TUTELA

UK

State of Mobile Experience

Analysts

Chris Mills

Fiona Armstrong

Annual Report

SEPTEMBER 2020

www.tutela.com

Table of contents

Introduction

It is hard to find a country where the telecoms stories of 2020 are not dominated by 5G and Covid-19, and the UK is no exception to this.

As the pandemic highlighted the importance of reliable connectivity, telecoms regulator Ofcom confirmed plans for a January 2021 auction of 700 MHz and 3.6-3.8 GHz spectrum to support 5G with up to a 20% increase in capacity(1), noting in the announcement how important it was "to make the spectrum available to mobile users without unnecessary delay." This spectrum will likely be pivotal in shaping the nationwide 5G landscape in the UK, with rare low-band available to support operators who have traditionally been limited in this space, usually in more rural locations, as well as significant 5G mid-band assets that will go to add capacity to operator's current and future urban deployments.

(1) Ofcom, Ofcom confirms plans for spectrum auction early next year https://www.ofcom.org.uk/about-ofcom/latest/media/media-releases/2020/plans-for-spectrum-auction Retrieved 17 September 2020

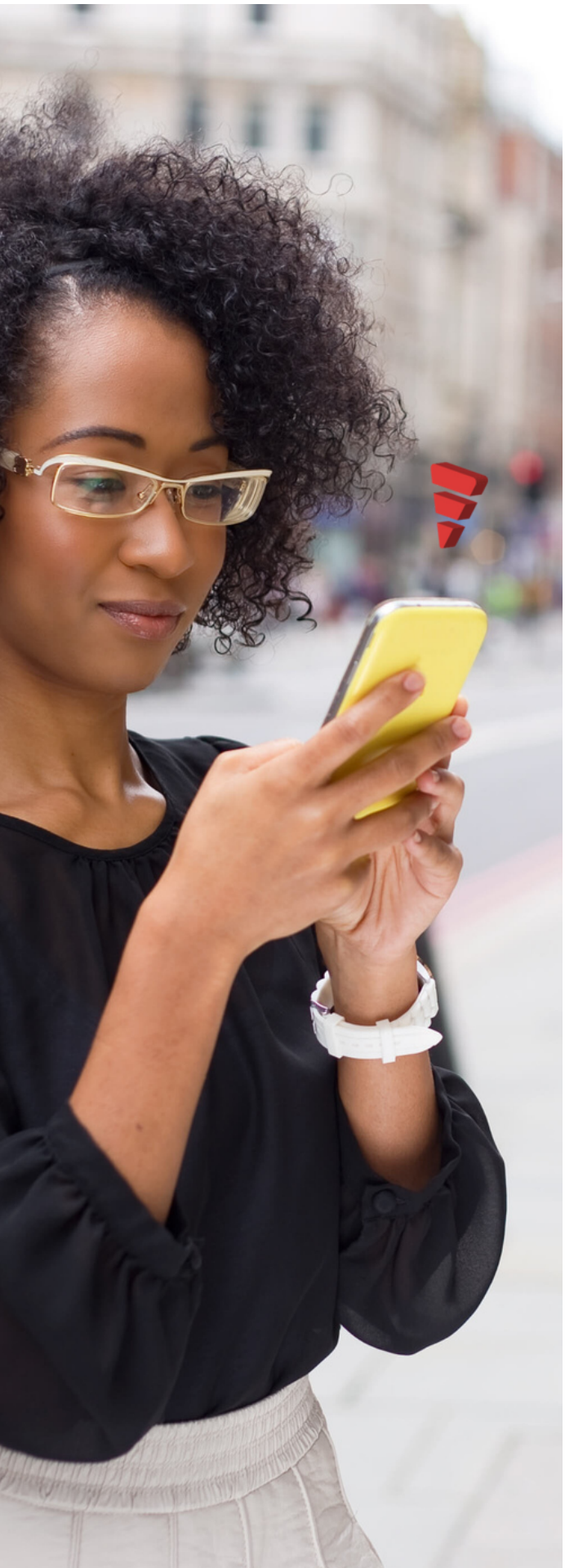
Meanwhile, Tutela's country-level mid-band 5G report(2), released in August this year, saw the initial results of 5G deployments in the UK. This highlighted two things – impressive performance increases, but ongoing coverage challenges. 5G device users in the UK saw download speeds over 120% faster on 5G than on 4G, but 5G coverage was only available from any operator in 1.3% of the geographic area tested.

Beyond the realms of these two overarching trends, however, the telecoms market in the UK has experienced its own significant disruption. For a start, the merger of O2 and Virgin Media in May highlighted the latest move towards telecom and media service convergence that echoes the 2016 tie-up between BT and EE. It is still early to speculate on the impact this will have on the market overall, with the merger expected to complete in mid-2021. Meanwhile, the big four (O2, Vodafone, EE and 3) signed on to the Shared Rural Network plan, which aims to deliver 95% 4G geographic coverage by 2026. Achieving this will take unprecedented collaboration, but success in the project will no doubt see notable increases in rural subscriber mobile experience.

Against this backdrop, Tutela's 2020 State of Mobile Experience report evaluated over 180 million speed and latency tests, in the UK, from over 2 million devices collected between 1st March and 31st August 2020 to provide insight into the average experience of subscribers on each of the UK's "big four" providers.

"5G device users in the UK saw download speeds over 120% faster on 5G than on 4G, but 5G coverage was only available from any operator in 1.3% of the geographic area tested."

(2) Tutela, The impact of mid-band 5G: lessons learned from early adopters
https://www.tutela.com/hubfs/The%20impact%20of%20mid-band%205G_%20lessons%20learned%20from%20early%20adopters.pdf
Retrieved 17 September 2020



Key findings

- EE remains dominant in Tutela's reporting, with its subscriber base experiencing the highest Excellent Consistent Quality (representative of a range of use-cases such as 1080p video streaming, HD/group video calls, and realtime mobile gaming), fastest median download and upload speed, and best overall coverage of the big four operators.

- However, EE's lead is not unchallenged: Vodafone's subscribers experienced the highest Core Consistent Quality - this means that Vodafone customers enjoy a connection capable of SD video streaming, web browsing and social media sharing more often than subscribers of other operators (in areas where all operators offer service, called "Common Coverage Areas"). Additionally, Vodafone outperformed EE for Excellent Consistent Quality in Wales, as well as tying with EE in Scotland.

- The gap between 3 and the other operators remains across almost every KPI tested, with the exception of upload throughput. This is likely due in part to 3's more limited 4G coverage, with users spending a notable amount of time on 3G, and 3's significant amount of 3G-only geographic coverage. 3's initial 5G deployments have shown promise in the UK, but major investment in both infrastructure and spectrum licenses in the upcoming auctions will be critical for 3 to continue to compete with the rest of the UK's operators.

Results overview

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Mobile experience results

UK, September 2020

	EE	vodafone	O2	3
Excellent Consistent Quality	★ Winner			
Core Consistent Quality		★ Winner		
Download throughput	★ Winner			
Upload throughput	★ Winner			
Latency	★ Winner			
Coverage	★ Winner			

Results from over 180 million speed and latency tests in the UK, from over 2 million devices collected between 1st March and 31st August 2020.

"EE delivered the highest percentage of Excellent Consistent Quality in Tutela's tests"

TUTELA
Best Mobile Network Experience
SEPTEMBER 2020

Based on the highest Excellent Consistent Quality in Common Coverage Areas.

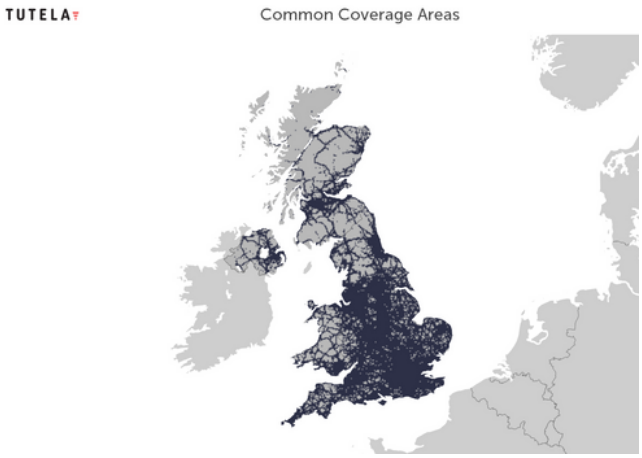
Understanding this report

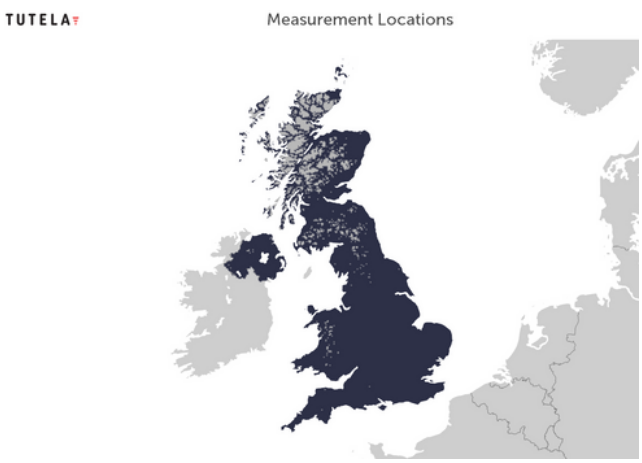
Tutela uses two key methodological components to best compare user experience across operators: Consistent Quality and Common Coverage Areas. Consistent Quality is a set of metrics that Tutela has developed to objectively evaluate when connections are (and are not) enabling users to do almost everything that they want to do on their smartphones.

To best serve Tutela's goal to accurately measure and represent the real-world, end-to-end experience of actual users, our methodology is subject to ongoing improvements, which allow us to update the methodology in line with changes in network technology, measurement capabilities, and the realities of how people use their smartphones. As of September 1st 2020, the methodology includes an updated version of Consistent Quality that better accounts for reliability, an area-based Coverage Score, a more granular Common Coverage measurement, and the separation out of users on MVNO or flanker brands. As a result, changes in the numeric values in this report compared to 2019 are not necessarily representative of year-on-year changes in the end-to-end user experience.

The methodology is covered in detail at the end of this report and on our website, but simply put, there are two sets of thresholds, Excellent and Core. A connection that hits the Excellent threshold is sufficient for use-cases like 1080p video streaming or multiplayer gaming, while a Core connection will stream standard-definition video or handle things like web browsing or uploading photos to social media. The percentages you see in this report represent the percentage of tests on a given operator that were above the Excellent or Core thresholds.

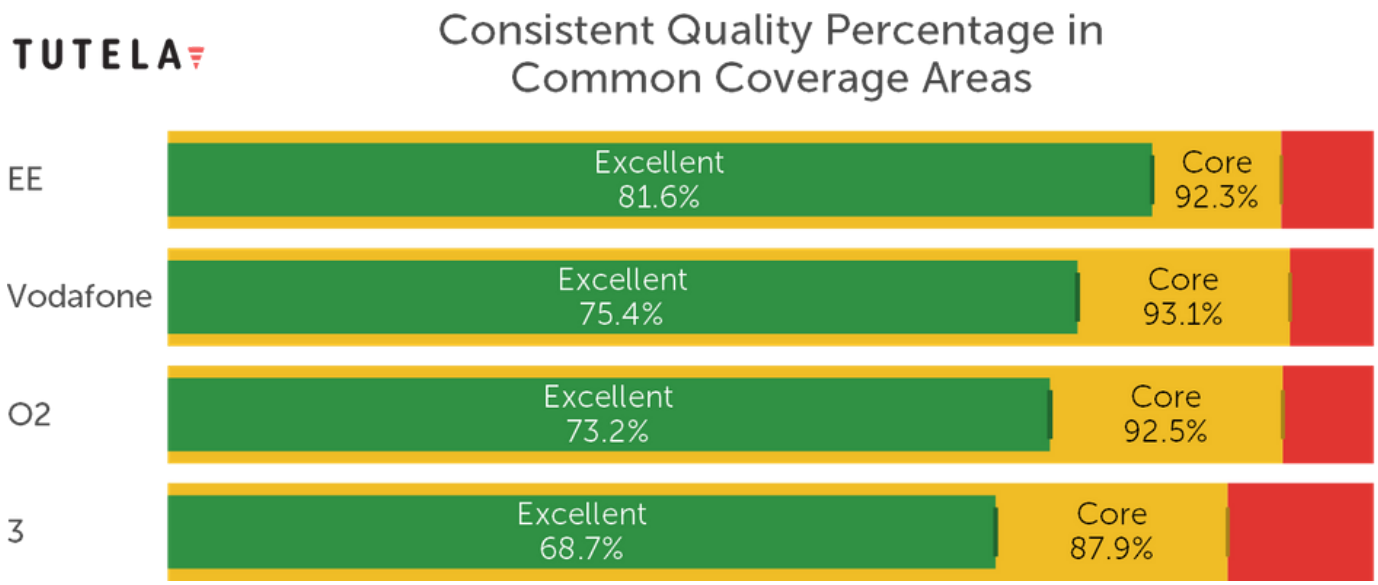
Common Coverage Areas are parts of the country where all national operators offer service, either on their own network or through a domestic roaming agreement.





Consistent Quality

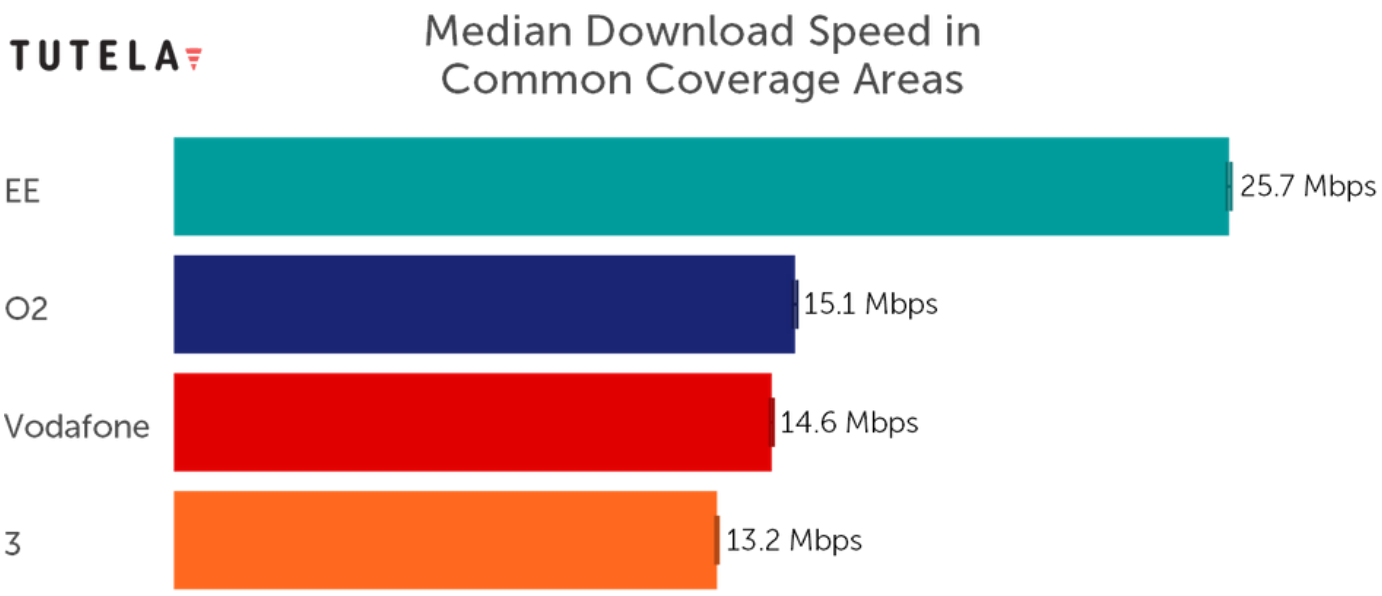
EE achieved the highest Excellent Consistent Quality, meaning that 81.6% of the time, subscribers in Common Coverage Areas of the UK have a network experience suitable for use-cases like 1080p video streaming, real-time mobile gaming or, perhaps most relevantly in the current era, HD video calling. Vodafone placed second, with over six percentage points separating the two, while O2 was a close third. However, when it comes to Core Consistent Quality, Tutela's metric for when a mobile connection meets the requirements for use-cases like SD video streaming, social media sharing and web browsing, Vodafone subscribers had a suitable experience the most often at 93.1%, followed by O2 in second place at 92.5%. For every mobile network operator other than 3, over 90% of Core Consistent Quality tests passed the thresholds, meaning that the vast majority of the time, EE, Vodafone and O2 subscribers had a good enough mobile connection for most basic mobile activities.



Broken down by nation, a more complex picture emerges. EE is the dominant provider for Excellent Consistent Quality in the UK and Northern Ireland, but ties with Vodafone in Scotland. Vodafone also places first in Wales. Vodafone's lead for Core Consistent Quality is also demonstrated in every one of the four nations.

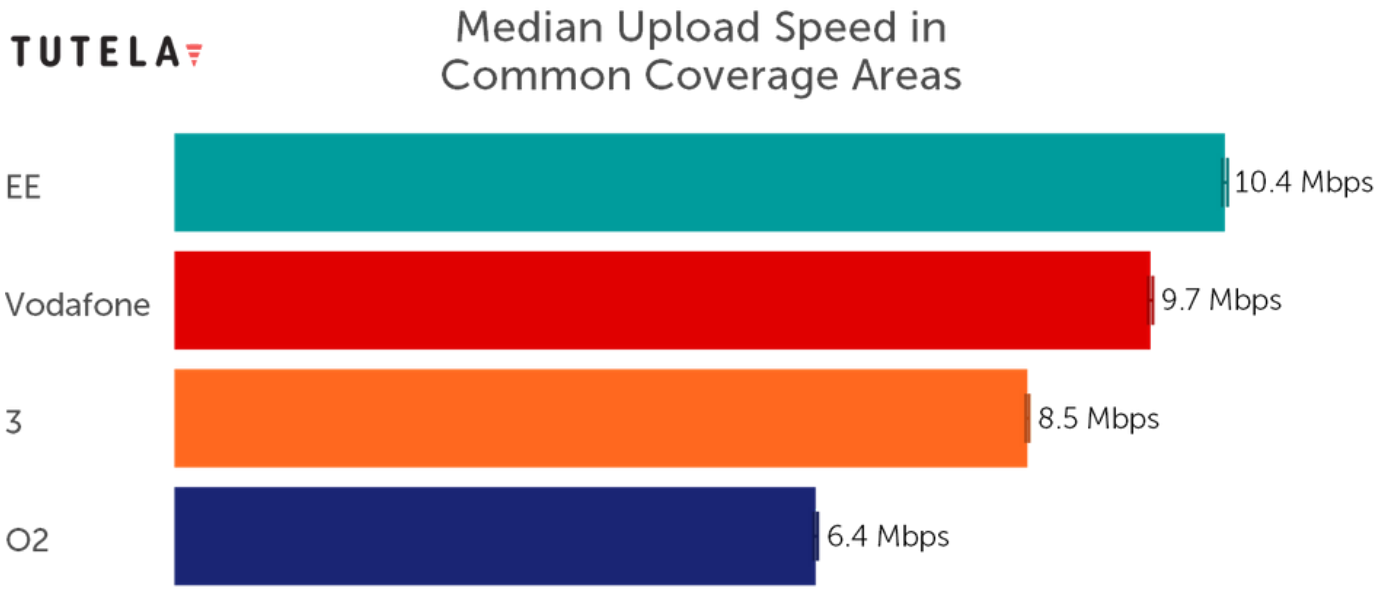
Download throughput

While download speeds do not tell the full story when it comes to mobile network experience, EE's lead for median download speed was day and night. EE's network was over 10 Mbps faster on average than second-place O2, with a median result of 25.7 Mbps. The rankings were much closer between O2 and Vodafone, with just 0.5 Mbps separating the two, and then 3 placed last at 13.2 Mbps.



Upload throughput

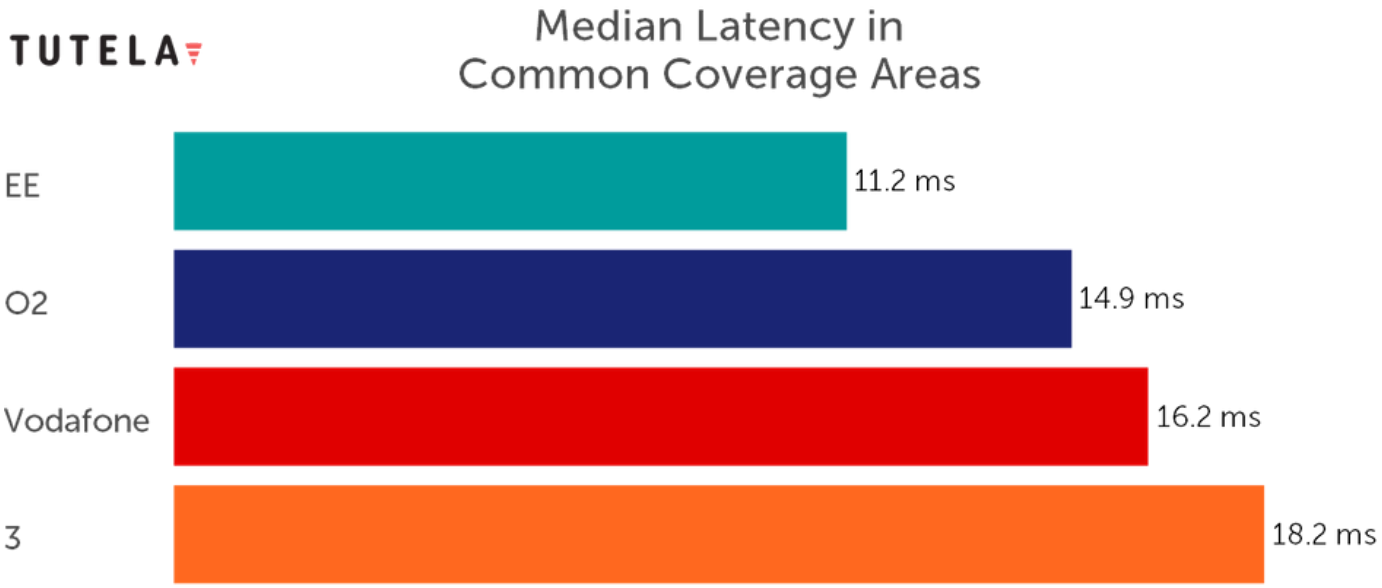
EE also took the lead for median upload speed at 10.4 Mbps, although the rankings between the operators were considerably closer than for download speed. Here, Vodafone placed second at 9.7 Mbps, 3 third at 8.5 Mbps and O2 last at 6.4 Mbps – all, on average, comfortably above the 1.5 Mbps minimum that Tutela uses as part of the Excellent Consistent Quality metric, and which Zoom recommends(3) for group video calls in "gallery view and/or 720p HD video."



(3) Zoom, System requirements for Windows, macOS, and Linux
https://support.zoom.us/hc/en-us/articles/201362023-System-requirements-for-Windows-macOS-and-Linux
Retrieved 17 September 2020

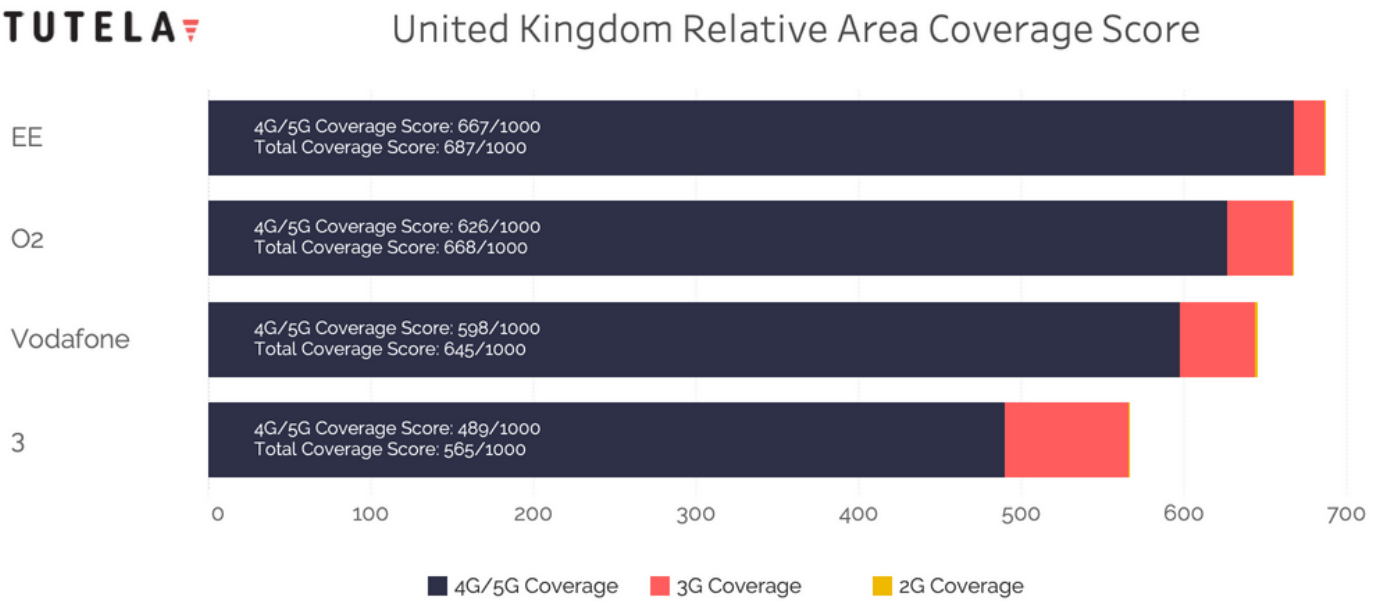
Latency

EE's subscribers experienced a notably more responsive network than subscribers on any of the other big four providers, with a median one-way latency of just 11.2 ms. O2 was second at 14.9 ms, Vodafone third at 16.2 ms and 3 last at 18.2 ms – a full 7ms slower than on EE.



Coverage

Out of the total observed area in the UK where any operator offered a connection, EE demonstrated the greatest overall geographic coverage, with a coverage score of 667 on a 4G/5G connection, and 687 overall. O2 and Vodafone were close behind with scores of 668 and 645 respectively. 3 had notably less coverage overall, with a score of 565, and just 489 for 4G/5G coverage.



Tutela measures relative coverage between providers in a country by looking at the geographic area that an operator's subscribers have seen coverage, compared to the total area of the country where the subscribers of any operator can get a mobile connection. The geographic area covered by each operator, relative to the total covered area of the country, is presented as a score out of 1,000.

Tutela measures this coverage from the perspective of end users – that is to say, inclusive of times when coverage is provided as part of a domestic roaming agreement or shared infrastructure program. An equal number of representative samples are considered from each operator in a country to determine coverage. Coverage is assessed over the preceding 12 months to ensure any effects of seasonality are appropriately included.

Technology usage

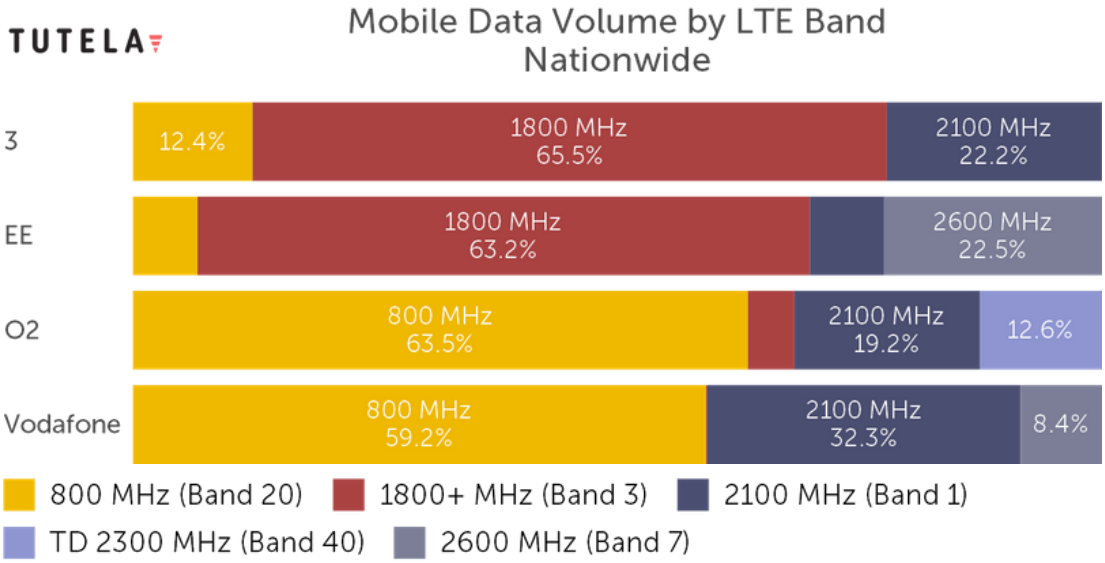
When it comes to spectrum deployment, the UK operators fall into two distinct camps – those that highly rely on 1800 MHz, and those that don't. It is unsurprising that O2 and Vodafone's subscribers use similar volumes of LTE data on the same bands given the longstanding infrastructure sharing agreements(4), but it is odd at first glance to see 3 and EE so similarly grouped when the two are often the bookends of any UK national operator comparison.

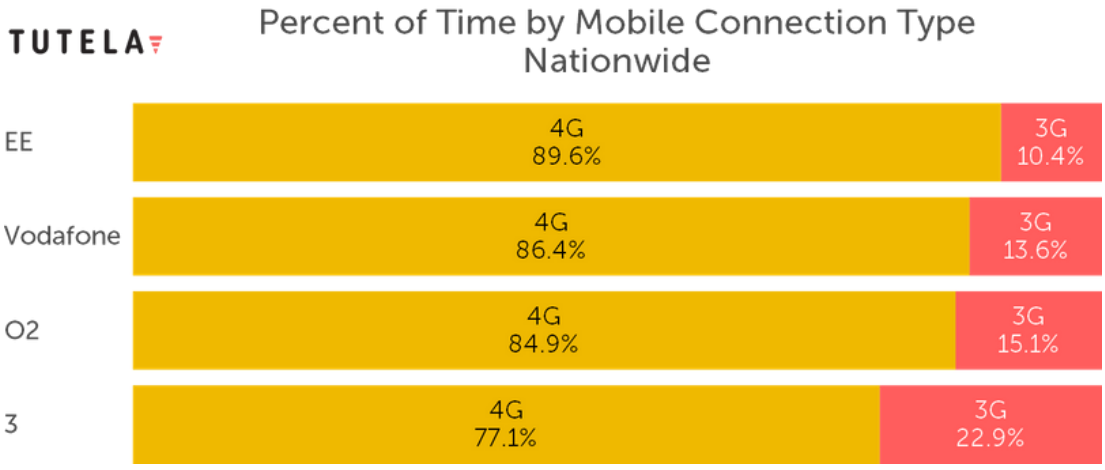
Part of this comes down to availability. Both 3 and EE have just 10 MHz of 800 available, while Vodafone and O2 have 20 MHz. Meanwhile, EE has three times the 1800 MHz bandwidth available of any other operator – with 90 MHz nationwide compared to 3's 30 MHz, and Vodafone and O2's 11.6 MHz. This then contributes to the performance delta between 3 and EE – while both EE and 3 use the 1800 MHz heavily, EE simply has more of it available, meaning it has far better capacity and can deal with higher network usage without declines in performance.

(4) BBC, Vodafone and Telefonica team up over 4G
https://www.bbc.co.uk/news/business-18350697
Retrieved 17 September 2020

This also goes some way to explaining why EE tends to fare extremely well in national comparisons, yet surprisingly is second to Vodafone for Excellent Consistent Quality in Wales and ties with Vodafone for best Excellent Consistent Quality in Scotland – EE's mid-band (and high-band) holdings are ideal for managing congestion in densely populated areas, but less effective for more rural areas where there is less need for high capacity. Nonetheless, EE's sheer breadth of coverage and significant spectrum holdings that bolster capacity mean it is well positioned to take the lead in most scenarios.

When comparing 4G and 3G usage in the UK, EE subscribers spend the most time on 4G at 89.6% of time. However it's notable that subscribers on all operators spend a significant amount of time on 3G connections – particularly 3 subscribers, who are on 3G 22.9% of the time. 5G is not included in this chart as all current significant 5G deployments in the UK rely on a 4G primary cell to support these. This means there is no real volume of time where a UK subscriber is on a 5G-only connection.





Methodology

Tutela is an independent crowdsourced data company with a global panel of over 300 million smartphone users. We gather information on mobile infrastructure and test wireless experience, helping organizations in the mobile industry to understand and improve the world's networks. Tutela is a member of the Comlinkdata family.

Tutela collects data and runs network tests via software embedded in a diverse range of consumer applications, which enable the measurement of real-world quality of experience for mobile users, 24/7. For this report, Tutela has collected over 180 million speed and latency tests, between 1st March and 31st August 2020.

Tutela measures mobile experience based on the real-world performance of actual network subscribers for a given brand, inclusive of occasions when a network or tariff may be throttled or congested. Results in this report are based on a testing configuration designed to represent the typical (rather than maximum) performance that users experience. We use a 2 MB file to perform our download testing and a 1 MB file to perform our upload testing. Latency performance in this report reflects one-way UDP latency. Tests are conducted against the same content delivery networks that power many of the world's most popular consumer applications and websites, and as such reflect the end-to-end performance of the network.

Consistent Quality

Download speed is most often used as a proxy for network quality, but while download throughput is important, it's just one of several crucial requirements for a "good" connection.

As operators have upgraded 3G networks through to the latest 5G technology, theoretical (and even real-world) peak throughput speeds have increased to where they vastly outstrip the maximum needed for any current use-case. Real-world speeds above 100 Mbps are now common in parts of the world, and with a 4K video stream — which itself is rarely something smartphone users need — using a fifth of that, average download speed has lost some of its relevance as the dominant statistic used to measure the quality of wireless networks.

At its most basic, a good connection is one that doesn't get in the way of users doing what they want to do. In the real world, smartphone users aren't running speed tests all day — they're browsing the web, using apps, voice calling their friends, streaming Netflix and YouTube, or making video calls. To more objectively evaluate when connections are (and are not) enabling users to do those things, Tutela has developed a standard called Consistent Quality.

Simply put, it's two sets of thresholds, called Excellent and Core. If a connection hits the Excellent standard, it's sufficient for the most demanding mobile use-cases, like HD group video calling or 1080p video streaming. A Core connection is good enough for SD video streaming, web browsing, emails, and VOIP calling, but users are more likely to experience delays or buffering when trying to use more demanding apps. Tutela also considers times when a Consistent Quality style test was attempted, but subsequently failed for distinguishable connectivity issues on the download or server response component, towards the total percentage of "failed" tests against both sets of thresholds. Tutela bases the threshold values on the minimum performance requirements published by popular apps. We most recently updated our Consistent Quality thresholds on September 1st, 2020. Tutela's consistent quality metric, as used in our reports, simply measures the percentage of time that users can hit the thresholds. The higher the number, the more often users have a Core or Excellent quality connection.

Excellent Quality

KPI	Download throughput	Upload throughput	Latency	Jitter	Packet loss	Time to first byte
Minimum acceptable value	5 Mbps	1.5 Mbps	50 ms	30 ms	1%	3.2 s

Core Quality

KPI	Download throughput	Upload throughput	Latency	Jitter	Packet loss	Time to first byte
Minimum acceptable value	1.5 Mbps	500 Kbps	100 ms	50 ms	5%	10.67 s

Discover Tutela Explorer

Tutela Explorer is a powerful cloud-based solution for real-time analysis of crowdsourced data. Using the platform, mobile operators can:

- Create coverage and quality maps
- Benchmark network quality and coverage across all operators
- Drill down to any KPI at city, street or even building level
- Analyse spectrum utilisation, performance and more

Visit www.tutela.com/explorer to learn more

Learn more

Appendix

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Results Overview Nationwide

	Download Throughput	Upload Throughput	Latency	Excellent CQ	Core CQ
3	13.3 Mbps ± 0.03 Mbps	8.2 Mbps ± 0.02 Mbps	18.4 ms ± 0.012 ms	68.66% ± 0.07%	88.01% ± 0.04%
EE	25.3 Mbps ± 0.04 Mbps	10.0 Mbps ± 0.02 Mbps	11.5 ms ± 0.007 ms	81.12% ± 0.06%	92.38% ± 0.02%
O2	14.5 Mbps ± 0.04 Mbps	6.4 Mbps ± 0.02 Mbps	15.3 ms ± 0.013 ms	72.47% ± 0.09%	92.09% ± 0.04%
Vodafone	14.0 Mbps ± 0.03 Mbps	9.3 Mbps ± 0.02 Mbps	16.5 ms ± 0.010 ms	74.87% ± 0.08%	92.80% ± 0.03%

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Results Overview in Common Coverage Areas

	Download Throughput	Upload Throughput	Latency	Excellent CQ	Core CQ
3	13.2 Mbps ± 0.03 Mbps	8.5 Mbps ± 0.02 Mbps	18.2 ms ± 0.012 ms	68.66% ± 0.07%	87.90% ± 0.04%
EE	25.7 Mbps ± 0.05 Mbps	10.4 Mbps ± 0.03 Mbps	11.2 ms ± 0.007 ms	81.64% ± 0.06%	92.35% ± 0.02%
O2	15.1 Mbps ± 0.05 Mbps	6.4 Mbps ± 0.02 Mbps	14.9 ms ± 0.012 ms	73.16% ± 0.10%	92.47% ± 0.04%
Vodafone	14.6 Mbps ± 0.04 Mbps	9.7 Mbps ± 0.02 Mbps	16.2 ms ± 0.011 ms	75.44% ± 0.08%	93.07% ± 0.04%

About Tutela

Tutela Technologies, Ltd., is an independent crowdsourced data company with a global panel of over 300 million smartphone users. It gathers information on mobile infrastructure and tests wireless experience, helping organizations in the mobile industry to understand and improve the world's networks. Data and insights provided by Tutela are trusted by the engineering teams at mobile network operators and network equipment manufacturers around the world and used to compare operators as well as inform decisions in network and infrastructure planning and optimisation. The organization is headquartered in Victoria, British Columbia.

Tutela does not collect any sensitive personal data and is compliant with international privacy regulations including CCPA and GDPR.

For further information about the methodology, data and tools used to create this report, please contact analysis@tutela.com or visit www.tutela.com.

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