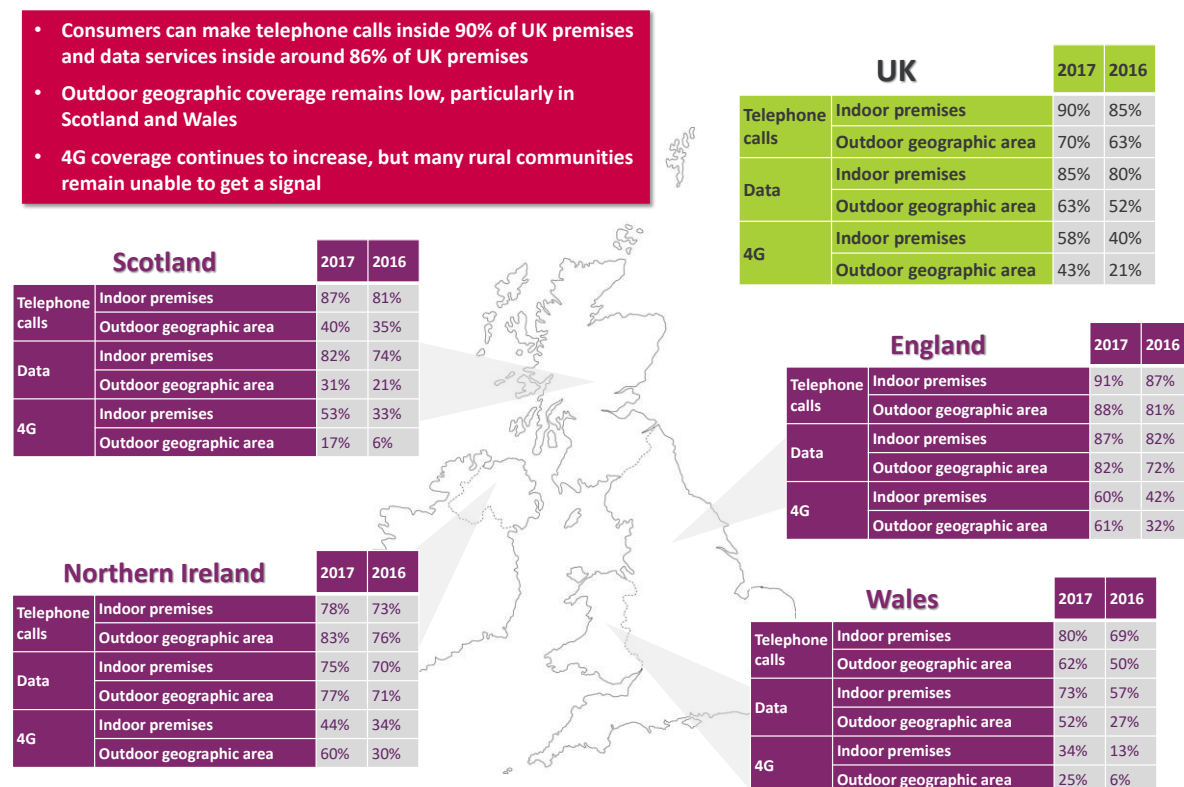
b) **Coverage away from home has improved, but is still poor**: 70% of the geographic area of the UK has telephone call coverage from all four networks, while 63% has mobile data coverage. These figures are up from 63% and 52% respectively last year;

c) **Coverage on roads also needs to improve.** It is possible to make a telephone call from all four networks while inside a vehicle on just 68% of A and B roads, while 58% of A and B roads have in-vehicle data coverage. These figures are up from 56% and 45% respectively last year. Our coverage figures take into account the reduction of mobile signal levels as they travel through the metal frame of a typical vehicle. Motorists increasingly rely on mobile connectivity for a wide range of services, from entertainment to navigation, and we expect this reliance to increase as 'connected cars' become more popular;

d) **Urban areas have better coverage than rural; England has better coverage than the other nations.** While people inside 90% of UK premises can now make telephone calls on all four mobile networks, this falls to 57% in rural areas. People can make outdoor telephone calls from 70% of the geographic area of the UK, but only 40% of the geographic area of Scotland.

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[15] Wi-fi calling is now supported by many mobile phones and we expect its use to continue to grow.

**Figure 3: The state of mobile services across the UK**

- Consumers can make telephone calls inside 90% of UK premises and data services inside around 86% of UK premises
- Outdoor geographic coverage remains low, particularly in Scotland and Wales
- 4G coverage continues to increase, but many rural communities remain unable to get a signal

### UK

| | | 2017 | 2016 |
|---|---|---|---|
| Telephone calls | Indoor premises | 90% | 85% |
| | Outdoor geographic area | 70% | 63% |
| Data | Indoor premises | 85% | 80% |
| | Outdoor geographic area | 63% | 52% |
| 4G | Indoor premises | 58% | 40% |
| | Outdoor geographic area | 43% | 21% |

### Scotland

| | | 2017 | 2016 |
|---|---|---|---|
| Telephone calls | Indoor premises | 87% | 81% |
| | Outdoor geographic area | 40% | 35% |
| Data | Indoor premises | 82% | 74% |
| | Outdoor geographic area | 31% | 21% |
| 4G | Indoor premises | 53% | 33% |
| | Outdoor geographic area | 17% | 6% |

### England

| | | 2017 | 2016 |
|---|---|---|---|
| Telephone calls | Indoor premises | 91% | 87% |
| | Outdoor geographic area | 88% | 81% |
| Data | Indoor premises | 87% | 82% |
| | Outdoor geographic area | 82% | 72% |
| 4G | Indoor premises | 60% | 42% |
| | Outdoor geographic area | 61% | 32% |

### Northern Ireland

| | | 2017 | 2016 |
|---|---|---|---|
| Telephone calls | Indoor premises | 78% | 73% |
| | Outdoor geographic area | 83% | 76% |
| Data | Indoor premises | 75% | 70% |
| | Outdoor geographic area | 77% | 71% |
| 4G | Indoor premises | 44% | 34% |
| | Outdoor geographic area | 60% | 30% |

### Wales

| | | 2017 | 2016 |
|---|---|---|---|
| Telephone calls | Indoor premises | 80% | 69% |
| | Outdoor geographic area | 62% | 50% |
| Data | Indoor premises | 73% | 57% |
| | Outdoor geographic area | 52% | 27% |
| 4G | Indoor premises | 34% | 13% |
| | Outdoor geographic area | 25% | 6% |

Coverage is for all operators, i.e. the percentage of premises or geographic area where there is likely to be a signal from all operators. Coverage levels for individual operators will be higher. **Based on Ofcom coverage definitions, which are different to those used in coverage obligations.**

*Source: Ofcom analysis of operator data, June 2017*

1.14 **We are working with industry to ensure that coverage measurement reflects the consumer experience.** We recently established a cross-industry working group to agree a consistent means of measuring coverage, building on and refining the principles set out here. We expect this to require further testing, using both traditional test equipment and crowdsourcing. The working group will consider how this can best be presented to consumers, so that they can choose the service that best meets their needs. We will continue to seek ways to improve both how we measure coverage and how we present information via our own coverage checker app for tablets and smartphones[16].

1.15 **Coverage obligations are the main means by which we can improve mobile coverage.** We can improve mobile coverage by applying coverage obligations to the spectrum licences held by operators. There are currently two such obligations. One requires operators to provide coverage for telephone calls to 90% of UK landmass; the other requires O2 to deliver an indoor data service of at least 2Mbit/s to 98% of UK premises. Both of these obligations require delivery by the end of 2017, and early in 2018 we will be examining whether they have been complied with.

1.16 **Historic coverage obligations do not fully meet the needs of modern mobile users.** When these coverage obligations were established they adopted the approach to measurement

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[16] https://www.ofcom.org.uk/phones-telecoms-and-internet/advice-for-consumers/advice/ofcom-checker

that had historically been used by the mobile industry. Since then, increased consumer expectations and changes in the devices used to access mobile services mean the levels of coverage actually achieved will be lower - by approximately 10 percentage points. Based on how we now measure coverage to reflect modern smartphone use, and assuming the operators meet their obligations, the historic coverage obligations would in practice mean that all operators would provide outdoor coverage to 80% of the UK landmass (rather than 90%), and O2 would deliver an indoor data service to 88% of UK premises (rather than 98%).

1.17    **We are considering new coverage obligations associated with the 700 MHz spectrum auction**. As set out in our Strategic Review of Digital Communications[17], the award of the mobile airwaves in the 700 MHz band provides an important opportunity to improve coverage. We intend to define these new obligations in a way that reflects the actual experience of today's mobile users. We also believe that they should focus on rural areas, where the current experience is poorest and is least likely to be addressed by operators' commercial deployments. We are planning to consult early in 2018 on specific proposals.

1.18    **Increasing coverage and take-up of 4G is driving data use.** The average volume of data consumed per subscriber per month is now 1.9GB, up from 1.3GB last year – an increase of 46% year on year. A total of 156PB was sent over all mobile networks in June 2017, a 47% increase on the year before. Even so, this represents less than 4% of the total volume of data sent over fixed broadband networks in a month.

## Network security and resilience

1.19    Communications providers must protect the availability and resilience of their networks. We require operators to report major incidents to us and received 678 incident reports last year, broadly in line with previous years. We also require operators to demonstrate that they adopt security best practice.

1.20    **Cyber security is a major area of current focus.** Historically most network failures have been due to physical faults, for example hardware failures. In the light of the growing threat of cyber attack, we are working with the Department for Digital, Culture, Media & Sport (DCMS) and the National Cyber Security Centre (NCSC) on a programme to proactively test operators' cyber-readiness.

1.21    **The dependence of mobile networks on mains power merits further attention.** Mobile networks are increasingly important as a means of safety-critical communications. For example, 70% of calls to the emergency services are now made over mobile networks. We believe that more needs to be done to improve the resilience of mobile networks in the face of electricity supply failure, and we will work with both industry and government to identify options for improvement.

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[17] https://www.ofcom.org.uk/phones-telecoms-and-internet/information-for-industry/policy/digital-comms-review/conclusions-strategic-review-digital-Communications

# Dashboard

Data relating to fixed coverage was collected in May 2017. All other 2017 data relates to June. All figures for data usage combine both download and upload volumes.

| Fixed broadband | 2017 | 2016 |
|---|---|---|
| **Broadband, all speeds** | | |
| Access to services ('coverage'), premises | 100% | ≈100% |
| Average download speed of active connections | 44Mbit/s | 37Mbit/s |
| Average upload speed of active connections | 6Mbit/s | 4Mbit/s |
| Total fixed monthly data usage | 4,170PB | 2,750PB |
| Average monthly data usage, per residential connection | 190GB | 132GB |
| **Broadband (download speed of 10Mbit/s and higher)** | | |
| Access to services ('coverage'), premises | 97% | 95% |
| Average download speed of active connections | 57Mbit/s | 51Mbit/s |
| Average upload speed of active connections | 7Mbit/s | 5Mbit/s |
| Total fixed monthly data usage | 3,581PB | 2,230PB |
| Average monthly data usage, per residential connection | 215GB | 153GB |
| **Superfast broadband (download speed of 30Mbit/s and higher)** | | |
| Access to services ('coverage'), premises | 91% | 89% |
| Average download speed of active connections | 77Mbit/s | 74Mbit/s |
| Average upload speed of active connections | 10Mbit/s | 8Mbit/s |
| Total fixed monthly data usage | 2,445PB | 1,434PB |
| Average monthly data usage, per residential connection | 231GB | 169GB |
| **Full fibre coverage[18]** | | |
| Access to services ('coverage'), premises | 3% | 2% |
| **Broadband (download speed up to 10Mbit/s)** | | |
| Access to services ('coverage'), premises | 3% | 5% |
| Average download speed of active connections | 6Mbit/s | 6Mbit/s |
| Average upload speed of active connections | 1Mbit/s | 1Mbit/s |
| Total fixed monthly data usage | 588PB | 521PB |
| Average monthly data usage, per residential connection | 111GB | 81GB |

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[18] We currently consider a property covered by full fibre services only if they can be connected within 14 days.

| Mobile[19] | 2017 | 2016 |
|---|---|---|
| **4G services** | | |
| Premises (indoor) covered by all operators[20] | 58% | 40% |
| Geographic area covered by all operators | 43% | 21% |
| Geographic area not covered by any operator | 22% | 37% |
| Coverage of A and B roads by all operators | 33% | 16% |
| A and B roads not covered by any operator | 16% | 35% |
| **Telephone call services (2G, 3G and 4G)** | | |
| Premises (indoor) covered by all operators | 90% | 85% |
| Geographic area covered by all operators | 70% | 63% |
| Geographic area not covered by any operator | 9% | 11% |
| Coverage of A and B roads by all operators | 68% | 56% |
| A and B roads not covered by any operator | 5% | 7% |
| **Data services (3G and 4G)** | | |
| Premises (indoor) covered by all operators | 85% | 80% |
| Geographic area covered by all operators | 63% | 52% |
| Geographic area not covered by any operator | 12% | 16% |
| Coverage of A and B roads by all operators | 58% | 45% |
| A and B roads not covered by any operator | 7% | 11% |
| **Mobile (data use)** | | |
| Total number of active mobile connections | 84.06m | 83.6m |
| Total mobile data usage | 155.9PB | 105.5PB |
| Average monthly data usage, per SIM | 1.9GB | 1.3GB |

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[19] Coverage thresholds are: 2G outdoor (-81dBm), 3G outdoor (-100dBm), 4G services outdoor (-105dBm), 4G voice services outdoor (-105dBm) and 4G data services outdoor (-115dBm).
[20] The indoor coverage figures in this report take into account the effects of walls, doors, roofs etc. which will reduce or block mobile signals as they pass through. We have assumed that all buildings block mobile signals in the same way (by reducing signal strength by 10dB). In reality, some buildings will block signals more than others and we will reflect this in subsequent updates.

# 2. Fixed broadband services

2.1    Since the first Connected Nations Report in 2011, we have tracked the progress of superfast broadband rollout. More recently, we have started to see investment in gigabit-capable full fibre services, which are capable of delivering both high speeds and a better consumer experience.

2.2    We also monitor the proportion of premises that do not have access to a decent broadband[21] service capable of delivering a download speed of at least 10Mbit/s and an upload speed of 1Mbit/s. This is the UK Government's proposed specification for its broadband Universal Service Obligation (USO).[22]

2.3    It is important to distinguish between *coverage* and *take-up*. We receive data[23] about the speeds available at every residential and small business property in the UK from a range of fixed broadband infrastructure providers. We also receive information on the actual measured speed of every active line in the country. This gives us a highly detailed picture of both the range of services that *can* be delivered to every home and small business (i.e. coverage); and the speeds of services that are *actually* being used (i.e. take-up).

## Around 1.1m premises do not have access to decent broadband

2.4    In July, the UK Government consulted on its plans for a Universal Service Obligation (USO). This would give every household and small business the right to request a broadband service capable of a download speed of at least 10Mbit/s, and an upload speed of at least 1Mbit/s**.**

**Figure 4: Estimate of the number of premises that would qualify for the USO**

|  | Premises unable to receive download speed at least 10Mbit/s | Premises unable to receive at least 10Mbit/s down and 1Mbit/s up |
|---|---|---|
| **UK** | 942,000 | 1,100,000 |
| **England** | 675,600 | 790,000 |
| **Northern Ireland** | 56,000 | 56,000 |
| **Scotland** | 140,000 | 150,000 |
| **Wales** | 71,000 | 74,000 |

*Source: Ofcom analysis of operator data*

2.5    We estimate that around 1.1 million UK premises (4%) do not have access to a decent broadband service with those speeds. This affects people and businesses in rural areas in

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[21] We consider that this is the minimum level of broadband performance required for internet access to services such as web browsing, email and certain video services.
[22] https://www.gov.uk/government/news/universal-broadband-to-reach-every-part-of-the-uk
[23] Data on coverage of fixed networks was collected in May 2017. Data on the performance of the line, such as data use and the speed of the active service, relates to June 2017.

particular; 17% of premises in the UK's rural areas cannot receive decent broadband services, compared to just 2% in urban areas. This urban-rural divide is particularly stark in Northern Ireland and Scotland. In Northern Ireland, fewer than 1% of urban properties cannot get decent broadband, compared with 23% of rural properties. In Scotland, 2% of urban properties cannot get decent broadband, compared with 27% in rural Scotland.

2.6     We have refined the way in which we estimate the number of premises that do not have access to a decent broadband service. In previous reports, we used data provided by Openreach to estimate the maximum broadband speed for every property of the UK. This approach can be used even where no service is currently being provided, or where the speed of the specific service that is being provided is capped by the provider. However, we have recently learned that the model that generates this data does not fully reflect some technology enhancements that provide more upstream bandwidth, so underestimates upload speeds. We have therefore used actual speed measurements, where these are available, to cross-check the model. As a result we have identified several hundred thousand more lines that are capable of delivering decent broadband.

2.7     We will continue to refine and improve the methodology and will provide data for the end of 2017 in our next update.

## Over 91% of UK properties can now receive superfast broadband

2.8     Almost 27 million, or over 91%, of UK properties have access to fixed broadband services capable of delivering a download speed of at least 30Mbit/s. Superfast coverage has increased in all four nations, with Scotland and Wales experiencing the largest year-on-year increase of premises, of around four percentage points.

**Figure 5: Coverage of fixed broadband services capable of delivering superfast speeds continues to increase across the UK**



*Source: Ofcom analysis of operator data*

2.9     The average download speed of connected, or active, broadband lines has increased from 37Mbit/s to just over 44Mbit/s, continuing the trend of recent years. However, the average upload speed has increased for the first time since 2014, from 4Mbit/s to 6Mbit/s. The upload speed of broadband connections is becoming more important as consumers and businesses make greater use of services such as photo sharing or video calling.

## The UK Government has moved closer to meeting its target for superfast broadband coverage

2.10    The UK Government is aiming for at least 95% of premises to have access to superfast broadband services by the end of 2017, using its own benchmark of 24Mbit/s or more. We estimate that 92% of UK premises (around 27 million) had available to them broadband at this speed as of May 2017. This is an increase of over one million properties since last year. We will report on the extent of coverage as of the end of 2017 in our next update.

2.11    This figure is lower than some numbers reported elsewhere, such as by thinkbroadband.com, whose figures are cited by Government to track superfast broadband rollout. Unlike our estimate, which is based on analysis of speeds available to every residential and small business property in the UK, other such reports are extrapolated from consumer line speed tests for a small sample of lines.

## Broadband coverage is lower for small businesses

2.12    Broadband coverage for small businesses[24] has continued to increase, but has lagged behind the wider population. This is a significant concern, resulting in download speeds which are insufficient to run key activities for certain types of small business:

a)    We estimate that around 230,000 small businesses (7%) cannot receive a decent broadband service, compared with 4% for the population as a whole. These will benefit from the UK Government's planned broadband USO; and

b)    Some 2.7 million small businesses (84%) have access to superfast services, compared to 91% for the population as a whole.

2.13    Coverage is lower for those in business parks and trading estates, where only 74% of small businesses can access superfast services. Almost 65,000 small businesses in business parks and trading estates do not have access to a decent broadband service. However, businesses that are situated in serviced office space may be able to take advantage of shared leased line connections that offer at least superfast speeds.

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[24] We define a small business as a Small-or Medium-Sized Enterprise (SME) with at least one employee

**Figure 6: Coverage for small businesses continues to improve but significant gaps remain**

| | Superfast coverage | Full fibre coverage | Cannot get decent broadband |
|---|---|---|---|
| **UK** | 84% | 2% | 7% |
| **England** | 85% | 2% | 7% |
| **Northern Ireland** | 75% | 0% | 12% |
| **Scotland** | 78% | 0% | 11% |
| **Wales** | 81% | 4% | 11% |

*Source: Ofcom analysis of operator data*

## Smaller network providers are helping to extend full fibre coverage

2.14    'Full fibre' broadband is where a home or office is connected all the way to the telephone exchange by fibre-optic cables. It is often contrasted with services that are based fully or partially on copper wires.

2.15    Full fibre networks can provide a better quality of broadband; one that has more stable performance, especially at peak times, and therefore can more easily meet the advertised headline speeds. Because they do not involve older copper wires, full fibre lines also suffer considerably fewer faults which affect service. Full fibre can also deliver both download and upload speeds of 1Gbit/s, making it significantly faster than existing services delivered over part-copper networks.

2.16    Full fibre services are currently available to around 840,000 (3%) of UK premises, up from 2% last year.[25] Smaller companies provide around half of this coverage. We expect this to increase in the coming years, as a number of network operators have recently announced plans to extend their full fibre networks:

   a)    Virgin Media is extending its ultrafast broadband network to an additional four million premises, of which two million are expected to be full fibre;[26]

   b)    City Fibre, in partnership with Vodafone, recently announced plans to roll out full fibre to five million premises by 2025[27]. Hyperoptic has also announced plans to provide full fibre coverage to five million premises by 2025[28]. Gigaclear, targeting more rural areas, aims to cover 150,000 premises by 2020[29]. KCOM has also announced it plans to have full fibre

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[25] We consider a property covered by full fibre services only if they can be connected within 14 days.
[26] http://www.libertyglobal.com/pdf/press-release/Virgin-Media-Fixed-Income-Q3-2016-FINAL.pdf
[27] https://www.cityfibre.com/news/vodafone-cityfibre-bring-gigabit-speed-fibre-uk/
[28] https://www.hyperoptic.com/press/posts/hyperoptic-secures-100million-to-accelerate-full-fibre-rollout/
[29]  https://www.ispreview.co.uk/index.php/2017/05/gigaclear-raise-111m-1gbps-rural-broadband-150000-uk-premises.html

coverage across all of its network area by March 2019, providing coverage to 200,000 premises[30];

c) Openreach has outlined its ambition to roll out full fibre services to two million premises by the end of 2020[31], and indicated that it may be possible to extend this to 10 million premises by the mid-2020s[32].

2.17 Virgin Media has also upgraded its cable network to support speeds of up to 300Mbit/s (and up to 350Mbit/s for business lines). As a result, coverage of broadband with download speeds of up to 300Mbit/s has increased significantly. These speeds are now available to more than 10 million premises (36%), up from 485,000 premises (2%) in 2016.

## Nearly four in ten broadband connections are superfast

2.18 Around 38% of premises have bought broadband connections that deliver superfast speeds, up from 31% in 2016. However, there are still many consumers who do not subscribe to superfast services even where they are available.

**Figure 7: Many consumers could get faster speeds by upgrading to superfast**
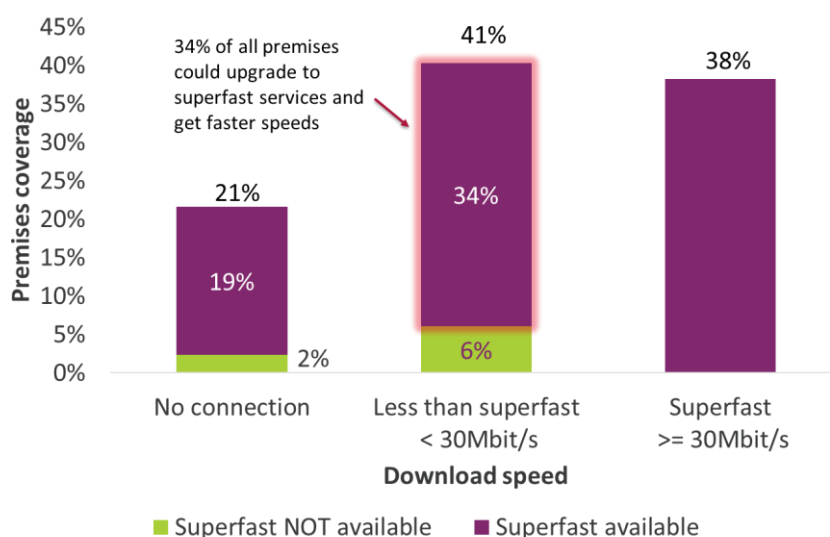


*Source: Ofcom analysis of operator data*

2.19 Around a third of premises (34%) currently have a download speed less than 30Mbit/s but could already upgrade to a superfast service. There are a number of reasons why consumers may not choose to purchase a superfast service when one is available. Some 46% of respondents to 2017 Ofcom research said they did not see the need for superfast broadband and a further 15% felt superfast broadband was too expensive for their needs[33].

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[30] https://www.kcomhome.com/news/articles/kcom-full-steam-ahead-for-fibre-broadband/
[31] http://www.btplc.com/Sharesandperformance/Quarterlyresults/Investormeetingpack.pdf
[32] https://www.homeandbusiness.openreach.co.uk/news/industry-has-welcomed-our-ambition-to-build-a-large-scale-fttp-broadband-network
[33] Table 18, https://www.ofcom.org.uk/__data/assets/pdf_file/0036/99792/Consumer-issues-survey-experience-of-nuisance-calls-March-2017.pdf, March 2017

2.20     Overall, better coverage and adoption of faster services is driving up data use. The total amount of data carried by UK fixed access networks in a month has increased by 52% over the last year, to 4.17 exabytes. This equates to an average of 190GB per residential connection per month, up from 132GB last year, an increase per connection of 44%.

## Lines with download speeds below 10Mbit/s still constrain data use more than faster lines

2.21     Ofcom's analysis shows that the average amount of data used by people increases rapidly in line with the available download speed – up to around 10Mbit/s. Above this speed the correlation between data use and download speed is far less pronounced. This suggests 10Mbit/s continues to be a reasonable threshold for a decent broadband download speed; it is the speed below which people's usage is notably constrained.

**Figure 8: Average data use for lines with different download speeds**
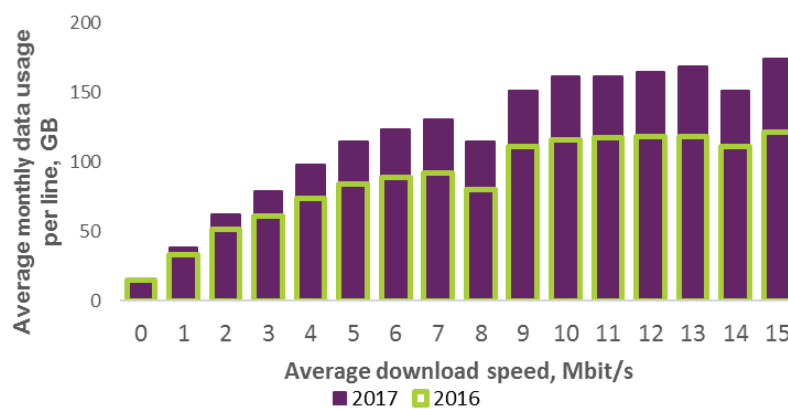


*Source: Ofcom analysis of operator data*

# 3. Mobile telephones and data services

3.1 Our expectation of mobile services is changing as we become more dependent on mobile services and need to access them wherever we are – indoors, outdoors or on the move. At the same time the devices we use to access mobile services have changed, with increasing take-up of smartphones and tablets, which require stronger signals than older, simpler phones.

3.2 We have therefore carried out an extensive programme of practical tests to ensure mobile coverage information reflects the actual experience of today's mobile users. This has resulted in a new approach for defining mobile coverage that we set out in the box below.

3.3 The Government and the National Infrastructure Commission (NIC) have supported this approach. In December 2016, the NIC recommended that common measures should be developed to reflect the actual consumer experience of using mobile services.[34] In March 2017, the UK Government published 'Next Generation Mobile Technologies: A 5G strategy for the UK'.[35] This report asked Ofcom to set out, by the end of 2017, how reporting of mobile coverage might provide 'a genuine and meaningful reflection of the services experienced by customers'.

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**A new approach for defining coverage that reflects consumer experience**

We start by defining mobile coverage in a way that will likely deliver a decent experience to smartphone users:

- **Telephone calls:** Nearly all 90-second telephone calls should be completed without interruption;
- **Data services:** Nearly all connections should deliver a speed of at least 2Mbit/s. This is fast enough to allow users to browse the internet and watch glitch-free mobile video.

We then link these user-facing definitions of coverage to technical definitions that can be used by our engineers to measure coverage. We do this using crowdsourced data from consumer handsets to identify the signal levels needed to meet these targets at least 95% of the time.

Finally, we apply signal level thresholds to the actual signal level predicted in different geographic locations to determine whether there is coverage at that location. These actual signal levels are based on those predicted by each operator's theoretical model of their own coverage, validated using our own extensive on-the-ground measurement programme.

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3.4 Based on our new approach we have concluded:

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[34] https://www.gov.uk/government/publications/connected-future
[35] https://www.gov.uk/government/publications/next-generation-mobile-technologies-a-5g-strategy-for-the-uk

a) 4G telephone call and data coverage requires a higher signal level than previously estimated[36]; and

b) Our own measurements suggest that the operator's predictions largely reflect the signal strengths actually available. However, there are some differences between our measurements and the some of the predicted signal strengths provided EE[37].

3.5 As well as allowing us to derive the mobile coverage statistics which are presented in this report, our approach makes it possible to provide more accurate data to individual consumers. Our coverage checker app is available on tablets and smartphones and allows consumers to identify the operators who are most likely to provide a good mobile experience in the locations that matter most to them. This also helps promote to competition between operators to improve coverage.

3.6 We have established an industry working group to provide more consistent cross-industry messages and information on mobile coverage. This will involve agreeing a common means of measuring coverage, building on and refining the principles set out here. We expect this to require further testing, using both traditional test equipment and crowdsourcing. The working group will also consider how coverage information should be presented to consumers to make it easy to understand.

3.7 While the speed of a mobile data connection is important, there are other factors that can affect the quality of the service a person receives on their mobile phone, such as contention, which happens when many users try to use the network at the same time. We will continue to work on measuring the impact of these factors.

## Mobile coverage in the UK

3.8 Over the past year, indoor and outdoor mobile coverage has continued to generally improve in the UK, as shown in Figure 9. However, many consumers still experience poor coverage, especially in rural areas and while on the move.

**Figure 9: Summary of UK coverage from all operators, June 2017**

|  | Indoor coverage, % premises | Outdoor geographic coverage, % landmass | A&B roads, % road network | Motorways, % road network |
|---|---|---|---|---|
| **Telephone calls** | 90% (↑ 5pp) | 70% (↑ 7pp) | 68% (↑ 12pp) | 97% (↑ 4pp) |
| **Data** | 85% (↑ 5pp) | 63% (↑ 11pp) | 58% (↑ 13pp) | 91% (↑ 8pp) |

Figures in brackets are percentage point (PP) changes since 2016

*Source: Ofcom analysis of operator data*

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[36] To provide comparable year-on-year figures, we have re-calculated 4G coverage for June 2016 using these higher signal levels.

[37] To date, we have been unable to fully explain these differences to our satisfaction. We are undertaking further measurements and have decided to include in this report the predicted coverage data as provided by EE. We will continue to work with EE and expect to reflect the outcome of these discussions in our next update.

## Indoor premises coverage

3.9     Most, but not all, people have coverage in their home or office. Indoor telephone call coverage by all four operators is available to 90% of UK premises, up from 85% in 2016. Coverage for data services stands at 85% of UK premises, up from 80% last year.

3.10    Our coverage figures account for the reduction in mobile signals caused by different buildings. This reduction is higher for premises with thermally efficient building materials. The wider use of these materials is increasing the challenge of providing reliable indoor coverage from mobile networks. Two developments are helping meet this challenge:

   a)  People in premises that do not have indoor coverage from a mobile network may still be able to access data over wifi, and are increasingly able to make telephone calls over wifi; and

   b)  4G services are using lower frequency spectrum bands to carry telephone calls and data services over longer distances and deeper into buildings. These are making an increasingly important contribution to outdoor and indoor mobile coverage.

## Outdoor geographic and road coverage

3.11    Coverage away from home has also improved, but it is still relatively poor. The proportion of the UK's geographic landmass where reliable telephone calls can be made on all four mobile networks has reached 70%, up from 63% in 2016. Coverage of data services is lower, with 63% of UK landmass covered by all operators, an increase from 52% last year.

3.12    Figure 10 shows that increases in coverage of earlier generation 2G and 3G networks are levelling off alongside more significant growth in coverage from newer 4G networks.

**Figure 10: Increases in geographic coverage from all operators since 2015**
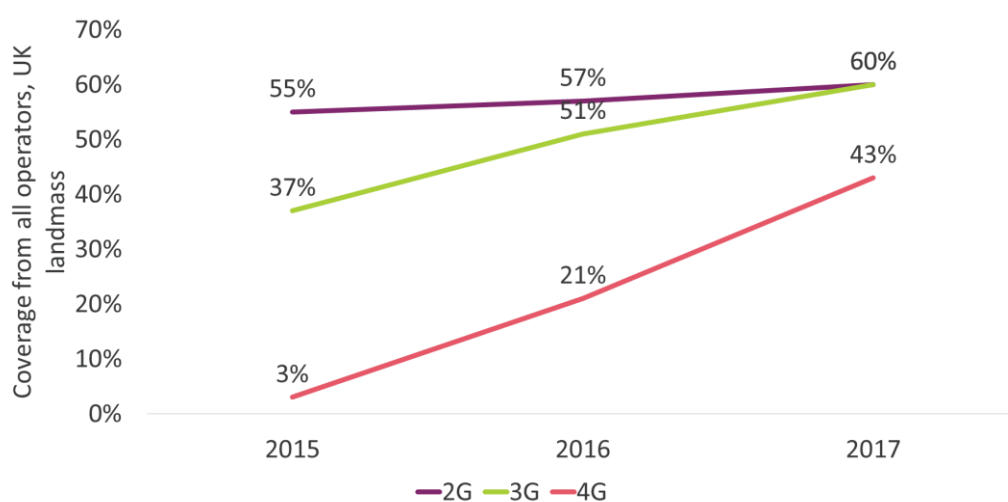


*Source: Ofcom analysis of operator data, latest data is June 2017*

3.13    While the UK's motorways are well covered by both telephone and data networks, coverage on A and B roads is quite poor. It is possible to make a telephone call from all four networks

while inside a vehicle on just 68% of A and B roads, while 58% of A and B roads have in-vehicle data coverage. These figures are up from 56% and 45% respectively last year. Our coverage figures take into account the reduction of mobile signal levels as they travel through the metal frame of a typical vehicle.

3.14    Motorists increasingly rely on mobile connectivity for a wide range of services, from entertainment to navigation, and we expect this reliance to increase as 'connected cars' become more popular. Coverage on roads will need to improve significantly to adequately support these services.

## Coverage in the nations and rural areas

3.15    There are some significant variations in coverage across the nations of the UK. As Figure 11 shows, coverage is generally higher in England than in the other nations.

a)    Northern Ireland is particularly poor for indoor coverage, which is around 10 percentage points lower than for the UK as a whole. This is likely because there is a greater proportion of properties in Northern Ireland that are dispersed throughout the countryside, compared to other nations.

b)    Scotland is particularly poor for outdoor coverage. Just 40% of the landmass in Scotland is covered by mobile telephone services from all operators, compared to 70% in the UK as a whole. Data coverage is even lower, at just 31% of geographic area. Consequently, coverage on A and B roads is also the lowest of the nations. This is due to the challenges in delivering coverage across the large and often mountainous areas of Scotland with low population densities.

c)    There are similar challenges in delivering coverage in Wales, which also has a large proportion of rural and mountainous areas. Both indoor and outdoor geographic coverage is lower in Wales than in the UK as a whole by around 10 percentage points.

**Figure 11: Coverage of telephone call and data services across the UK and nations**

| | Indoor coverage, % premises | | Outdoor geographic coverage, % landmass | | A&B roads, % road network | | Motorways, % road network | |
|---|---|---|---|---|---|---|---|---|
| | Telephone calls | Data | Telephone calls | Data | Telephone calls | Data | Telephone calls | Data |
| **UK** | 90% | 85% | 70% | 63% | 68% | 58% | 97% | 91% |
| **England** | 91% | 87% | 88% | 82% | 78% | 66% | 97% | 91% |
| **Northern Ireland** | 78% | 75% | 83% | 76% | 62% | 54% | 91% | 81% |
| **Scotland** | 87% | 82% | 40% | 31% | 46% | 38% | 96% | 88% |
| **Wales** | 80% | 73% | 62% | 52% | 53% | 41% | 99% | 96% |

*Source: Ofcom analysis of operator data*

3.16    In the rural areas of all nations, including England, consumers continue to experience levels of coverage that are substantially lower than those in towns and cities. As Figure 12 shows, just 18% of rural premises can receive an indoor 4G service from all operators, compared to 64% of premises in urban areas.

**Figure 12: Indoor 4G coverage from all operators in urban and rural areas**
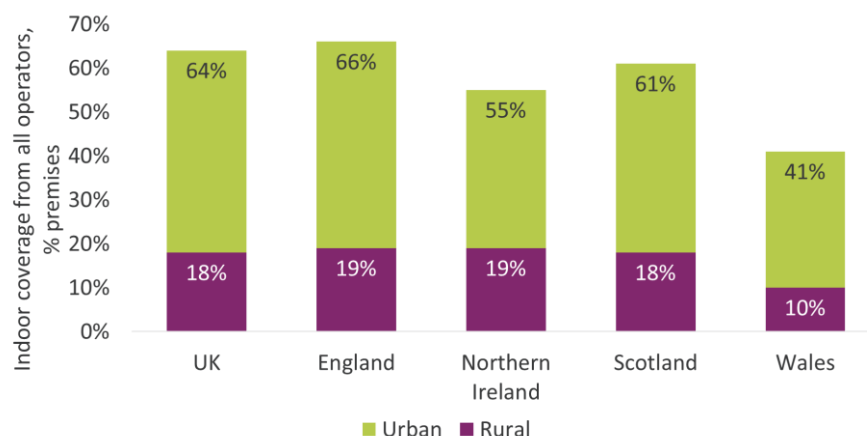


*Source: Ofcom analysis of operator data*

3.17    Improving coverage in rural areas is challenging, especially in mountainous or extremely remote locations. In addition to practical difficulties of installing and maintaining network equipment in these locations, the commercial business case for operators to provide coverage in areas of low population density can be challenging.

## Increasing 4G coverage is driving data use

3.18    The increasing coverage and take-up of higher speed 4G services is driving data use. The average volume of data consumed per subscriber per month is now 1.9GB, up from 1.3GB last year – an increase of 46% year on year. A total of 156PB was sent over all mobile networks in June 2017, a 47% increase on the year before. Even so, this represents less than 4% of the volume of data sent over fixed broadband networks.

## Using coverage obligations to improve mobile coverage

3.19    Coverage obligations are the main means by which we can improve mobile coverage. There are currently two coverage obligations which reflect the consumer expectations and devices in use at the time that they were drafted:

a)    In February 2015, Ofcom varied the licences of the UK's four mobile network operators, with their consent, to commit them to provide telephone call coverage across 90% of the UK's landmass by the end of 2017; and

b)    O2 is under an obligation to provide indoor coverage of a mobile data service capable of 2Mbit/s or more, to 98% of UK premises by the end of 2017. The other operators have indicated that they will match this commitment.

3.20    We can use the data presented in this report to assess progress against the first of these obligations, which requires each operator to provide 90% outdoor coverage. We estimate that the mobile coverage provided by each operator in June 2017, based on the signal strength thresholds agreed for the original 90% coverage obligation, was 87% for EE, 91% for O2, 83% for Three and 93% for Vodafone. We cannot use the data in this report to make a meaningful assessment of O2's progress against its obligation to provide 98% coverage for indoor data coverage.

3.21    We will assess formal compliance with the mobile operators' coverage obligations as early as possible in 2018.

3.22    When these coverage obligations were established they adopted the approach to measurement that had historically been used by the mobile industry. Since then, consumers have come to expect better coverage and the increased use of smartphones to access mobile services means that the levels of coverage actually achieved will be lower - by approximately 10 percentage points. Based on how we now measure coverage to reflect modern smartphone use, the historic coverage obligations would in practice mean that all operators would provide outdoor coverage to 80% of the UK landmass (rather than 90%), and O2 would deliver an indoor data service to 88% of UK premises (rather than 98%).

3.23    As set out in our Strategic Review of Digital Communications[38], the award of the mobile airwaves in the 700MHz band provides an important opportunity to improve coverage. We intend that these new obligations will be defined to reflect the actual experience of today's mobile users. We also believe that they should focus on rural areas, where the current experience is poorest and is least likely to be addressed by operators' commercial deployments. We are planning to consult early in 2018 on specific proposals.

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[38] https://www.ofcom.org.uk/phones-telecoms-and-internet/information-for-industry/policy/digital-comms-review/conclusions-strategic-review-digital-Communications

# 4. Security and resilience

4.1     The security and resilience of fixed, mobile and broadcast television networks and services is increasingly important. The Communications Act 2003 places requirements on providers to protect the security of their networks and services. Providers are also required to notify Ofcom when there are incidents which have significant impact on the operation of their network and services or reduction in the availability of their networks.

4.2     In the past year we have received reports on 678 security incidents by fixed and mobile providers. Incidents that have a wide impact, affecting tens of thousands of customers, are less common. Ofcom sets different criteria for reporting an incident, with most reported to us under the 'emergency access threshold'; that is, incidents that affect voice access to the emergency services for at least 1,000 customers, and for one hour or more.

**Figure 13: The impact of incidents reported to Ofcom, between September 2016 and August 2017**
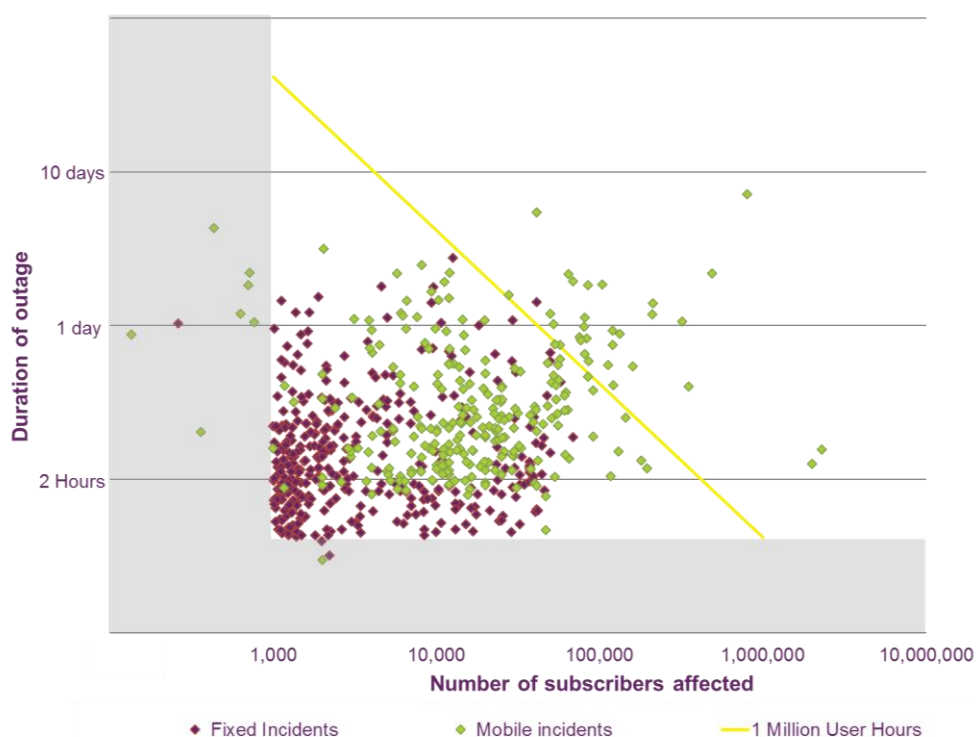


*Source: Ofcom analysis of operator data*

4.3     The four most significant causes (hardware failure, power cut, software bug and cable failure) together account for over 86% of the incidents that were reported to us.[39]

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[39] We categorise the root and primary cause of reported incidents according to the taxonomy provided in the ENISA (European Union Agency for Network and Information Security) Article 13a Technical Guideline on Threats and Assets, https://resilience.enisa.europa.eu/article-13/guideline_on_threats_and_assets

## We are increasing our focus on threats from cyber attacks

4.4    A relatively small number of service-affecting incidents over the past year were attributed to a cyber-attack. However, there is a clear risk that a major cyber-attack on telecommunications networks could have very serious consequences for the UK at some point in the future.

4.5    We therefore need to take a proactive approach to managing this risk. We are working with the Department for Digital, Culture, Media & Sport (DCMS) and the National Cyber Security Centre (NCSC) on a programme to test operators' cyber-readiness. This will assess the real-world level of cyber defences that providers have put in place. It is modelled on the CBEST scheme, which the Bank of England has been operating for financial institutions for several years.[40] As well as assessing providers' defences against such attacks, such testing would also show how well it could detect and respond to any successful attempts.

4.6    The scope of our responsibility for cyber security is about to expand. Under current Government proposals[41], Ofcom will also take on responsibility for enforcing the Network and Information Systems (NIS) Directive for companies in the digital infrastructure sector, such as internet exchanges and domain name services, when this comes into force. The NIS Directive is due to be transposed into UK law in May 2018.

## We are concerned about the dependence of lifeline services on mains power

4.7    Traditional corded telephones are powered over the copper line which runs from the local exchange, and this makes it possible for people to make emergency calls from their home even when there is a power cut. This is important, given the possibility that a power cut is associated with some other event which means people need to call for help. However, as traditional corded telephones are replaced by new types of telephone (wireless handsets, devices which enable telephone calls over broadband), and as copper exchange lines are replaced by fibre, this facility may no longer be available.

4.8    We recognised the importance of this issue in our Strategic Review of Digital Communications. We need to protect people's ability to access lifeline services, whilst giving operators flexibility to do this in a manner that does not hold back investment and innovation in new services. We therefore stated we would assess what operators are doing on a case-by-case basis provided the technical solution delivers a level of protection equivalent to that provided by traditional means. We continue to engage with operators on this basis.

4.9    We also believe that more needs to be done to improve the resilience of mobile networks in the face of electricity supply failure. Mobile networks are increasingly used as a means of safety-critical communications, in particular around 70% of 999 calls are now made on a mobile phone. This dependence of lifeline services on mobile networks is likely to increase

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[40] http://www.bankofengland.co.uk/financialstability/fsc/Pages/cbest.aspx
[41] https://www.gov.uk/government/consultations/consultation-on-the-security-of-network-and-information-systems-directive

over time. However, mobile networks generally rely on mains electricity more than 'legacy' fixed telephone networks. We believe that more needs to be done to improve the resilience of mobile networks in the face of electricity supply failure, and we will work with both industry and government to identify options for improvement.

4.10    We plan to include data on power resilience in our next report and to ask mobile network operators for information about their primary and back-up power arrangements at cell and core sites.

## We are working with industry to prepare for the migration of telephone services to an internet-based system

4.11    As consumer behaviours and technology change, the Public Switched Telephone Network (PSTN) historically used to deliver telephone services is now approaching the end of its life. Providers are looking to switch off the PSTN and deploy in its place an Internet Protocol (IP) based network, with voice treated as any other data application, albeit with a higher priority[42].

4.12    This migration will affect a number of important applications that are not directly related to the delivery of voice, such as fax machines, point-of-sale card readers and personal care alarms. We are engaging with the providers of such services and public-sector stakeholders to ensure that these services remain operational, or are replaced, in good time ahead of PSTN switch off.

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[42] This process is independent of the replacement of copper local access connections with full fibre services as all-IP voice solutions can be deployed on most forms of fixed and wireless connections.

# Annex: Summary tables for mobile coverage

**Figure 14:  Mobile telephone call coverage from all operators**

| | Geographic coverage, % landmass | | Indoor coverage, % premises | | Outdoor coverage, %premises | |
|---|---|---|---|---|---|---|
| | **2017** | **2016** | **2017** | **2016** | **2017** | **2016** |
| **UK** | 70% | 63% | 90% | 85% | 98% | 97% |
| **England** | 88% | 81% | 91% | 87% | 99% | 97% |
| **Northern Ireland** | 83% | 76% | 78% | 73% | 95% | 93% |
| **Scotland** | 40% | 35% | 87% | 81% | 96% | 94% |
| **Wales** | 62% | 50% | 80% | 69% | 93% | 89% |

*Source: Ofcom analysis of operator data*

**Figure 15: Mobile data coverage from all operators**

| | Geographic coverage, % landmass | | Indoor coverage, % premises | | Outdoor coverage, % premises | |
|---|---|---|---|---|---|---|
| | **2017** | **2016** | **2017** | **2016** | **2017** | **2016** |
| **UK** | 63% | 52% | 85% | 80% | 96% | 93% |
| **England** | 82% | 72% | 87% | 82% | 97% | 95% |
| **Northern Ireland** | 76% | 71% | 75% | 70% | 93% | 90% |
| **Scotland** | 31% | 21% | 82% | 74% | 93% | 87% |
| **Wales** | 52% | 27% | 73% | 57% | 88% | 76% |

*Source: Ofcom analysis of operator data*