

# UK Home Broadband Performance

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



Published 9 September 2021

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# Overview

Reliable, good-quality broadband connectivity is an essential part of life for most people in the UK. The growing use of data-hungry activities such as video streaming, and increased levels of home working and learning during the Covid-19 pandemic, mean the need has never been greater.

Our [Communications Market Report 2021](#) shows that 86% of UK households take fixed home broadband. To understand how these services perform, we commissioned SamKnows to set up a panel of people who connected a monitoring unit to their broadband router. Data from this panel, along with some data from broadband providers, enables us to measure the performance of home broadband services and assess how they vary by technology, package, location and time of day.

## What we have found

**Average home broadband download speeds have continued to increase.** In March 2021 the median average download speed of UK home broadband connections was 50.4 Mbit/s, a 20% increase compared to November 2019 as people upgraded to superfast and ultrafast services.

**Take-up of faster broadband packages continued during the pandemic.** The proportion of home broadband lines with an advertised download speed of 30 Mbit/s or higher was 85% in March 2021, and 5% of connections were ultrafast packages with advertised speeds of 300 Mbit/s or more.

**The gap between urban and rural performance is narrowing.** During peak-times (8-10pm), 17% of rural lines had a median average speed under 10 Mbit/s in March 2021, down 5 percentage points (pp) vs November 2019, while 65% had an median speed of 30 Mbit/s or more (up 9pp). However, urban median average peak-time speeds (55.1 Mbit/s) were still a third higher than those in rural areas (41.3 Mbit/s).

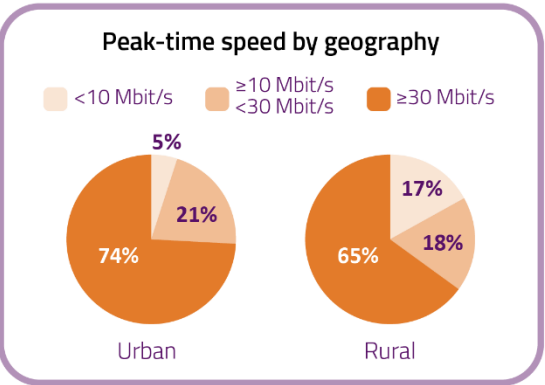
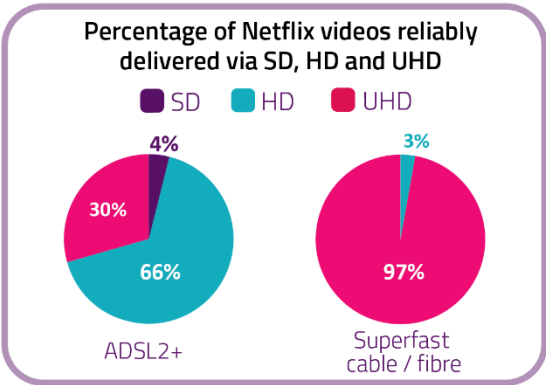
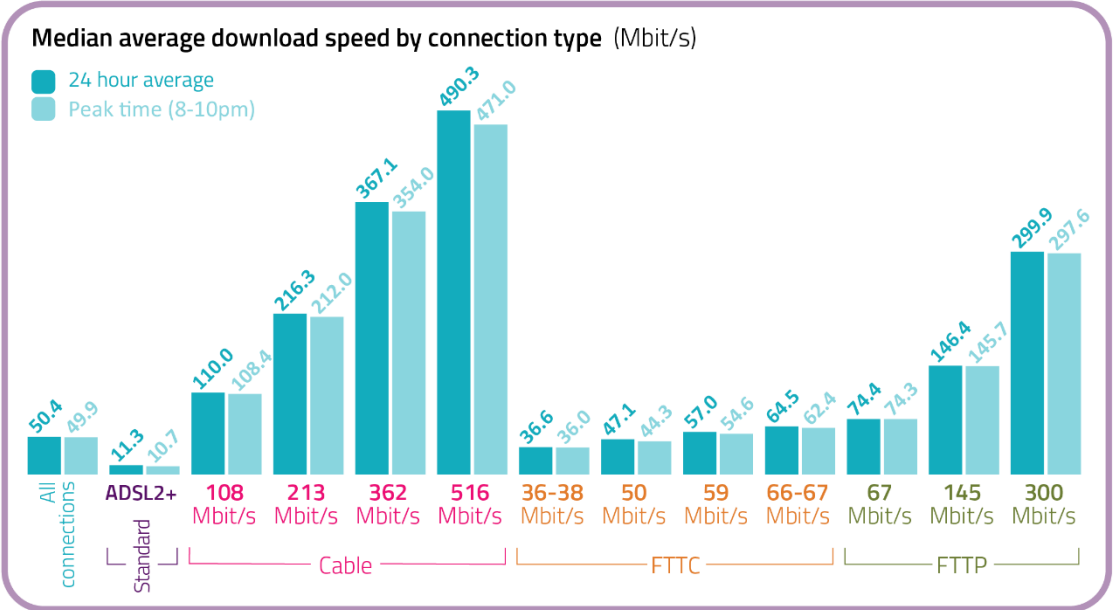
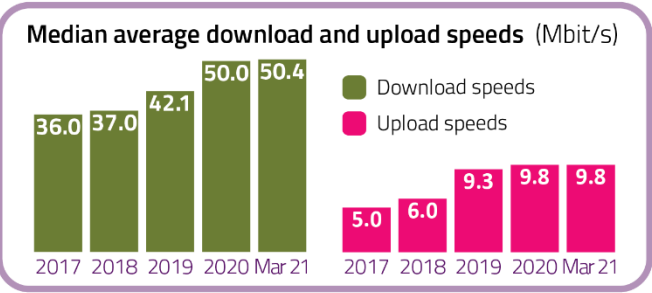
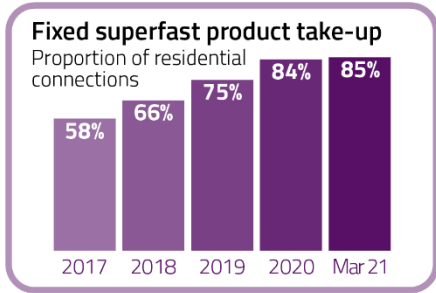
**Upload speeds have increased as people upgrade to faster packages.** Median average upload speeds increased by 5% to 9.8 Mbit/s between November 2019 and March 2021.

**Cable and full-fibre lines recorded the highest speeds.** Virgin Media's 516 Mbit/s service provided the fastest median average 24-hour download speed among the packages in the report (490.3 Mbit/s) while BT's 300 Mbit/s full-fibre service had the highest median upload speed (50.6 Mbit/s).

**While there was some slowdown in busy periods, on average connections were just 2% slower than their maximum speed in the peak period (8pm to 10pm).** 516 Mbit/s cable services delivered 86% of maximum speeds in peak periods, compared to over 99% for 67 Mbit/s full-fibre services.

**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 to a service with a higher advertised speed, but we find few differences between services provided by companies such as BT, EE, Plusnet, Sky and TalkTalk, that use the same Openreach wholesale inputs.

# Dashboard



## Notes on the data included in this report

We measure the performance delivered to the customer's router. While this is a measure of the performance delivered by an internet service provider to a customer's home, the performance delivered to connected devices in that home will vary as it is affected by several factors including wi-fi performance, in-house wiring, in-house contention when more than one device is using the broadband connection, device limitations and the performance of servers delivering content over the connection.

Analysis of the results of our testing during the March 2021 measurement period, including broadband provider package comparisons, can also be found in the [interactive dashboard](#) that accompanies this report.

There are other 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 each active line, which is provided to Ofcom by broadband providers. This approach gives a measure of 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 slightly higher than the 'end-to-end' line speed measurements we present here.

## Embedded panel tests

One of the limitations of our hardware-based measurement methodology is that the research can only include a package when we can recruit enough volunteer panellists for it, and this can make it difficult to include services that not many customers subscribe to.

BT and Virgin Media have SamKnows test firmware embedded into some of their routers and have given Ofcom access to anonymised test data from some of these customers. The embedded tests run on the BT routers are identical to those run on the main Ofcom panel's measurement units, apart from the video streaming and web page loading tests. SamKnows testing has confirmed that running the tests on a broadband provider's router rather than on one of SamKnows' 'whitebox' measurement units has no discernible effect on the measurements.

We have included BT embedded test data relating to three of its full-fibre services in the report, and have only used a subset of the data provided, to minimise the risk of any systematic biases arising from oversampling in certain geographic areas. We have not included Virgin Media's embedded data in the package comparisons section of this report but hope to do so in future reports.

## Measurement period covered in this report

We have changed the reporting schedule for our home broadband performance research: the measurement period covered by this report is 1 March to 31 March 2021.

The [last Home Broadband Performance narrative report](#) covered [November 2019](#), and although we have published data relating to two measurement periods since then ([May 2020](#) and [November 2020](#)), we focus in this report on changes that occurred between November 2019 and March 2021. We believe that looking at developments over this period is more meaningful than considering those in the four months from November 2020 to March 2021.

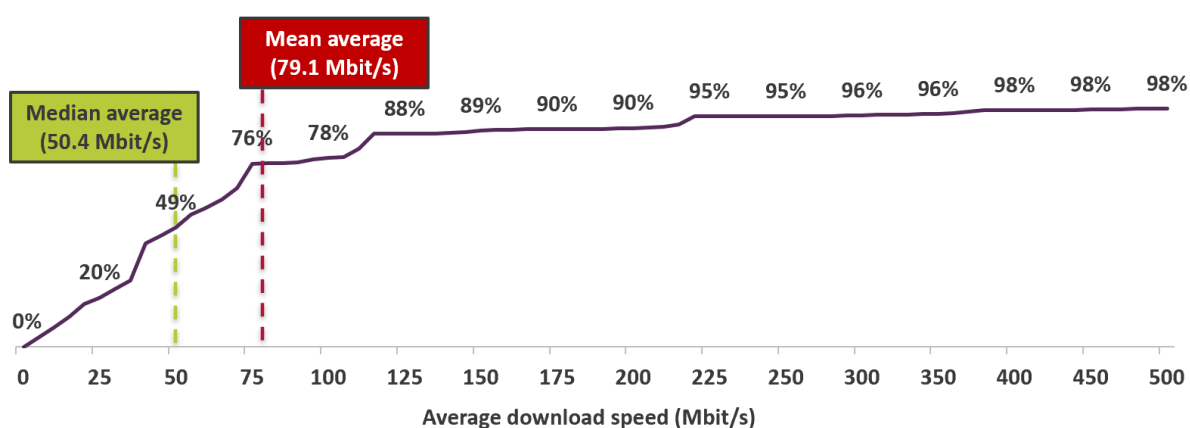
## Change from mean averages to median averages

In this report we have started using median averages (rather than mean averages) when analysing connection performance. The median average is calculated as the middle value when a dataset is ordered from lowest to greatest, whereas the mean value is calculated by adding all values in a dataset and then dividing by the number of values in that set.

We believe this change more accurately reflects the experience of consumers, as median average values describe a base level of performance that at least half of consumers will experience whereas mean average performance is distorted by a comparatively small number of very fast connections. This approach is in line with the Advertising Standards Agency (ASA) and the Committee of Advertising Practice (CAP)'s guidance on broadband speed claims<sup>1</sup> and provides information that is more easily comparable to the speed claims that providers make under ASA/CAP guidance.

Figure 1 below shows the cumulative distribution of average 24-hour download speeds for our panellists in March 2021. The median average actual download speed (50.4 Mbit/s) is significantly lower than the mean average speed (79.1 Mbit/s).

**Figure 1: Cumulative distribution of download speeds: March 2021**



Source: Ofcom, using data provided by SamKnows.

<sup>1</sup> CAP - Broadband speed claims Advertising Guidance 2018



# Download speeds

## Introduction

**Download speeds matter because they determine how long users must wait before content arrives on their devices. Higher download speeds are particularly important for downloading large files, such as films or apps, or when streaming video content. In this section we consider average UK download speeds and look at differences in performance between urban and rural areas.**

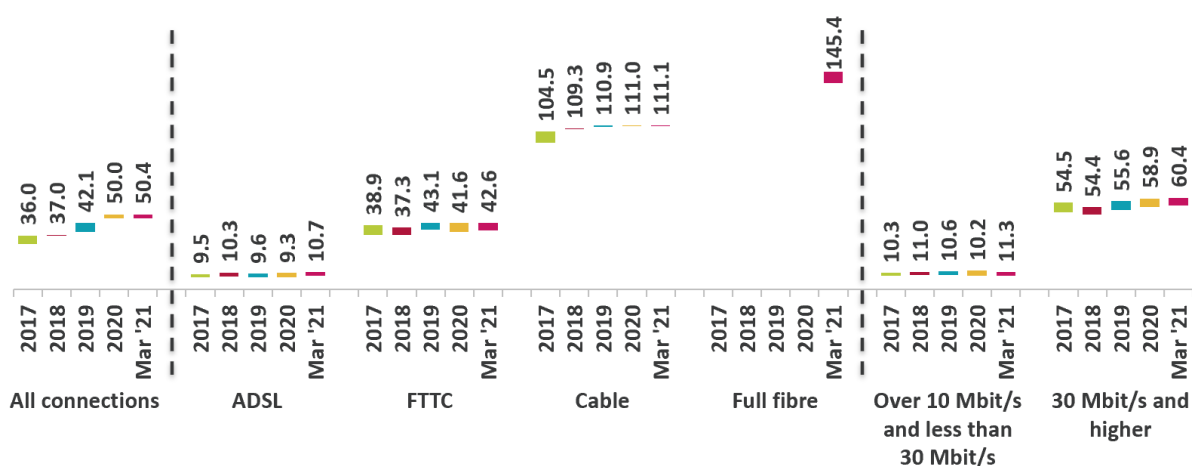
## Home broadband download speeds averaged over 50 Mbit/s

The median average actual download speed of UK residential fixed broadband services recorded over the 24-hour period increased by 8.3 Mbit/s (20%) to 50.4 Mbit/s between November 2019 and March 2021. The main driver of higher average connection speeds is people upgrading to faster packages rather than improvement in the performance of individual services.

Although it is overall the slowest technology of those measured, average speeds for asymmetric digital subscriber line (ADSL) standard broadband lines had the largest increase in their average download speed over this 16-month period, up by 1.0 Mbit/s to 10.7 Mbit/s, potentially due to those with particularly slow connections being more likely to have upgraded to a faster technology. There was also a small (0.2 Mbit/s) increase in the average download speed delivered by cable connections to 111.1 Mbit/s. The average download speed delivered by fibre-to-the-cabinet (FTTC) connections fell slightly to 42.6 Mbit/s over the same period, while full-fibre connections had the highest average download speeds across the technologies, at 145.4 Mbit/s.

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 7% to 11.3 Mbit/s in the 16 months to March 2021. This reflects the ADSL performance increase outlined above, as most home broadband connections in this category are provided using ADSL. Average download speeds for superfast, ultrafast and gigabit broadband products (those with an advertised speed of 30 Mbit/s or higher) also increased between November 2019 and March 2021, up by 4.7 Mbit/s (9%) to 60.4 Mbit/s.

**Figure 2: Median average actual broadband download speeds: 2017 to March 2021 (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 consists of ADSL1 and ADSL2+.

## Three-quarters of residential broadband lines have an average download speed of 30 Mbit/s or higher

UK broadband users are migrating to faster services, and the proportion of lines with an advertised download speed of 30 Mbit/s or more increased from 75% in November 2019 to 85% in the 16 months to March 2021. Over the same period, the proportion of lines with an advertised speed of 300 Mbit/s or more increased from 3% to 5%.

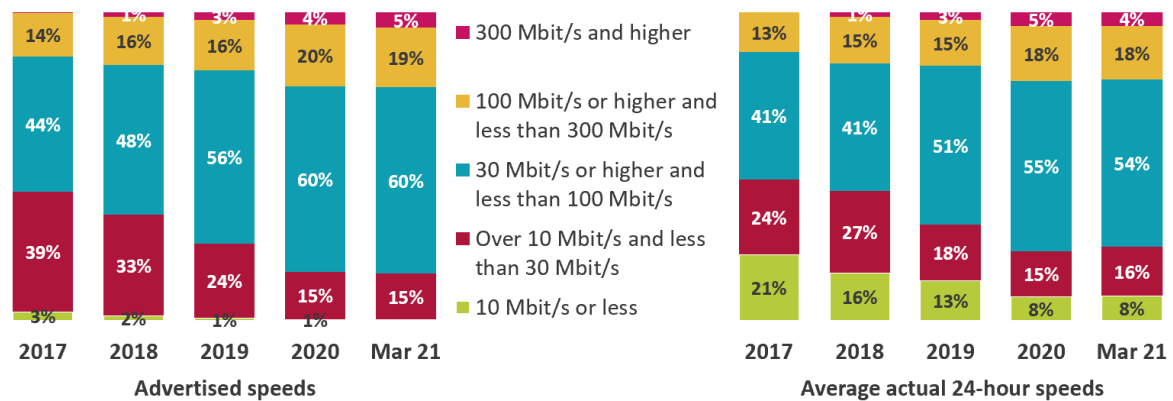
This has resulted in increases in actual connection speeds: over the same 16-month period the proportion of lines receiving an average 24-hour download speed of 30 Mbit/s or higher increased from 69% to 76%, and the proportion receiving an average actual 24-hour download speed of 300 Mbit/s or higher increased from 3% to 4%.

Our data also shows that while less than 1% of lines had an advertised speed of less than 10 Mbit/s, 8% of lines provided 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.

Most of these lines will be poorly-performing ADSL lines; since March 2020, consumers who cannot get 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 universal service obligation (USO).



**Figure 3: Distribution of UK residential broadband lines, by advertised and 24-hour average actual speeds: 2017 to March 2021**



Source: Ofcom / operators; see note [B] in the [Sources annex](#).

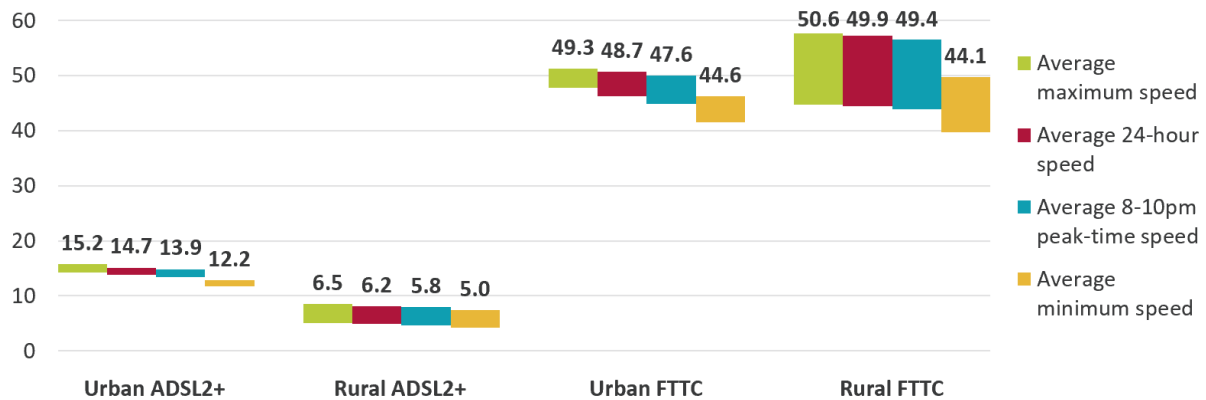
## Longer line lengths in rural areas result in lower average speeds for ADSL connections

A characteristic of the copper technologies used to deliver ADSL and FTTC broadband is that connection speeds slow down due to signal loss (attenuation) 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, whereas with FTTC copper is used only from the street cabinet to the end-user. As ADSL lines tend to be shorter in urban areas than in rural ones (where population density is lower), urban lines tend to perform better than those in rural areas.

For second-generation ADSL (ADSL2+) connections (which make up over 95% of all ADSL lines), the median average 24-hour download speed in urban areas (14.7 Mbit/s) was more than double the 6.2 Mbit/s average in rural areas in March 2021. There is less variation in the length of copper line from the street cabinet to the user's premises and therefore less variance in performance, and our data show that there was no difference between urban and rural FTTC download speeds.

Average rural FTTC download speeds were more than eight times faster than average rural ADSL2+ download speeds, indicating that most rural ADSL customers who upgrade to FTTC will experience a significantly better user experience.

**Figure 4: Median average ADSL2+ and FTTC download speeds, by rurality: March 2021 (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 urban and rural broadband performance is narrowing

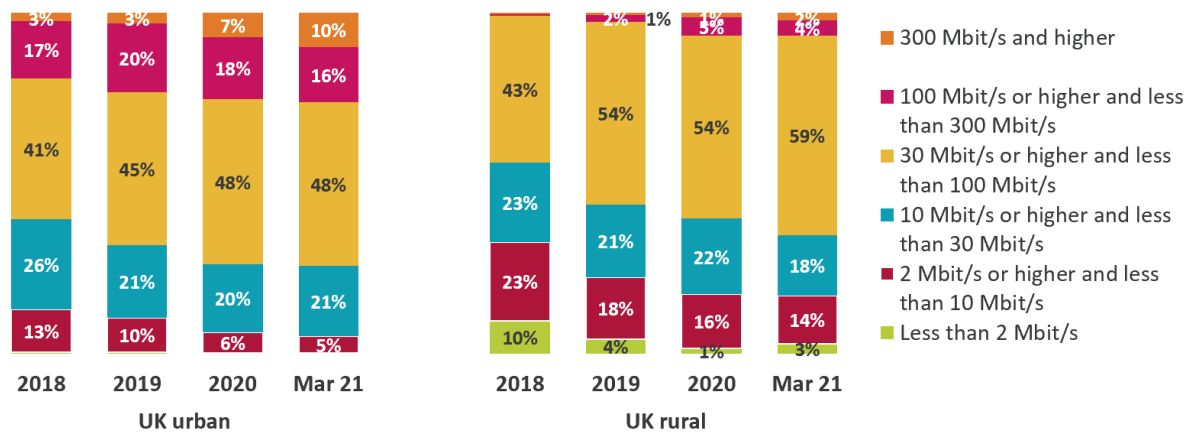
As the availability and take-up of superfast, ultrafast and gigabit services have increased in rural areas of the UK, the gap between urban and rural home broadband performance has narrowed.

Our data show that the 9pp difference between the proportion of urban (74%) and rural (65%) lines with an average evening peak-time speed of 30 Mbit/s or higher in March 2021 was lower than the 12pp difference recorded in November 2019.

However, the difference between the March 2021 proportions of urban (5%) and rural (17%) broadband lines with an average 8-10pm peak-time actual download speed of less than 10 Mbit/s (12pp) was unchanged since November 2019, when the respective urban and rural figures were 10% and 22%.

Although the difference between average urban and rural peak-time download speeds is declining, average peak-time download speeds in urban areas (55.1 Mbit/s) were still a third higher than those in rural areas (41.3 Mbit/s) in March 2021.

**Figure 5: Distribution of average 8-10pm peak-time home broadband download speeds, by rurality: 2018 to March 2021**



Source: Ofcom, using data provided by SamKnows; see note [D] in the [Sources annex](#).

# Download speeds: network slowdown

## Introduction

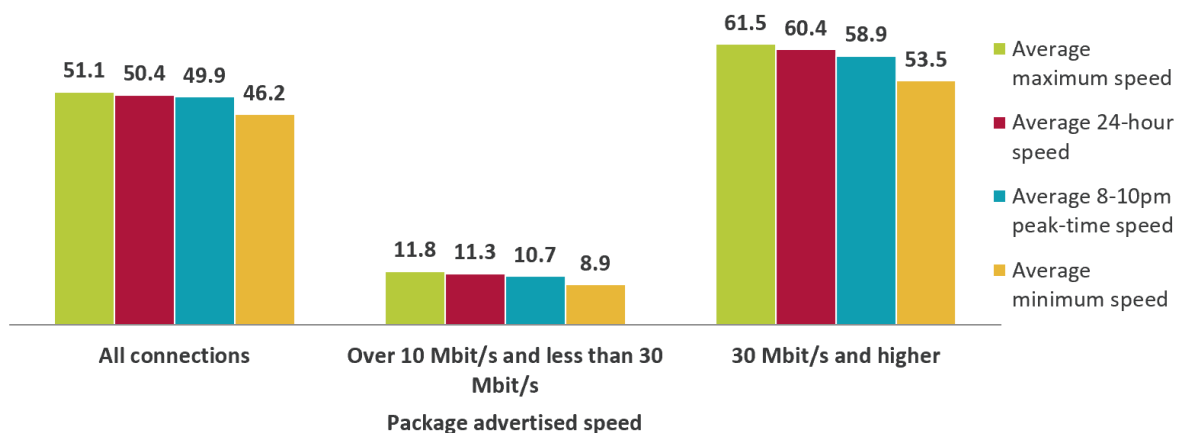
Average download speeds tend to fall during busy periods when broadband networks suffer the effects of network congestion (contention). In this section we look at the impact this has on download speeds throughout the day.

## Download speeds vary throughout the day

Across all connections the average daily minimum speed (46.2 Mbit/s) was 90% of the average maximum speed (51.1 Mbit/s), while the average 8-10pm peak-time speed (49.9 Mbit/s) was 98% of the average maximum.

The proportional impact of network slowdown on measured speeds was greater on slower lines than on faster ones. Lines with an advertised download speed of above 10 Mbit/s and less than 30 Mbit/s (mainly ADSL lines) received average 8-10pm peak-time speeds that were 91% of their average maximum speed, compared to 96% for fibre and cable lines with advertised speeds of 30 Mbit/s or more.

Figure 6: Median average UK broadband speeds, by time of day: March 2021 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [A] in the [Sources annex](#).

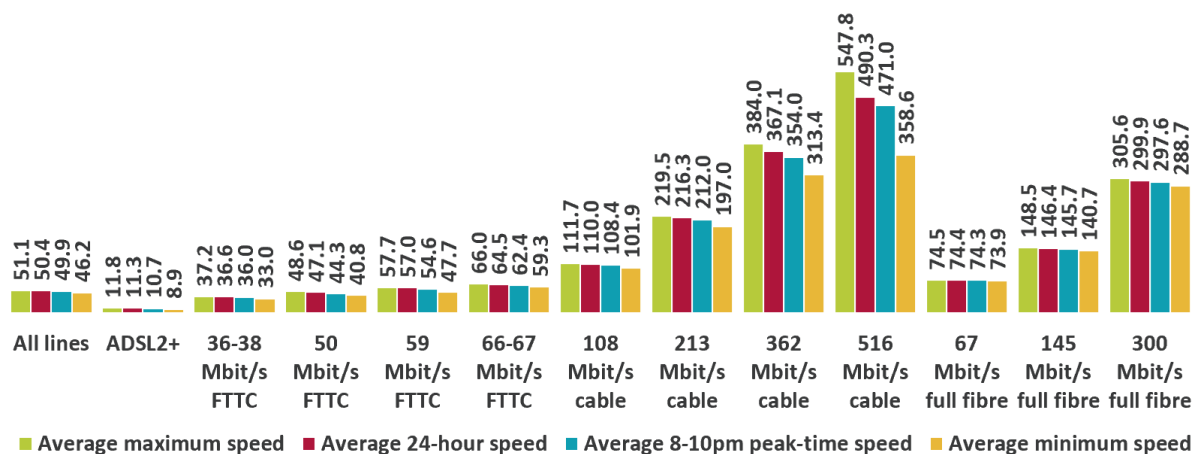
## Full-fibre connections have the least variation in performance

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

- For copper-based technologies such as ADSL and FTTC, the maximum speed that a line can support is dependent on the length and quality of the line from the end-user's home to the local exchange (for ADSL) or street cabinet (for FTTC); lines to some premises will never support the service's advertised speed (although under the [Voluntary Code of Practice for 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 tends to be higher for cable connections, due to network congestion occurring nearer to the customer, making it harder to add the additional capacity required to reduce the effects of congestion.

For 108 Mbit/s, 213 Mbit/s, 362 Mbit/s and 516 Mbit/s cable services, 8-10pm peak-time download speeds averaged between 85% and 98% of maximum speeds. For 36-38 Mbit/s, 50 Mbit/s, 59 Mbit/s and 66-67 Mbit/s FTTC services, average peak-time download speeds were between 91% and 97% of their average maximum download speeds. Among the full-fibre packages included in the research, average 8-10pm peak-time speeds were more than 97% of average maximum speeds. For ADSL2+ services, peak-time download speeds averaged 91% of maximum speeds.

Figure 7: Variations in download speeds, by time of day: March 2021 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [E] in the [Sources annex](#).

## Contention varies by network technology

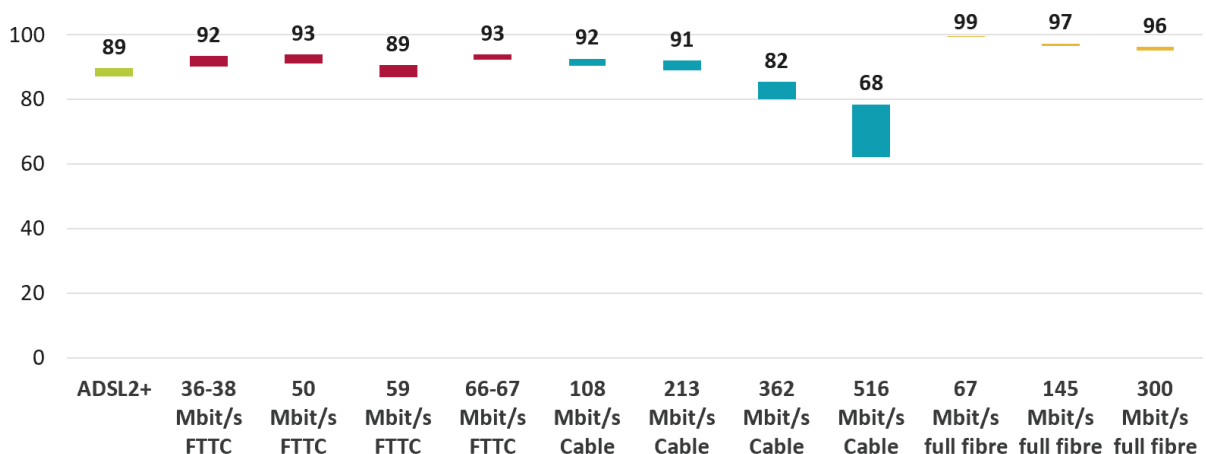
We can also measure network slowdown during busy periods (contention) by comparing broadband packages' average minimum and maximum speeds, our assumption being that the primary reason for any differences between the two is network congestion.

The proportions shown below are not comparable to those that would be derived from Figure 7 above. The values in Figure 8 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 an individual line can expect to experience. Figure 7, on the other hand, shows the median average minimum speed for each connection type as a proportion of the median average maximum speed for that connection type. This shows the variation in performance across the package category at a national level but does not necessarily show the difference between minimum and maximum speeds an individual line can expect to achieve.

Our analysis shows that all line types had a median average minimum speed as a proportion of average maximum speed that was greater than 80% except 516 Mbit/s cable connections. While these connections' median average minimum speed as a proportion of their maximum speed was lower (68%) they still delivered the highest average maximum, 24-hour 8-10pm peak-time and minimum speeds across the connection types included in our analysis.

Among the packages included in our analysis, the three full-fibre services provided more consistent speeds than the other technologies, with their median average minimum speeds as a proportion of their maximum speeds (all over 95%) being higher than those for ADSL2+ (89%) and the cable and FTTC packages.

**Figure 8: Median minimum speed as proportion of maximum: March 2021 (%)**



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) falls within the ranges shown; data labels show the median average values.



# Upload speeds

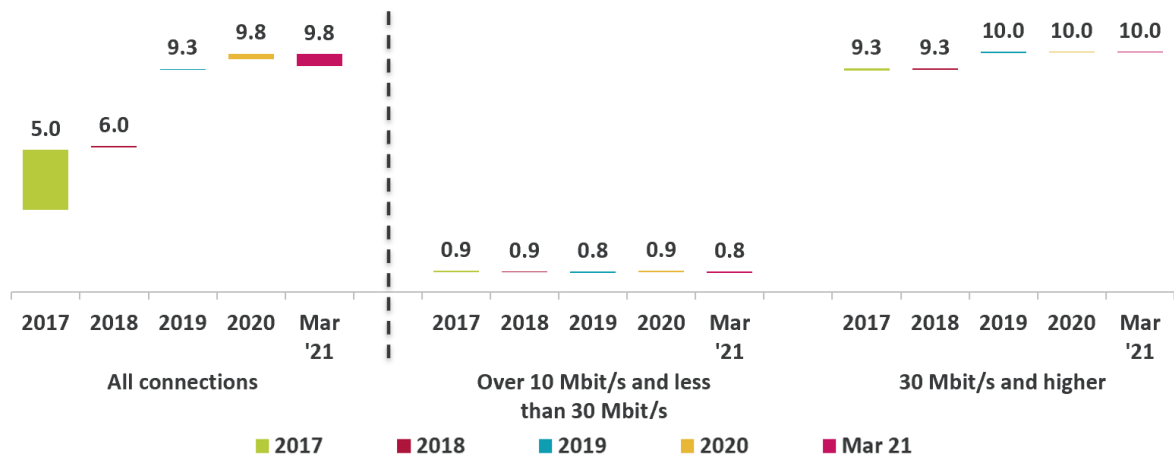
## Introduction

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

## Average UK upload speeds were just under 10 Mbit/s in 2021

Our research suggests that the median average upload speed of UK residential fixed broadband services increased by 0.5 Mbit/s (5%) to 9.8 Mbit/s between November 2019 and March 2021. The main driver of this increase was the growing take-up of superfast services (whose median average upload speed was unchanged at 10.0 Mbit/s over the same period).

Figure 9: Median average UK fixed broadband upload speeds (Mbit/s): 2016 to March 2021



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 any online activities when their internet service loses connectivity.

## Over 95% of fibre and cable Netflix streams are delivered in UHD

To understand how well various fixed broadband connections handle the streaming of video content, we measured the streaming performance of broadband connections when accessing content from Netflix. This service is taken by half of UK homes, as reported in Ofcom's [2021 Media Nations report](#).

The chart below shows the proportion of Netflix video streams that were delivered in the most commonly available resolutions – standard definition (SD), high definition (HD) and ultra-high definition (UHD) – for each connection type.

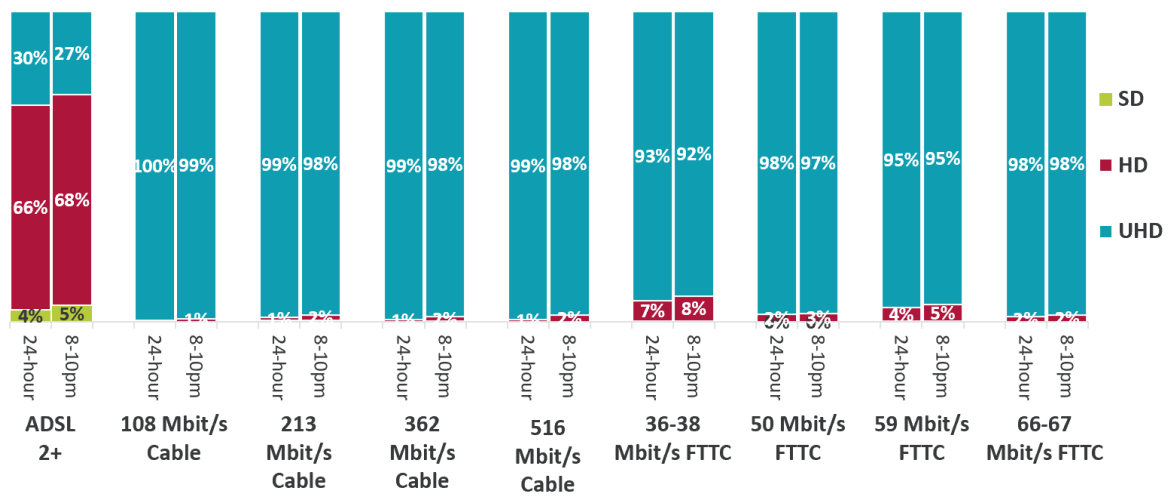
These results represent use where only one person is streaming Netflix on a broadband connection; the streaming quality that can be reliably achieved may drop when multiple users are simultaneously using the same connection. HD and UHD resolutions are available only to people taking Netflix's higher-tier plans.

Over two-thirds of ADSL2+ Netflix streams were reliably delivered at HD resolution, while a further 30% were delivered in UHD. ADSL2+ may therefore be enough to meet the current broadband requirements of some smaller households who are satisfied with HD rather than UHD quality, as video streaming is one of the most data-hungry uses of a home broadband connection.

The large majority of Netflix streams to fibre and cable lines with an advertised speed of 30 Mbit/s or higher were delivered in UHD (97%).



**Figure 10: Proportion of Netflix videos reliably delivered at the given video quality, over 24 hours and at peak times, by technology: March 2021**



Source: Ofcom, using data provided by SamKnows; see note [H] in the [Sources annex](#).

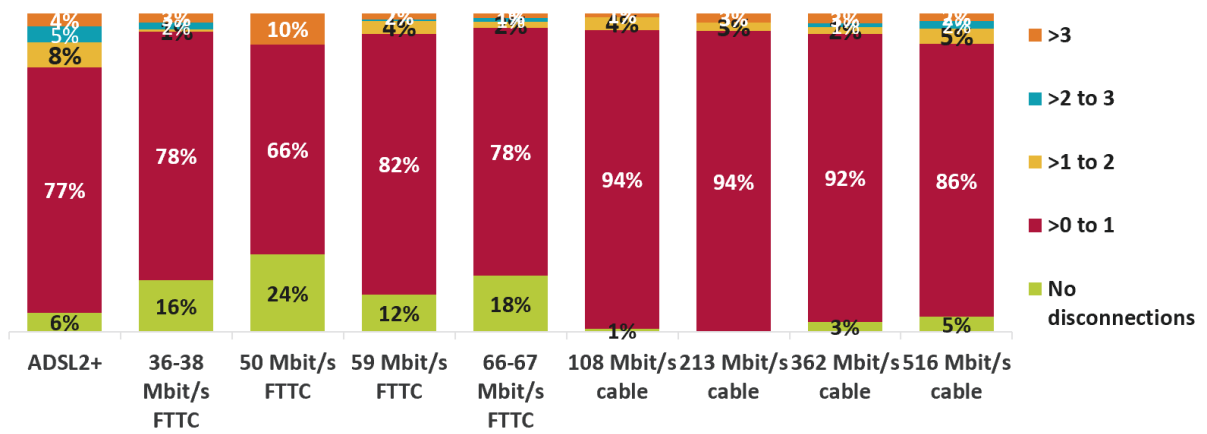
## Fibre connections recorded the fewest disconnections

To help understand how frequently disconnections occur, we analysed the average daily number of disconnections lasting longer than 30 seconds. Not all disconnections are due to network performance; for example, a panellist rebooting their router, or downtime during quiet hours for ISP network maintenance or upgrades, would be classified as disconnection events by our test.

Some broadband providers have started to offer home broadband services with a cellular back-up, whereby the router switches to a 4G mobile connection if the fixed broadband network goes down. This ensures that the user continues to be online with little or no interruption.

The proportions of ADSL2+ and cable panellists who experienced disconnections of 30 seconds or longer were higher than those of FTTC users and, among panellists who recorded disconnection events, panellists using ADSL2+ tended to experience disconnections more frequently than those with cable or fibre packages.

**Figure 11: Distribution of average daily disconnections of 30 seconds or longer: March 2021**



Source: Ofcom, using data provided by SamKnows; see note [1] 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 516 Mbit/s service had the highest average download speed

Out of all of the broadband packages with an advertised download speed of 30 Mbit/s or higher included in our report, Virgin Media's cable-based 516 Mbit/s service had the highest median and mean average 24-hour download speeds, at 490.3 Mbit/s and 473.3 Mbit/s respectively.<sup>2</sup>

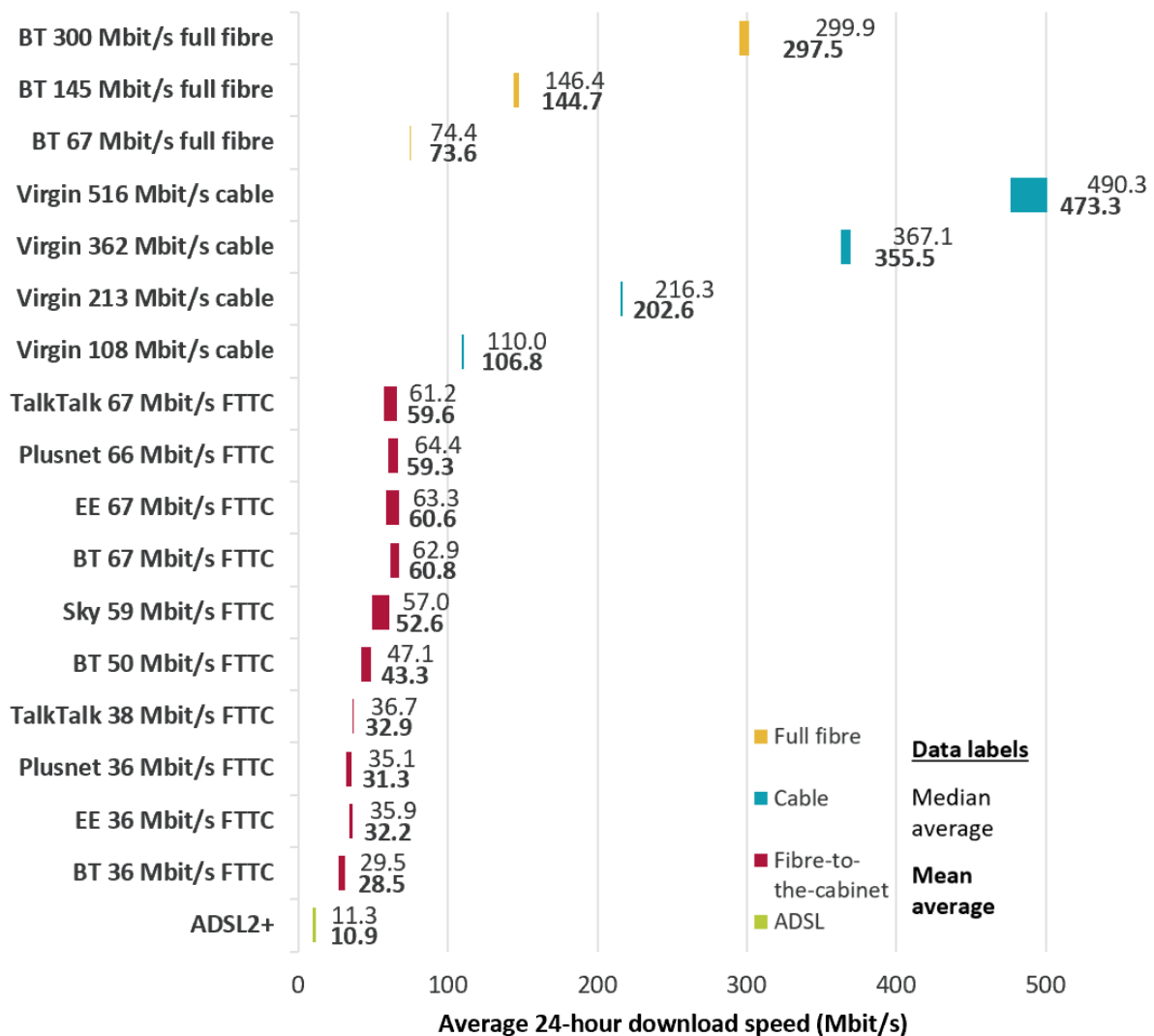
While half of Virgin Media's 516 Mbit/s customers will receive 490.3 Mbit/s download speed (the median average), the lower mean average suggests that some customers may receive considerably lower average download speeds. BT's 300 Mbit/s full-fibre package's download speed results (299.9 Mbit/s median average and 297.5 Mbit/s mean average) are much closer, suggesting that users may experience more consistent download speeds.

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

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<sup>2</sup> In addition to these packages, BT and Virgin Media provided information relating to the average download speeds provided by their higher-speed packages. These data, which are not comparable to the rest of the information in this report, suggest that the median average download speed of BT's 900 Mbit/s full-fibre service is around 930 Mbit/s, and the median average download speed for Virgin Media's 1.1 Gbit/s service is over 1 Gbit/s. We hope to include comparable data for these packages in future reports.

Figure 12: Average 24-hour download speeds, by broadband package: March 2021 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [J] in the [Sources annex](#).

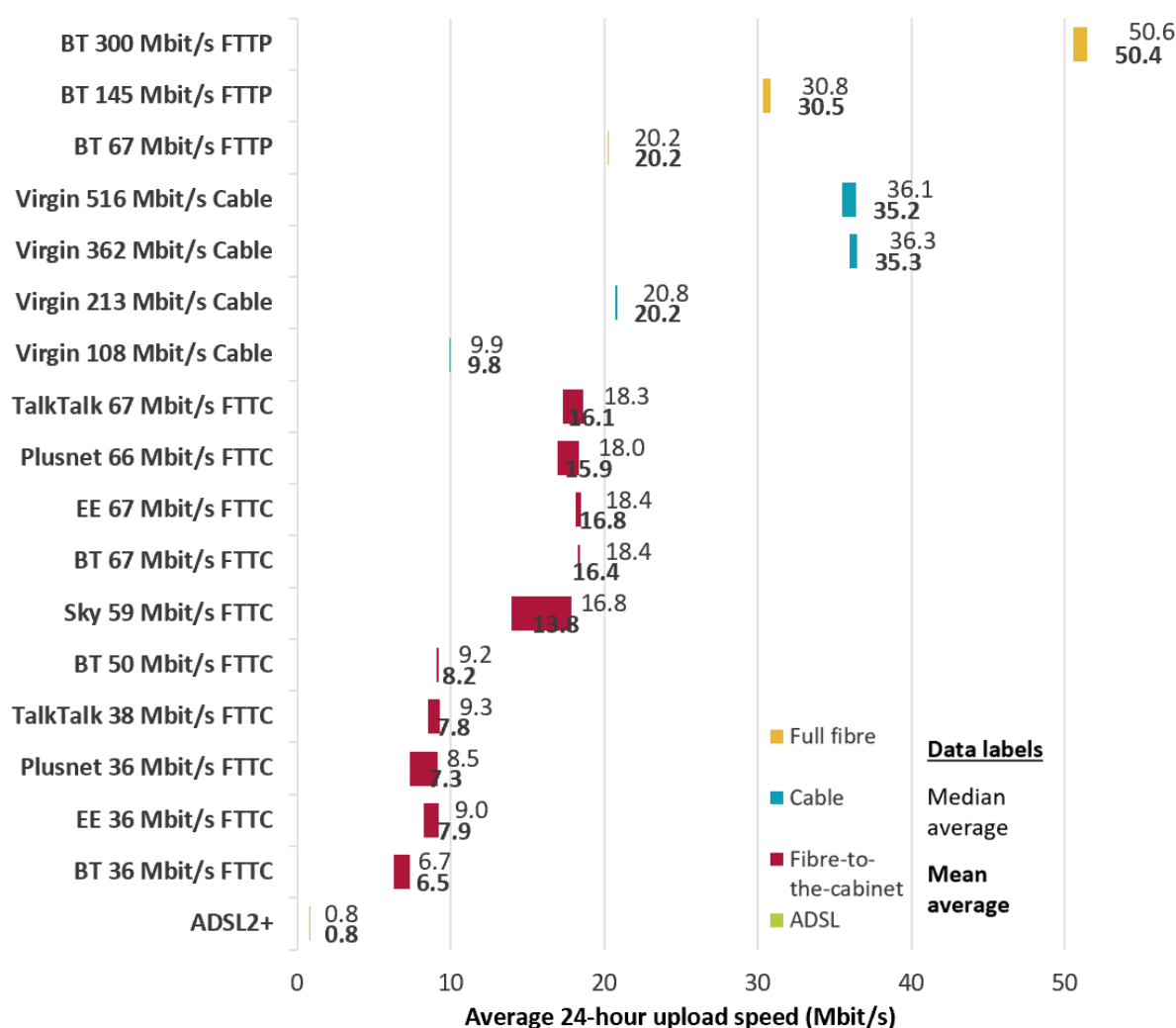
Note: The chart bars show that there is a 95% probability that the median average actual speed for all customers (i.e. not just the customer panellists in our sample) falls within the ranges shown.

## BT's 300 Mbit/s full-fibre service recorded the highest average upload speed

Of the superfast and ultrafast packages included in our research, BT's 300 Mbit/s full-fibre service had the highest median and mean average upload speeds, at 50.6 Mbit/s and 50.4 Mbit/s respectively. Virgin Media's 516 Mbit/s service, which provided the fastest download speeds, offered upload speeds that were in line with those of its 362 Mbit/s service, at around 36 Mbit/s.

On average, an ADSL2+ user who upgrades to a basic tier 36-38 Mbit/s FTTC service will benefit from an eleven-fold increase in upload speed from 0.8 Mbit/s to around 9 Mbit/s, in addition to their download speed more than tripling.

Figure 13: Average 24-hour upload speeds, by broadband package: March 2021 (Mbit/s)



Source: Ofcom, using data provided by SamKnows; see note [J] in the [Sources annex](#).

Note: 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; the 95% bar for Sky’s 59 Mbit/s FTTC service is wider than that of other FTTC services as it is provided using a mixture of wholesale inputs.

## Full-fibre services recorded the lowest connection delay

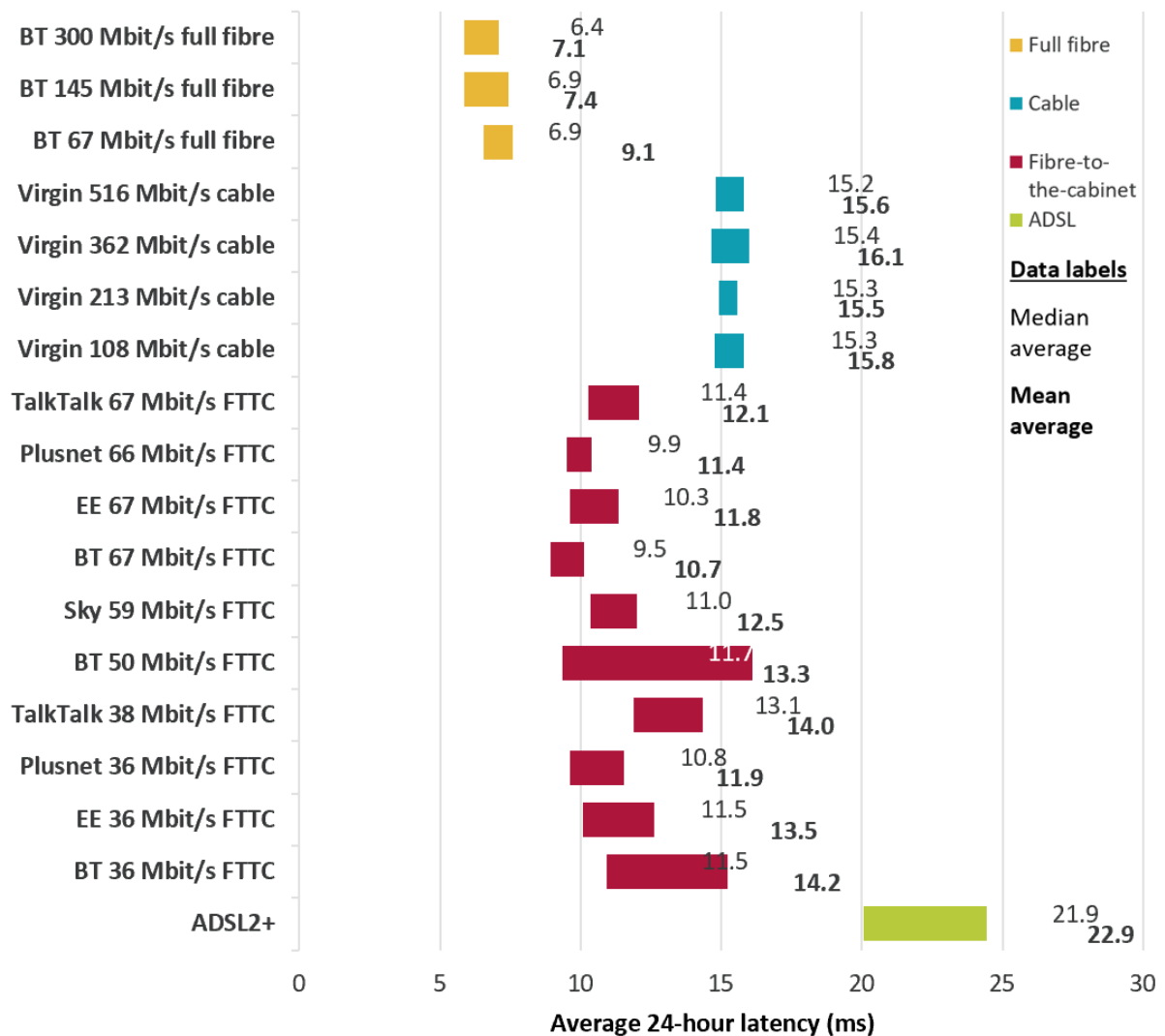
Latency (or delay) is the time it takes for a packet of data to travel to a third-party server and back. A connection with low latency will feel more responsive for simple tasks like web browsing, and certain real-time applications such as video-calling and online gaming perform far better with lower 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, the three BT full-fibre services had the lowest median average 24-hour latency values, ranging from 6.4ms to 6.9ms. The FTTC packages included in the comparisons recorded higher average latency values than full-fibre packages and, apart from BT’s 36 Mbit/s and 50 Mbit/s services, lower latency than Virgin Media’s cable services.

ADSL2+ lines recorded the highest latency across all the technologies tested, however, these averaged below 30ms and are unlikely to impact the user-experience of most users.

**Figure 14: Average 24-hour latency, by broadband package: March 2021 (ms, lower is better)**



Source: Ofcom, using data provided by SamKnows; see note [J] in the [Sources annex](#).

Note: 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.