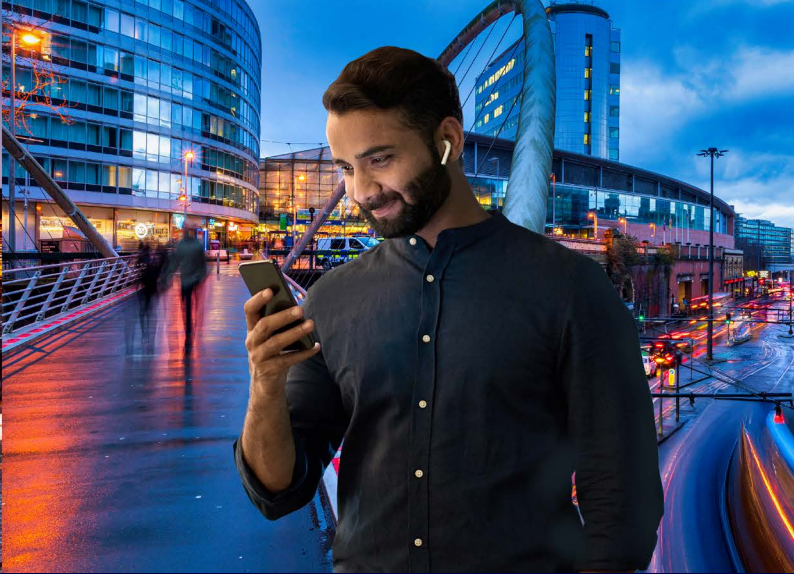


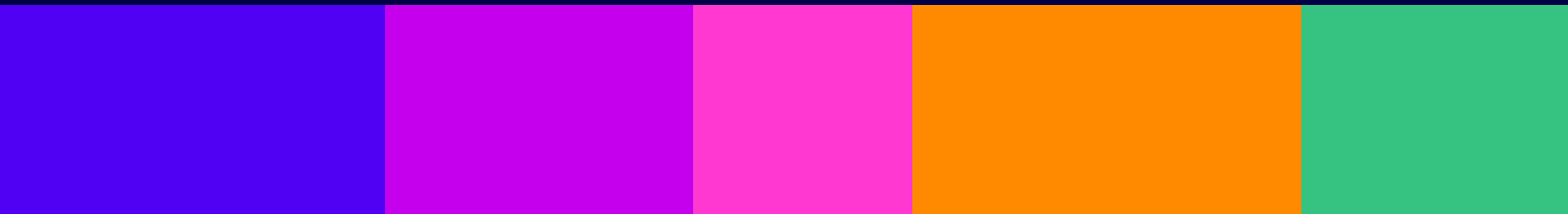
Ofcom



Connected Nations

UK Report 2024

Published 5 December 2024



Contents

Section

1. Overview	3
2. Fixed broadband and voice	6
3. Mobile, data and voice	28
4. Network security and resilience	47

1. Overview

This year's Connected Nations report provides updated data on the coverage and usage of fixed broadband and mobile networks within the UK. This includes updates on take-up of services on full-fibre and gigabit-capable networks, reporting on the further development of 4G networks and progress on the rollout of 5G networks.¹

In addition, we report on network security and resilience, including providing an update on our monitoring programme under the Telecoms (Security) Act 2021 (TSA).

Full-fibre network availability has risen sharply, reaching over two-thirds of households

The coverage of full-fibre networks continues to expand rapidly with full-fibre now available to 69% or 20.7 million of the UK's 30.1 million households. This is an increase of 12 percentage points or 3.6 million premises between September 2023 and July 2024. Residential premises in urban areas are more likely to have full-fibre coverage than in rural areas, at 71% and 52%, respectively.

Full fibre is also available to the majority of small and medium-sized businesses (SMEs). As of July 2024, 63% of SMEs in the UK were within reach of a full-fibre network, an increase of 12 percentage points from September 2023.

Gigabit-capable coverage has expanded to 83%

The coverage of gigabit-capable broadband networks – which includes hybrid fibre coaxial (HFC) cable in addition to full fibre – has grown to reach 83% or 25 million residential premises in the UK by July 2024. This suggests the Government's target of 85% coverage by 2025 is likely to be reached.

Take-up of broadband services is increasing, as are the speeds they offer

More residential and business customers are taking up services on full-fibre networks. The take-up of services on full-fibre networks where available has risen to 35% or 7.5 million premises as of July 2024, up from 28% of all premises in May 2023.

Take-up of full fibre is notably higher in rural areas than in urban areas. Of premises with full fibre access, 52% of premises in rural areas have taken full fibre, compared to 32% in urban areas.

In a new sub-section of the report this year, we provide performance data for broadband services on different networks. Customers are moving to higher speed services, with UK average maximum download speeds up from 170 Mbit/s in 2023 to 223 Mbit/s in 2024.

¹ The topics covered in this year's report differ in some cases from our previous annual reports. For example, we are not setting out our analysis on 'crowdsourcing' as a means of measuring mobile network performance, nor are we including a chapter on climate change and telecoms networks as in last year's report. Such matters continue to be areas of interest to Ofcom, and we will consider returning to them in future Connected Nations reports or other publications.

Take-up of superfast broadband services reaches 75% threshold for review of broadband USO

The take-up of broadband services with download speeds of at least 30 Mbit/s, at premises (residential and business) across the UK, has increased from 72% to 75%. This meets a statutory threshold for Government to ask Ofcom to review specific aspects of the broadband universal service obligation (USO). We will continue to engage with Government on the broadband USO.

Fewer premises have no access to decent broadband, while satellite broadband connections are growing

Although gigabit-capable services are available to most people across the UK, there remains a small number of customers without access to a decent broadband connection from either a fixed-line or Fixed Wireless Access (FWA).² 58,000 or 0.2% of premises (residential and small businesses) have no access to decent broadband, a reduction from 61,000 in 2023.

Meanwhile, satellite services are expanding as a new option for people and businesses to access broadband. In 2024, there were 87,000 connections across the UK, a more than doubling from 42,000 in 2023. The majority of these customers are in rural areas, with relatively high numbers (8%) of these premises in areas with no access to decent broadband from fixed lines or FWA services.³

Mobile availability continues to grow

Mobile operators are steadily deploying 5G networks

The availability of mobile 5G continues to expand, with mobile network operators (MNOs) coverage ranging between 61% and 79% outside premises.⁴ However, 5G coverage where all MNOs are present outside premises remains low, at 38% for our High Confidence level. We continue to see significant differences across the UK, with 5G deployed in 42% of sites in urban areas, compared with 16% of sites in rural areas.

The deployment of mobile 5G standalone sites has increased to around 3,300 sites this year, representing just below 15% of reported mobile 5G sites. These sites carry 14% of the total 5G monthly traffic representing around 3% of overall monthly mobile traffic in the UK.

4G remains the most used technology and geographic coverage has expanded

4G remains the primary technology for mobile users, reaching outside more than 99% of UK premises and carries 78% of total mobile data traffic. 4G coverage where it is available from at least one MNO has now reached 95% of the UK landmass (delivering early on one of the key targets for the Shared Rural Network programme), with 4G geographic coverage across individual MNOs in the UK rising from a range of 80-87% last year to 88-89% this year. We note the 4G geographic coverage improvements because of the Shared Rural Network programme.⁵

² FWA services can be delivered by MNOs or Wireless Internet Service Providers. See page 17 of the report.

³ UK legislation defines 'decent broadband' as providing at least 10 Mbit/s download and 1 Mbit/s upload speeds.

⁴ At our High Confidence level.

⁵ Ofcom, [Mobile coverage obligations](#).

We are working to improve our mobile reporting

Current coverage reporting at national and local level (mobile coverage web-checker), based on existing signal strength predictions from the MNOs, has some limitations and does not always reflect consumers' lived experience. We are improving our coverage and performance reporting over the next 12 months, including overhauling our mobile web-checker in the summer.

Mobile traffic continues to grow at a slower pace

Total monthly mobile traffic overall has grown by 18% this year to 1069 PB⁶, at a slower pace compared to the 25% growth observed between 2022 and 2023. Traffic carried on 5G represents around 21% of total monthly traffic, however it has seen the highest increase by approximately 50%, from 151 PB in 2023 to 227 PB in 2024.

The phasing out of legacy mobile networks has begun

MNOs have begun phasing out their 3G networks, with two operators having completed the process, and have committed to shutting down their 2G networks by 2033. The number of customers using devices reliant on 2G or 3G connectivity has fallen from 2.4 million to 2.1 million.⁷

We are stepping up our monitoring of network security and resilience

In this report, we provide an update on our TSA monitoring programme. We observe significant investment by providers to align their processes with their new legal obligations. We note the importance of this work, given the increased number of actors and capabilities posing a threat to telecoms infrastructure.

Meanwhile, there has been an increase in the number of significant network resilience incidents reported to us. This includes a 45% rise in incidents regarding the legacy public switched telephone network (PSTN), though there was a 55% decrease in the number of PSTN service hours lost, as increasing numbers of customers have moved to digital voice services.

Nations and interactive reports

Alongside this UK report, we are also publishing separate reports for each of the UK's four nations, including updates on fixed and mobile availability in these nations. Additionally, we publish an [interactive report](#) that allows users to explore the data in further detail, including looking at network coverage in their local area and tracking trends over time.

These reports support our objective of making communications work for everyone and promoting high-quality, reliable and widely available networks. It also fulfils Ofcom's legal duty to report on the status of the UK's telecommunications infrastructure and services.

⁶ 1 PB (Petabyte) is equivalent to 1,000,000 GB (Gigabyte).

⁷ The 2.1 million figure only includes direct customers of MNOs and MVNOs. It does not include third-party devices, such as smart meters or devices using roaming SIMs.

2. Fixed broadband and voice

Introduction

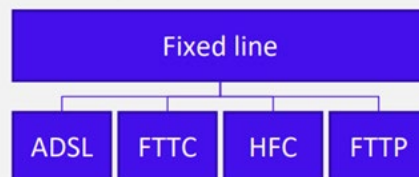
This section presents our latest findings on the roll-out of full-fibre networks and other fixed-line networks, and reports on the take-up of services over these networks. We also provide an update on the deployment of Fixed Wireless Access networks and take-up of satellite broadband services, that now offer alternative means to secure broadband connectivity for some customers. While the majority of premises now has access to a high-speed network, we provide the latest data on the small number of properties that do not yet have access to a decent broadband service. In addition, we provide data on average speeds for broadband services and report on the continuing migration of residential customers from the traditional voice network to digital voice services.

Highlights

- **Over two-thirds of the UK's 30.1 million residential premises now have access to full-fibre networks.** As of July 2024, full fibre is available to 69% or 20.7 million premises, an increase of 12 percentage points or 3.6 million premises compared to September 2023. Gigabit-capable broadband covers 83% of households or 25 million premises.
- **Take-up of services on full-fibre networks by residential and business customers has risen.** Take-up as a proportion of premises where full fibre is available is up from 28% in May 2023 to 35% in July 2024. This equates to an increase of 2.9 million new full-fibre connections for a total of 7.5 million connections.
- **As a proportion of all UK premises, the take-up of superfast broadband services has reached 75%.** This meets a statutory threshold for Government to ask Ofcom to review specific aspects of the broadband universal service obligation (USO). We will continue to engage with Government on the broadband USO. Meanwhile, the vast majority of people have access to superfast broadband from fixed lines, which is now available at 98% of premises, up from 97% last year.
- **Consumers continue to move to higher speed broadband services, with average download speeds increasing by 31%.** The average speed in 2024 is now 223 Mbit/s, up from 170 Mbit/s in 2023. This reflects customers moving onto new full-fibre networks as they become increasingly available, combined with a move to higher speed packages.
- **Some customers are taking up alternative broadband options delivered over fixed wireless and satellite networks.** The number of satellite connections has more than doubled from 42,000 to 87,000 in the last year.
- **The number of premises (both residential and small businesses) without access to decent broadband has fallen to around 58,000.** This is down from the 61,000 premises last year that were unable to access decent broadband from either fixed-line or FWA networks. We estimate that around 10,000 of these premises will be connected via publicly funded schemes by December 2025 leaving only about 48,000 premises without access to decent broadband.
- **Consumers continue to move from legacy voice services towards digital landlines.** As the switch-off of the legacy public switched telephone network (PSTN) progresses, PSTN connections now account for just over a quarter of all residential landline connections (27%).

Background: fixed-line broadband services

Fixed connections provide broadband access at specific locations, such as residential or business premises. Fixed-line broadband technologies can be broken down into different technology types.



There are **four** primary types of fixed-line connections for fixed broadband access:

- **ADSL**⁸ – Copper (telephone) cables are used to connect the exchange to each premises. Maximum download speed is up to 24 Mbit/s. Actual speeds delivered diminish with length of cable from exchange to the premises.
- **Fibre to the cabinet (FTTC)** – FTTC involves fibre to the street cabinet, with copper cables connecting the cabinet to the premises. FTTC uses ‘very high-speed digital subscriber line’ (VDSL) technology.⁹ As with ADSL, speeds diminish with length of cable, but as cabinets are generally located close to premises, maximum download speed is normally up to 80 Mbit/s.
- **Hybrid fibre coaxial (HFC) cable** – With HFC, there is fibre to a street cabinet and coaxial cable from the cabinet to the premises. Because coaxial has less signal loss compared to telephone copper wires, HFC can deliver higher speeds over longer distances. Cable broadband in the UK is provided by Virgin Media O2, and its cable network can deliver gigabit speeds.¹⁰
- **Full fibre or ‘fibre to the premises’ (FTTP)** – The connection from the exchange to the premises is provided entirely over fibre. Generally, distance to the premises does not affect the speed delivered. Full fibre can deliver gigabit speeds.¹¹

We categorise fixed broadband connections based on the download speed they can provide:

- **Decent** – can provide at least 10 Mbit/s download and 1 Mbit/s upload speeds.¹² It can be delivered by ADSL, FTTC, HFC cable or full fibre. Decent broadband provides sufficient speeds for making a high-definition video call. Over minimum decent broadband, downloading a one-hour HD TV episode (1 GB) would take almost 15 minutes.
- **Superfast** – can provide download speeds of at least 30 Mbit/s and can be delivered by FTTC, HFC cable or full fibre. Superfast broadband provides sufficient speed for one person streaming 4K/UHD video. Downloading a one-hour HD TV episode would take under four and a half minutes and several devices can work simultaneously.
- **Gigabit-capable** – can offer download speeds of 1 Gbit/s and above. It can be delivered by HFC cable or full fibre. With gigabit-capable broadband, it is feasible to download a full 4K film (100 GB) in under 15 mins, or a one-hour HD TV episode in eight seconds.

⁸ ADSL: Asymmetric Digital Subscriber Line.

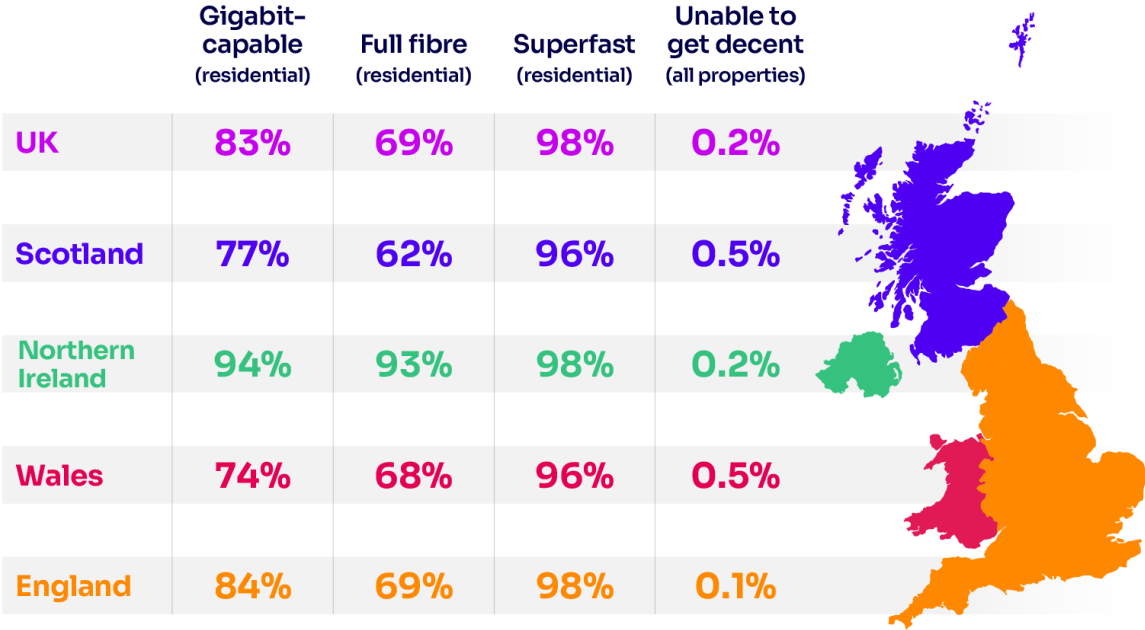
⁹ Another technology known as G.fast is also sometimes deployed at, or near, a limited number of cabinets offering higher speeds than VDSL.

¹⁰ Cable broadband HFC access networks are shared between a large number (usually hundreds) of premises.

¹¹ Most full-fibre access networks utilise Passive Optical Network (PON) approaches where capacity in the downstream and upstream direction is shared between around 30 to 60 users.

¹² The UK Government defines the characteristics of ‘decent broadband’. This is the level of connection currently deemed necessary for consumers to participate in a digital society.

Figure 2.1 Summary of broadband coverage at a fixed location across the UK and nations



Source: Ofcom analysis of provider data (July 2024).

Coverage and take-up of full-fibre & other gigabit-capable networks continue to rise

Full-fibre broadband is now available to over two-thirds of UK residential premises

There has been a further significant expansion in the availability of full-fibre networks. As of July 2024, 69% or 20.7 million residential premises across the UK had access to a full-fibre broadband network (Table 2.1 below).¹³ This is an increase of 12 percentage points, or 3.6 million premises, compared to September 2023.

Residential premises in urban areas across the UK are more likely to have access to full-fibre network coverage (71% for urban areas). But even in rural areas over half of households (52%) now have access to full fibre.

Coverage in each of the four nations has risen, most significantly in England and Wales where both nations had a 13 percentage point increase (to 69% and 68% respectively). Meanwhile, Northern Ireland has the highest level of full-fibre coverage of the four nations at 93%, while there was a 9 percentage point increase in Scotland to reach 62%.

¹³ Where providers have indicated that coverage of their fixed broadband network has not changed, we have used their most recent previous submitted data in our analysis.

Table 2.1: Residential full-fibre and gigabit-capable network coverage

	Full fibre			Gigabit capable		
	Total	Urban	Rural	Total	Urban	Rural
England	69% (17.3m)	71% (15.6m)	52% (1.7m)	84% (21.1m)	88% (19.4m)	54% (1.7m)
Northern Ireland	93% (0.8m)	96% (0.6m)	86% (0.2m)	94% (0.8m)	97% (0.6m)	86% (0.2m)
Scotland	62% (1.7m)	67% (1.5m)	42% (0.2m)	77% (2.1m)	85% (1.9m)	43% (0.2m)
Wales	68% (1.0m)	74% (0.8m)	48% (0.2m)	74% (1.1m)	81% (0.9m)	49% (0.2m)
UK	69% (20.7m)	71% (18.5m)	52% (2.2m)	83% (25.0m)	88% (22.7m)	54% (2.3m)

Source: Ofcom analysis of provider data (July 2024).

Gigabit-capable broadband is now available to 83% of UK residential premises

Gigabit-capable broadband can be delivered over both full-fibre and HFC technologies; therefore, the increase in full-fibre coverage has also resulted in an increase in the number of premises able to access gigabit-capable broadband. By July 2024, 83% or 25 million residential premises across the UK had access to a gigabit-capable broadband network. This is an increase of 5 percentage points, or an additional 1.8 million residential premises compared to September 2023.

As of July 2024, 14 million or 47% of all residential premises had access to more than one gigabit-capable network. This is a substantial increase from September last year when 35% or 10.5 million residential premises had access to more than one gigabit-capable network. Furthermore, 12% of all residential premises have a choice of three or more gigabit-capable networks.

Most small and medium-sized enterprises can now access full-fibre networks

Access to high-speed broadband is important for many small and medium-sized enterprises (SMEs). In 2024, the availability of both full-fibre and gigabit-capable broadband for SMEs has risen.

As of July 2024, 63% of SMEs in the UK had access to a full-fibre network (Table 2.3), which represents an increase of 12 percentage points from September 2023. Seventy-nine per cent of SMEs in the UK had access to a gigabit-capable network, an increase of five percentage points from September 2023.

Coverage remains highest for micro businesses, which are often based in residential areas and can make use of residential services. Our coverage data does not include networks used to deliver point-to-point FTTP businesses leased lines, so coverage may be higher than indicated in Tables 2.2 and 2.3 below, particularly for medium-sized businesses.

As with residential broadband, SMEs in Northern Ireland have the greatest availability of full-fibre and gigabit-capable networks, followed by England (Table 2.3).

Table 2.2: SME full-fibre and gigabit-capable network coverage by size of business

	Full fibre		Gigabit capable	
	Sept 2023	July 2024	Sept 2023	July 2024
Micro (1-9 employees on site)	52%	63%	75%	80%
Small (10-49 employees on site)	45%	56%	65%	71%
Medium (50-249 employees on site)	42%	52%	61%	67%

Source: Ofcom analysis of operator data (July 2024).

Table 2.3: SME full-fibre and gigabit-capable network coverage by nation

	Full fibre			Gigabit capable		
	Total	Urban	Rural	Total	Urban	Rural
England	63%	64%	51%	80%	84%	53%
Northern Ireland	85%	86%	84%	88%	91%	84%
Scotland	55%	59%	38%	71%	78%	40%
Wales	61%	66%	47%	66%	73%	47%
UK	63%	64%	51%	79%	84%	53%

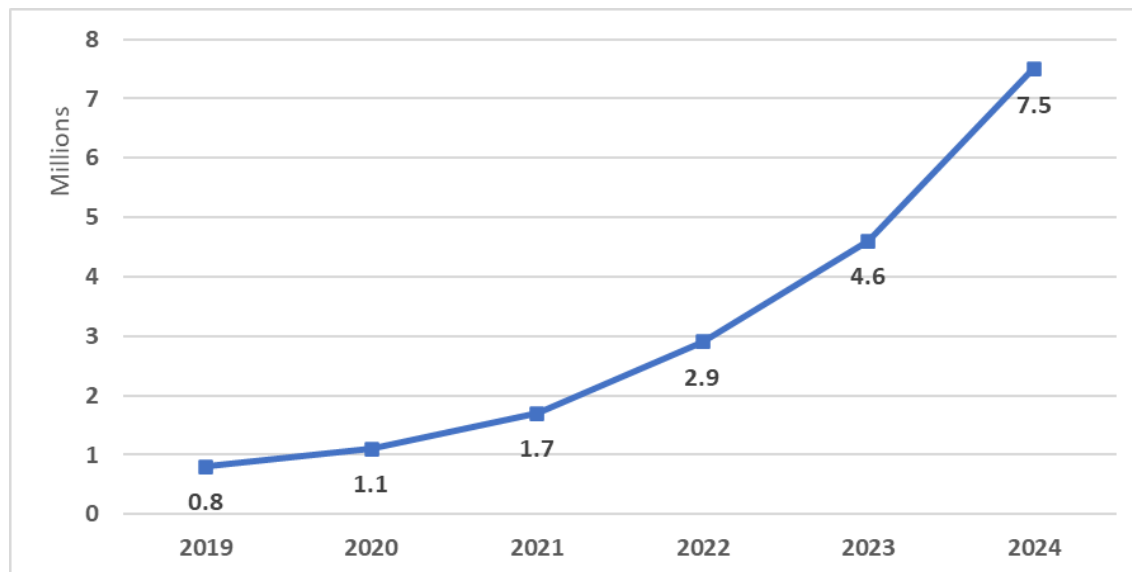
Source: Ofcom analysis of operator data (July 2024).

Take-up of services on full-fibre networks is rising

An increasing number of customers are using broadband services on full-fibre networks as their coverage expands. In May 2023, we reported that across the UK approximately 28% of premises where full fibre was available had taken it up. In July 2024, take-up of services on full-fibre networks at all premises (residential and commercial), where available, was 35% or 7.5 million premises (Figure 2.2, Table 2.4). This is an increase of seven percentage points in take-up over the last year.

There have been 2.9 million new full-fibre connections in the period since May 2023, with the total rising from 4.6 million to 7.5 million connections in July 2024.

Figure 2.2: Estimated total full-fibre broadband connections, 2019-2024



Source: Ofcom analysis of provider data (July 2024).

Meanwhile, our data indicates that take-up of services on gigabit-capable networks, where they are available, is now at 49%. There has been an increase of 7 percentage points in take-up from 42% reported last year.

Full-fibre take-up rates are highest in Northern Ireland and in rural areas

Across the four nations, take-up of services on full-fibre networks where available is highest of the four nations in Northern Ireland at 53%. It is lower in England (33%) and Scotland (35%), though both nations have recorded marked increases in take-up rates (6 percentage points in England, 7 percentage points in Scotland). There was an 8 percentage point increase for take-up in Wales (from 31% to 39%).

Table 2.4: Estimated full-fibre broadband take-up as a percentage of premises where full-fibre networks are available by nation: 2021-2024

	2021	2022	2023	2024
England	25%	25%	27%	33%
Northern Ireland	19%	25%	39%	53%
Scotland	22%	23%	28%	35%
Wales	24%	28%	31%	39%
UK	24%	25%	28%	35%

Source: Ofcom analysis of provider data (July 2024).

To date, take-up of full fibre has been notably higher in rural areas than in urban areas. Of premises with full fibre access, 52% of premises in rural areas have taken a full-fibre service, compared to 32% in urban areas.

As a proportion of all premises in the UK (including those that do not yet have access to full-fibre networks), full-fibre take-up is now 23%. Of the four nations, Northern Ireland has the highest proportion of all premises taking up full fibre at 49%. We have published updated data on take-up rates at the local authority level in our Connected Nations performance open data files.

Time elapsed since build impacts on take-up rates

We continue to find that the longer fibre has been available in a particular area, the higher the take-up. For example, where full fibre has been available at a property for more than four years then there is a 53% probability that services on a full-fibre network will have been taken up. By contrast, if full fibre has only been available for one year or less, there is only a 12% probability of take-up.

Table 2.5: Likelihood of full-fibre take-up with respect to length of time it has been available

Years full fibre has been available at the property	Probability that the property has taken full fibre
One year or less	12%
Greater than one year, up to two years	27%
Greater than two years, up to three years	37%
Greater than three years, up to four years	47%
Greater than four years	53%

Source: Ofcom analysis of provider data (July 2024).

The vast majority of people have access to superfast broadband services

Most residential premises in the UK have access to superfast broadband. This is defined as a broadband connection that can provide download speeds of at least 30 Mbit/s. Our 2024 data shows that the proportion of residential premises that have access to superfast broadband has increased by one percentage point and has now reached 98% of (or roughly 29.4 million) UK residential premises (Table 2.6). This includes the 25 million premises that have access to faster, gigabit-capable networks as discussed above. An increase in superfast broadband coverage in rural areas of Scotland of four percentage points (from 79% to 83%) has contributed to this increase.

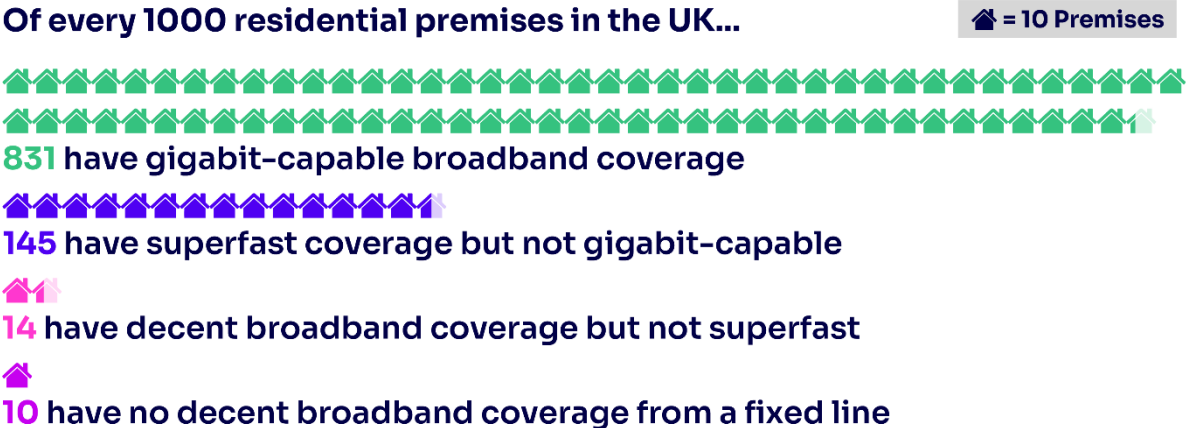
Table 2.6: Residential superfast coverage by nation

	Total	Urban	Rural
England	98%	99%	90%
Northern Ireland	98%	99%+	95%
Scotland	96%	99%	83%
Wales	96%	99%	87%
UK	98%	99%	89%

Source: Ofcom analysis of operator data (July 2024).

Looking at all fixed-line coverage for residential premises (Figure 2.3), around 831 in every 1,000 premises in the UK have gigabit-capable coverage, while an additional 145 premises have superfast but not gigabit-capable coverage. Of the remaining residential premises, 14 have decent broadband but not superfast, while 10 do not have access to decent broadband connection from a fixed-line.

Figure 2.3: Residential fixed-line broadband availability in the UK



Source: Ofcom analysis of provider data (July 2024).

Broadband performance

This sub-section provides insights on broadband performance experienced by consumers and builds on the coverage and take-up of services described earlier. It includes information on data usage, speeds across different technologies, the range of different speed packages taken by consumers, and how performance is affected in network ‘busy times’.

Data usage over fixed broadband is higher over full-fibre connections

Our 2024 data shows an average monthly data usage of 531 GB per connection across all technologies, and an average of 766 GB for full-fibre connections only (see Table 2.8). This higher usage figure may reflect consumers with higher data needs choosing full fibre as well as some consumers making more use of data intensive applications once they have moved to these higher speed technologies.

Table 2.8: Average monthly data usage per connection GB (gigabytes)

	Average monthly data usage per connection (GB)	
	All connections	Full-fibre connections
England	539	805
Northern Ireland	510	589
Scotland	480	627
Wales	508	646
UK	531	766

Source: Ofcom analysis of provider data (July 2024). Data usage is the total data downloaded and uploaded over the broadband connection during July 2024. Due to a change in methodology, this usage data is not directly comparable with usage data reported in previous years.¹⁴

Broadband download speeds continue to rise

As full-fibre networks are rolled out, more customers are moving to higher speed broadband services. This is reflected in a 31% increase in UK average maximum download speeds, up from 170 Mbit/s in 2023 to 223 Mbit/s in 2024.¹⁵ A similar increase in average maximum download speeds can also be seen for all the nations (Table 2.9).

Out of the four nations, Northern Ireland has the highest average maximum download speed of 259 Mbit/s compared to the UK average of 223 Mbit/s (Table 2.9 below). This higher average is likely to reflect the greater availability and take-up of full-fibre broadband in Northern Ireland.

Table 2.9: Average maximum download speed by nation

	Average maximum download speed (Mbit/s)	
	2023	2024
England	173	225
Northern Ireland	191	259
Scotland	155	215
Wales	136	181
UK	170	223

Source: Ofcom analysis of provider data (July 2024).

Download speeds delivered to consumers differ from the maximum speed potentially available

The maximum download speed to consumers, as recorded by providers, may be less than the maximum speed potentially achievable on a given technology. This is because the maximum speed (as recorded)

¹⁴ For 2024, we collected data usage measurements aggregated at the Optical Line Terminal (OLT) or headend, rather than on a ‘per line’ data usage basis as in previous years.

¹⁵ This is the average (i.e. mean) across each of the nations of the maximum download speeds delivered to the customers’ premises (e.g. the router) as reported by the providers’ systems. Information on how speeds are analysed are set out in more detail in the methodology annex.

will vary depending on a range of factors including the type of package purchased by consumers and the technology used (i.e. ADSL, FTTC, HFC, FTTP).

Table 2.10: Average maximum download speed by technology

Technology	Average maximum download speed delivered ¹⁶ (Mbit/s)		Maximum speed of the technology
	2023	2024	
ADSL	13.3	14.8	24 Mbit/s
Fibre to the Cabinet (FTTC)	58	58	80 Mbit/s
Hybrid fibre coaxial cable (HFC)	322	437	Gigabit capable
Full fibre (FTTP)	362	406	Gigabit capable
All connections	170	223	N/A

Source: Ofcom analysis of provider data (July 2024). Maximum technology speeds assume an unimpaired, uncongested access connection, with actual speeds dependent on line length for ADSL and FTTC which use copper cables or wires – see also the Background to fixed-line broadband services for a more detailed description of the different technology types.

For technologies such as full fibre (FTTP) and HFC cable, the difference between the maximum download speeds (as recorded) and the maximum speeds potentially available is more likely to reflect the fact that some consumers purchase broadband service packages with lower speeds than the highest speed available over a technology. For example, 17% of FTTP customers are taking packages with speeds of less than 100 Mbit/s even though the maximum speed over that technology could be up to 1 Gbit/s or over (see next sub-section).

The differences in the average download speed for FTTP and HFC (406 Mbit/s and 437 Mbit/s respectively) reflect differences in the mix of speed packages taken by consumers across these technologies, both of which can potentially deliver speeds of 1 Gbit/s or more (i.e. gigabit capable).

For older technologies relying on copper wires, broadband speeds to consumers (as recorded) will also be lower than the maximum speed potentially available. This difference will vary depending on the technology used (e.g. ADSL or FTTC) as well as the length and quality of the copper lines. A clear example of this is for ADSL, where the average download speeds delivered across all these broadband lines is 14.8 Mbit/s even though ADSL can potentially deliver up to 24 Mbit/s (Table 2.10).

There is variation in speed packages taken by customers on full-fibre networks

While increasing numbers of customers are moving from legacy broadband technologies to full fibre, not all customers taking up services on full-fibre networks will need or want the packages that offer the

¹⁶ We asked providers to submit for each of their customer connections the maximum recorded download speed and, for technologies other than FTTP, the average recorded download speed as well. The methodology for 2024 uses maximum download speeds to ensure a comparison across service providers and technologies, so is not comparable with previous reports which relied on average speeds. To enable a year-on-year comparison, the 2023 data has been re-analysed using the 2024 methodology, which is described in more detail in the methodology annex.

fastest speeds that these networks can actually provide.¹⁷ However, between 2023 and 2024, we observed a general move by customers towards higher speed packages.

For example, we find that 17% of customers are taking a speed package with a download speed of less than 100 Mbit/s, a decrease from 29% in 2023 (Table 2.11). In contrast, 27% of consumers on full fibre are taking advantage of speeds from 300 Mbit/s up to 600 Mbit/s in 2024 compared to 18% in 2023. The overall effect of this change in the mix of all the speed packages taken by customers is an increase in the average maximum download speed for services on full-fibre networks from 362 Mbit/s in 2023 to 406 Mbit/s in 2024 (see Table 2.10 above).

Table 2.11: Take-up of services on full-fibre networks by advertised download speed

Advertised download speed	Take-up	
	2023	2024
<100 Mbit/s	29%	17%
>=100 & <300 Mbit/s	39%	39%
>=300 & <900 Mbit/s	18%	27%
>=900 Mbit/s	14%	17%

Source: Ofcom analysis of provider data (July 2024).

Download speeds reduce slightly at peak times

Download speeds across the network “from router to internet” at peak times (8pm to 10pm for residential users) is between 98.7% and 99.7% when compared to the average across the day. This varies slightly depending on the technology (Table 2.12). These slightly lower peak time speeds reflect factors such as congestion within the network or across the internet at these peak times.¹⁸ The largest difference between peak times and the average across the day is on the older ADSL-based technology (98.7%).

Table 2.12: Time of day speed variations by technology

Technology	Average 8-10pm peak-time download speed as a % of average 24-hour download speed
ADSL	98.7%
Fibre to the Cabinet (FTTC)	99.3%
Hybrid fibre coaxial (HFC)	99.7%
Full fibre (FTTP)	99.4%

Source: Ofcom analysis of four providers’ embedded test data on a sample of consumer lines (March 2024). Peak time performance for an individual consumer may therefore differ from the average results

¹⁷ Our broadband coverage checker shows the estimated fastest speeds and operators that are available at a particular address.

¹⁸ The connection experienced by consumers using devices connected to the provider’s router will be impacted by a range of factors including Wi-Fi performance, the quality of any in-home wiring, in-home congestion as well as the performance of servers within the internet that deliver content.

shown in this table. An explanation of how the data was processed is available in the methodology annex.^{19, 20}

Broadband services can be delivered over wireless and satellite networks

Background to wireless networks and satellite services

In addition to existing fixed-line connection technologies, it is also possible to receive fixed broadband via wireless networks and satellite.



Fixed Wireless Access (FWA) can be delivered by:

- **Mobile network operators (MNOs)** – Fixed Wireless Access on mobile networks is offered on licensed 4G and 5G networks, usually to an indoor router. These services share the network capacity with mobile users, meaning that the capacity of the network must be carefully managed between the demands of existing mobile users and FWA customers. There may be areas of high mobile demand where a reliable FWA service cannot be offered.
- **Wireless internet service providers (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 premise. These networks mostly use spectrum under licence exemption or light licence authorisation. We are beginning to see some use of 5G technology specifically for Fixed Wireless Access services, which is enabling WISPs to provide superfast and above speeds much more widely. The performance of services may be impacted by line of sight issues, which can become more significant at higher frequencies (WISPs have a range of frequency options, with choice informed by capacity and performance requirements, as well as technology and kit available in a given band).²¹

Fixed broadband can also be delivered over satellite and there are two types of satellite services:

- **Geostationary orbit (GSO) satellites** – These orbit the earth at about 36,000 km and have traditionally been the primary way of delivering satellite communications services. GSO

¹⁹ This ‘time of day’ analysis is based on a sample of data from four large providers, meaning that ‘time of day’ speed for other providers may vary from the data presented in the table.

²⁰ Only embedded data collected from the main four internet service providers (ISPs) is used for calculating ‘time of day’ speed differences, and this calculation does not use ‘SamKnows’ data (provided by volunteers with a hardware monitoring unit connected to their broadband router) as used in previous [Home Broadband Performance \(HBP\) reports](#). That circumstance, together with other differences such as sample size, means the ‘time of day’ data in this report is not directly comparable with the HBP reports published by Ofcom until 2023. We are continuing to explore the use of alternative data sources, including ISPs’ ‘embedded’ test data and how it might be used in future reports.

²¹ Ofcom introduced its Shared Access framework in 2019 to support local spectrum access for local networks. The framework includes the 3.8-4.2 GHz band and part of the 26 GHz band that are suitable for the provision of high-speed networks based on 5G technology.

providers can provide satellite broadband to most premises across the UK, including some in the most remote areas, but the connection's performance can be limited by its higher latency.

- **Low Earth orbit (LEO) satellites** – These satellite constellations are now also available offering residential and business broadband to UK customers. LEO satellites can deliver lower latency services due to their lower orbit (below 2,000 km), enabling a more seamless use of applications such as two-way video calling and gaming.

FWA (both that provided by MNOs and by WISPs) and satellite fixed broadband connections can also provide decent and superfast speeds and, under certain conditions, may be gigabit capable, but this will be dependent on the specific deployment, available capacity at the site, and the number and location of users.

Broadband services are available across large parts of the UK using fixed wireless networks

Fixed Wireless Access via mobile networks

FWA services from the MNOs are provided primarily over 5G networks and advanced 4G networks (LTE-A). Based on information from the MNOs about their coverage levels, we estimate that 95% of all UK premises have access to decent broadband through an MNO FWA service (Table 2.9), in line with the coverage we reported last year.²²

FWA services offered over 4G and 5G networks share the network capacity with mobile users, meaning that capacity has to be carefully managed between the demands of existing mobile users and FWA customers. As such, there may be areas of high mobile demand where a reliable FWA service cannot be offered, and elsewhere the reliability of FWA services may fluctuate as demand for mobile services does. MNO FWA services are typically sold as 'plug and play' indoor routers.

The performance of the broadband FWA connection is dependent on the quality of the mobile signal that is received indoors. Some operators have offered or are offering solutions to improve the quality of the signal received indoors for example through a pre-configured external antenna combined with an internal router designed for self-installation by customers. This then makes use of the stronger outdoor mobile signal to provide for an improved broadband experience.²³

Additionally, the availability of higher spectrum frequencies provides the capability to support higher speeds. However, the coverage that can be achieved with higher frequencies, with less range, is reduced so necessitating a greater number of masts to achieve coverage at higher speeds. At the same time, advances in the technology such as the use of massive MIMO are allowing better (i.e. more efficient) use of the spectrum.²⁴

²² Our reporting here is based on data from EE and Three – see the annex for further information on the methodology.

²³ For example, Three have recently launched what is called a '5G Outdoor hub'.

²⁴ MIMO (Multiple Input, Multiple Output) system is an advanced antenna array technology that improves spectral efficiency and increases the amount of data transferred over wireless links.

Fixed wireless access via wireless internet service providers

This year we collected data from 20 WISPs (compared to 21 in 2023).²⁵ Based on estimates from these WISPs, around 7% of all UK premises (residential and SME) have decent broadband coverage from a WISP network (Table 2.13), unchanged from the previous year.²⁶

FWA provided by WISPs has been primarily over the 5 GHz band. The availability of the additional spectrum in the 3.8-4.2 GHz band, primarily considered to be a 5G band, is allowing WISPs greater flexibility in the deployment of higher speed services over 5G standard equipment. This may allow for the availability of higher speed services in places where fibre has not yet been deployed, and where FWA services may be more cost effective than satellite services.

Table 2.13: Coverage of MNO and WISP FWA networks with at least decent broadband (all premises)

	MNO FWA	WISP FWA
England	96%	6%
Northern Ireland	84%	3%
Scotland	95%	2%
Wales	93%	22%
UK	95%	7%

Source: Ofcom analysis of provider data (July 2024).²⁷

MNOs continue to provide fibre backhaul to a number of masts across the UK that deliver mobile and FWA services. These masts have the potential to support higher speed FWA services in the future.

Take-up of satellite broadband is increasing and may offer an alternative for customers in poorly served areas

Satellite technologies continue to evolve, and Low Earth Orbit (LEO) satellite constellations particularly could potentially help to serve parts of the UK which are harder to reach through more traditional technologies.

LEO satellite constellations can offer high-speed, lower latency services relative to traditional geostationary orbit (GSO) satellites. The LEO retail market is at an early stage of development and take-up remains low compared to terrestrial broadband services, though it is increasing.

Starlink currently offers the only direct-to-consumer LEO service in the UK through its retail product. This offers nationwide broadband coverage, including in harder-to-reach areas. In addition, business-to-business (B2B) services are available from OneWeb. At the time of writing, we have authorised a total of 6 LEO operators to provide broadband services in the UK so we expect further development in both

²⁵ See the methodology annex for further information.

²⁶ The analysis for WISPs includes SME and residential users.

²⁷ Several factors may impact on coverage figures, for example, some WISPs are migrating customers to their full-fibre networks and withdrawing some wireless sites, and one WISP indicated a change in their reporting model, thus potentially impacting figures on overall WISP coverage, for example, in Wales.

business-to-consumer (B2C) and business to business (B2B) markets as these operators start to launch satellites and services in the coming years.²⁸

The data provided to us by Starlink indicates that around 87,000 connections in the UK in June 2024 make use of LEO satellites for their broadband service (up from 42,000 in August 2023). This includes both residential and business packages, and our analysis of the location of these customer connections suggests that:

- The majority of these premises are in rural areas.
- Around 8% of these premises are in areas with no decent broadband, compared to a UK average of only 0.2% of premises with no decent broadband.
- Just over 24% of these premises have access to full fibre, compared to a UK average of 67% of premises with access to full fibre.

Relative to UK premises as whole, premises with a satellite broadband connection are therefore more likely to be in a rural area, and less likely to have access to a decent fixed-line or FWA broadband service.

Although satellite services do not typically guarantee any minimum speeds on their packages, in the data submitted to Ofcom, Starlink indicate average download speeds of over 160 Mbit/s in 2024, slightly down from over 170 Mbit/s in 2023. Starlink reported average upload speeds on their connections to be around 18 Mbit/s in 2024.

Some premises still cannot access decent broadband coverage

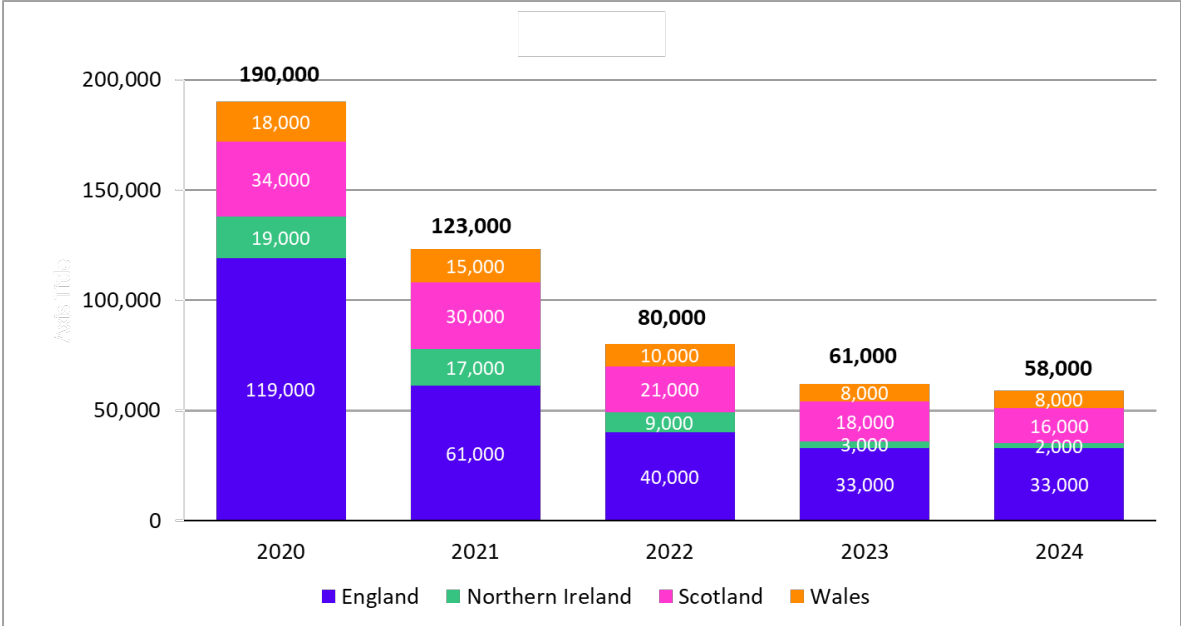
The number of premises unable to access decent broadband via a fixed connection has fallen

We estimate that 1% of all UK premises, residential and commercial, cannot access decent broadband, which is defined as connections which provide at least 10 Mbit/s download speed and 1 Mbit upload speed, from a fixed-line connection. This is around 385,000 premises in July 2024, a drop of 25,000 since September 2023, when we reported that around 410,000 premises did not have decent broadband via a fixed-line.

Of those premises that do not have decent broadband via fixed lines, a large share is able to access decent broadband via FWA services offered by MNOs or WISPs. Taking account of the coverage available from FWA, we estimate that this leaves around 58,000 or 0.2% premises in the UK without a decent broadband service from either fixed-line or FWA (Figure 2.5). The remaining number of premises without access to a decent broadband service has therefore fallen by around 3,000 from the approximately 61,000 premises we reported last year. These figures have dropped significantly in the past five years, from 190,000 in 2020 to 58,000 in 2024.

²⁸ Information about LEO satellite constellations which are licensed in the UK can be found on [Ofcom's website](#). This page also includes information about applications from LEO satellite constellations and other Non-GSO (NGSO) satellite systems.

Figure 2.5: Approximate number of premises without access to a decent broadband service from either a fixed or Fixed Wireless Access network, 2020-2024²⁹



Source: Ofcom analysis of provider data (July 2024)

We estimate that around 10,000 of these premises will be connected via publicly funded schemes by December 2025, meaning that the number of premises remaining without a decent broadband from a fixed-line or FWA could be around 48,000 by the end of 2025.

The universal service obligation (USO) can offer decent broadband to some premises currently without access

The broadband USO provides all premises with the right to request a broadband connection with a download speed of at least 10 Mbit/s and an upload speed of 1 Mbit/s (as well as several other specific technical characteristics).³⁰

Where an affordable service with these characteristics is not available, or due to become available in the next 12 months under a publicly funded scheme, the customer is eligible for the USO if the costs of providing the connection are below £3,400.³¹ Where the costs are above £3,400, the customer has the option to pay the excess costs to get a USO connection. BT is the universal service provider for the UK (excluding Hull), and KCOM for the Hull area. They are required to provide the USO and to report at six monthly intervals on delivery.³²

²⁹ All figures have been rounded to the nearest 1,000.

³⁰ In particular, these characteristics are: (i) a contention ratio of no more than 50:1; (ii) latency which is capable of allowing the end user to make and receive voice calls effectively; and (iii) the capability to allow data usage of at least 100 GB a month.

³¹ In March 2020, we specified in the USO conditions that an affordable service was one that costs £45 per month, rising annually by CPI. This has now risen to £56.20 per month in line with CPI.

³² BT, [USO Reports](#). KCOM, [USO Reports](#). To date, we understand that KCOM has not received any eligible USO orders.

As of September 2024, BT had received just over 2,000 USO orders since the launch of the USO in March 2020. Each order requires network build that can serve multiple premises, and therefore these orders will lead to full-fibre connections being built that can serve over 10,000 premises.³³

Table 2.14: USO orders and number of premises built by nation

2024	Number of USO Orders	Total premises passed by resulting build
England	1,558	7,478
Northern Ireland	89	726
Scotland	115	540
Wales	247	1,334
UK	2,009	10,078

Source: Ofcom analysis of BT data (September 2024).

The increase in the number of USO orders since last year’s Connected Nations report was very small (around 40 new orders up to September 2024). Data analysis by BT has indicated that the cost of connecting more than nine out of ten of the remaining premises without access to decent broadband are likely to exceed the £3,400 threshold. In these cases, customers will receive excess cost quotes that may be quite high and, in most cases, unaffordable for customers. Those premises that are the most expensive to connect are likely to need alternative solutions.

To ensure the broadband USO remains relevant, a review provision was included in the legislation and the process to review is likely to be triggered when superfast broadband is taken up by at least 75% of all premises.³⁴ As of July 2024, 75% of all premises have taken up superfast broadband.

In October 2023, the Government consulted on a review of the broadband USO and we will continue to engage with Government on the future approach to the USO.

Private sector investment is spearheading rollout of faster networks; and public schemes support harder-to-reach areas

Estimated expenditure on telecoms infrastructure totalled £9.9bn

We collect network investment information to better understand how the UK’s largest fixed and mobile telecoms operators are investing in network infrastructure.³⁵ The information collected relates to

³³ BT’s public reporting shows a slightly lower number of total confirmed orders. This is because it only covers orders prior to, and during, network build; whereas the 2,009 figure also includes orders made once build has completed.

³⁴ Under the Communications Act 2003, the Secretary of State is likely to issue Ofcom with a direction to review the broadband USO if it appears to them that, on the basis of information we have published, take-up of superfast broadband has reached at least 75% of all UK premises.

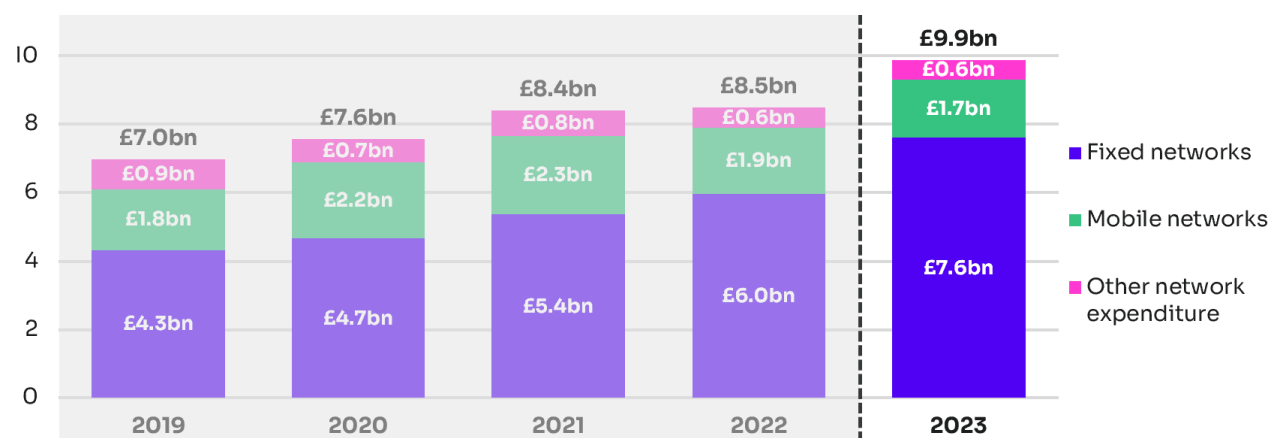
³⁵ Only capital expenditure required to provide and operate network infrastructure in the UK is included; figures exclude VAT and expenditure on retail activities (e.g. retail billing or marketing systems). Figures include capital expenditure on tangible and intangible assets, including capitalised staffing and labour expenditure, and expenditure on assets in the course of construction (AICC). Figures exclude expenditure on assets that have been

providers' annual financial reporting periods, and the information received is pro-rated to estimate calendar year figures.³⁶

The figures include public funding provided to support the rollout of better fixed and mobile connectivity, such as UK Government funding, funding provided via the governments of the devolved nations and local authority funding. This year, we have received data for around 20 additional full-fibre network operators (resulting in data collection from around 50 providers). While this means our analysis better represents spend on fixed telecoms networks (and total telecoms network investment), a consequence is that the 2023 total and fixed telecoms figures are not directly comparable to those for previous years.

We estimate that UK operators invested a total of £9.9bn in network infrastructure in 2023. Fixed network investment totalled £7.6bn during the year (77% of the total) with mobile network investment accounting for £1.7bn (17% of the total). A further £0.6bn related to 'other network expenditure', i.e. investment in infrastructure used to provide both fixed and mobile services.

Figure 2.6: Estimated telecoms network capital expenditure: 2019 to 2023



Source: Ofcom analysis of operator data.

Notes: Adjusted for CPI (2023 prices); 2023 fixed network data is not directly comparable to previous years.

Fixed telecoms network infrastructure investment was estimated to be £7.6bn

We estimate that UK operators invested £7.6bn in fixed telecoms network infrastructure in 2023. Most investment in fixed network infrastructure during the year related to access networks (£7.1bn, or 93% of the total) with the remaining £0.5bn (7% of the total) being investment in fixed core and backhaul networks.

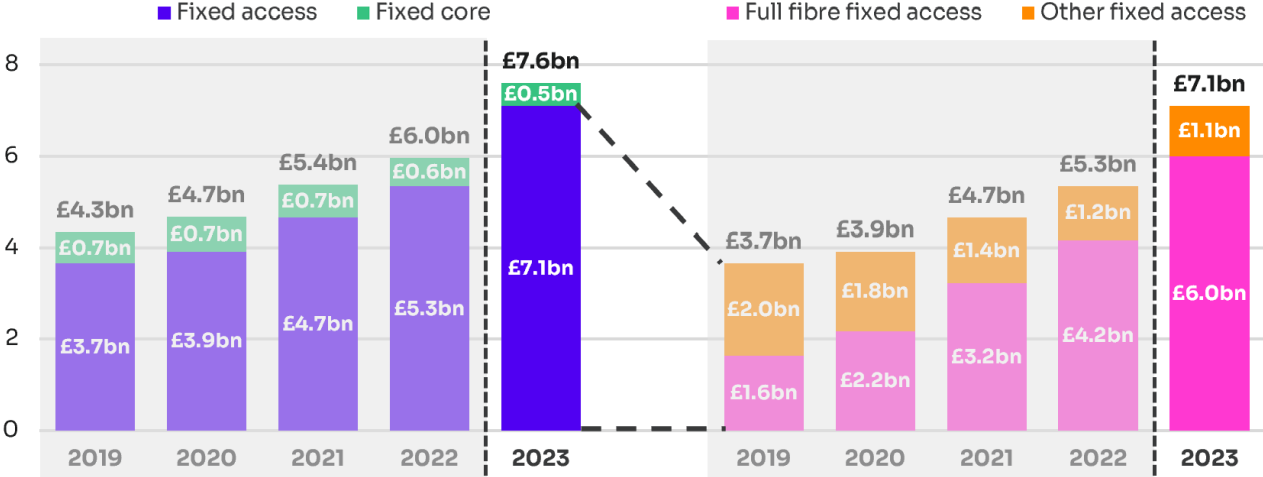
Full-fibre access networks was estimated at £6.0bn in 2023, representing 79% of all fixed network investment and 61% of total telecoms network investment. Additionally, some of the £1.1bn that was

added to a balance sheet through adoption of the IFRS16 accounting standard, or assets held for sale, and the costs of maintenance contracts purchased alongside hardware. Expenditure associated with asset transfers and leasing follows the same guidelines the Office for National Statistics provides when requesting information in its quarterly acquisitions and disposals of capital asset survey. While the figures shown have been rounded, any percentage changes shown are calculated using the unrounded data.

³⁶ The most recent period for which we hold network infrastructure investment data is 2023 as, unlike much of the other data in this report, this data covers the whole of the calendar year and is not a snapshot taken at a point in 2024.

invested in other fixed access infrastructure may be used to support the rollout of future full-fibre services where it relates to physical infrastructure upgrades (such as fibre deployment in fibre-to-the-cabinet networks).

Figure 2.7: Estimated fixed telecoms network capital expenditure: 2019 to 2023



Source: Ofcom analysis of operator data.

Notes: Adjusted for CPI (2023 prices); 2023 data is not directly comparable to previous years. Our September Planned network deployment update set out industry’s estimated progress over the next 3 years.

The availability of full-fibre and gigabit-capable networks is expected to continue to increase over the next few years. A range of network operators plan to continue deploying new infrastructure, using varying business models.

Ofcom gathers stated deployment plans from network operators. In September 2024, we published [our latest forward-looking update](#) on planned network deployments. This update is based on operators’ deployment plans within three years from May 2024, for both full-fibre and Fixed Wireless Access networks, and includes plans that are funded privately or supported through public funds.

The proportion of residential premises expected to have full-fibre coverage in 2027 could be as high as 96% (29 million properties), while gigabit-capable coverage could be in excess of 97%.

Our estimates indicate that there could be 26,000 premises that continue to be without access to decent broadband from fixed-line or fixed wireless networks by May 2027.

Table 2.15: Estimated number of remaining premises unable to access decent broadband by May 2027

	May 2027
England	14,000
Northern Ireland	1,000
Scotland	7,000
Wales	4,000
UK	26,000

Source: Ofcom analysis of operator data (May and July 2024).

Physical infrastructure access continues to play an important role in the deployment of new networks

Significant investment and engineering resources are required to deploy new networks. Many providers reduce the cost and timeframes for deployment if they roll out parts of their network using Openreach's network, which is made up of approximately 496,000 km of duct and 4.1 million poles. Since 2019, our rules have allowed easier access to Openreach's physical infrastructure (PIA). As of the end of September 2024, 172 providers had registered with Openreach as customers of PIA, and 140 of these had already built network using PIA or had placed orders to do so. Providers have ordered around 176,000 km of duct routes (101,000 km of which has been delivered) and approximately 1.2 million attachments to poles (750,000 of which have been delivered) to deploy networks.³⁷

Public sector investment has a key role in achieving connectivity, particularly in hard-to-reach areas

Governments across the UK continue to supplement commercial rollout. This includes an August 2024 [announcement](#) from the new UK Government regarding the latest stages of the Project Gigabit initiative, including the first contract under Project Gigabit to boost connection in Wales. In the recent Budget, the Government said the wider Project Gigabit plan will make £800 million available to deliver gigabit connections across Great Britain, and it added that it was on track to achieve full gigabit coverage by 2030.³⁸

Further information is available on projects led by the devolved governments in the individual [nations reports](#).

Migration from legacy voice services to digital voice services

The retirement of the legacy public switched telephone network is progressing

The UK's traditional landline voice services continue to undergo a substantial transition as network operators retire their legacy systems (referred to as the public switched telephone network, or 'PSTN') and replace them with modern systems.

BT and Openreach are now looking to retire BT's PSTN network and the Openreach wholesale services that deliver PSTN by January 2027, and we understand that other providers are following a broadly similar timescale.³⁹

To make sure landline services continue to be available to their customers, providers of legacy telephony networks have started delivering landline calls over a broadband connection, using a digital technology called Voice over Internet Protocol (VoIP). This is commonly known as a digital landline. BT has also developed an interim solution, called 'pre-digital phone line', for certain complex or difficult to migrate customers such as landline-only or critical national infrastructure customers. This will allow those customers to move off the PSTN without the need to install a broadband connection or change legacy equipment.⁴⁰

³⁷ Multiple communications provider customers may build on the same piece of Openreach infrastructure.

³⁸ HM Treasury, [Autumn Budget 2024](#), 30 October 2024.

³⁹ BT, [BT Group refines its digital switchover programme for the UK's full fibre future](#), 20 May 2024.

⁴⁰ BT, [BT Group refines its digital switchover programme for the UK's full fibre future](#), 20 May 2024.

The industry has made steady progress over the last few years in migrating customers off the PSTN, mainly through a combination of customers choosing to move to IP (customer-led migrations) and providers actively moving them onto IP (provider-led migrations). The latter has mainly been used by BT, VMO2 and to a lesser extent Zen, KCOM and Vodafone.

While progress has been steady, migration numbers slowed significantly in 2024 due to an agreement between the UK Government and all the main providers to temporarily pause provider-led migration of customers until additional steps are taken to protect vulnerable consumers through the transition.⁴¹

While moving from the PSTN to digital landlines should be smooth for most customers, these changes can be more complex and raise potential risks for some groups of customers – for example, those with additional needs or vulnerabilities, landline-dependent customers and users of non-voice devices that rely on the PSTN such as telecare/security alarms and smart meters.

We continue to monitor the migration closely and engage with providers to ensure that disruption is minimised and vulnerable customers are protected from harm.⁴²

Customers with landlines are increasingly using VoIP

We collected data from seven of the largest providers of retail voice services to residential customers. We found PSTN connections now account for just over a quarter of residential landline connections (27%). Around 5.2 million residential landline customers still use the PSTN.

The remainder of customers with a landline have either switched to VoIP (8.6 million landline connections) or use emulated PSTN, which has similar features to the PSTN but does not rely on PSTN technology.

Table 2.16: Number and share of residential landline customers by technology⁴³

	Approximate number of customers	Share of all landlines
PSTN	5.2 million	27%
VoIP	8.6 million	45%
Emulated PSTN	5.3 million	28%
Total	19.1 million	100%

Source: Ofcom analysis of provider data (July 2024).

In the year to July 2024, 1.8 million residential customers who previously had a PSTN line migrated to a VoIP service. 53% (970,000 lines) of these were as a result of a provider-led migration, while the remaining 47% (870,000 lines) were as a result of customer-led migrations.

⁴¹ [Public Switched Telephone Network charter](#), 18 December 2023. Network operators such as Openreach also signed a [similar voluntary charter](#) in early 2024.

⁴² Ofcom, [Protecting customers during the migration to digital landlines](#), 18 December 2023.

⁴³ This table only captures retail residential landlines and is not comparable with landline data from last year’s Connected Nations report.

Switching to broadband-only lines

We also found that just over a million households ceased their landline in favour of a broadband-only service in the year to July 2024. Last year we reported that just under half a million households ceased their landline in the year to September 2023.

As households cease their landline services, some consumers may be making use of personal online communication services (OCS), such as Skype or WhatsApp, to make voice and video calls and / or relying on their mobile phones for voice calls.

3. Mobile, data and voice

Introduction

Mobile connectivity has become an integral part of modern living; it enables effective communication, provides access to information and services, enhances productivity, and supports various aspects of daily life.

This section provides an update on the progress MNOs are making with their 5G mobile rollout plans, while continuing to report on the broader availability of 4G mobile coverage outside and inside premises, across the UK's landmass and on roads. In addition, we provide updates on 2G and 3G coverage and MNOs' switch-off plans. We also report on investment in, and the take-up of mobile services, reflected in the continuing growth of mobile traffic.

Our current approach to mobile reporting, which is based on existing signal strength predictions from the MNOs, has limitations. It does not necessarily reflect consumers' lived experience, particularly in the context of trying to determine coverage at a local level, which we provide on our mobile coverage web-checker.

We have a work programme in place (which we set out in the sub-section entitled 'Approach to mobile reporting') to update how we report on coverage and performance and, to deliver improvements at the local level in our web-checker. These changes will be designed and implemented throughout next year and beyond, starting with our first round of web-checker improvements. Until this work is implemented, mobile coverage reported in this report will be based on the same approach and criteria as that used in previous Connected Nations reports.

Highlights

- **The availability of 5G mobile continues to grow steadily** with MNOs' coverage ranging between 61% and 79% outside premises.⁴⁴ 5G coverage outside premises where it is available from at least one MNO has increased to 90-95%, up from 85-93% in 2023 (across a range covering Very High and High Confidence levels).⁴⁵ MNOs' 5G predictions indicate that BT/EE has the most extensive outside premises coverage at both our High Confidence level (79%) and Very High Confidence level (76%).
- **There has been further deployment of 5G standalone sites for mobile.** Last year, we reported that the deployment of commercial 5G mobile standalone sites had begun, and this year, this has increased to over 3,300 sites accounting for just below 15% of 5G sites. 5G mobile standalone now carries 14% of the total monthly 5G traffic (around 3% of overall monthly mobile traffic in the UK).
- **4G continues to be the main technology for mobile users.** 4G remains the primary technology for mobile users, reaching outside more than 99% of UK premises and carries 78% of total monthly mobile data traffic. 4G geographic coverage where it is available from at least one MNO has now reached 95% (delivering early on one of the key targets for the Shared Rural Network programme), with 4G geographic coverage across individual

⁴⁴ The coverage ranges here refer to the span between the MNO with the least coverage, and that with the most coverage at our High Confidence level.


⁴⁵ Please refer to our 'Background to mobile technologies' section in this chapter where these levels are defined.

MNOs in the UK rising from a range of 80-87% last year to 88-89% this year. We note the 4G geographic coverage improvements as a result of the Shared Rural Network programme.⁴⁶

- **Mobile traffic continues to grow, though at a slower pace**, with overall monthly traffic levels increasing by around 18% to 1069 PB this year compared to the c.25% growth between 2022 and 2023. Monthly 5G traffic has seen the highest increase from 151 PB in 2023 to 227 PB in 2024, an increase of around 50%.⁴⁷
- **MNOs have started switching off their 3G networks, with two of them having already completed the process.** MNOs have also committed to switching off their 2G networks by 2033 at the latest. The number of customers using devices reliant on 2G or 3G connectivity has fallen from 2.4 million down to 2.1 million.⁴⁸

Figure 3.1: Overview of voice and data coverage across the UK and UK nations⁴⁹

	5G outside premises (MNO range)	4G outside premises (MNO range)	4G geographic (MNO range)	4G total not spots	Voice and text total not spots
UK	61-79%	99-99+%	88-89%	5%	3%
Scotland	54-76%	99-99+%	77-80%	11%	7%
Northern Ireland	36-90%	98-99%	89-95%	2%	<1%
Wales	16-80%	98-99%	83-89%	5%	3%
England	65-81%	99-99+%	94-96%	1%	1%



Source: Ofcom analysis of MNO predictions (September 2024)

Background to mobile technologies

Mobile services described in this section include:

- **5G, the current generation of wireless technology**, is faster than previous generations of wireless technology, as it offers greater capacity, allowing an increased number of devices to be connected at the same time in a small area. It is also more responsive by reducing latency which is the time between instructing a wireless device to perform an action and that action being completed.

⁴⁶ Ofcom, [Mobile coverage obligations](#), 20 February 2024.

⁴⁷ 1 PB (Petabyte) is equivalent to 1,000,000 GB (Gigabyte). Additionally, traffic reported in this section, except for MNO IoT traffic, is rounded up to the nearest whole number.

⁴⁸ The 2.1 million figure only includes direct customers of MNOs and MVNOs. It does not include third-party devices, such as smart meters or devices using roaming SIMs.

⁴⁹ The coverage ranges in this figure refer to the span between the MNO with the least coverage and that with the most coverage on a given measure. For 5G outside premises, the coverage range is based on our High Confidence level, rather than the Very High Confidence level which we also use in this report.

- **5G non-standalone (5G NSA)** involves deploying 5G radio equipment alongside existing 4G and is supported by the 4G core network. This delivers an increase in capacity and allows MNOs to support demand as it continues to grow, without the congestion and degradation of service quality that would otherwise result.
- **5G standalone (5G SA)** involves the deployment of a new 5G core network. This could enable new use cases such as Augmented Reality (AR)/Virtual Reality (VR) and robotics, supported by the broader capabilities of 5G including ultra-low latency, advanced virtual network (slicing) functions,⁵⁰ and potentially improved coverage.⁵¹ 5G SA referred to in this chapter is specifically in relation to mobile standalone deployment.

When reporting on 5G mobile availability predictions, we refer to confidence ranges reflecting the likelihood of on the ground coverage for consumers as:⁵²

- **High Confidence** associated with a signal strength (-110 dBm), to equate to at least an 80% confidence level.
- **Very High Confidence** associated with a higher signal strength (-100 dBm), to equate to a circa 95% confidence level.
- **4G, 3G and 2G** are older generations of mobile standards with specified features. In particular, 3G supported the use of data applications such as web browsing, while 4G has supported more data intensive activities such as streaming and gaming.

Mobile coverage

Approach to mobile reporting

The mobile coverage data in this report is based on signal strength predictions provided to us by the MNOs. To evaluate the accuracy of the information provided, we undertake regular testing to ensure that the predictions are suitable for national and regional reporting.⁵³

However, this approach to reporting on coverage has limitations. In particular, signal strength predictions - while generally reasonable for determining average coverage over a wide area - come with significant uncertainty when trying to determine coverage in a specific location, particularly where the signal strength is low.

⁵⁰ Network slicing is a feature of 5G SA networks that allows an MNO to create multiple virtual networks (slices) on top of its common shared physical infrastructure. The virtual networks are then customised to operate with specific quality of service and meet the specific needs of applications, services, devices, customers or operators.

⁵¹ Augmented Reality (AR): an enhanced version of the real physical world that is achieved through the use of digital visual elements, sound, or other sensory stimuli delivered via technology. It overlays digital content, which could include a combination of sound, video, text, and graphics, onto a real-world environment using a headset or a device with a camera, such as a mobile phone.

Virtual Reality (VR): use of a headset to access a virtual experience, which could be digitally created or a captured 360° photo or video.

⁵² Signal strength measured on the 4G common reference signal and 5G secondary synchronisation block – for further detail see our Methodology annex.

⁵³ For more information on this, please see the Methodology annex.

So we are working to improve our mobile coverage and quality reporting. Set out below is our programme of improvement:

- We are planning to use higher signal strength thresholds when presenting local predictions
- We will overhaul our website in the summer and provide clearer explanation of the issues and the specific functions of the web-checker
- We will assess predicted signal strength information at a more granular level (50 or 25 square metres instead of the current 100 square metres) to determine if it is possible to reduce the local uncertainty to some extent.

We will also look to use measured data, including crowdsourced data, to build on the coverage predictions, providing more insight into where and when the consumers can expect a good experience. We acknowledge the limitation of data sampling for crowdsourced data, but we consider it could help consumers understand which MNO would best suit their needs in a given area.

Following implementation of our current programme of work, we will consider undertaking a larger-scale performance measurement programme to complement coverage predictions and enhance our mobile reporting.

We will continue to engage with Government and MNOs, over the next 12 months, to improve reporting of mobile coverage and performance.

5G standalone deployment

We are seeing an increase in reported 5G mobile standalone (SA) deployments. Last year, we reported around 2,000 5G SA sites. This year, a total of over 3,300 sites was reported, representing just below 15% of reported 5G mobile sites and 14% of the total 5G traffic (c.3% of overall mobile traffic in the UK).⁵⁴

5G mobile services are still mostly being delivered in non-standalone (NSA) mode. This means that services can be delivered over 5G alone or a mix of 4G and 5G but supported by existing 4G infrastructure. We report 5G mobile coverage as merged 5G NSA and SA. We aim to explore ways with MNOs to report on 5G SA and 5G NSA separately as mobile networks evolve.

5G availability continues to grow steadily

5G continues to reach a growing number of consumers, with around 50% of mobile handsets now 5G capable and notable increases in coverage observed across the UK.⁵⁵

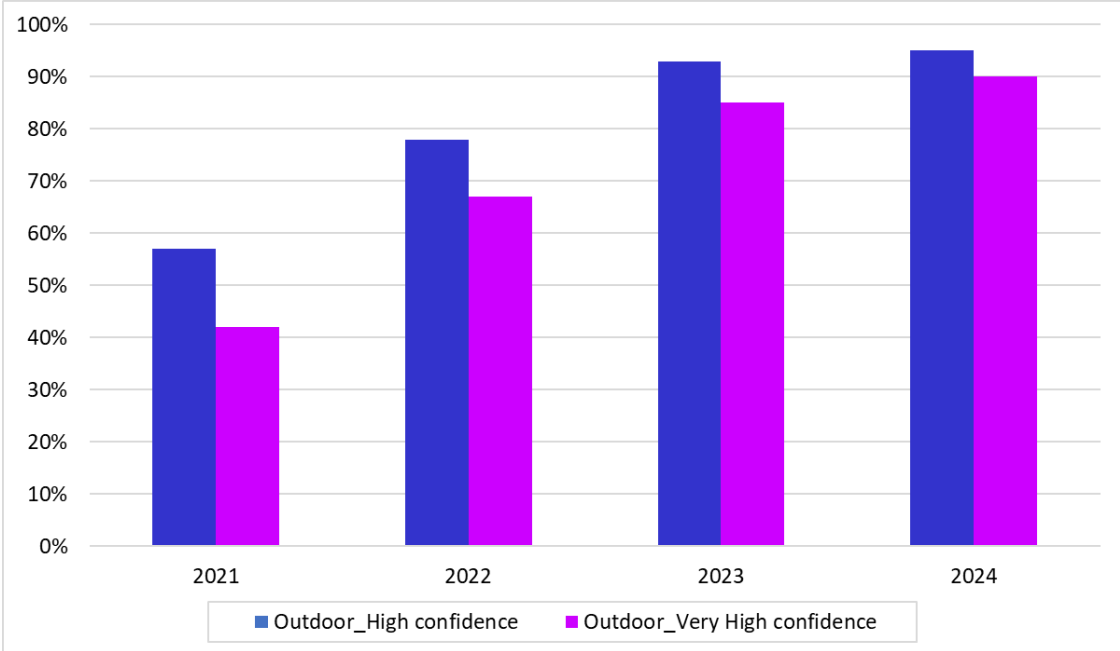
The availability of 5G, where consumers are likely to connect to a 5G network, continues to grow, although it varies by MNO and geography. In 2024, there has been an increase in 5G coverage across the UK, with 95% (High Confidence) and 90% (Very High Confidence) 5G coverage in areas outside of

⁵⁴ The total traffic and number of 5G sites reported here are likely to be slightly lower than the actual figures. This is because one of the MNOs has underreported its site count and, consequently, the associated traffic due to data issues with its performance reporting tool.

⁵⁵ Based on analysis of operators' data. The methodology for calculating the total number of devices varies across MNOs, making this figure an approximation rather than an exact figure. Additionally, we note that not all 5G capable devices may be enabled with a 5G subscription.

premises where it is available from at least one MNO.⁵⁶ This is an improvement from 93% and 85% respectively in 2023 (see Figure 3.2).⁵⁷

Figure 3.2: 5G coverage outside UK premises where it is available from ‘At least one MNO’ (2021 - 2024)



Source: Ofcom analysis of operator data (September 2024)

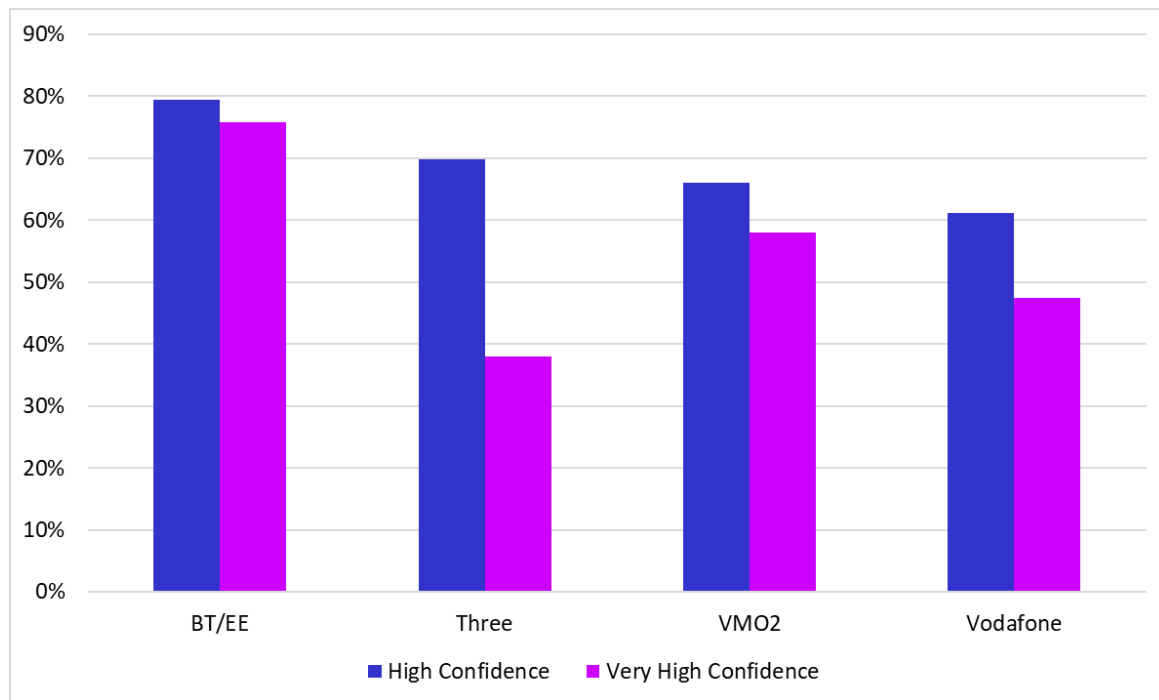
The footprint where all MNOs provide 5G coverage remains considerably lower. However, it has increased, now covering outside 38% of premises at the High Confidence level and 19% at the Very High Confidence level, up from 25% and 16% respectively last year.

Across individual MNOs, 5G coverage outside premises varies across UK Nations as follows: 65-81% for England; 54-76% for Scotland; 16-80 % for Wales; and 36-90% for Northern Ireland (all based on the High Confidence level). BT/EE leads in 5G coverage outside premises at both our Very High Confidence and High Confidence levels extending to around 76% and more than 79% respectively (see Figure 3.3).

⁵⁶ 5G coverage figures reported in this chapter are slightly lower than the actual 5G coverage due to data inconsistencies affecting 5G standalone reported by one of the MNOs during the later stages of our publication process. We are looking into the effect of this at both the UK and nations level to determine if an update is needed.

⁵⁷ By ‘coverage outside premises’, we mean that coverage is predicted in a 100x100m area in which a dwelling is located, which can be seen as a proxy for outdoor coverage of populated areas in the UK. By ‘At least one MNO’, we mean the combined coverage that would be available if the total coverage of each MNO was included in an aggregated coverage footprint.

Figure 3.3: MNO 5G coverage outside UK premises, at Very High and High Confidence levels⁵⁸



Source: Ofcom analysis of operator data (September 2024)

The expansion of 5G landmass coverage by individual MNOs is progressing, albeit at a modest pace. Currently, coverage ranges from 15% to 42% of the UK landmass at the High Confidence level, and from 8% to 35% at the Very High Confidence level. This marks an increase from last year’s figures of 11% to 38% and 6% to 26%, respectively.⁵⁹ BT/EE leads in 5G landmass coverage in the UK reaching around 35% (at Very High confidence) and 42% (at High Confidence).

These increases in coverage have been driven by additional 5G deployments, with over 23,100 5G sites now operational across roughly 81,000 sites in the UK, up from around 18,500 reported in 2023 (c.24% increase).⁶⁰ 84% of these sites are in England, 9% in Scotland, 4% in Wales and 2% in Northern Ireland, consistent with previous years and mirroring the national distribution of mobile traffic.⁶¹ Urban areas have seen the most significant deployment with 42% of sites in urban areas now equipped with 5G, compared to 29% in suburban areas and 16% in rural regions, an increase from 34% for urban, 20% for suburban and 10% for rural reported last year.⁶²

⁵⁸ The data we have received from Three shows a drop in its 5G coverage compared to our reporting in last year’s Connected Nations report from September 2023. Three has stated that this is mainly due to configuration changes in their network and some minor adjustments in their prediction model for a handful of sites, but that these changes do not have an adverse impact on the overall 5G experience for their customers.

⁵⁹ The coverage ranges refer to the span between the MNO with the least coverage and that with the most coverage on a given measure.

⁶⁰ These deployments do not necessarily equate to a total of individual sites across all MNOs. For example, two MNOs may be offering coverage from the same site. Also, this encompasses the various 5G mobile deployment types i.e. 5G NSA, 5G SA and Dynamic Spectrum Sharing (DSS).

⁶¹ Note that the percentages do not add up to 100% due to rounding to the nearest whole number.

⁶² The aggregated number of sites, represented by the percentages in both rural and urban classifications and the nations split of sites, is slightly less than the total sites. This is because not all sites could be spatially mapped onto the UK due to limitations in the ONS 2021 Census [National Statistics Postcode Lookup](#) (August 2023) and [Locale](#)

4G coverage

While 5G coverage is expanding, it is important to note that most people still use voice and data services over 4G. Below we outline 4G coverage from different MNOs.

Outdoor premises coverage remains high

As in previous years, individual operators maintain 4G coverage outside more than 99% of UK premises. Additionally, 99% of premises enjoy outdoor 4G coverage from all MNOs, an increase of 1 percentage point from last year's figure of 98%. Voice and text service coverage remains robust, with each MNO providing outdoor voice call coverage at around 99%+.⁶³

In rural areas, individual operator 4G coverage outside premises ranges from 97% to 98%, an improvement from last year's 94% to 98%. In contrast, each MNO continues to cover 99%+ of urban premises. Outdoor voice coverage across the UK remains at 99%+, unchanged from 2023.

Indoor coverage continues to be widely available

The coverage that people receive indoors depends on a range of factors including the thickness of walls, building materials used in construction and where in a building people are using their phone.⁶⁴

Consequently, there may be differences between MNOs' predicted indoor coverage data and the actual coverage available in some premises.⁶⁵

Indoor 4G coverage now serves 94-96% of premises across different MNOs, a small change from last year's 93-96%. Indoor voice call availability remains the same as last year estimated at 96-99%+, although we note that all MNO voice coverage has decreased by around 2 percentage points this year. Some notable differences remain between indoor 4G and voice coverage in rural and urban areas, as shown in Table 3.1 below.

Table 3.1: 4G and voice indoor coverage across MNOs in rural and urban areas

	4G		Voice	
	2023	2024	2023	2024
Urban	96-98%	97-99%	99-99%+	99-99%+
Rural	73-82%	78-84%	81-97%	82-98%
Total	93-96%	94-96%	96-99%	96-99%+

Source: Ofcom analysis of operator data (September 2023 and September 2024)

Where indoor coverage is poor or unreliable, other solutions can improve the user experience. These include broadband-based voice or video calls on services such as WiFi calling, online communications

[classification](#) files, which we used to generate the classifications and geographical boundaries. However, this should not have a significant impact on figures reported as the number of sites affected is minimal.

⁶³ The MNOs' coverage is rounded up to the nearest percentage point.

⁶⁴ Ofcom's [Mobile Coverage Checker](#) provides information on the likelihood of there being indoor coverage in buildings at different locations and explains more about the factors that affect mobile signal indoors. This Ofcom produced map uses MNOs' coverage predictions indicating signal levels at every location in the UK.

⁶⁵ Ofcom determines indoor coverage by applying an average building entry loss of 10dB across buildings. We acknowledge this approach provides only a simplified view of indoor coverage and that the real experience depends heavily on the types of building material and insulation in a specific building.

services such as instant messaging and calling applications, or femtocell.⁶⁶ All MNOs offer WiFi calling, although not all phones are configured to support this. The percentage of voice over WiFi calls reported by three of the MNOs ranges between 9% and 17% across individual MNOs.⁶⁷

4G geographic coverage

Overall, 4G geographic coverage across individual MNOs in the UK has increased significantly since 2023, rising from a range of 80-87% to 88-89% this year. From the data reported to us, the percentage coverage by MNO is 89% (up from 87% in 2023) for BT/EE, 88% (up from 82% in 2023) for Virgin Media O2, 89% (up from 80% in 2023) for Three, and 89% (up from 83% 2023) for Vodafone. 4G geographic coverage where it is available from at least one MNO has now reached 95% compared to 93% in 2023. As the majority of the UK landmass is rural, rural coverage levels are similar to overall UK levels, while urban areas report moderately higher geographic coverage.

As of September 2024, MNOs' predicted geographic coverage in UK's nations ranged from 94-96% (compared to 92-95% in 2023) in England; 89-95% (compared to 88-92% in 2023) in Northern Ireland; 77-80% (compared to 59-76% in 2023) in Scotland; and 83-89% (compared to 73-85% in 2023) in Wales (Figure 3.4). This means that compared with 2023, the coverage range for England and Northern Ireland had modest increases at both lower and upper bounds, ranging from 1 to 3%. Scotland experienced a substantial increase in coverage range rising by 18 percentage points at the lower bound and 4 percentage points at the upper bound. Similarly, Wales coverage range increased significantly, with an increase of 10 percentage points at the lower bound and 4 percentage points at the upper bound. However, significant differences remain in 4G geographic coverage across the UK's nations.⁶⁸ We note the 4G geographic coverage improvements as a result of the Shared Rural Network programme.⁶⁹

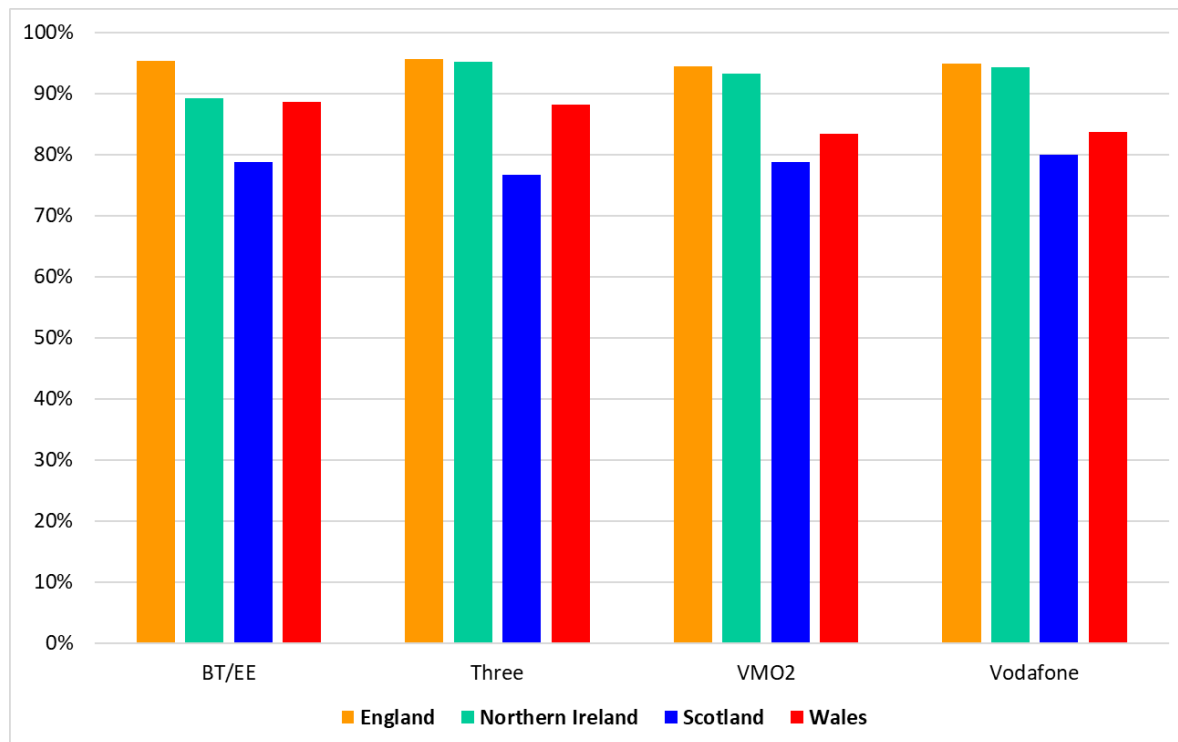
⁶⁶ WiFi calling is the ability to make and receive a call and text/SMS over a WiFi network. A femtocell is a small low-power cellular base station connected to the phone network over the internet.

⁶⁷ One of the MNOs was unable to differentiate between overall voice calls that are made over Wi-Fi (voWiFi) and overall voice calls that are delivered via VoLTE (VoLTE) on its network.

⁶⁸ This coverage is reported to the nearest full integer (whole number), consistent with past publications. We note that, in assessing the coverage obligations for the [Shared Rural Network](#), we report MNOs progress against their commitments to one decimal place, providing a more detailed view of each MNO's level of progress for that purpose.

⁶⁹ Ofcom, [Shared Rural Network \(SRN\) coverage obligations](#), 20 February 2024.

Figure 3.4: Differences in 4G geographic coverage in England, Northern Ireland, Scotland and Wales



Source: Ofcom analysis of operator data (September 2024)

Update on Shared Rural Network (SRN)

On 9 March 2020, the UK Government announced that it had entered into an agreement with the four MNOs to grant funding for a Shared Rural Network (SRN).⁷⁰ Under the terms of this agreement, each of the four MNOs has committed to provide good quality 4G data and voice coverage to 88% of the country’s landmass by 30 June 2024, and 90% by 31 January 2027.⁷¹

On 12 September 2024, Ofcom published an update on the compliance of UK’s MNOs with their SRN coverage obligations and confirmed that BT/EE, Vodafone and VMO2 had met the 88% UK-wide threshold and their individual thresholds for each UK nation.⁷² We reported that, as of 30 June 2024, their UK wide 4G coverage levels were 88.9%, 88.7 % and 88.1%, respectively. We said we would undertake a further assessment of new information provided by Three and published a further update on 6 November 2024.⁷³ This confirmed that Three had subsequently met its outstanding UK-wide and Scotland coverage obligation thresholds, reaching 88.6% 4G geographic coverage.⁷⁴ This assessment was informed by coverage predictions submitted by the MNOs for the time these obligations fell due, and Ofcom’s subsequent measurement work.⁷⁵

⁷⁰ The SRN programme is detailed on our Mobile Coverage Obligations website: [Mobile coverage obligations - Ofcom](#)

⁷¹ Good quality coverage is defined as the ability to sustain a 90 second voice call and access data speeds of at least 2 Mbps, with a methodology to assess this based on a 4G signal of at least -105 dBm.

⁷² [Shared Rural Network Coverage Obligations](#) – Assessing the mobile network operators’ compliance with their geographic coverage obligations.

⁷³ [Shared Rural Network \(SRN\) Coverage Obligations - 2024 assessment update](#)

⁷⁴ 4G geographic coverage where it is available from at least one MNO has now reached 95.3% (Source: Ofcom analysis of operator data, September 2024).

⁷⁵ [2020 coverage obligations - Notice of compliance verification methodology](#)

Road coverage

4G coverage is predicted to be available inside vehicles⁷⁶ on motorways and A roads⁷⁷ across individual MNOs in a range of 89-92%. This falls to a range of 80-83% for B roads. Outside vehicles, 4G coverage on motorways and A roads ranges between 98-99% across individual MNOs (compared to 94-98% in 2023), and between 95-96% for B roads (compared to 90-95% in 2023).

Coverage of in-vehicle mobile voice services on motorways and A roads ranges between 90-98% across individual MNOs (91-97% in 2023).⁷⁸ This falls to a range of 80-95% for B roads (81-92% in 2023). Voice call coverage outside vehicles on motorways and A roads ranges from 99-99+% across individual MNOs, compared to 98-99% in 2023. Coverage for voice calls outside vehicles on B roads ranges from 96-99% across individual MNOs (compared to 94-97% in 2023).

Rail

We currently do not report on rail coverage or quality. In December 2019, we published open data on mobile signal strength along UK railways based on measurement equipment temporarily installed on 'yellow trains' or maintenance stock.⁷⁹ We also provided advice to Government in 2018 and 2020 on improving rail passenger access to data services.⁸⁰

Since then, we have continued to explore the feasibility of reporting on coverage on trains in a relevant way. We currently consider that a new approach is needed to report mobile coverage and quality on trains. While our existing methods, including coverage prediction data from MNOs, provide reasonable estimates of aggregate coverage outside of trains, they fall short in accurately predicting quality on trains. The challenges of external mobile signals penetrating trains, combined with the substantial variance between predicted and measured signal strength, highlight the inadequacy of current prediction data for this purpose.

The high volume of concentrated mobile service demand on moving trains may cause capacity and service challenges which cannot be characterised using signal strength alone. Additionally, while some measurements might be sufficient to determine the availability of mobile services at a particular location, more in-depth measurements are often necessary. These measurements may need to consider factors such as the time of day, the location within the carriage, and the type of rolling stock to provide a comprehensive understanding of mobile service performance.

We are continuing work to explore alternative measurement and data collection methods to provide information on mobile quality on trains. We expect to provide an update in Connect Nations 2025.

Switch-off of 3G and 2G networks

3G switch-off is underway

All MNOs made a commitment to the Government to switch off their 2G and 3G networks by 2033 at the latest. This will result in improved network efficiency and enable more spectrum to be used for 4G and 5G services.⁸¹

⁷⁶ Ofcom determines inside vehicle coverage by applying a 10 dB attenuation of outdoor signals.

⁷⁷ Motorways and A roads are collectively referred to as 'major roads' in our interactive report.

⁷⁸ Mobile voice services through 2G, 3G and 4G.

⁷⁹ [Mobile signal strength measurement data from Network Rail's engineering trains](#)

⁸⁰ [Advice to Government on improving rail passenger access to data services](#)

⁸¹ [A joint statement on the sunsetting of 2G and 3G networks and public ambition for Open RAN rollout as part of the Telecoms Supply Chain Diversification Strategy](#)

In February 2023, we set out a number of expectations on mobile providers on 3G and 2G switch-off, which are designed to ensure that customers are treated fairly and any disruption to customers is minimised.⁸²

The MNOs are responsible for their own switch-off timetables for these legacy technologies, with 3G being switched off first. This year, Vodafone and EE both completed their respective 3G switch-offs.⁸³ Ofcom has received very few complaints from customers about the impact of 3G switch off, and MNOs have not reported any significant disruption related to the switch to Ofcom. Three is in the process of switching off 3G, and Virgin Media O2 plans to switch off its 3G services in 2025.⁸⁴ We will continue to closely monitor these switch-off processes through to completion.

Over 2 million devices remain reliant on 2G/3G networks

Our latest estimates from MNOs about mobile providers' direct customers suggest there are 2.1 million devices reliant on 2G/3G networks, decreasing from 2.4 million in 2023.⁸⁵ Of the 2.1 million devices reliant on 2G/3G networks, the number identified by MNOs as residential devices (for example mobile devices such as handsets) stands at around 1 million.

There has been a rise in voice traffic being carried on 2G networks in 2024. Given that two MNOs have already completed 3G switch off, it appears that more calls may be being made over 2G because some customers are relying on devices which do not have the capability to make calls over 4G/5G networks.

This highlights the need for mobile providers to continue their efforts in contacting customers ahead of 2G switch off to ensure that they upgrade to 4G/5G VoLTE devices and can continue to access the services they need.

Virgin Media O2 is the only MNO to have announced plans for changes to its 2G network. It intends to start moving customers off its 2G network in 2025, other than for certain uses such as emergency calling and smart energy meters.⁸⁶

In addition to mobile providers' direct customers, third-party devices that operate on 2G, including some telecare, fire and security alarms, will also require upgrading ahead of changes to 2G networks. The supply chain for these services can be complex, but we expect MNOs to make a sustained commitment to raising awareness so that suppliers have sufficient time to update their devices and their customers do not lose access to vital services.

There are additional key services that rely on 2G, such as smart meters and eCall, that will require efforts led by Government to ensure a smooth transition, and Ofcom will continue to offer support on this.

Emergency calling via 4G VoLTE, and the ability to roam onto another network using VoLTE are becoming increasingly important as MNOs continue phasing out their 3G networks. As of July 2024, all UK MNOs, except for VMO2, had already integrated emergency calling via VoLTE.

⁸² [Ofcom's expectations of mobile providers for 2G and 3G switch-off](#)

⁸³ [Vodafone UK successfully switches off 3G across the UK - boosting 4G and 5G](#)
[We're Switching Off Our 3G Network](#)

⁸⁴ [Our plans to switch off 3G](#)

[Virgin Media O2 to begin switching off 3G in 2025 with enhanced customer experience as network evolves](#)

⁸⁵ 2.1 million figure only includes direct customers of MNOs and MVNOs and does not include third-party devices such as smart meters or devices using roaming SIMs.

⁸⁶ [Mobile network evolution: meeting customer needs now and for future](#)

Mobile performance

Mobile performance explores various aspects of the connectivity that people experience, including upload, download speeds and latency, which extend beyond basic signal strength measured by coverage metrics. Signal strength alone does not necessarily correlate with the service performance experienced by users. Capturing performance parameters requires significantly more effort than measuring coverage and is also more variable, depending on factors such as the time of day.

Mobile performance using crowdsourced data

Ofcom's latest Mobile Matters Report provides analysis of mobile data service experiences across the UK.⁸⁷ The report, which uses crowdsourced data collected between October 2023 and March 2024, focuses on several key areas.

In our Connected Nations: UK Report 2023, we provided an initial snapshot of mobile performance, informed by crowdsourced data and we also identified the limitation of the dataset due to the availability of data points across the UK.

We are currently exploring the role innovative measured data, including crowdsource data, might play in providing an improved localised view of performance. We plan to provide further insights into mobile performance and quality reporting in the next 12 months.

Mobile traffic

Gradual slowdown in mobile traffic growth with rising 5G share

The growth in monthly mobile traffic as a whole has been slower, though absolute growth remains significant. Total monthly traffic has risen from 905 PB to 1069 PB,^{88 89} an annual increase of c.18%, compared to a c.25% increase in 2023.⁹⁰ This aligns with other reports on mobile traffic internationally over the last year. We will continue to report on these traffic levels in future years to allow any long-term changes to be observed.

5G traffic has shown the highest growth from 151 PB in 2023 to 227 PB in 2024, an increase of around 50%. This data traffic was generated from a device pool which now includes at least 50% 5G capable handsets (up from around 43% in 2023)⁹¹ and represents around 21% of the total monthly mobile traffic, up from around 17% in 2023. 14% of this traffic is 5G SA traffic, around 3% of overall monthly mobile traffic in the UK. While 5G traffic has increased rapidly, 4G continues to carry most of the mobile data traffic, accounting for c.78% of total monthly data traffic (a decrease from 81% reported last year) (see Figure 3.5).⁹²

⁸⁷ Ofcom, [Mobile Matters](#), 20 July 2023.

⁸⁸ [Mobile Matters 2024 : using crowdsourced data to assess people's experience of using mobile networks](#)

⁸⁹ Traffic data rounded up to the nearest whole petabyte.

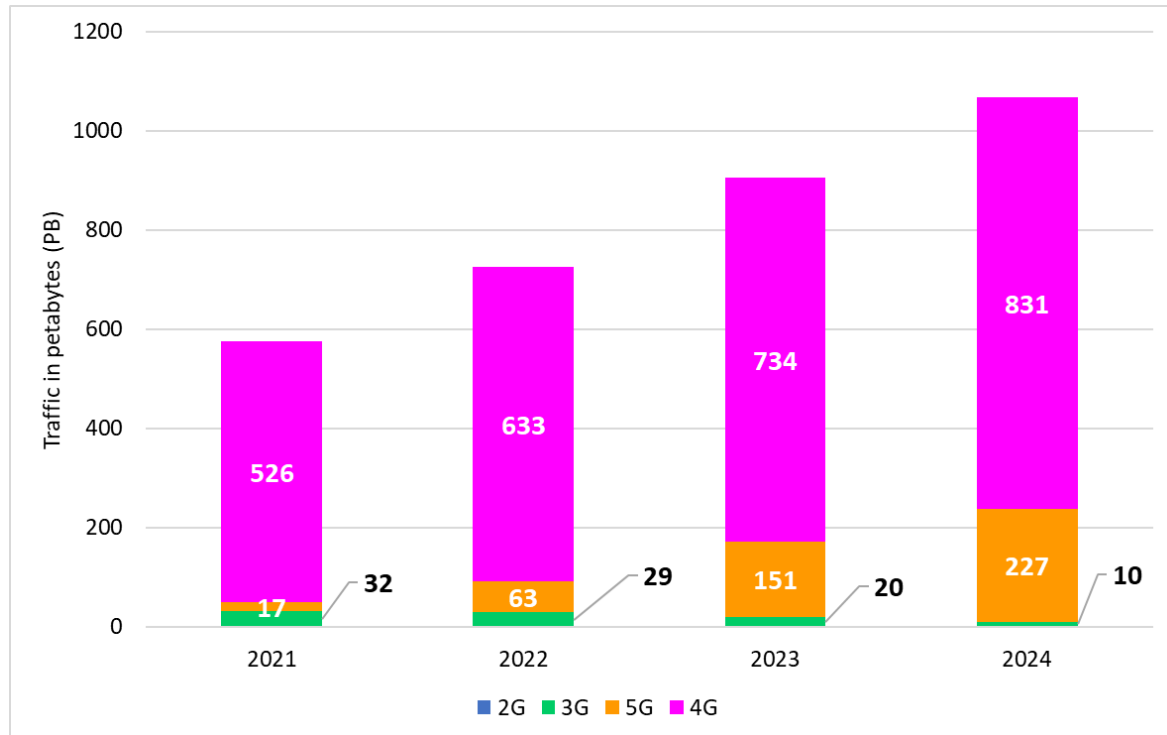
⁹⁰ The total traffic reported here is likely to be less than the actual traffic as one of the MNOs has underreported its traffic due to data issues on its performance reporting tool.

⁹¹ The reported total monthly traffic includes all traffic across mobile networks, and therefore includes traffic generated by Fixed Wireless Access, where operators are offering domestic fixed broadband services over their wireless networks. All MNOs, except for one, offer FWA services with varying traffic splits, ranging from approximately 1% to 49%.

⁹² Methodology for calculating total number of devices varies across MNO making this figure an approximation rather than an exact figure. Additionally, we note that not all 5G capable devices may be enabled with a 5G subscription.

⁹³ In comparison, only about 1% of data is now carried on 3G networks reflecting a long-term downward trend, with most voice traffic shifting to 4G/5G VoLTE and some to 2G networks.

Figure 3.5: Total monthly traffic by technology (2021-2024)



Source: Ofcom analysis of operator data (May 2021, May 2022, May 2023, July 2024)

Distribution of mobile traffic

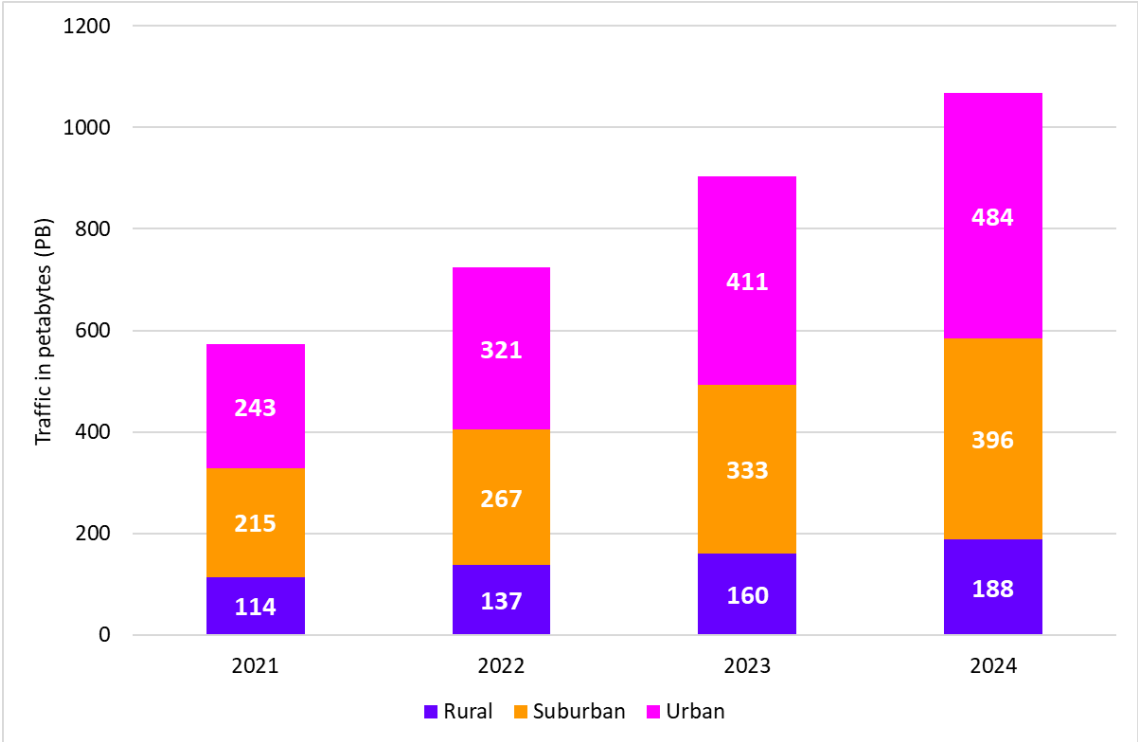
Data consumption continues to be divided between urban and rural areas as well as across the various nations of the UK in a way which largely mirrors population distribution, rather than any significant difference in data consumption of a typical user in rural areas or any specific UK nation when compared. Most of the monthly mobile data traffic (c.82%) is generated in urban and suburban areas (Figure 3.6).^{93 94}

Suburban areas experienced the highest monthly mobile traffic growth at 19%, slightly higher than the UK average of approximately 18%, but lower than the previous year’s 25%, aligning with the broader traffic trends observed. Meanwhile, urban areas experienced a modest increase of around 18%, closely matching the UK average mobile growth. Rural areas also experienced growth with an increase of 17%, consistent with last year’s increase of 17%.

⁹³ The rural population of England, Scotland and Wales is estimated to be between 17-20%, with the rural population in Northern Ireland somewhat higher. UK Government, [Depopulation in rural areas](#), 09 September 2024. Scottish Government, [Rural Scotland Key Facts 2021](#), 24 February 2021. Welsh Government, [A Statistical Focus on Rural Wales](#), 2008. Northern Ireland Executive, [Key Rural Issues, Northern Ireland 2023](#).

⁹⁴ The total mobile traffic, represented by the percentages in both rural and urban classifications as well as the nations’ split, is slightly less than the total mobile traffic reported by MNOs. This is because not all sites could be spatially mapped onto the UK due to limitations in the ONS 2021 Census [National Statistics Postcode Lookup](#) (from August 2023) and [Locale classification](#) files, which we used to generate the classifications and geographical boundaries. However, this should not have a significant impact on figures reported as the number of sites affected is minimal.

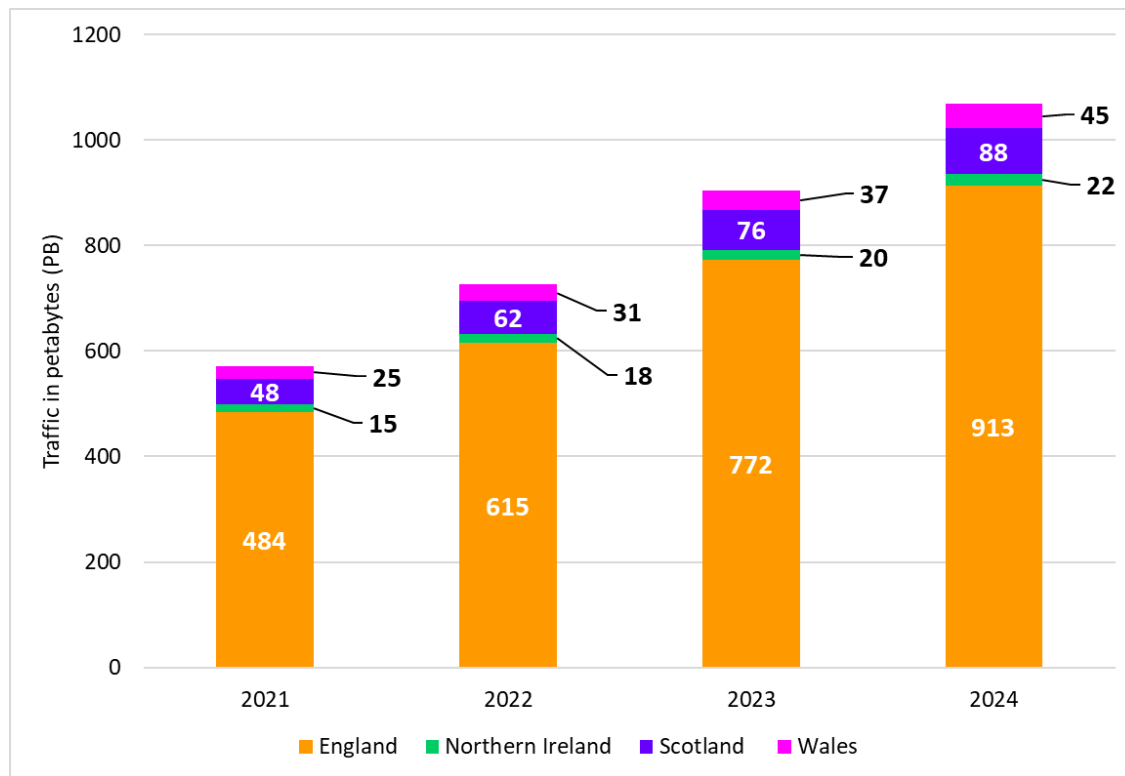
Figure 3:6: Total monthly mobile data traffic in rural, suburban and urban areas (2021-2024)



Source: Ofcom analysis of operator data (May 2021, May 2022, May 2023, July 2024)

Across nations, Wales had the highest monthly mobile traffic increase of c.20% since last year, slightly above the national average. Northern Ireland had the slowest increase at around 9%. England and Scotland also had notable increases of approximately 18% and 16%, respectively (see Figure 3.7). However, there has been a general decline in traffic growth across all nations compared to last year, aligning with the broader traffic trends observed.

Figure 3.7: Total monthly mobile data traffic trends by UK nations (2021-2024)



Source: Ofcom analysis of operator data (May 2021, May 2022, May 2023, July 2024)

Open RAN adoption

In December 2021, the UK Government confirmed an ambition for 35% of mobile traffic to be carried over open and interoperable systems (Open RAN)⁹⁵ by 2030, and in September 2023, in collaboration with the four major UK MNOs, reaffirmed this shared ambition for 35% of network traffic to take place over Open RAN.^{96 97}

Currently, Open RAN deployment remains limited, with just below 50 sites reported this year compared to around 40 sites reported last year. Similarly, mobile traffic carried over such architectures remains limited at around 24,600 GB, a decrease from 78,600 GB reported last year. We note, however, that we are still at an early stage in the commercialisation of Open RAN, and we will continue to monitor progress in the years ahead.

⁹⁵ Open Radio Access Network (Open RAN) is a network infrastructure that enables greater choice and flexibility in telecoms supply chains. It is considered to be one option that could allow the supply chain to be disaggregated with the use of “open” and “interoperable” off-the-shelf hardware, vendor-neutral protocols, and software-defined technology – Ofcom’s article, [What is Open RAN and why does it matter?](#) provides further information on Open RAN.

⁹⁶ Minister for Media, Data and Digital Infrastructure, [Telecoms Diversification: Update Against Taskforce Recommendations](#), 8 December 2021.

⁹⁷ [UK and Mobile Network Operators' memorandum of understanding on Radio Access Network \(RAN\) solutions and Open RAN principles - GOV.UK](#)

MNO private networks and IoT

Mobile services are not limited to public use; they also play a valuable role in supporting business connectivity and enabling device-to-device services. In today's digital environment, many businesses and public sector organisations depend on wireless broadband services to deliver their products and services effectively. Consequently, both MNO and non-MNO entities are leveraging the capabilities of 5G technology (in addition to other technologies) to provide customised connectivity solutions across a wide range of industries.

5G and private mobile networks

Emerging opportunities for private mobile networks, driven by 5G capabilities and its potential for ultra-low latency, are increasingly being leveraged by organisations seeking secure, high-capacity connectivity solutions, tailored to specific industry needs, such as real-time analytics, automation, and IoT applications. These networks are playing an increasingly important role in the digital transformation of many sectors of the economy, spanning from the enhancement of operations in ports to elevating user experiences in sports, media, and events. With a diverse range of providers, encompassing both MNOs and non-MNO entities and the opportunity for a broader set of players to emerge, this remains an active and developing area.

Whilst MNOs remain engaged in this space, the number of fully operational commercial private mobile networks run by UK MNOs remain limited. As of July 2024, less than 30 fully operational commercial private mobile networks were reported by MNOs, an increase of 11 compared to 2023. These networks utilise 4G, 5G, or a combination of both technologies primarily operating within 3400-4200 MHz and 2600 MHz bands. Of the reported private mobile networks, just over ten operate on 5G SA, with one of these private mobile networks delivered as a slice of the commercially deployed 5G SA network.⁹⁸

Non-MNO players, including network equipment vendors, systems integrators, and specialist providers, continue to play a part in delivering private mobile networks across UK. Some of these players are accessing spectrum for their networks using our Shared Access licences (which also support a variety of other applications, including Fixed Wireless Access).⁹⁹ As set out in 2023, we consider that many Shared Access licences support private mobile network solutions. The number of Shared Access licences issued by Ofcom is just below 1,000, a decline from over 1,500 licences reported last year that is largely attributable to the return of a number of 'legacy' 1800 MHz licences that predated our Shared Access regime.¹⁰⁰ The majority of current licences fall within the 3800-4200 MHz band (c.57%), with an increase of around 60 additional licences this year, indicating an increase in the use of 5G-based solutions. Of these 3800-4200 MHz band licences, 63% are for medium power, with the remainder

⁹⁸ Network slicing is a feature of 5G SA networks. It allows an MNO to create multiple virtual networks (slices) on top of its common shared physical infrastructure. The virtual networks are then customised to operate with specific quality of service and meet the specific needs of applications, services, devices, customers or operators.

⁹⁹ Authorisations are provided either for single base stations at a medium power level, or multiple lower power base stations authorised within a 50m radius. Ofcom remains committed to enhancing this framework to support further sharing and improve the application experience for users. [Statement and further consultation: Supporting increased use of shared spectrum](#)

¹⁰⁰ Shared Access licences are available in parts of the 1800 MHz and 2.3 GHz bands, as well as 3.8-4.2 GHz and 26 GHz. Since 2023, BT EE has returned a large number of licences associated with its BT One Phone product, which predated the Shared Access regime.

being low power licences. These licences are distributed across the UK, with 86% in England, 8% in Wales, 5% in Scotland, and 1% in Northern Ireland.¹⁰¹

Internet of Things

The Internet of Things (IoT) refers to a network of devices and sensors which are capable of collecting and sharing data with people or with other devices, and taking action based on this information. These devices range from personal gadgets to industrial sensors and operate across various sectors, including healthcare, energy, manufacturing, and transport. In the UK, IoT connectivity is delivered by both MNOs and other non-MNO players, often operating in a specific local area. These providers utilise a range of frequencies, primarily within the lower and mid-band ranges that are either licence-exempt or authorised for use by MNOs.¹⁰²

We have reported on both MNO and non-MNO IoT connectivity in previous years. This year, we are reporting on MNO IoT connectivity. We previously reported on estimations of IoT connections and data traffic based on data from a limited number of IoT providers in the UK. However, that reporting did not include a comprehensive set of stakeholders to provide a complete range of available IoT connectivity offerings. We plan to engage with the IoT stakeholder community to understand how development of our information gathering in this area would be helpful in providing a wider view of this offering in future reports.

IoT connectivity available from MNOs

UK MNOs continue to deliver IoT connectivity using their existing 2G, 3G, 4G, and 5G networks, as well as Low Power Wide Area Networks (LPWANs)¹⁰³ including NB-IoT¹⁰⁴ and LTE-M,¹⁰⁵ supporting a wide range of applications including asset tracking, utility metering, travel and transport, environmental monitoring, energy management solutions for smart buildings, car telemetry, and video surveillance.

The number of active IoT connections on MNO networks increased by 6.5%, reaching just above 26.5 million, though this marks a slowdown from the previous increase in 2023 of 31%. While these connections typically generate much lower data volumes than consumer handsets, MNO IoT traffic volumes continue to rise, increasing by 11% to 1.96 PB per month (a decline from the 17% growth reported last year). However, these volumes still represent less than 1% of overall data traffic.

¹⁰¹ The aggregated number of shared access licences, represented by the percentages across nations is slightly less than the total shared access licences. This is because not all shared access licences could be spatially mapped onto the UK due to limitations in the ONS 2021 Census [National Statistics Postcode Lookup](#) (from August 2023) and [Locale classification](#) files, which we used to generate the classifications and geographical boundaries. However, this should not have a significant impact on figures reported as the number of sites affected is minimal.

¹⁰² Frequencies used by IoT services typically range from around 700MHz to 3800MHz.

¹⁰³ Low-power wide-area networks (LPWANs) are designed for IoT applications and services which have low data rates, long battery lives and, if required, 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.

¹⁰⁴ Narrowband IoT (NB IoT) is a wide-area solution that supports massive deployment of IoT devices and is also optimised for a very long battery life. NB-IoT networks can be deployed in mobile bands and integrated on existing mobile base stations.

¹⁰⁵ Long Term Evolution for Machines (LTE-M) is a complementary technology to NB-IoT with the added capability of supporting IoT applications with higher data rates and lower latency requirements. It can also be deployed in mobile bands and integrated on existing mobile base stations.

IoT has the potential to play a growing role across a range of services

The increase in IoT devices and traffic suggests that businesses are increasingly leveraging IoT capabilities to enhance efficiency and innovation.

The ongoing phase-out of legacy 2G, 3G, and PSTN networks has implications for a range of sectors which include domestic and business customers, with the potential for IoT to play a crucial role in providing sustainable alternatives for essential services like security systems, telecare, and utility monitoring. Beyond these immediate applications, IoT's versatility supports a broad range of future innovations, driving improvements in service delivery across numerous sectors.

Network infrastructure is gradually being provided by an evolving set of players

MNO infrastructure underpins most of the coverage we report here. However, a variety of third-party players, from neutral host providers to satellite operators, are increasingly contributing to the provision of infrastructure¹⁰⁶ that supports both public and private networks. These players offer a range of services, from passive infrastructure¹⁰⁷ to comprehensive active infrastructure¹⁰⁸ tailored for specific environments such as office buildings, stadiums, and underground train stations. Some models even combine both approaches.

A neutral host provider in mobile communications is a third-party company that builds and manages network infrastructure, such as 5G towers and small cells, which it leases to one or multiple MNOs. This infrastructure approach can reduce costs, enhance efficiency, and improve network coverage, especially in areas where individual deployments would be expensive. For the year 2024, MNOs reported over 17,900 deployments on neutral host infrastructure, with around 89% of these deployments being sites for macrocells.¹⁰⁹ Indoor deployment continues to make up a small proportion, around 5%, of MNO reported neutral host deployments.¹¹⁰

We previously reported on estimations of mobile sites provided by neutral hosts and level of sharing, based on number of public networks hosted on the sites using data from some neutral host providers in the UK. However, this did not include a comprehensive set of stakeholders to provide a complete range of neutral host infrastructure offerings. We are therefore considering further development to our information gathering in this area by engaging further with the NH stakeholder community to provide a clearer view of this offering in future reports.

¹⁰⁶ This includes, but is not limited to, remote rural lattice masts, urban rooftop sites, satellite constellations and street furniture with small cells to indoor coverage solutions and indicates a potential for this diversity of provision to grow in the future.

¹⁰⁷ Third party providers offer only the physical infrastructure required for network deployment, such as towers, antennas, and cables but do not manage the active components like radio equipment or the spectrum.

¹⁰⁸ Third party providers offer both the physical elements (passive infrastructure) like towers, antennas, etc., as well as the electronic components or elements of the network necessary for signal transmission and reception (i.e., active layer). For example, radio equipment.

¹⁰⁹ Note that we use unique eastings and northings to count individual MNO neutral host deployments. These deployments do not necessarily equate to a total of individual sites across all MNOs. For example, two or more MNOs may be hosted on the same site.

¹¹⁰ Most of the deployments reported here support one operator with tower structures from MNOs, enabling MNOs to transition capital expenditure to operating costs. The neutral host providers could subsequently lease access to the infrastructure to numerous tenants.

Expenditure on mobile telecoms infrastructure

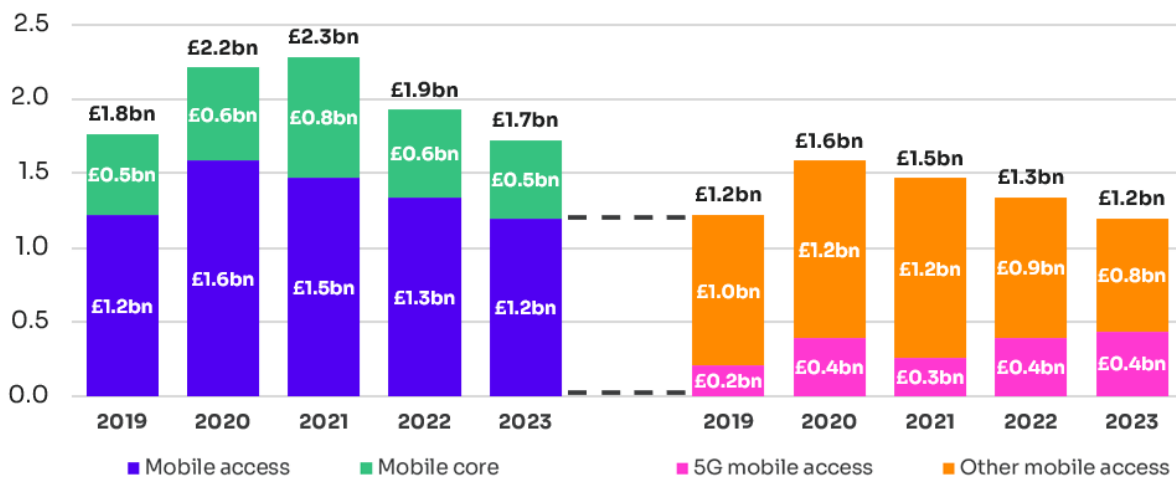
Estimated expenditure on mobile telecoms network infrastructure fell to £1.7bn in 2023

We estimate that mobile network operators (MNOs) invested £1.7bn in UK mobile network infrastructure in 2023, a £0.2bn (11%) year-on-year decline in real terms. In addition to this investment, £0.6bn was invested in infrastructure used to provide both fixed and mobile telecoms services.

Of the estimated mobile investment total, £1.2bn (69% of the total) was investment in mobile access network infrastructure (including site acquisition, equipment, and electronics). This represented a real-term fall of £0.1bn (11%) year-on-year. The remaining £0.5bn was spent on mobile core and backhaul networks, a £0.1bn (11%) fall compared to 2022.

All four UK MNOs continued to deploy 5G network infrastructure in 2023, when investment in 5G access networks totalled around £440m. This represented a £43m (11%) real-term increase compared to 2022. For the first time, we also collected information relating to investment in 5G core and backhaul networks (that are used to support standalone 5G mobile services) which totalled over £60m during the year.

Figure 3.8: Estimated mobile telecoms network capital expenditure: 2019 to 2023



Source: Ofcom analysis of operator data

Note: Adjusted for CPI (2023 prices)

4. Network security and resilience

Introduction

In December 2022, we published our [procedural guidance](#) on the exercise of Ofcom's functions to ensure compliance with the security duties in the Communications Act 2003 (the Act). This included our plans for a compliance monitoring programme and guidance on what security compromises are reportable to us and when they should be reported. We plan to consult on revising this next year, in particular to reflect our new resilience guidance and to update and further clarify our expectations on security compromise reporting.

In this section, we provide an update on our compliance monitoring programme, including our findings from our first information request, security compromises reported to us, and our work on monitoring compliance with high-risk vendor requirements. We note the importance of this work, given the increased number of actors and capabilities posing a threat to telecoms infrastructure.

We also report on our work on network resilience. We provide the latest summary of trends from the incident reports we receive from providers. In addition, we provide an update on our work on power back-up for mobile radio access networks.

Highlights

- **We are monitoring industry compliance with the telecoms security framework.** From our first information request, we are seeing significant investment by the providers to align their internal processes with their new legal obligations and providers appear to be making good progress on some of the initial measures.
- **Providers have ongoing obligations to report certain security compromises to us, which includes reporting both resilience and cyber-related incidents.** We are reviewing how our cyber compromise reporting guidance has been working in practice.
- **We have submitted three reports so far to the Secretary of State in October 2023, January 2024 and March 2024 based on the information gathered from relevant providers about high-risk vendors.** This follows the responsibility we were given to assist Government in its compliance assessment with the new restrictions on certain providers' use of Huawei products.
- **We have published significantly updated [Resilience Guidance for Communications Providers](#).** This sets out the measures we expect providers to take to keep their networks and services running reliably.
- **The total number of significant resilience incidents reported to us has increased.** We received 1,523 submissions this reporting year, compared to 1,209 last year. In terms of lost customer hours, network change activities again caused the most serious cases, while hardware faults accounted for under a third of total lost hours.
- **There are resilience risks associated with legacy technologies and extreme weather events.** For example, this year saw a 45% rise in the number of PSTN incidents reported to us, although there was a 55% decrease in the number of PSTN service hours lost. On extreme weather incidents, the number of outages fell during the 2023/24 storm season, but certain events such as Storms Isha and Jocelyn caused significant impacts.

Network security

An update on our Telecommunications (Security) Act monitoring programme

As outlined in [last year's report](#), a new security framework came into force in 2022 placing new obligations on providers and giving Ofcom powers to monitor and enforce compliance.¹¹¹ The evidence we have gathered as part of our monitoring programme indicates that regulated providers are investing significantly in new programmes of work to align their internal processes with their new legal obligations, by reference to the recommended measures in the [Telecommunications Security Code of Practice](#) (the 'Code').

Our monitoring programme primarily focuses on the largest national-scale (Tier 1) public telecoms providers and to a lesser extent the medium-sized (Tier 2) providers.¹¹² We are in the early stages of our monitoring programme with deadlines in the Code spanning from 2024 to 2028 and the programme will continue to evolve as new threats emerge. We note the importance of this work, given the increased number of actors and capability posing a threat to telecoms infrastructure.

As set out in our procedural guidance, we are issuing statutory information requests approximately every nine months, with providers having six months to respond.

Our first round of statutory information requests sent in June 2023 focused on understanding the networks, services and assets in scope of the new framework, and some of the initial measures taken by the providers in response to a subset of measures set out in the Code. These requests asked all providers standardised questions in order to understand what they are doing in relation to each of these measures. Some questions included in our first statutory request were around:

- how providers keep records and test their externally facing systems,¹¹³
- ensuring default passwords are changed on equipment during installation,
- and understanding the signalling entering and leaving their networks and how malicious signalling could impact the equipment and data in their networks.

Due to the complexity of the networks and services some of the providers operate, we will often not have a complete picture of how they are adhering to each measure from their responses to each information request. We will continue to ask follow-up questions on areas where we want more detail, where answers are not clear, or we want to check on progress.

In general, our monitoring work to date suggests providers have good or improving governance practices with established policies, standards and processes in place, with significant investments underway to improve their security in line with the measures set out in the Code. Providers appear to be making good progress on initial measures, which focus on having security boundaries between the exposed edge and critical functions, ensuring privileged access is regularly reviewed and logged, and changing default passwords when setting up devices or services respectively.

¹¹¹ The relevant provisions of the Telecommunications (Security) Act 2021 ('the Security Act') and The Electronic Communications (Security Measures) Regulations 2022 (the 'Regulations') came into force in October 2022.

¹¹² Tier 1 and 2 providers are those that have a relevant turnover of greater than £1bn and £50m respectively.

¹¹³ Any system or service with an externally-facing interface. An externally-facing interface is defined as any system interface that is accessible to people or systems outside of the provider's direct control.

We will be following up on several areas, including some of the signalling measures on how providers understand and monitor the signalling entering and leaving their networks, their processes in place for third party management, and asset management (including legacy and end of life equipment).

As part of the process set out in our procedural guidance and the Code regarding provider tiering, we have been through the first reporting cycle.¹¹⁴ We sent the second round of our monitoring requests in June 2024 and responses are due in early 2025. In next year's Connected Nations report, we expect to share an overview of our findings from the second information request, and any additional information from our follow-up questions.

We have also onboarded new providers who have moved subsequently into Tier 2 and are starting our monitoring programme with them.

Finally, we would like to note that the National Cyber Security Centre (NCSC) is working on additional security advice to industry, some of which relates to topics covered by the Code. We have engaged with NCSC to support an international standard made available through the European Telecommunications Standards Institute (ETSI), which will support vendors in delivering suitable products to our regulated providers.¹¹⁵

Cyber security compromises reported to us

Providers have an ongoing obligation to report security compromises that meet certain criteria to us. Reporting of resilience-related incidents was a feature of the previous regime, and as such, our guidance and the processes followed by the providers are well-defined and embedded. In contrast, our guidance on cyber security compromise reporting is new and we expect to refine this over time. To help us understand how it is working so far, we engaged with the larger providers to understand how they handle cyber security compromises internally and the decision making involved on whether a cyber security compromise is reportable to us.

We are considering updating our procedural guidance to further clarify our expectations on security compromise reporting, particularly on the legal duty to report pre-positioning attacks. These are where an attacker gains initial access to the network or service in preparation to carry out a subsequent attack that would have a significant effect on the operation of the network or service.

Providers are required to report security compromises that are an indicator of pre-positioning as defined above or anything that has a significant effect on the operation of the network or service.

To date, while we have had very few incidents reported to us, those that have been reported have given various causes for those incidents, including Distributed Denial of Service (DDoS), ransomware, phishing and exploitation of vulnerabilities. We are aware that only a small number of overall cyber security incidents will meet the criteria under s105K of the Act¹¹⁶ and therefore become reportable, while providers are likely to deal with a large number of less impactful cyber security compromises.

As part of our incident triage process, we sometimes ask follow-up questions on areas where we want more detail or to check on the provider's progress if they have mentioned any programmes of work in response to the incident, such as a root cause analysis. If there are concerns about a potential breach,

¹¹⁴ [Telecommunications Security Code of Practice - the tiering system](#) (page 7), [Ofcom's procedural guidance - compliance monitoring based on tiering](#) (page 10).

¹¹⁵ [ETSI TS 103 994-1](#)

¹¹⁶ A provider must report (a) any security compromise that has a significant effect on the operation of the network or service; (b) any security compromise within section 105A(2)(b) that puts any person in a position to be able to bring about a further security compromise that would have a significant effect on the operation of the network or service.

we will work with our enforcement team and discuss the best way forward including the option to open an investigation.

Outside their reporting duties, we see some examples of providers sharing findings from their cyber threat intelligence work with us, which suggests an encouraging degree of security maturity is developing in the sector.

We are continuing to follow the High-Risk Vendor monitoring direction issued by the DSIT Secretary of State

In October 2022, the DSIT Secretary of State placed restrictions on certain providers regarding the use of Huawei products within their networks and services, which provided for providers to comply with certain restrictions by various due dates.¹¹⁷ In June 2023, DSIT issued a monitoring direction that requires us to collect information on whether providers are complying with the restrictions. We have published a [redacted version of the direction on our website](#).

As required under the Direction, we have provided the Secretary of State with reports in each of October 2023, January 2024, and March 2024 setting out information on levels of compliance. The due dates for further restrictions are in 2025 and 2027 and we expect to follow the same process for each of these.

Global Titles and mobile network security

As discussed in our update above on our monitoring programme, signalling is an essential part of the networks and services providers offer and is an area we will be following up on. As part of our wider work, we became aware of mobile network security concerns arising from the leasing of Global Titles (GTs). GTs are created from UK mobile numbers, which Ofcom allocates, and enable access to the global mobile signalling network. GTs normally underpin the provision of legitimate mobile services, but there is evidence that GTs are sometimes being misused, for example to illicitly locate and track people using their mobile phones on other networks.

In July 2024, we consulted on proposals designed to tackle malicious signalling originating from UK GTs, including proposing a ban on the leasing of GTs to third parties by operators that hold UK mobile numbers.¹¹⁸ We are currently considering responses to the consultation, and we are aiming to publish our final decisions on new rules in a Statement in Q4 2024/25.

SMS Blasters

We are also acutely aware of the telecoms fraud and spectrum impacts relating to the use of “SMS Blasters”¹¹⁹ within the UK. Successful interventions have taken place by the Police,¹²⁰ and we continue to work with NCSC and other partners to ensure this new threat can be managed effectively.

¹¹⁷ The Secretary of State may give a ‘designated vendor direction’ to a public communications provider if they consider that the direction is necessary in the interests of national security and proportionate (s.105Z1 of the Communications Act 2003).

¹¹⁸ Ofcom, [Global Titles and Mobile Network Security – proposals to address misuse of Global Titles](#), 22 July 2024.

¹¹⁹ An illegitimate telephone mast that bypasses mobile phone networks’ systems in place to block suspicious text messages and is used to send smishing messages, posing as banks and other official organisations, to members of the public.

¹²⁰ City of London Police, [Two people arrested in connection with investigation into homemade mobile antenna used to send thousands of smishing text messages to the public | City of London Police](#), 7 June 2024.

Network resilience

Updated Resilience Guidance for Communications Providers

Following our public consultation from 8 December 2023 to 1 March 2024,¹²¹ we published the updated Network and Service Resilience Guidance for Communications Providers¹²² and the associated statement¹²³ on 6 September 2024.

As more and more people rely on the internet to stay connected both at home and work, having resilient telecoms networks is vital to both consumers and businesses across the UK. Communications providers have a legal obligation to identify, prepare for and reduce the risk of anything that compromises the availability, performance or functionality of their network or service.

We have significantly updated our resilience guidance for communications providers, which sets out the measures we expect them to take to keep their networks and services running reliably. The updated guidance describes a range of practices in the architecture, design, and operational models that underpin robust and resilient telecommunications networks and services, as well as more specific measures that we expect communications providers to consider. These are designed to help achieve our aim of ensuring an appropriate level of resilience for services across the UK.

The measures include:

- making sure networks are designed to avoid or reduce single points of failure;
- making sure key infrastructure points have automatic failover functionality built-in, so that traffic is immediately diverted to another device or site when equipment fails; and
- setting out the processes, tools, and training that should be considered to support the requirements on resilience.

We will use the guidance as a practical reference both:

- in information gathering and monitoring of network and service resilience when engaging with communications providers and the wider industry; and
- as a starting point for considering compliance as part of any enforcement activities in relation to resilience issues.

We continue to receive reports of ‘resilience incidents’ from communications providers

As in previous years, we continue to receive reports from communications providers throughout the year about resilience incidents that had a significant impact on their networks and services. Our [procedural guidance](#) for providers explains the types and sizes of incidents we expect them to report to us in order for them to comply with their regulatory obligations.

The total number of reported incidents has increased over the last year

We received a total of 1,523 reports of resilience incidents from providers during this reporting year (September 2023 - August 2024), which covers both fixed and mobile incidents. This is 26% higher than the 1,209 reports received in 2023.

¹²¹ Ofcom, [Resilience guidance consultation and Call for Input on mobile RAN power back up](#), 8 December 2023.

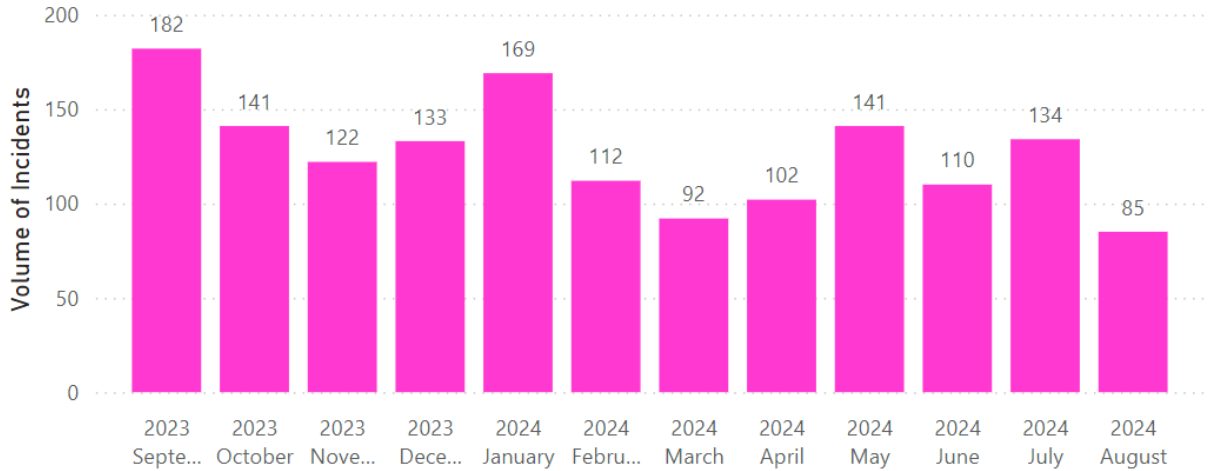
¹²² Ofcom [Statement: Network and Service Resilience Guidance](#), 8 December 2023.

¹²³ Ofcom [Statement: Network and Service Resilience Guidance](#), 8 December 2023. ¹²⁴ Lost Customer Hours is a metric calculated using the impact of an incident and its duration.

Fixed network incident reports increased substantially from 600 in 2023 to 910 in 2024. The volume of fixed incidents, particularly relating to PSTN voice, has grown over the years due to the equipment being beyond its intended lifespan and the reduction of qualified personnel within industry with experience of these legacy technologies. This year has seen a 45% increase in the number of PSTN incidents reported to us, although a 55% decrease in the amount of service hours being lost for customers (the ongoing migration of customers from PSTN to Digital Voice services means that fewer customers are impacted by service loss when the incidents occur).¹²⁴

Meanwhile, mobile network resilience incidents reported to us increased from 609 in 2023 to 696 in 2024.

Figure 4.1: Volume of incidents reported to Ofcom each month



Source: Ofcom analysis of provider data (September 2023 - August 2024).

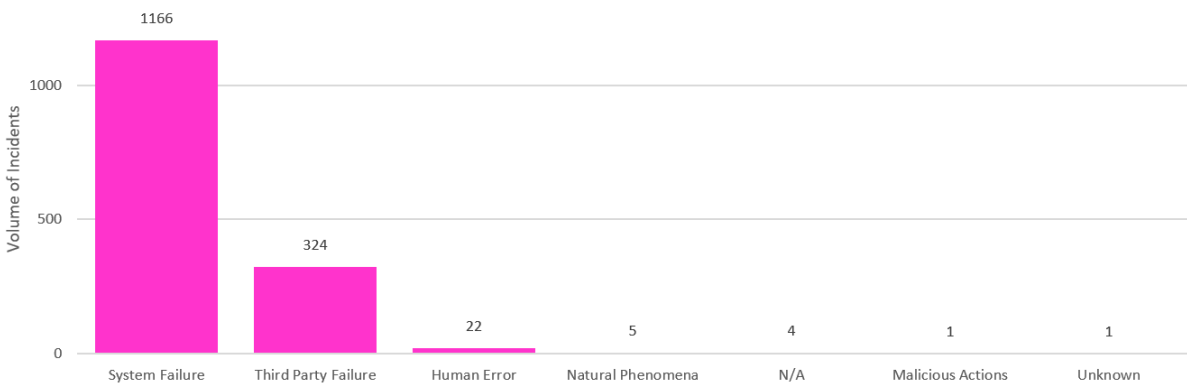
From the incidents that were reported to us over the period, we have seen that outages above the reporting thresholds¹²⁵ impacted a total of 24m customers and resulted in approximately 235m customer hours of service lost. This compares to last year when 17.5 million customers were impacted, and approximately 107 million customer hours of service were lost.¹²⁶ The large variation between the years is not uncommon and can be impacted by a small number of significant incidents rather than any one specific trend.

¹²⁴ Lost Customer Hours is a metric calculated using the impact of an incident and its duration.

¹²⁵ [Annex 1 - General statement of policy under section 105Y of the Communications Act 2003](#)

¹²⁶ Due to an established set of Causes and Threats we use ENISA categorisations. [About ENISA - The European Union Agency for Cybersecurity — ENISA \(europa.eu\)](#).

Figure 4.2: Volumes of incidents by root cause of incident

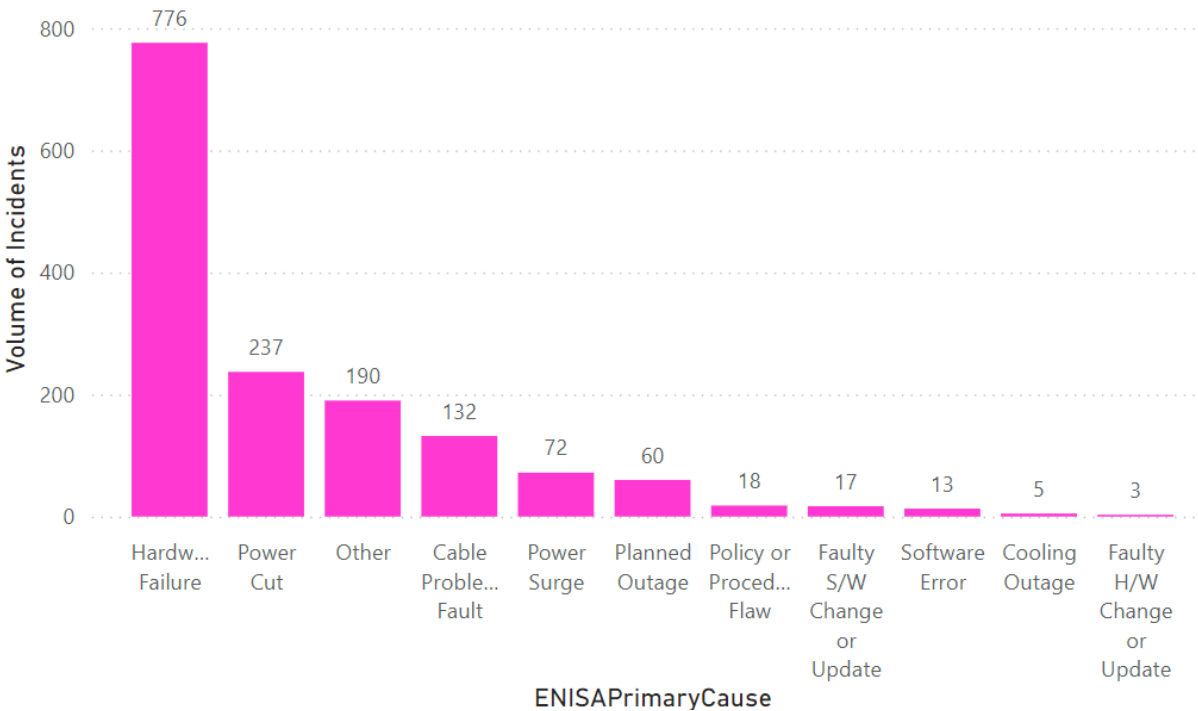


Source: Ofcom analysis of provider data (September 2023 - August 2024).

The most prevalent root cause for the majority of reported failures was system failures. This root cause category includes primary causes such as hardware failures, design errors, and faulty changes (Figure 4.2).

Failing equipment still generates the highest volumes of reported incidents

Figure 4.3: Volumes of incidents reported by primary cause of incident



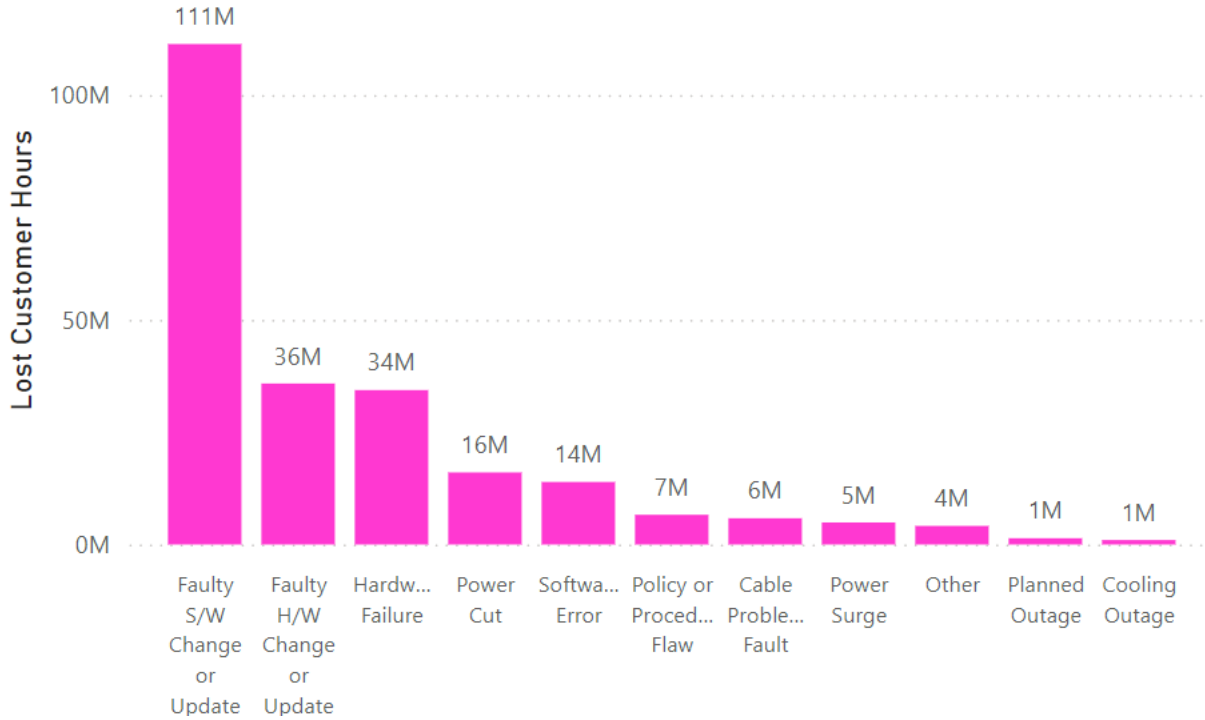
Source: Ofcom analysis of provider data (September 2023 - August 2024)

The root causes used to categorise incidents in Figure 4.2 are quite broad. By looking deeper into the primary causes, we can gain further insight into the specific factors that are driving customers to lose service (see Figure 4.3 and Figure 4.4).

As in previous years, hardware failures are the largest volume (776) of reported incidents when categorised by primary cause, exceeding over half of the total number of reports received. However, the hardware failure incidents generated under a third of the total lost customer hours reported to us this year (30%).

This year we received 237 reports related to power cuts, leading to 16 million user hours being lost. There were a further 72 power surge incidents reported, resulting in 4.9 million user hours being lost. This means that power incidents reported to us generated 20% of the total volume of incidents reported but fewer than 9% of the reported total user hours lost. 57% of these hours lost impacted mobile base stations or the associated backhaul transmission systems.

Figure 4.4 : Volume of lost customer hours by primary cause



Source: Ofcom analysis of provider data (September 2023 - August 2024)

Changes to networks are driving the highest impact incidents

As last year, 20 resilience incidents were reported to us this year with impacts exceeding 1 million user hours of lost service.

This represented 83% of user hours lost across all incident reports. Of these, the five largest outages were all related to change activities and represented 62% of user hours lost across all incident reports.¹²⁷ The top five were related to a “Faulty Software (S/W) Change or Update” or “Faulty Hardware (H/W) Change or Update.”

CrowdStrike Outage

On 19 July 2024, American cybersecurity company CrowdStrike distributed a faulty update to its ‘Falcon Sensor security software’ that caused an IT outage.¹²⁸ As widely reported in the press this impacted an estimated 8.5 million Microsoft Windows computers globally.¹²⁹

¹²⁷ ‘Change activities’ are where a communication provides makes planned modifications to a network or service. This could be for example updating software or hardware, adding a new feature, fixing a bug etc.

¹²⁸ CrowdStrike, [Remediation and Guidance Hub: Channel File 291 Incident](#), 6 August 2024. Falcon Content update.

¹²⁹ BBC News, [CrowdStrike IT outage affected 8.5 million Windows devices, Microsoft says - BBC News](#), 20 July 2024.

We had limited reports of incidents due to there not being a significant impact on communication providers networks and services. Based on the feedback we did receive from communication providers, this was at least partly due to the use of Microsoft Windows computers being of lower prevalence within communication providers networks.

999 emergency call handling service enforcement action and investigations

On Sunday 25 June 2023, BT, which manages the Emergency Call Handling Services (ECHS) system, experienced a disruption to the service. During the incident, nearly 14,000 call attempts – from 12,392 different callers – were unsuccessful.

The incident also caused disruption to text relay calls, which meant people with hearing and speech difficulties were unable to make any calls, including to friends, family, businesses and services. This left deaf and speech-impaired users at increased risk of harm. Following the incident, on 28 June 2023, we opened an investigation into BT's compliance with its security duties under the Act and various General Conditions.¹³⁰

Our investigation found that BT had breached security duties imposed under section 105A of the Act and Regulation 9 of the Electronic Communications (Security Measures) Regulations 2022, as it did not adequately prepare for the occurrence of an outage of the ECHS. Specifically, we found BT did not take sufficient measures:

- to ensure that it had clearly defined and tested means and procedures in place for identifying, assessing and addressing the occurrence of security compromises; and
- to prepare for the occurrence of security compromises by having in place an appropriate backup system capable of adequately limiting the adverse effects of the security compromise and enabling BT to recover.

As a result of BT's failures, Ofcom decided to fine the company £17,500,000.¹³¹

Ofcom have also opened two further investigations related to provision of 999 services in the past year:

- We have opened an investigation following Vonage's notification of an incident which resulted in disruption for its business customers to emergency call services between 23 October 2023 and 3 November 2023.¹³²
- We are investigating whether Gigaclear Limited (Gigaclear) failed to provide accurate and reliable caller location information to emergency organisations between January 2022 and March 2024.¹³³

¹³⁰ Ofcom, [Ofcom Investigation into BT following 999 emergency call service outage on 25 June 2023](#), 13 July 2023.

¹³¹ Ofcom, [BT fined £17.5ml for 999 call handling failures](#), 22 July 2024.

¹³² Ofcom, [Investigation into Vonage's compliance with emergency calls access rules](#), 19 March 2024.

¹³³ Ofcom, [Investigation into Gigaclear Limited's compliance with General Conditions A3.5 and A3.6\(a\)](#), 11 October 2024.

Extreme weather events and preparedness

This year there have been a number of named storms including Isha and Jocelyn in January 2024.^{134 135} Whilst these have not been as acute and widespread as storms in previous years, there was still a significant impact on the availability of telecoms services to customers.¹³⁶

It is crucial to continue the work with Government, industry, other regulators, and relevant bodies to understand necessary adaptations and transformations, as the frequency and severity of storms are likely to increase.¹³⁷ This is especially important in a world where our dependence on communications is only going to grow ever greater.¹³⁸

We are working with the Electronic Communications Resilience & Response Group (EC-RRG) to investigate potential options to improve the Ofcom incident reporting mechanisms for severe weather events.

Update on Power Backup for Mobile Radio Access Networks

Mobile networks are dependent on electrical power, and power outages can cause service disruption for mobile customers. In this year's reporting window (September 2023 to August 2024), the impact of power issues on mobile radio access networks was 12 million customer hours lost.

Mains power disconnections can impact mobile access networks. In severe cases, this can lead to outages affecting many mobile cell sites in an area at the same time, for several hours in some cases. This means that, unless overlapping coverage is available from mobile cell sites that are unaffected by a mains power outage, or the mobile mast has power back-up to provide power, customers on the relevant networks will be unable to use their phones for voice and data services until the power is restored.

As our reliance on mobile services grows, there has been an increasing focus and dependence on the resilience of mobile access networks. This year, we asked the four MNOs for an update on their power resilience capabilities at their mast sites. While the overall situation across the UK is broadly similar to that which we reported last year, some MNOs have increased the number of sites for which power backup is available. This new data suggests that around 20% of all mobile radio sites (i.e. across all MNOs) have some power back-up to maintain functionality at the RAN for more than 15mins, with around 5% of sites able to withstand a six-hour power loss (excluding battery back-up for transmission traffic).

Next Steps

Alongside the consultation on the revised Resilience Guidance covered earlier in this chapter, we published a call for input (CFI) on power backup for mobile radio access networks (RAN).¹³⁹ Our aim was to prompt a discussion about what power backup MNOs can and should provide for their networks and

¹³⁴ Met Office, [UK storm season, 2023/24](#).

¹³⁵ Shortly before the publication of this report there have been further named storms, including Storm Bert, at the beginning of the [UK storm season, 2024/25](#). We are still assessing the impact on the availability of telecoms services to customers and will update in our Connected Nations 2025 report.

¹³⁶ See for example, [Fibrus: Storm-damaged broadband repairs may take a week - BBC News, 24 January 2024](#).

¹³⁷ [Government resilience: extreme weather - NAO report](#)

¹³⁸ [Digital development strategy 2024 to 2030 - GOV.UK](#), 18 March 2024.

¹³⁹ Ofcom [Statement: Network and Service Resilience Guidance](#), 8 December 2023. Consultation on resilience guidance and mobile RAN power back-up responses.

services. We have published the responses to this CFI so interested parties can consider the views shared by respondents.

While the feedback showed strong interest in mobile resilience, some highlighted the need for a broader approach to power backup beyond the telecoms sector.¹⁴⁰ Additionally, responses offered valuable insights into potential harms from power outages, such as the effect on emergency services and communication difficulties, particularly in rural areas where communities could be more vulnerable to the impacts of outages.

We are analysing the information gathered to determine if additional resilience measures are needed for the mobile RAN. This analysis will consider a range of solutions, rather than a one-size-fits-all approach, and we plan to work with the UK Government and industry to identify the most suitable way forward.

¹⁴⁰ Ofcom, [Statement: Network and Service Resilience Guidance](#), 8 December 2023. Consultation on resilience guidance and mobile RAN power back-up responses.