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UK Home Broadband Performance

The performance of fixed-line broadband delivered to UK residential consumers

Published 21 October 2022

Welsh overview

Overview

Ofcom research published in our Communications Market Report 2022 shows that nearly nine in ten UK households (87%) take a home fixed broadband service. The widespread use of video streaming and other bandwidth-intensive services, along with growth in remote working following the Covid-19 pandemic, mean that people are demanding more of their broadband connections.

Good quality, reliable broadband connectivity is therefore an essential for most people in the UK; this report summarises our research to understand how these services are performing. The research is based on two main datasets: data collected by SamKnows Limited from its panel of volunteers who connect a hardware monitoring unit to their broadband router; and data provided to Ofcom by broadband providers.

What we have found

The increase in average home broadband connection speeds has continued. By March 2022 the median average download speed of UK home broadband connections was 59.4 Mbit/s, a 9.0 Mbit/s (18%) increase on the previous year, as people upgraded to faster services**.**

More than 90% of broadband homes take a superfast package. The proportion of home broadband connections that were superfast packages with an advertised download speed of 30 Mbit/s or higher was 91% in 2022, and 8% were ultrafast packages with advertised speeds of 300 Mbit/s or more.

The gap between average urban and rural speeds has widened following a sustained period during which it narrowed. During the 8-10pm peak-time period, there was a 58% difference between average urban (62.1 Mbit/s) and rural (39.4 Mbit/s) download speeds, up from 42% in 2021. While rural speeds increased, the rate of increase was lower than in urban areas where growth in the availability and take-up of faster cable and full-fibre services is higher.

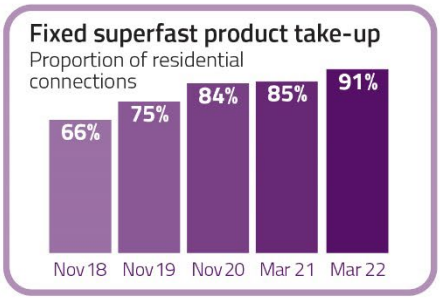
Upload speeds have also increased as homes upgrade to faster fibre and cable packages. Median average upload speeds increased by 9% to 10.7 Mbit/s in the year to March 2022.

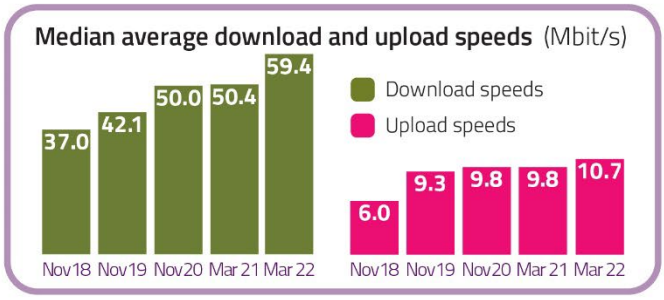
Cable and full-fibre lines recorded the highest speeds. Among the packages in the report, Virgin Media's 1.1 Gbit/s service had the fastest median average 24-hour download speed (1,137.5 Mbit/s) while TalkTalk's 500 Mbit/s full-fibre service had the highest median upload speed at 73.0 Mbit/s.

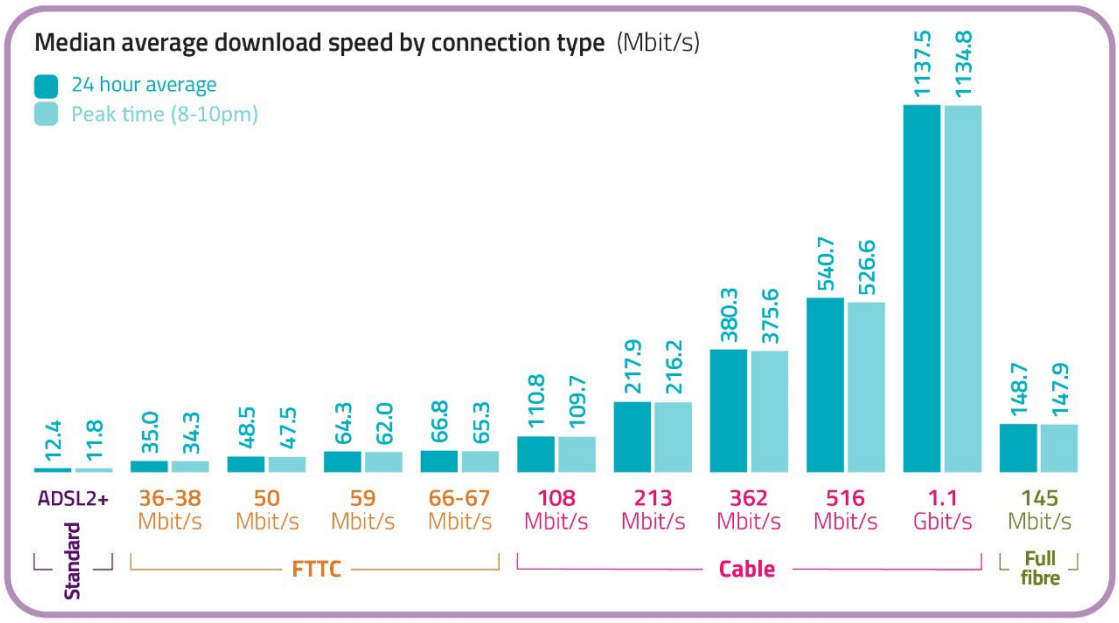
On average, 8-10pm peak period download speeds were 6% slower than average maximum speeds. Cable services with an advertised speed of 1.1 Gbit/s delivered the highest proportion of their average maximum or advertised speeds at peak times, at over 99%, and there was a noticeable reduction in cable network slowdown compared to 2021.

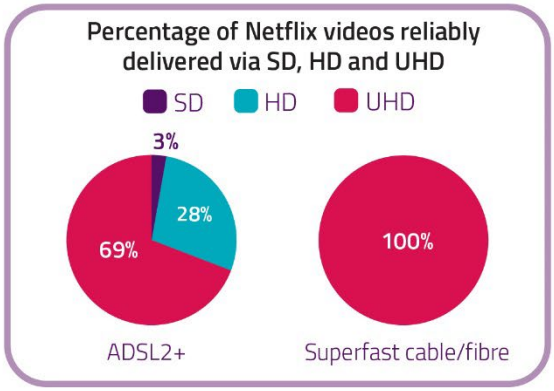
Performance varies by service and technology, but services using the same wholesale input tend to have similar performance. People can receive better performance by switching technology or moving to a higher service tier, but we find few differences between comparable services provided by companies such as BT, EE, Plusnet, Sky and TalkTalk, which use the same Openreach wholesale inputs.

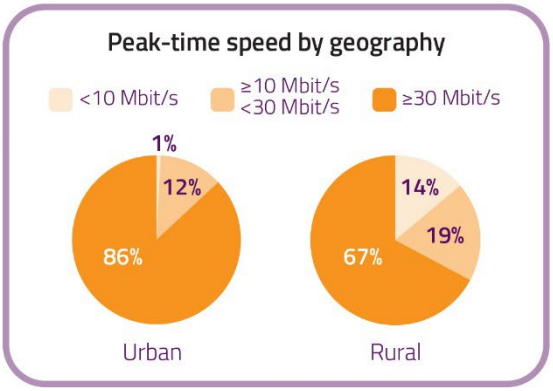
Dashboard


Fixed superfast product take-up
Proportion of residential connections
66%
75%
84%
85%
91%
Nov 18
Nov 19
Nov 20
Mar 21
Mar 22


Median average download and upload speeds (Mbit/s)
Download speeds
Upload speeds
37.0
42.1
50.0
50.4
59.4
6.0
9.3
9.8
9.8
10.7
Nov 18
Nov 19
Nov 20
Mar 21
Mar 22


Median average download speed by connection type (Mbit/s)
24 hour average
Peak time (8-10pm)
12.4
11.8
35.0
34.3
48.5
47.5
64.3
62.0
66.8
65.3
110.8
109.7
217.9
216.2
380.3
375.6
540.7
526.6
1137.5
1134.8
148.7
147.9
ADSL2+
36-38 Mbit/s
50 Mbit/s
59 Mbit/s
66-67 Mbit/s
108 Mbit/s
213 Mbit/s
362 Mbit/s
516 Mbit/s
1.1 Gbit/s
145 Mbit/s
Standard
FTTC
Cable
Full fibre


Percentage of Netflix videos reliably delivered via SD, HD and UHD
SD
HD
UHD
3%
28%
69%
100%
ADSL2+
Superfast cable/fibre


Peak-time speed by geography
<10 Mbit/s
≥10 Mbit/s <30 Mbit/s
≥30 Mbit/s
1%
12%
86%
14%
19%
67%
Urban
Rural

Notes on the data included in this report

Our methodology measures the performance delivered to the customer's router.

While this is a measure of the performance delivered by an internet service provider into a customer's home, the connectivity delivered to devices using a home's connection will vary, as it is affected by other factors not captured in our research. These include wifi performance, the quality of in-house wiring, in-house connection slowdown when more than one device is using the broadband connection, device limitations and the performance of servers delivering content over the connection. We have published advice on our website on how broadband users can improve their wifi experience, along with a broadband availability checker.

Further analysis of our March 2022 test results, including broadband provider package comparisons covering other aspects of broadband services that help determine the overall user experience, can be found in the interactive dashboard that accompanies this report.

There are alternative ways in which broadband performance can be measured. For example, our Connected Nations reports include analysis of broadband speeds based on information on the 'sync speed' or 'configured speed' of active broadband lines, which is provided to Ofcom by broadband providers. This approach measures the maximum connection speed achieved between the broadband provider's access network and the customer's premises, which is not affected by network slowdown and is usually higher than the 'end-to-end' actual line speed measurements we present here.

Embedded panel tests

One of the limitations of our hardware-based measurement methodology is that we can only include a package when we have enough volunteer panellists using it, and this can make it difficult to include services with lower take-up, including those using newer technologies such as full fibre.

In the past we have used data collected from internet service providers to supplement SamKnows' panel data. But this year we requested much larger datasets, covering March 2022, from the UK's four biggest providers and this report includes some of our initial analysis of this information.

BT and Virgin Media have SamKnows test firmware embedded into some of their routers, and Sky and TalkTalk have similar tests provided by another test provider (ASSIA Inc.) in some of their routers. These ISPs have given Ofcom access to anonymised March 2022 test data for upload speeds, download speeds and latency (where available) from some of these customers.

Ofcom benchmarking has confirmed that running the tests on a broadband provider's router rather than on one of SamKnows' 'whitebox' measurement units has little impact on the recorded measurements, although there are some differences which mean that like-for-like comparison is not always possible. As such, we have noted in the report where we have used data collected from tests embedded in the broadband provider's router.

We intend to adjust provider-embedded test data, to enable comparison between datasets, in our future Home Broadband Performance reports.

Most SamKnows whitebox measurement units will be connected to the panellist's broadband router using Gigabit Ethernet. Gigabit Ethernet can transmit data at a speed of 1Gbit/s but, because of packet overhead, the maximum speed at which data can be transferred over a Gigabit Ethernet interface is about 940 Mbit/s. This limits the maximum connection speed that can be accurately

measured over Gigabit Ethernet to around 940 Mbit/s. For this reason, we have been unable to include download speed data captured by SamKnows' whiteboxes relating to 1.1 Gbit/s cable services in this report and have instead used embedded test data provided to Ofcom by Virgin Media.

Mean and median averages

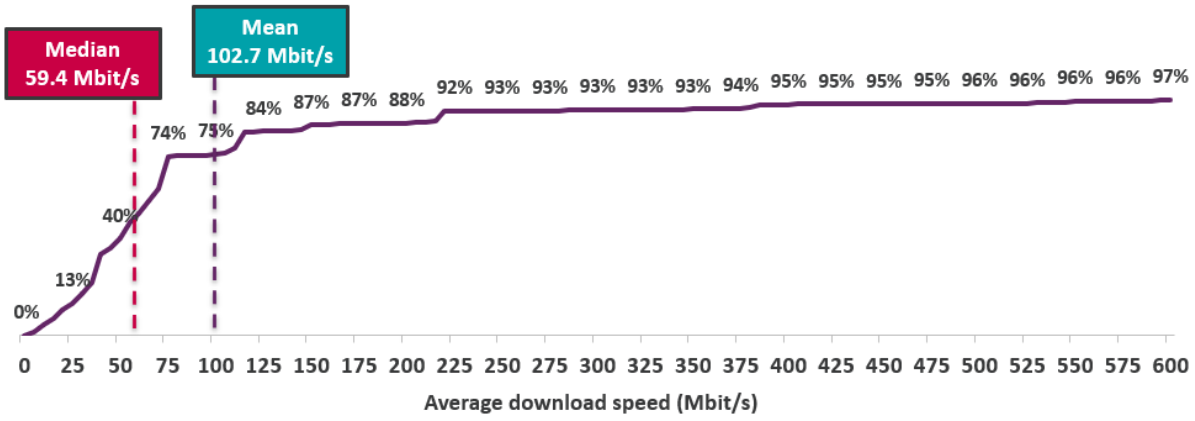
In our last Home Broadband Performance report (September 2021) we started using median averages (the middle value when a dataset is ordered from lowest to highest) rather than mean averages (calculated by adding all values in a dataset and then dividing by the number of values in that set) when analysing connection performance.

We continue to do so in this report, and the interactive dashboard that accompanies it shows both median average and mean averages where available (and appropriate).

Median averages more accurately reflect the experience of consumers, as average performance is not distorted by a comparatively small number of very fast connections. This approach is in line with the Advertising Standards Authority (ASA) and the Committee of Advertising Practice (CAP)'s guidance on broadband speed claims[1] and provides information that is more easily comparable to the speed claims that providers make in their advertising.

Figure 1 below shows the cumulative distribution of average 24-hour download speeds in March 2022. The median average actual download speed (59.4 Mbit/s) is significantly lower than the mean average speed (102.7 Mbit/s), as the mean is pulled up by a small proportion of lines with very fast connection speeds. We expect that the difference between the median and mean averages will continue to grow until the point when less than half of home broadband connections are provided using copper-based technologies, at which point it will start to narrow.

Figure 1: Cumulative distribution of download speeds: March 2022



Source: Ofcom, using data provided by SamKnows.

[1] CAP - Broadband speed claims Advertising Guidance 2018

Contents

Download speeds

Introduction

Download speeds matter because they determine how long it takes before information arrives on a user's device. Higher download speeds are particularly important for downloading large files, such as films or apps, or when streaming high-resolution video content. In this section we consider average UK download speeds and look at differences in performance between urban and rural areas of the UK.

The median average download speed was just under 60 Mbit/s in 2022

UK residential fixed broadband services recorded a median average 24-hour actual download speed of 59.4 Mbit/s in March 2022, a 9.0 Mbit/s (18%) increase compared to the previous year. The main cause of increasing average download speeds is a shift in the mix of connections as people upgrade to superfast, ultrafast and gigabit packages, rather than improvements in the performance of individual ISP packages. Our Connected Nations update: Summer 2022 shows that 70% of UK homes had access to ultrafast broadband offering actual download speeds of 300 Mbit/s or higher by May 2022 and 68% had access to network infrastructure capable of providing gigabit speeds of 1 Gbit/s or higher. This included 37% of homes which had access to full fibre services.

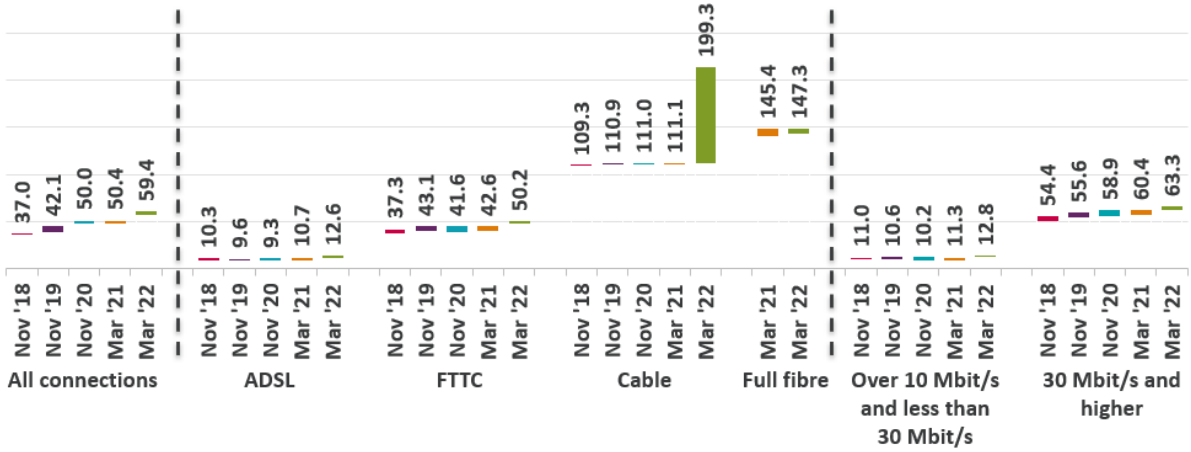
Cable connections had the largest increase in their median average download speed in the year to March 2022, up by 88.1 Mbit/s to 199.3 Mbit/s. This large increase is because cable customers have migrated to faster packages: in 2022 the median performance for cable services related to a service with an advertised speed of 213 Mbit/s, whereas in 2021 it related to a 108 Mbit/s service.

There was a smaller (7.6 Mbit/s) increase in the average download speed delivered by fibre-to-the-cabinet (FTTC) connections; this rose to 50.2 Mbit/s. This was partly due to the growing take-up of services that use G.fast technology, which offers advertised connection speeds that are more than double those of the very high-speed digital subscriber line (VDSL) technology which is used for most FTTC connections. The median average download speed delivered by full-fibre connections increased slightly to 147.3 Mbit/s during the year, while asymmetric digital subscriber line (ADSL) standard broadband connections had the lowest average download speeds across all the technologies (12.6 Mbit/s) despite having increased year-on-year.

The average download speed of standard broadband connections with an advertised speed greater than 10 Mbit/s and less than 30 Mbit/s increased by 13% to 12.8 Mbit/s in the year to March 2022. This reflects the ADSL performance increase outlined above, as most home broadband connections in this category are provided using ADSL technology. Average download speeds for superfast,

ultrafast and gigabit broadband products (those with an advertised speed of 30 Mbit/s or higher) also increased slightly during the year, up by 2.9 Mbit/s (5%) to 63.3 Mbit/s.

Figure 2: Median average actual broadband download speeds: 2018 to 2022 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [A] in the Sources Annex.
Notes: The chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists within our sample) falls within the ranges shown; data labels show the median average values; ADSL comprises ADSL1 and ADSL2+.

Over 90% of residential broadband lines are superfast products

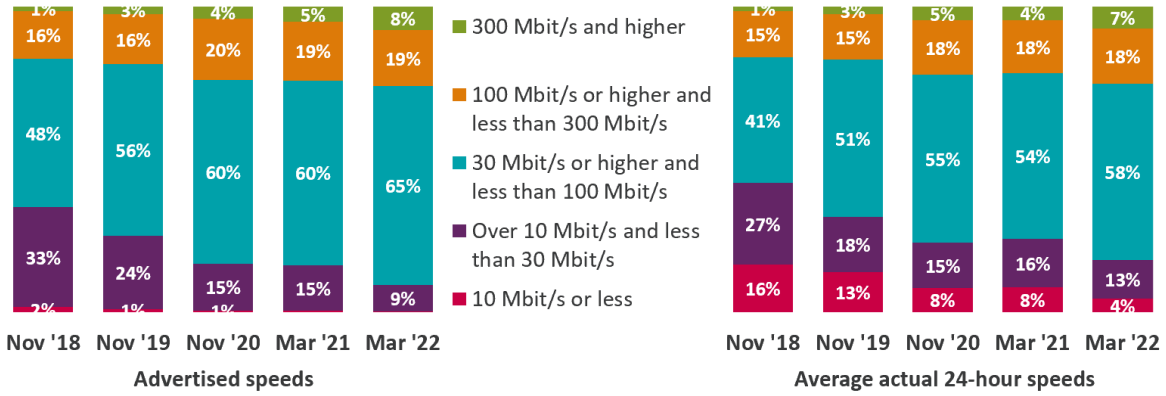
The proportion of home broadband lines that are superfast products with an advertised download speed of 30 Mbit/s or more increased from 85% to 91% in the year to March 2022 due to UK broadband users migrating to faster services. Over the same period, the proportion of lines with an advertised download speed of 300 Mbit/s or more increased from 5% to 8%.

The growing take-up of higher-bandwidth services is reflected in an increase in the actual connection speeds delivered. In the year to March 2022 the proportion of lines receiving a 24-hour average download speed of 30 Mbit/s or higher increased from 76% to 83%, while the proportion receiving an average actual 24-hour download speed of 300 Mbit/s or higher was 7%, up from 4% in March 2021.

Our data also shows that 4% of lines had an average 24-hour actual speed of under 10 Mbit/s, the minimum download speed required for a decent broadband connection as defined by the Government for the broadband universal service obligation (USO). This was despite less than 1% of lines being on packages with an advertised speed of less than 10 Mbit/s.

Most lines receiving download speeds of less than 10 Mbit/s will be ADSL connections that perform poorly: since March 2020, consumers who cannot receive a download speed of 10 Mbit/s and an upload speed of 1 Mbit/s have been able to request an upgraded connection under the broadband USO.

Figure 3: Distribution of UK residential broadband lines, by advertised and 24-hour average actual speeds: 2018 to 2022



Source: Ofcom / operators and Ofcom, using data provided by SamKnows; see note [B] in the Sources Annex.

Rural ADSL2+ lines are slower than urban ones

A characteristic of the technologies used to deliver ADSL and FTTC broadband is that connection speeds slow down due to attenuation (signal loss) in the copper over which data travels.

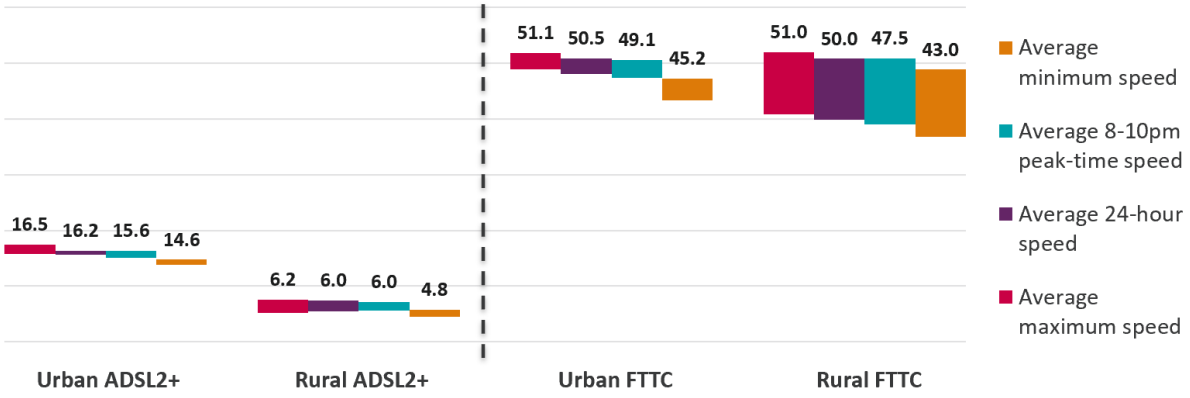
With ADSL, data travels over copper all the way from the local exchange to the end-user's premises, while in FTTC deployments copper is used only from the street cabinet to the end-user's premises. As population density is higher in urban areas than rural areas, urban ADSL lines tend to be shorter than those in rural areas and urban ADSL lines tend to perform better than those in rural areas.

We have used a new weighting methodology when calculating the March 2022 urban and rural performance information shown in this report. While this results in more accurate figures, it means that the ADSL2+ and FTTC numbers shown in the chart below are not directly comparable to those published in previous Home Broadband Performance reports. More details can be found in this report's Statistical Annex.

For ADSL2+ connections (which make up over 95% of all ADSL lines), the median average 24-hour download speed in urban areas (16.2 Mbit/s) was more than double the 6.0 Mbit/s average in rural areas in March 2022.

There is less variation in the length of copper line from the street cabinet to the user's premises and therefore a smaller difference in performance for FTTC. Our data shows that the average rural 24-hour FTTC download speed (50.0 Mbit/s) was in line with the 50.5 Mbit/s recorded in urban areas in March 2022. Average rural FTTC download speeds were around eight times faster than average rural ADSL2+ download speeds in March 2022, indicating that most rural ADSL customers who upgrade to an FTTC service will experience a significantly improved user experience.

Figure 4: Median average ADSL2+ and FTTC download speeds, by rurality: March 2022 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [C] in the Sources Annex.
Notes: The chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists within our sample) falls within the ranges shown; data labels show the median average values.

The gap between rural and urban download speeds has widened

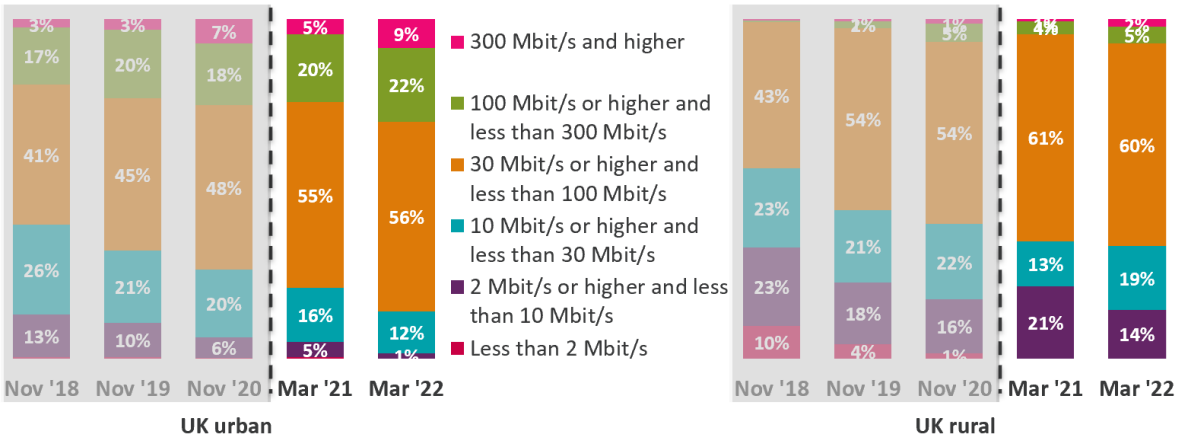
The new weighting methodology mentioned earlier has been used to calculate the March 2022 urban and rural download speed distributions shown in the chart below and has been retrospectively applied to calculate the March 2021 data. This means that the March 2021 data below differ from that in the last Home Broadband Performance report. The new methodology (which is outlined in the Statistical Annex of this report) results in more accurate figures but means that data relating to March 2021 and 2022 are not directly comparable to those for earlier periods.

The gap between urban and rural 8-10pm peak-time home broadband download speeds performance has widened due to growth in the availability and take-up of superfast, ultrafast and gigabit services being higher in urban areas of the UK than rural ones. This follows a prolonged period during which the difference in download speeds was narrowing.

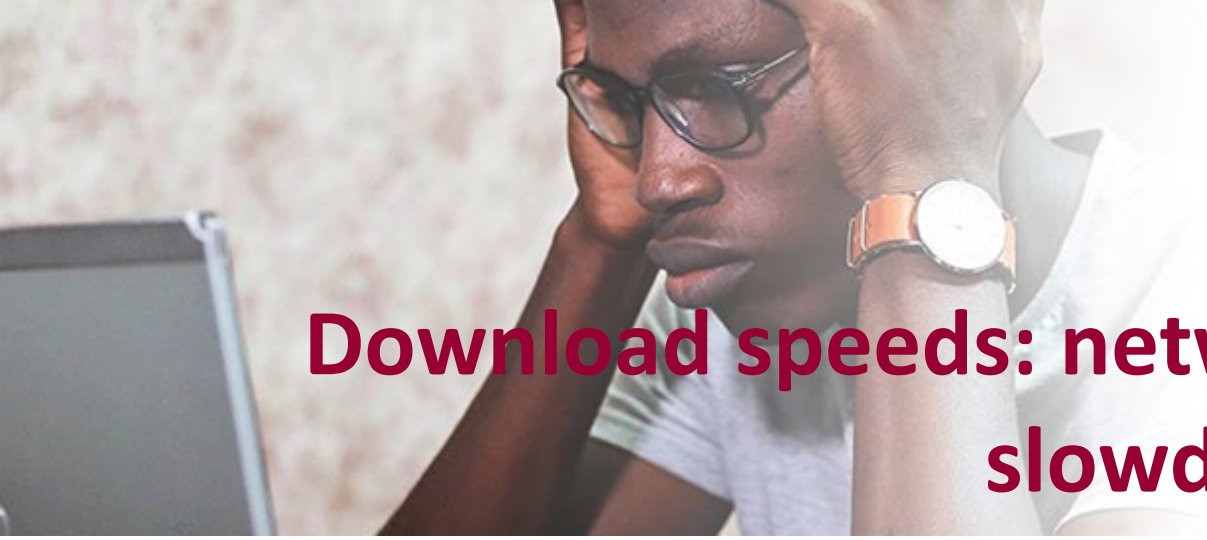
Our data shows that there was a 22.7 Mbit/s (58%) difference between the median average peak-time download speeds in urban (62.1 Mbit/s) and rural (39.4 Mbit/s) areas of the UK in March 2022. This compares to a 15.6 Mbit/s (42%) difference) in March 2021, when average urban and urban peak-time speeds were 52.7 Mbit/s and 37.1 Mbit/s respectively. However, rural speeds are increasing, just not as quickly as in urban areas where growth in the availability and take-up of ultrafast and gigabit cable and full fibre services is higher.

In March 2022 there was a 19 percentage point (pp) difference between the proportion of urban (86%) and rural (67%) lines with an average evening peak-time speed of 30 Mbit/s or higher in March 2022. This was higher than the 14pp difference recorded in March 2021. Conversely, the 13pp difference between the March 2022 proportions of urban (1%) and rural (14%) broadband lines with an average 8-10pm peak-time actual download speed of less than 10 Mbit/s was lower than the 16pp difference in March 2021 (when the respective urban and rural figures were 5% and 21%).

Figure 5: Distribution of average 8-10pm peak-time home broadband download speeds, by rurality: 2018 to 2022



Source: Ofcom, using data provided by SamKnows; see note [D] in the Sources Annex.
Note: Figures relating to March 2021 and March 2022 are not directly comparable to those for previous periods due to a methodological change: see the Statistical Annex for more details.



Download speeds: network slowdown

Introduction

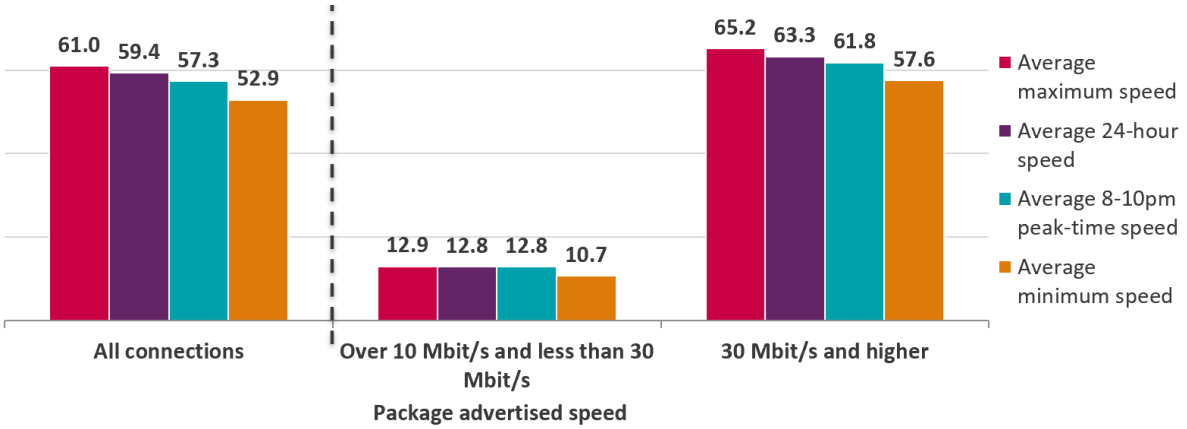
Average download speeds tend to fall during busy periods when broadband networks suffer the effects of network congestion (contention). In this section we look at the impact this has on download speeds throughout the day.

Download speeds fall at busy times due to network congestion

Our research shows that across all connections the average 8-10pm peak-time speed (57.3 Mbit/s) was 94% of the 61.0 Mbit/s average maximum speed, and the average daily minimum speed (52.9 Mbit/s) was 87% of the average maximum speed.

The proportional impact of network slowdown on measured speeds was greater on slower lines than on faster ones. Fibre and cable lines with advertised speeds of 30 Mbit/s or more received average minimum speeds that were 88% of their average maximum speed, compared to 83% for lines with an advertised download speed of above 10 Mbit/s and less than 30 Mbit/s (which are mainly ADSL2+ lines).

Figure 6: Median average UK broadband download speeds, by time of day: March 2022 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [A] in the Sources Annex.

Full-fibre and cable connections have less variation in performance than ADSL2+

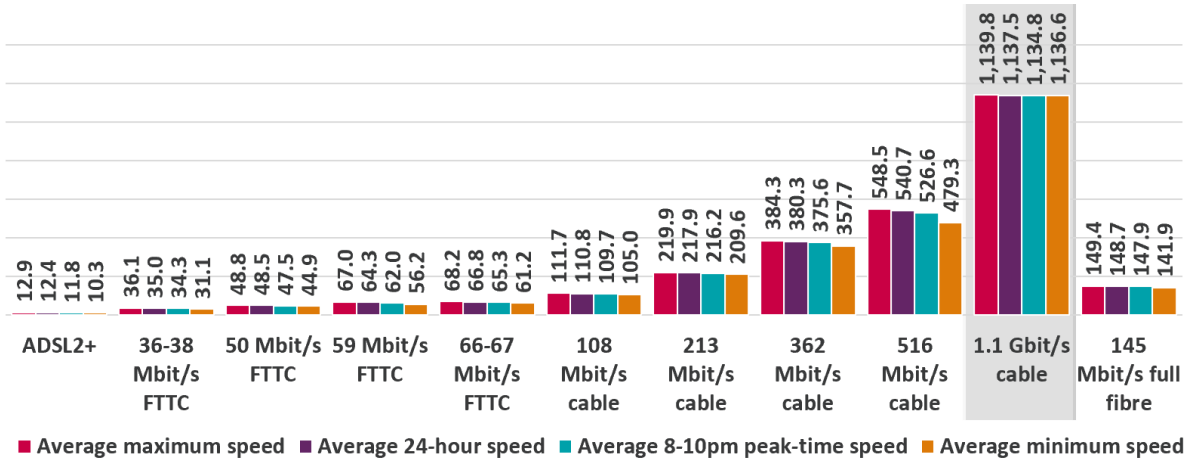
There are two main reasons why home broadband connections do not always provide their maximum or headline (advertised) speed:

- For copper-based technologies such as ADSL, VDSL and G.fast, the maximum speed that a line can support is dependent on the length and quality of the copper line from the end-user's home to the local exchange (for ADSL) or street cabinet (for VDSL and G.fast). This means that the lines to some premises will never support the service's advertised speed (although under the Voluntary Codes of Practice on Better Broadband Speeds, broadband providers must provide an estimate of the speed that the line can support before purchase).
- The actual speeds of all connection types tend to fall when broadband providers' networks are busy. The variation in speeds at peak times is often higher in cable connections due to network congestion occurring nearer to the customer, making it harder to add the additional network capacity required to reduce the effects of congestion.

For 36-38 Mbit/s, 50 Mbit/s, 59 Mbit/s and 66-67 Mbit/s FTTC services, peak-time download speeds averaged between 93% and 97% of their average maximum download speeds in March 2022. Similarly, among 108 Mbit/s, 213 Mbit/s, 362 Mbit/s and 516 Mbit/s cable services, average 8-10pm peak-time download speeds were between 96% and 98% of maximum speeds.

For customers taking 145 Mbit/s full-fibre packages, average 8-10pm peak-time speeds were more than 99% of average maximum speeds. For ADSL2+ services, peak-time download speeds averaged 92% of maximum speeds.

Figure 7: Variations in download speeds, by time of day: March 2022 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [E] in the Sources Annex.
Note: For the reasons outlined on pages 3-4 of this report, data for 1.1Gbit/s cable connections is taken from embedded test data. Caution should therefore be taken when comparing the performance of these connections to those of other package types.

Reduction in cable broadband slowdown during busy periods

Another way to measure network slowdown during busy periods is to compare the average minimum and maximum speeds for a broadband service, our assumption being that the primary reason for any differences between the two is network congestion.

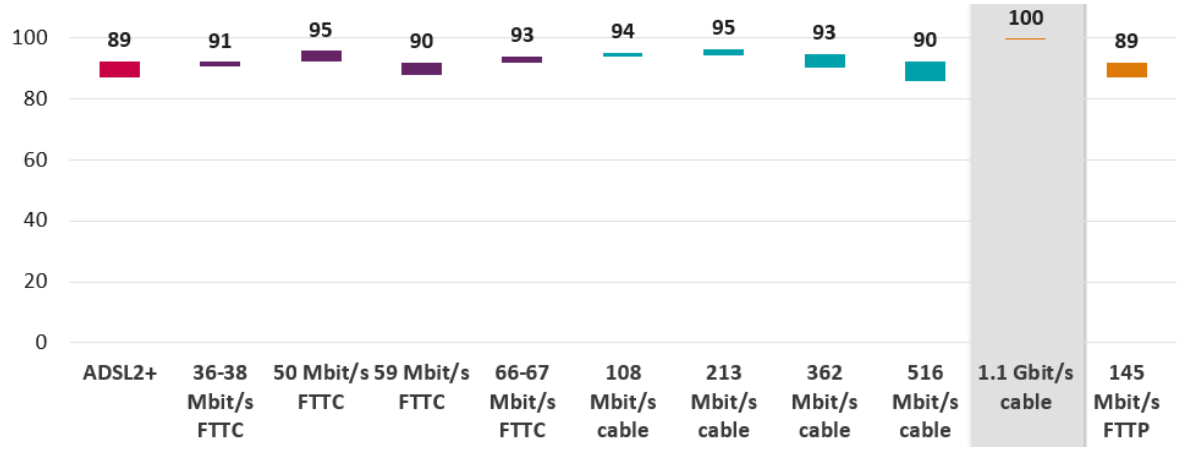
The proportions shown below are not comparable to those that would be derived from Figure 7 above. The values in Figure 7 show the median average minimum speed for each connection type as a proportion of the median average maximum speed for that connection type. This represents the variation in performance across the package category overall but does not necessarily show the difference between minimum and maximum speeds that an individual line can expect to achieve.

The values in Figure 8, conversely, are calculated as the median average of the ratios of minimum over maximum speeds for each individual panellist in a package category. This more accurately shows the average variation in download speeds that an individual line can expect to achieve. We use the advertised speed in this calculation where the average maximum speed is higher than the advertised speed to ensure than performance above what the customer might expect does not result in a package type appearing to perform less well in this analysis.

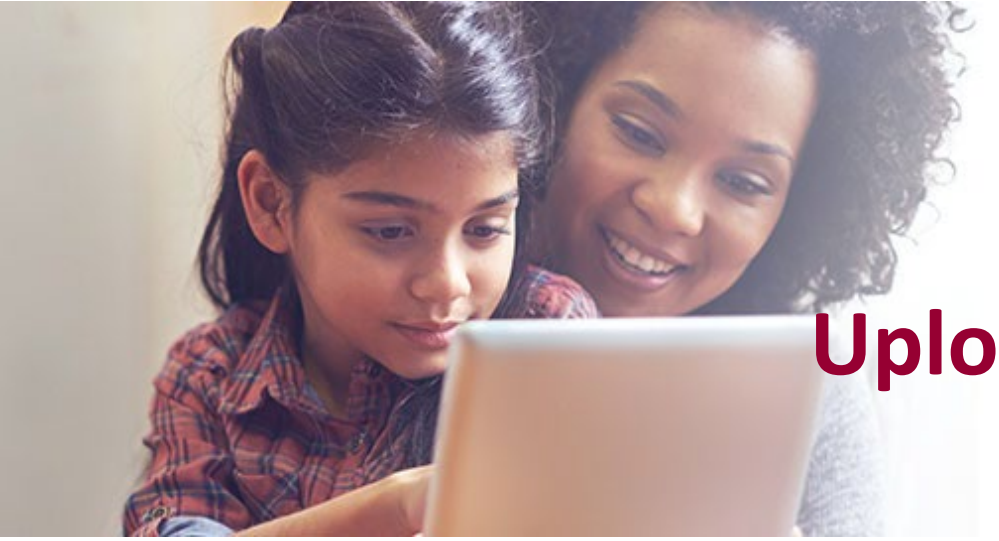
Our analysis shows that all of the line types we included in our analysis had a median average minimum speed that was over 90% of their average maximum speed except ADSL2+, 516 Mbit/s cable and 145 Mbit/s full-fibre connections (all above 89%). Cable services with an advertised speed of 1.1 Gbit/s delivered minimum speeds that were over 99% of their maximum speeds, the highest proportion among the package types we looked at.

There was a notable improvement since last year in the performance of the cable packages included in the analysis, with average minimum speeds for 108 Mbit/s, 213 Mbit/s, 362 Mbit/s and 516 Mbit/s cable packages ranging from 90% to 95% of average maximum speeds in March 2022. This compared to a range from 68% to 92% for the same packages in March 2021, suggesting that Virgin Media has invested in adding capacity to its network in the intervening period.

Figure 8: Median minimum speed as proportion of maximum: March 2022 (%)



Source: Ofcom, using data provided by SamKnows; see note [F] in the Sources Annex.
Notes: The chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists in our sample) will fall within the ranges shown; data labels show the median average values; for the reasons outlined on pages 3-4 of this report, data for 1.1Gbit/s cable connections is taken from embedded test data. Caution should therefore be taken when comparing the performance of these connections to those of other package types.



Upload speeds

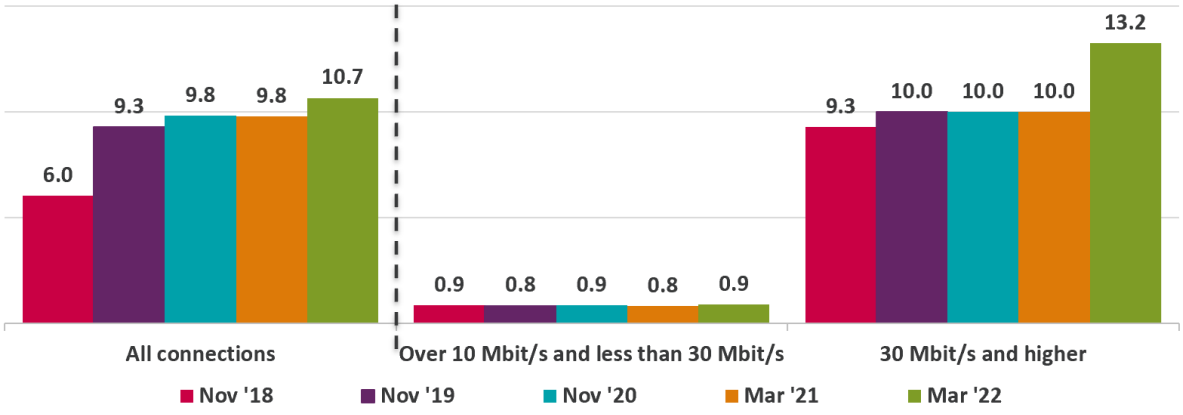
Introduction

Upload speeds are important to users who use real-time video communication services, upload or share files or engage in online gaming.

Average UK upload speeds were over 10 Mbit/s in 2022

Analysis of SamKnows whitebox data suggests that the median average upload speed of UK residential home broadband services increased by 0.9 Mbit/s (9%) to 10.7 Mbit/s in the 12 months to March 2022. The main reasons for this increase were a 3.2 Mbit/s (32%) increase in the median average upload speed of superfast broadband products (those with an advertised download speed of 30 Mbit/s or higher) and growing take-up of these services.

Figure 9: Median average UK fixed broadband upload speeds (Mbit/s): 2018 to 2022



Source: Ofcom, using data provided by SamKnows; see note [G] in the Sources Annex.
Notes: The chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists within our sample) falls within the ranges shown; data labels show the median average values.

Netflix streaming and disconnections

Introduction

Video streaming requires a reliable connection, and higher connection speeds enable better-quality video to be delivered with fewer buffering events. Disconnections can be inconvenient and frustrating as users cannot undertake online activities when their internet service loses connectivity.

Most broadband connections can deliver Netflix in UHD

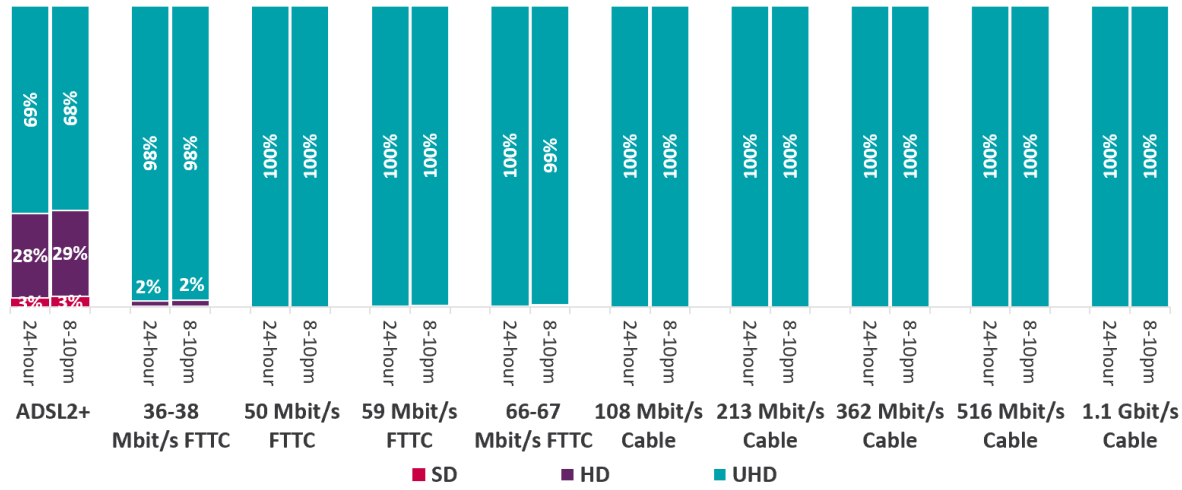
Streaming video content is one of the most bandwidth-hungry activities that people use their home broadband connections for, and our Media Nations 2022 report shows that 67% of homes took a subscription video-on-demand (SVoD) service in Q2 2022. To understand how well various home broadband services handle the streaming of video content, we measured the streaming performance of broadband connections when accessing content from Netflix, the UK's most popular SVoD service, used by 60% of UK homes in 2022.

The chart below shows the proportion of Netflix video streams that were delivered in the most commonly available resolutions – ultra-high definition (UHD), high definition (HD) and standard definition (SD) – for each connection type. These results represent use when one piece of content is being streamed from Netflix over a broadband connection: the streaming quality may drop when multiple users are simultaneously using the same connection. HD and UHD resolutions are only available to people taking Netflix's higher-tier plans and some content is not available in higher resolutions.

About 70% of ADSL2+ Netflix streams were reliably delivered at UHD resolution in March 2022, a marked improvement since 2021, when two-thirds of ADSL2+ streams were delivered in (lower) HD quality. The higher ADSL2+ download speeds noted previously in this report are unlikely to account for all of this change, and it is likely that improvements to Netflix's video compression technology is also a contributing factor. In 2022, around 30% of ADSL2+ streams were delivered in HD, with a further 3% in SD). ADSL2+ may therefore be sufficient to meet the current broadband requirements of some smaller households.

Almost all superfast fibre and cable products (those with an advertised speed of 30 Mbit/s or higher) were able to reliably deliver Netflix streams in UHD, both during the 24-hour period and at peak times.

Figure 10: Proportion of Netflix videos reliably delivered at the given video quality, over 24 hours and at peak times, by technology: March 2022



Source: Ofcom, using data provided by SamKnows; see note [H] in the Sources Annex.

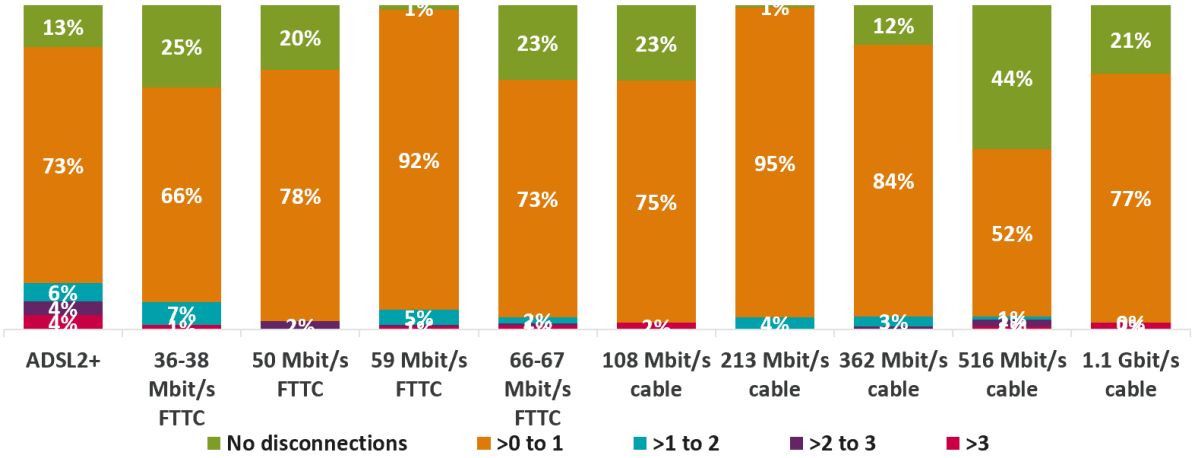
ADSL2+ connections have more disconnections than other technologies

To help understand how frequently disconnections occur, we look at the average daily number of disconnections of 30 seconds or longer. Not all the disconnections recorded are due to network issues: for example, a panellist rebooting their router, or network downtime during quiet hours for ISP network maintenance or upgrades, would be classified as disconnection events by our tests.

The proportion of 516 Mbit/s cable connections without any disconnection events in March 2022 (44%) was higher than for the other package types included in the analysis. Panellists using ADSL2+ tended to experience disconnections more frequently than those with cable or fibre packages and had the highest proportion of lines with an average of more than two daily disconnections of 30 seconds or longer in March 2022 (9%). This was almost three times as high as the proportion for any of the other connection types included in the analysis.

Some broadband providers have started to offer home broadband services with a cellular back-up, whereby the router switches to a mobile connection if the fixed broadband network is unavailable. This ensures that the user can continue to use their broadband connection with little or no interruption.

Figure 11: Distribution of average daily disconnections of 30 seconds or longer: March 2022



Source: Ofcom, using data provided by SamKnows; see note [I] in the Sources Annex.
Note: In some cases, testing may record scheduled maintenance as being a disconnection event.

Broadband package comparisons

Introduction

In this section we look at average upload speeds, download speeds and latency (delay) for several popular superfast and ultrafast broadband packages. Connection speed is one of many factors that determines the home broadband user experience, although as average speeds increase, speed becomes less of a limit to performance and other metrics such as latency (delay) and packet loss (when data fails to reach its destination) become more important.

The interactive dashboard that accompanies this narrative report includes package comparisons over a much wider range of metrics, along with tables showing whether any apparent differences in performance are statistically significant or not.

Virgin Media's 1.1 Gbit/s service had the highest average download speed among the packages we looked at

In this section we have supplemented SamKnows whitebox data with embedded test data provided by broadband providers where there were insufficient panellists or the whitebox measurements did not fully capture the performance of a package. Grey highlighted bars in this section indicate that the data for a package has been wholly derived from provider embedded test data and caution should be taken when comparing the performance of these services to that of other packages.

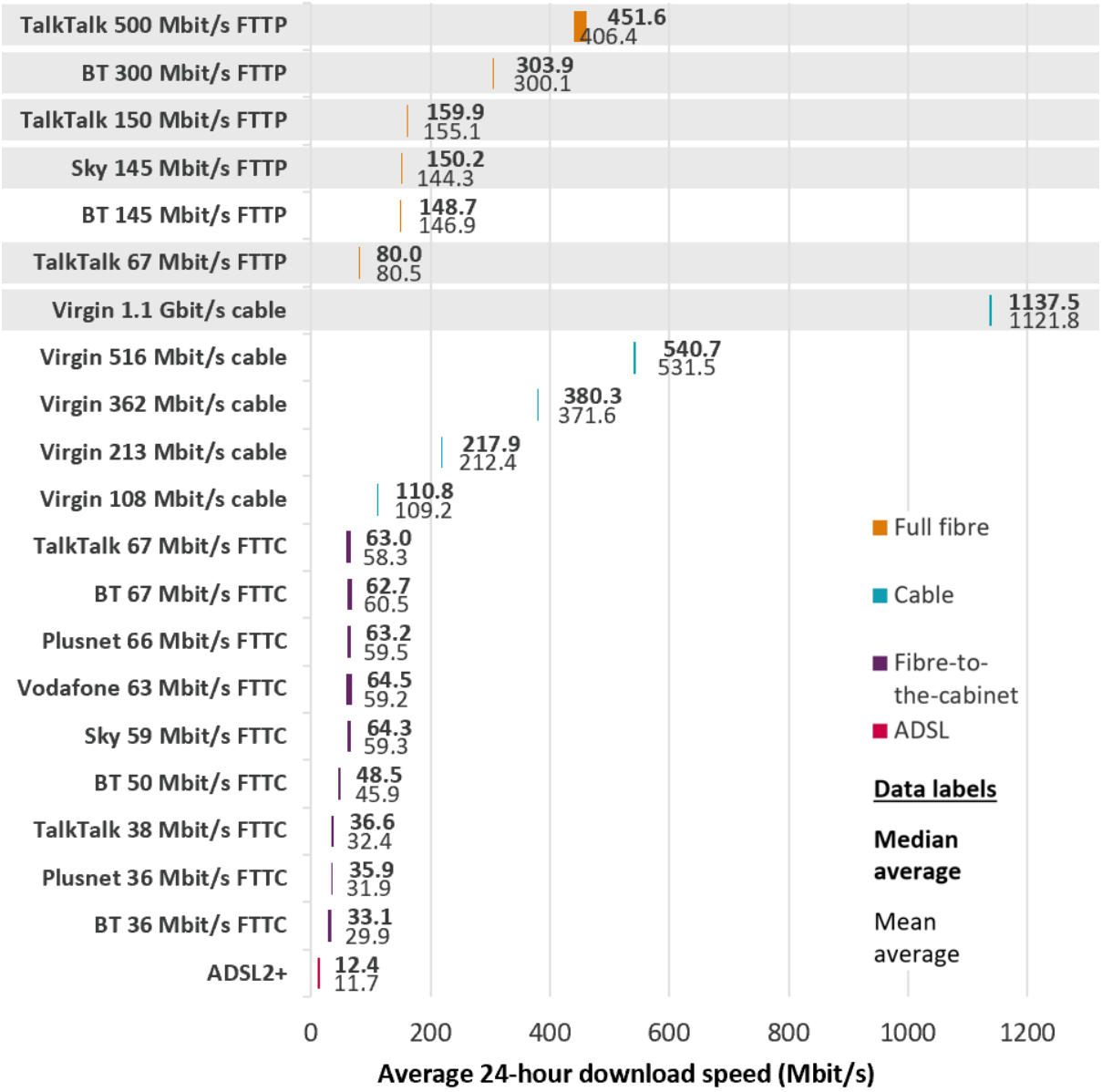
Virgin Media's 1.1 Gbit/s service recorded the highest median and mean average 24-hour download speeds among the packages included in our March 2022 analysis, at 1,137.5 Mbit/s and 1,121.8 Mbit/s respectively.

While our analysis shows that half of Virgin Media 1.1 Gbit/s cable customers will receive a download speed of 1,137.5 Mbit/s (the median average) or more, the lower mean average indicates that some customers may receive average download speeds that are considerably lower than the median. The same was true for the third-fastest service included in our analysis, TalkTalk's 500 Mbit/s full-fibre service.

BT's 300 Mbit/s full-fibre package's median and mean average download speed results (303.9 Mbit/s and 300.1 Mbit/s respectively) were closer to each other, suggesting that these users experience greater consistency in the download speeds that they receive.

This is explored in more detail in the 'Performance variation (ISP)' section of the accompanying interactive dashboard.

Figure 12: Average 24-hour download speeds, by broadband package: March 2022 (Mbit/s)



Source: Ofcom, using data provided by SamKnows and ISP-provided embedded test data; see note [J] in the Sources Annex.
Note: Many other ISP packages are available, some of which may match or better the performance of those included in the analysis above; the chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists in our sample) falls within the ranges shown; grey bars indicate that the data for a package has been wholly derived from provider embedded test data and caution should be taken when comparing the performance of these services to that of other packages.

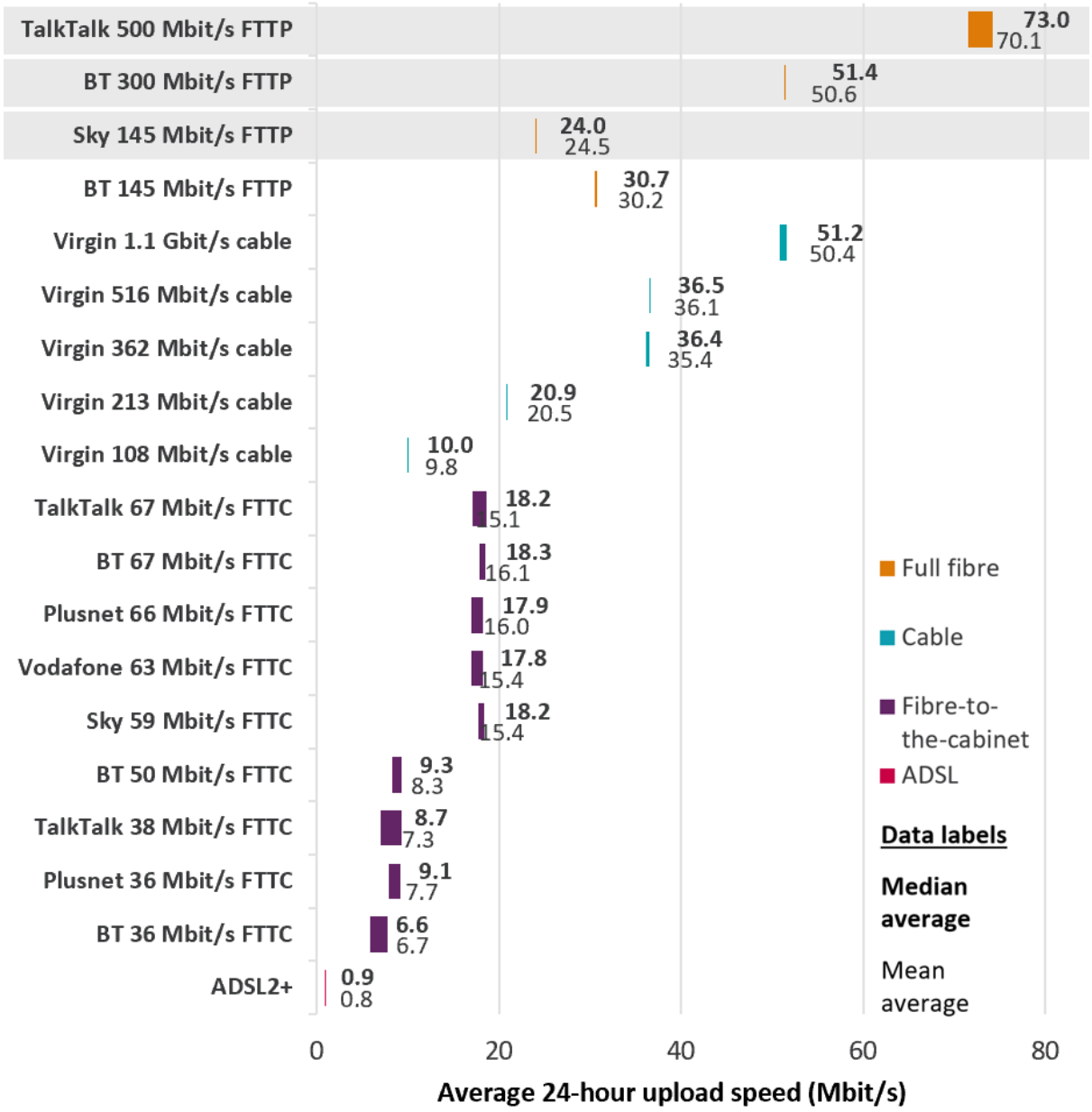
TalkTalk's 500 Mbit/s full-fibre service recorded the highest average upload speed

Among the packages included in the analysis shown below, TalkTalk's 500 Mbit/s full-fibre service had the highest median and mean average upload speeds, at 73.0 Mbit/s and 70.1 Mbit/s respectively. Virgin Media's 1.1 Gbit/s cable service, which provided the fastest download speeds,

and BT's 300 Mbit/s full fibre service offered almost identical mean and median upload speeds at just over 50 Mbit/s.

Our analysis shows that, on average, an ADSL2+ user who upgrades to a basic tier 36-38 Mbit/s FTTC service will benefit from a nine-fold increase in upload speed from 0.9 Mbit/s to over 8 Mbit/s, in addition to a tripling of their download speed.

Figure 13: Average 24-hour upload speeds, by broadband package: March 2022 (Mbit/s)



Source: Ofcom, using data provided by SamKnows and ISP-provided embedded test data; see note [J] in the Sources Annex.

Note: Many other ISP packages are available, some of which may match or better the performance of those included in the analysis above; the chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists in our sample) falls within the ranges shown; grey bars indicate that the data for a package has been wholly derived from provider embedded test data and caution should be taken when comparing the performance of these services to that of other packages.

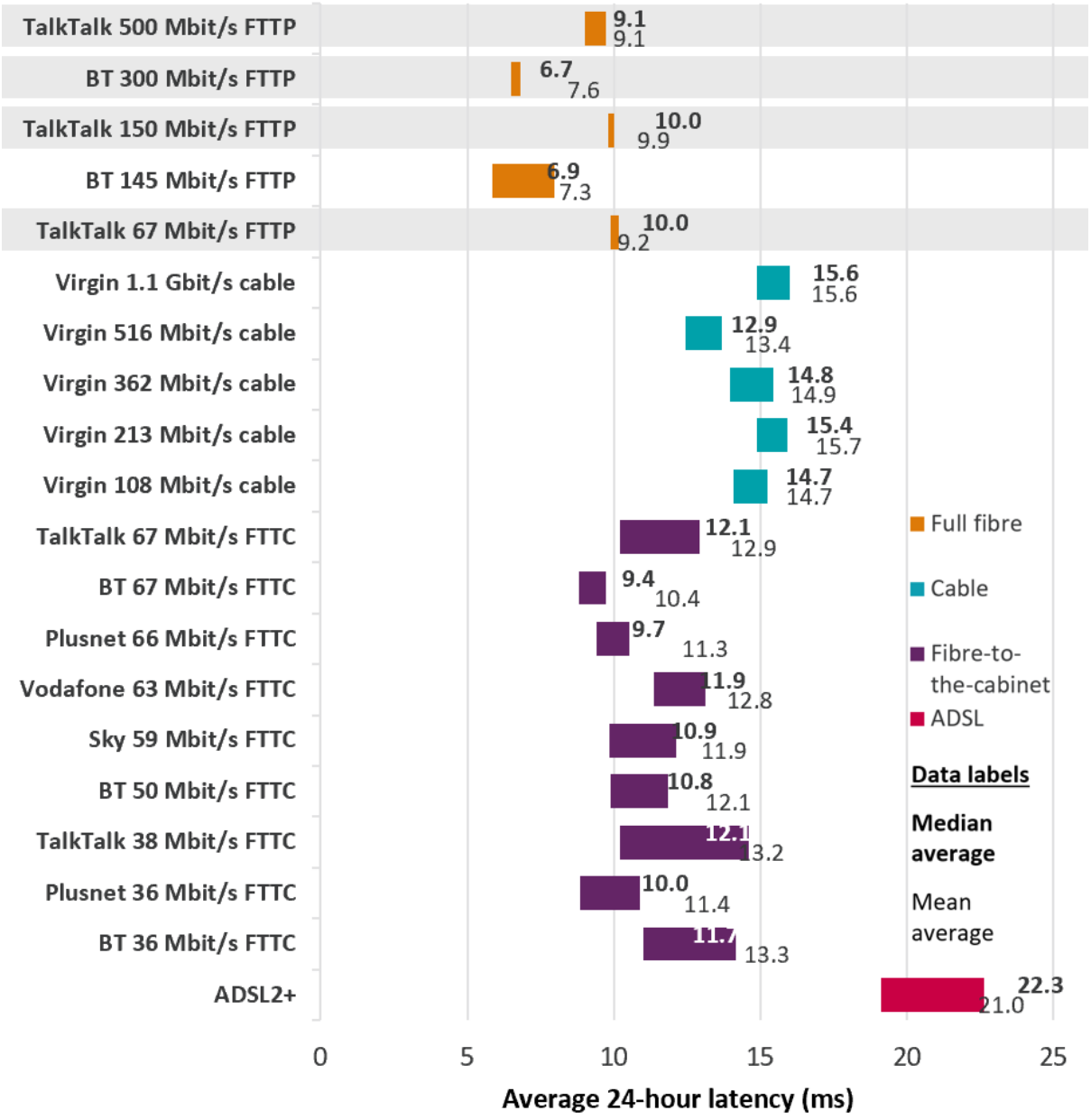
BT's 145 Mbit/s and 300 Mbit/s full-fibre services had the lowest connection delay

Latency (or delay) is the time it takes for a packet of data to travel to a third-party server and back. A connection with low latency will feel more responsive for simple tasks like web browsing, and certain real-time applications such as video-calling and online gaming perform far better with lower latency. Most online activities require a response time of less than 100ms to provide a good experience, although some online gaming apps require a response time of less than 50ms.

Of the packages included in our research, BT's 300 Mbit/s and 145 Mbit/s full-fibre services had the lowest median average 24-hour latency values, averaging just under 7ms. In general, the FTTC packages included in the comparisons had similar or higher average latency values to the full-fibre packages, and latency similar to or lower than Virgin Media's cable services.

ADSL2+ lines recorded the highest latency across all the technologies tested, but these averaged only around 22ms, a level at which latency is unlikely to adversely affect the user-experience.

Figure 14: Average 24-hour latency, by broadband package: March 2022 (ms, lower is better)



Source: Ofcom, using data provided by SamKnows and ISP-provided embedded test data ; see note [J] in the Sources Annex.

Note: Many other ISP packages are available, some of which may match or better the performance of those included in the analysis above; the chart bars show that there is a 95% probability that the median average latency for all customers (i.e. not just the customer panellists in our sample) falls within the ranges shown; grey bars indicate that the data for a package has been wholly derived from provider embedded test data and caution should be taken when comparing the performance of these services to that of other packages.

Geographic comparisons

Introduction

As router processing power has improved, it has become possible for internet providers to run performance tests similar to those run by SamKnows' whitebox measurement units from their broadband routers. This allows them to monitor network performance and help ensure that any connection speed information provided to customers buying broadband services under the Voluntary Codes of Practice on Better Broadband Speeds is accurate.

We have requested some of this 'embedded' test data from internet providers for the first time, and this section includes some of our initial analysis of data provided to Ofcom by BT, Virgin Media, Sky and TalkTalk. The interactive dashboard that accompanies this narrative report includes further analysis of this data.

We set out to understand how performance varies across the UK nations and English regions

BT and Virgin Media have SamKnows tests embedded into some of their broadband routers, while Sky and TalkTalk run similar tests provided by another provider, ASSIA, in some of their routers. Ofcom requested test data from these broadband providers covering upload speed, download speed and latency test data (where available) and each ISP provided March 2022 data taken from a sample of around 40,000 to 50,000 customers with embedded testing activated. This data was anonymised so that no individual customers could be identified.

Each provider's sample included performance data relating to customers distributed across the UK and using all of the packages that they offer. However, these samples were not designed to be representative of package take-up in each UK nation and English region, so it is not possible to draw conclusions regarding overall (average) performance in different areas of the UK. Having undertaken benchmarking of SamKnows and ASSIA test results against SamKnows' whitebox measurements, we found that while the results were broadly consistent and typically very similar (i.e. within a few per cent) there were some differences that mean that like-for-like ISP package comparisons are not possible at this stage.

Using this embedded test data, we set out to understand how different broadband packages/ package types perform across the various areas of the UK. The limitations listed above, along with the fact that we have compared the data as received from the ISPs and have not weighted it to consider differing customer base sizes, mean that the analysis here is only indicative, but it allows us to draw some interesting conclusions regarding geographic performance variations.

We have looked at the performance of higher-speed services using the most frequently used broadband technologies in the UK:

- second-generation ADSL (ADSL2+) services;
- higher-tier VDSL services, i.e. those provided using Openreach's 80:20 (80 Mbit/s downstream and 20 Mbit/s upstream) wholesale service, which are typically sold with an advertised download speed of 63-67 Mbit/s; and
- 500 Mbit/s full-fibre services.

To do this, we used the performance data recorded during the 8-10pm peak-time period, as not all of the internet providers from which Ofcom received embedded test data run tests throughout the day. These results may differ from those highlighted elsewhere in the report, due to the data being taken from a different source and for the reasons highlighted above. The results are calculated using test data collected from a minimum of 50 units for each package type in each UK nation/English region.

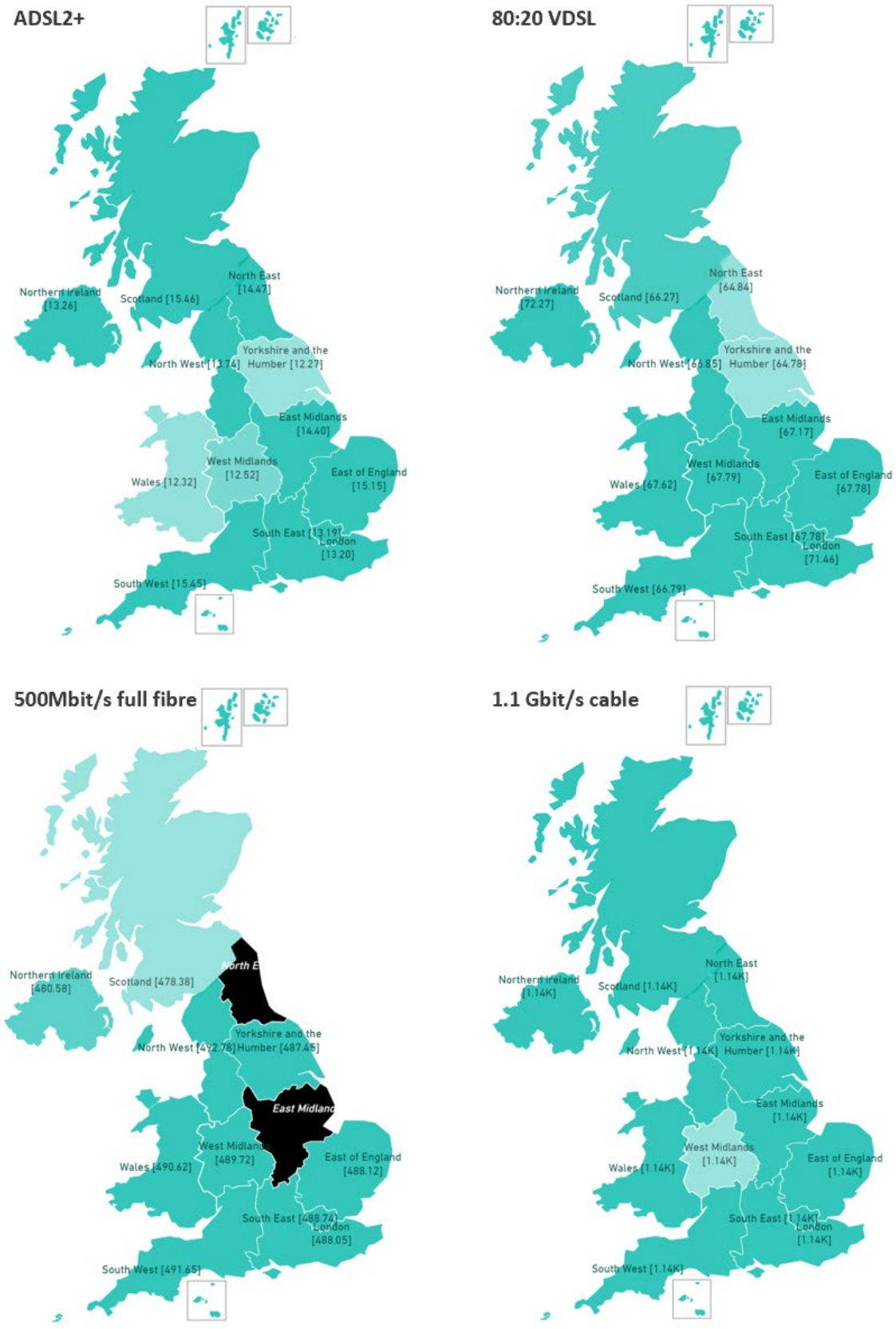
Details regarding the performance of other package types are included in the interactive dashboard that accompanies this report.

Northern Ireland recorded the highest median average download speed for 80:20 VDSL services

Our analysis showed that across the UK nations and English regions, median average peak-time download speeds for ADSL2+ broadband services ranged from 12.3 Mbit/s in Yorkshire and the Humber to 15.5 Mbit/s in Scotland. As we would expect, the 21% difference between the highest and lowest averages was larger than that found for 80:20 VDSL services, where there was a 10% difference between the 64.8 Mbit/s lowest and the 72.3 Mbit/s highest average peak-time download speeds recorded across the UK nations and English regions (in Yorkshire and the Humber and Northern Ireland respectively). This is due to the shorter copper line length over which data travels over VDSL compared to ADSL.

For 500 Mbit/s full-fibre services, median average peak-time speeds ranged from 478.4 Mbit/s in Scotland to 492.8 Mbit/s in the North-West of England. The 3% difference in these values was higher than the less than 1% difference for 1.1 Gbit/s cable services (where average speeds were lowest at 1,137.5 Mbit/s in the West Midlands and highest in the North-East of England at 1,142.4 Mbit/s). This was unexpected; typically, we would expect to see more variation in performance in cable networks than in full-fibre deployments due to the greater impact of network congestion.

Figure 15: Average 8-10pm peak-time download speeds for selected package types, by UK nation and English region: March 2022 (Mbit/s)



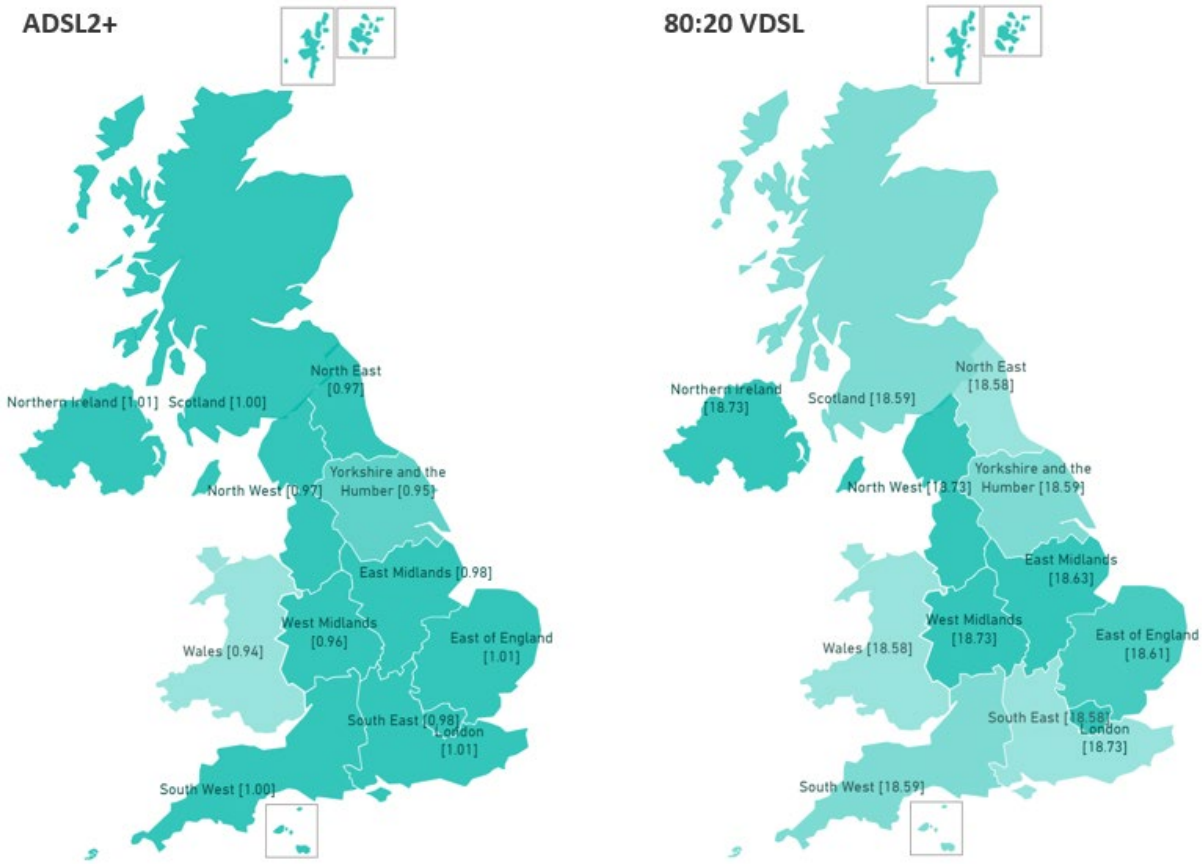
Source: Ofcom, using ISP-provided embedded test data

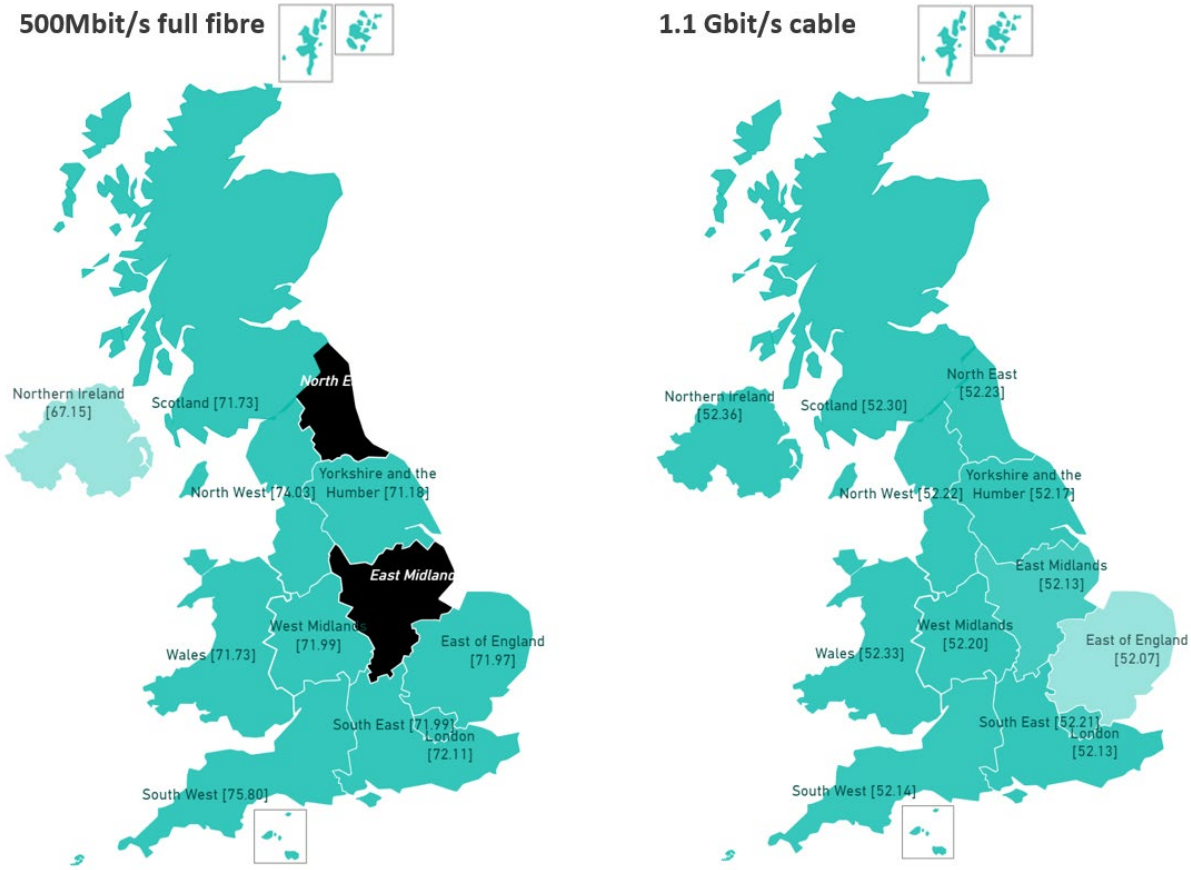
Note: Figures are indicative only; data not available for 500 Mbit/s full-fibre connections in the East Midlands and North-East of England due to insufficient sample size.

The variation in average upload speeds tended to be lower than for download speeds

Full-fibre services with an advertised download speed of 500 Mbit/s enjoyed the fastest 8-10pm peak-time speeds among the four package types included in this analysis, ranging from 67.2 Mbit/s in Northern Ireland to 75.8 Mbit/s in the South-West of England, an 11% difference. This compared to 1% differences between the lowest and highest recorded average 8-10pm upload speed ranges for both 80:20 VDSL (18.6 Mbit/s to 18.7 Mbit/s) and 1 Gbit/s cable (52.1 Mbit/s to 52.4 Mbit/s) services. ADSL2+ upload speeds were significantly lower than for the other package types in the analysis, ranging from 0.9 Mbit/s to 1.0 Mbit/s, giving a 7% difference between the highest and lowest averages.

Figure 16: Average 8-10pm peak-time upload speeds for selected package types, by UK nation and English region: March 2022 (Mbit/s)





Source: Ofcom, using ISP-provided embedded test data
Note: Figures are indicative only; data not available for 500 Mbit/s full-fibre connections in the East Midlands and North East of England due to insufficient sample size.