Mobile matters

Researching people's experience of using Android mobile services

Welsh summary available: Materion symudol

Overview

Mobile phones are essential items for millions of people across the UK. Whether it's for work, keeping in touch with family or shopping online, staying connected has never mattered more – particularly in light of the Covid-19 pandemic.

To better understand the changing ways in which people use their mobile services, and the experience they receive, Ofcom has analysed crowdsourced data collected between January and April 2020 from around 200,000 Android devices[1] across the UK.

In this report, we focus on the share of connections across wireless network technologies (2G, 3G, 4G, 5G, Wi-Fi), the success rate for mobile connections, response times and patterns in the ways people use their mobile phones. We also look at how these vary by factors such as location, day of the week and time of day.

In March, the UK entered a period of 'lockdown' in response to the Covid-19 pandemic. This had a substantial impact on our use of mobile communications services, as people became more reliant on smartphones and other devices to stay in touch with friends and family, work from home and keep up to date with the latest news. To look more closely at this change, we compared use pre-lockdown (1 January to 22 March) and post-lockdown (23 March to 30 April). For certain performance metrics – success rate for mobile connections and response times – we compared the pre-lockdown averages with figures from last year's report to see if there had been significant year-on-year changes. Due to changes in the panel, we are unable to make year-on-year comparisons for other metrics which rely on user behaviour.

For a more detailed description of the data collection and analysis, please see Annex 1: Technical Methodology and Annex 2: Statistical Methodology.

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[1] The dataset was licensed to Ofcom by network benchmarking specialist umlaut, and contains information on mobile user experience and network performance. The operating system used on iPhones (iOS) restricts the collection of network performance data by background apps, so the data in this report relate to Android devices only. These devices are predominantly smartphones, although there are a small number of tablets and other Android devices with a SIM card.

What we have found

Two-thirds (65%) of the time, devices were connected to Wi-Fi rather than to a cellular network.

People were able to connect to a 4G network on 97.3% of the occasions when they attempted to do so.

There were no significant differences in failure rates for mobile connections between mobile network operators, but people on EE were the most likely to connect to a 4G rather than a 3G network, while people on Three were the least likely to connect to a 4G network.

Analysis of performance in high-traffic areas shows that 3G and 4G connections were almost twice as likely to fail during peak times than at other times throughout the day.

The average length of a mobile call increased by almost two minutes during the early stages of lockdown.

Lockdown also resulted in a dramatic decrease in mobile use in the central areas of the UK's capital cities, as people stopped commuting into these areas and instead worked from home, typically over Wi-Fi.

Notes on the data included in this report

This research is part of a wider programme of work by Ofcom to research and provide information about mobile quality of service. The data in this report relate to performance when network coverage is available from an operator, while Ofcom's broadband and mobile checker provides information about mobile coverage from all four mobile networks across the UK.

The network share and data connection success rate figures in this report are based on background tests run every 15 minutes. These tests are run on the data network technology available at the time, as determined by the device, and recorded as either successful or unsuccessful. As we are unable to state whether unsuccessful tests would have succeeded on an alternative data network technology, these metrics are not a measure of overall network coverage.

There were three days in March that we have excluded from some of our analysis: the 17th, 18th and 19th. This is because there was temporary congestion on the Interconnect services between mobile network operators, which was resolved by increasing the capacity of these services progressively over a few days. In our data, we found that this had a substantial impact on mobile phone calls and the reliability of data connections. Due to the unusual circumstances, we did not include data for these days in our pre-lockdown analysis for mobile phone calls, reliability of data connections and the response time for data requests.

All analysis is conducted at the wholesale mobile network provider (MNO) level. References to the performance of the UK's four MNOs (EE, O2, Three and Vodafone) may also include the performance of panellists who are customers of mobile virtual network operators that use these networks, such as Tesco Mobile, GiffGaff, iD Mobile and Virgin Mobile.

The analysed metrics are only some of the factors that people may wish to consider when making decisions about their mobile service. Price, handset type, quality of customer service, coverage and contract terms are other relevant aspects that should be taken into account.

Contents

How people are connecting to wireless networks

Network share

Two-thirds of the time, people using their mobile phones during the research period were connected to Wi-Fi rather than to a mobile network (2G, 3G, 4G or 5G). This varied significantly by location and network operator. People in urban areas were slightly more likely than those in rural areas to be connected to Wi-Fi (66% vs. 64%), primarily due to greater access to Wi-Fi in offices and public spaces. Similarly, Wi-Fi share was higher at the weekends, when people tend to spend more time at home.

During the first six weeks of lockdown (23 March to 30 April) the percentage of time spent connected to Wi-Fi increased by 9pp to just under three-quarters (74%), as people were confined to their homes for most of the day and more likely to stay connected to their home Wi-Fi network.

Figure 1: Average network share[2] by technology, pre-lockdown
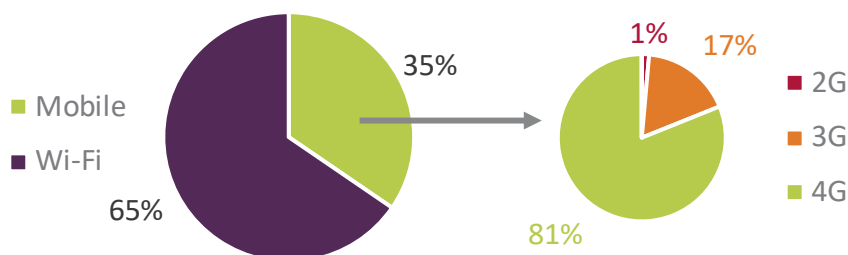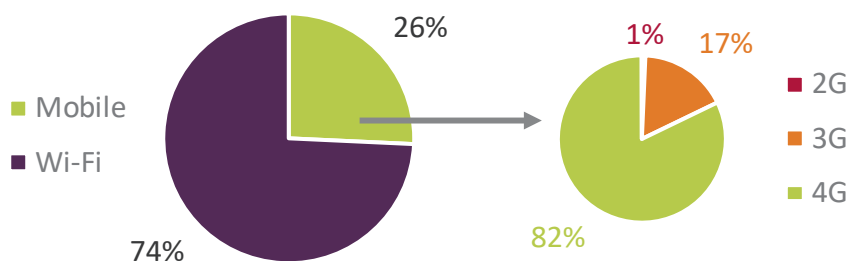

Figure 2: Average network share by technology, post-lockdown

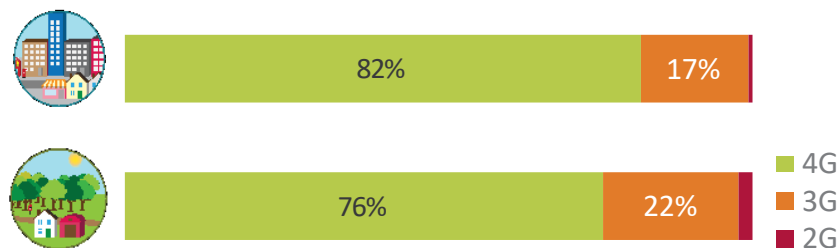*Source: Ofcom analysis of crowdsourced Android data*
Notes: percentages are rounded to the nearest whole percentage and refer to the percentage of connection tests run every 15 minutes, not data traffic; 'pre-lockdown' refers to 1 January to 22 March 2020; 'post-

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[2] umlaut's software records the type of network that the handset is connected to every 15 minutes. Network share is the breakdown of these records by technology – Wi-Fi or mobile, and within mobile 2G, 3G, 4G or 5G – which provides an overall picture of time spent connected to networks. More details on the data collection and analysis can be found in Annex 1: Technical Methodology and Annex 2: Statistical Methodology.

For connections made via mobile networks, people were connected to 4G for 81% of the time, with most of the rest of their time spent on 3G. Again, as seen in figure 3, this varied by location: people in urban areas were more likely to be connected to 4G than those in rural areas.

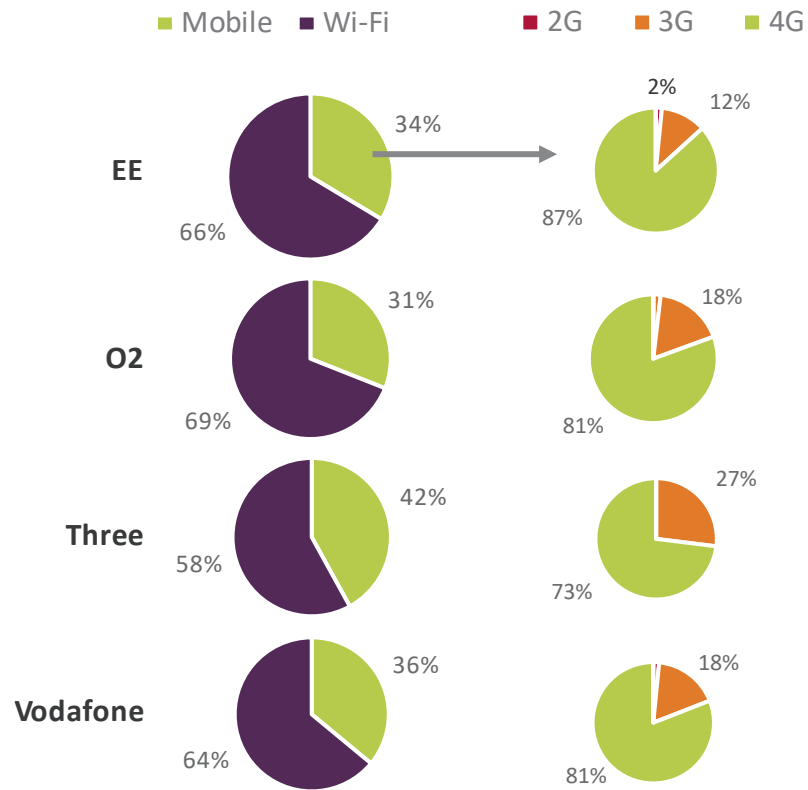**Figure 3: Average mobile network share by technology and rurality, pre-lockdown**

Source: Ofcom analysis of crowdsourced Android data
Notes: percentages refer to the percentage of connection tests recorded as being over a mobile network; 'pre-lockdown' refers to 1 January to 22 March 2020; 5G connections are not shown as the proportions are too low to display; separate 5G analysis can be found on page 18

During the pre-lockdown research period, people using Three's network continued to spend more time on mobile networks than those on EE, O2 and Vodafone (42% vs. an average of 33% for EE, O2 and Vodafone); this may be driven by higher take-up of high and unlimited data tariffs among Three customers. Looking at mobile connections, people using EE's network spent the highest proportion of time connected to 4G (87%) compared to those using Three's network who spent 73% of the time using on 4G. People using Three's network spent more time connected to 3G (27%) compared to others using either EE, O2 or Vodafone (total average of 16%). This is likely to be for two reasons: differing levels of 4G network coverage and different approaches to network management. For certain mobile activities, such as reading the news or browsing social media, the performance of a 3G connection can be as good as a 4G connection. Operators may revert customers to 3G in areas with weaker signal or network congestion to provide a more reliable connection and to manage capacity.

Figure 4: Average network share by technology and network operator, pre-lockdown

Legend: ■ Mobile ■ Wi-Fi ■ 2G ■ 3G ■ 4G

EE: 34% Mobile / 66% Wi-Fi → 87% 4G / 12% 3G / 2% 2G

O2: 31% Mobile / 69% Wi-Fi → 81% 4G / 18% 3G

Three: 42% Mobile / 58% Wi-Fi → 73% 4G / 27% 3G

Vodafone: 36% Mobile / 64% Wi-Fi → 81% 4G / 18% 3G

Source: Ofcom analysis of crowdsourced Android data
Notes: The charts show the percentage of connection tests (run every 15 minutes) that connect to different network types, they do not show the share of data traffic; 'pre-lockdown' refers to 1 January to 22 March 2020; analysis conducted at the wholesale mobile network provider (MNO) level; 5G connections are not shown as the proportions are too low to display; separate 5G analysis can be found on page 18

# How networks are performing

Reliability of data connections

With mobile phones increasingly important for everyday tasks like checking emails and train times, booking appointments and online banking, people rely on being able to connect to the internet wherever they are. The data collected reveal how often people could access data services when they were actively using their phone. It is not a measure of mobile coverage, but of how frequently people could connect to data services when they needed to, in areas where a network was available.

On average, people could use data services on 4G networks on 97% of occasions whenever they attempted to do so, with no significant difference by nation or rurality[3]. The success rate was lower on average for 3G connections, which were successful 94% of the time, but it is important to note that these connections are more likely to be at the 'edge' of a network, typically when a connection reverts to 3G when a 4G network is not available.

The overall percentages for the reliability of 3G and 4G data services for the pre-lockdown period in 2020 were in line with the average figures for the similar period in 2019. There were no significant differences in 4G data service availability by mobile network at the UK level, but 3G connections on the Three network were more likely to succeed than those on O2 and Vodafone (95.9% vs. 93.2% and 93.5% respectively). This is due in part to how operators configure their networks; people on the Three network are more likely than those on other networks to access a 3G rather than a 4G network.

Figure 5: Average success rate for 3G and 4G connections by rurality, pre-lockdown
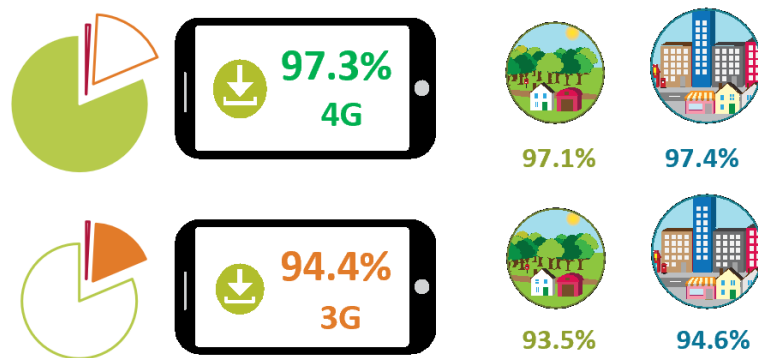
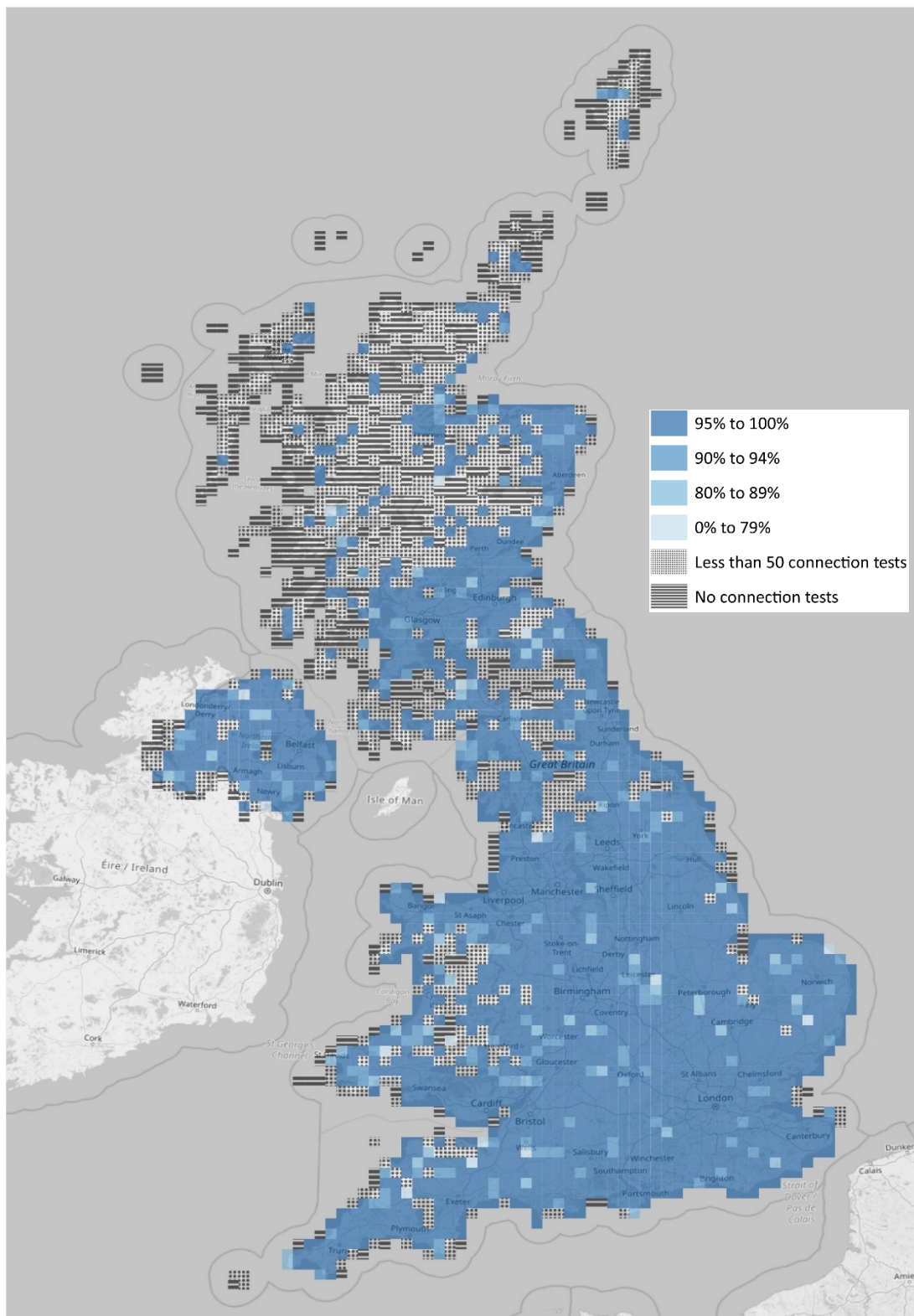*Source: Ofcom analysis of crowdsourced Android data*
Notes: percentages refer to the percentage of connection tests recorded as successful while the phone's screen was on; 'pre-lockdown' is here defined as 1 January to 22 March 2020

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[3] Note that this 97% success rate reflects the reliability of the network in the places that the people on our panel visited or travelled through, not the overall landmass coverage of the network.

To look more closely at variations in 4G performance by location, we divided the UK into 10x10km squares and calculated the average success rate for connections made in each one. The dotted squares in the diagram below had fewer than 50 4G samples and were excluded from the analysis. The dashed squares had no recorded 4G connection tests between 1 January and 22 March when the phone screen was on, which might be because there was no coverage, or because nobody on our panel visited that area during the period. This explains why there are so many dotted and dashed areas in more rural and remote locations, such as the Western Isles in Scotland and the Snowdon National Park in Wales.

The average success rate for 4G connections remained high in many areas, but there were a few areas where connections were less reliable, failing at least 20% of the time. An interactive version of this map is available here.

Figure 6: Average success rate for 4G connection tests, 1 Jan to 22 March 2020

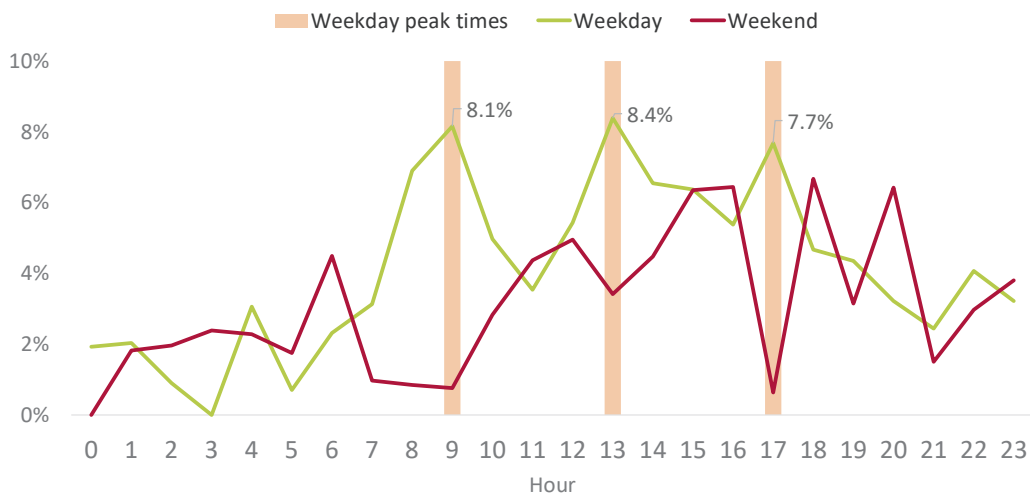|	
95% to 100%	
90% to 94%	
80% to 89%	
0% to 79%	
Less than 50 connection tests	
No connection tests	

Source: Ofcom analysis of crowdsourced Android data
Notes: percentages refer to the percentage of 4G connection tests recorded as successful while the phone's screen was on; black and white areas did not have enough samples to complete the analysis; this map does not depict landmass coverage of 4G networks; data refer to 1 January to 22 March 2020, excluding the 17-19 March outage period to be more representative of the average performance year-round

Performance in high-traffic areas

Analysis of performance in and around selected high-traffic areas shows that 3G and 4G connections were almost twice as likely to fail during peak times than at other times throughout the day. During the week at London Waterloo station, the UK's busiest railway station,[4] data connection failure rates were higher around lunch and commuter times than at other times of the day, probably due to increased demand on networks. At the weekend, 3G and 4G connections were more likely to fail during the afternoon and evening, reflecting the congestion in the area of Waterloo and the Southbank over the weekend[5].

Figure 7: Percentage of failed 3G and 4G connection tests around Waterloo station by time of day

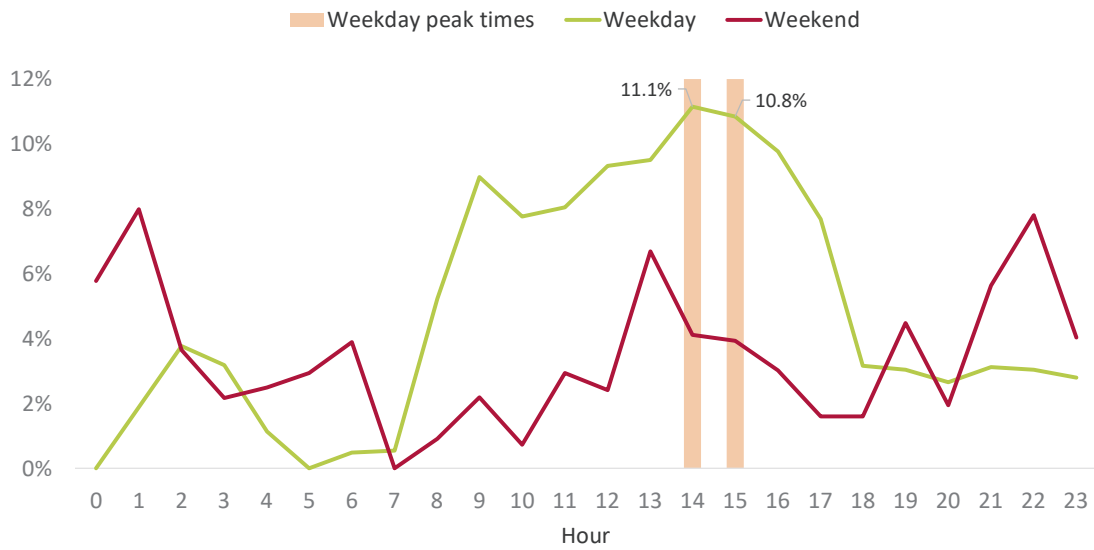*Source: Ofcom analysis of crowdsourced Android data*
Notes: percentages refer to the percentage of 3G and 4G connection tests recorded as unsuccessful; data refer to 6 January to 15 March 2020

Further analysis of data collected in and around other UK railway stations revealed similar variations in connection reliability, although failure rates peaked at different times of the day. 3G and 4G mobile connections around Cardiff Central were almost three times more likely to fail between 6pm and 7pm than any other hour of the day (11.1% vs. 4.2%), while at Manchester Piccadilly they were most likely to fail between 2pm and 4pm. During the week, 9.3% of data connections made at Manchester Piccadilly between 9am and 5pm failed, compared to an average of 2.7% at other times. There were no significant differences in failure rate by hour for Edinburgh Waverly and Belfast Lanyon Place stations, both of which had an average success rate of 97% across the day for 3G and 4G connections. This could be due to a number of factors, including the frequency of services and passenger throughput, which may result in less variation in demand for mobile data connections throughout the day, and the deployment of extra capacity in the network.

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[4] in terms of entries and exits, data from Office of Road and Rail 2018-19 Estimates of Station Usage, updated June 2020
[5] The data connection test failure rate at 3-4pm, 6pm and 8pm combined was 6.5%, compared to 2.7% across other times of the day.

Figure 8: Percentage of failed 3G and 4G connection tests around Manchester Piccadilly station by time of day

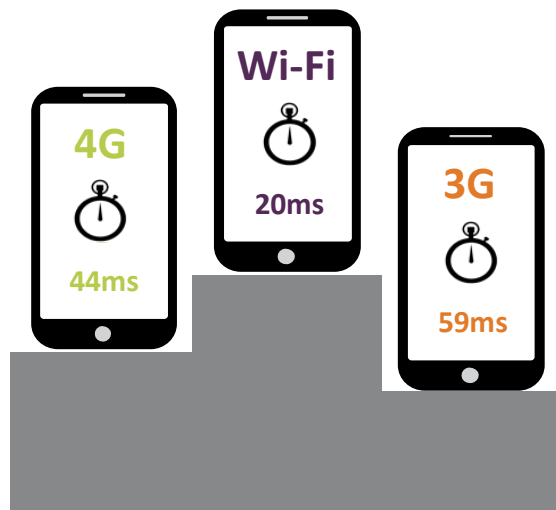Source: Ofcom analysis of crowdsourced Android data
Notes: percentages refer to the percentage of 3G and 4G connection tests recorded as unsuccessful; data refer to 6 January to 15 March 2020

Response times for data requests

The time it takes the network to respond to data requests – for example to load a web page or stream a video – can have a noticeable impact on user experience. In general, most mobile activities need a network response time (often referred to as 'latency') under 100ms to provide a good experience. For some video services, such as video calling, this drops to 50ms, while others such as web browsing will perform satisfactorily with a slower response time.

On average, Wi-Fi response times were half those of 4G connections, with no significant differences by rurality. Average response time on 3G networks were higher, with significant differences by rurality (64ms in rural vs. 58ms in urban areas). Looking at the data by nation, connections in England were the most responsive, while those in Northern Ireland were the least responsive, on both 4G and 3G networks. This could be due to more connections being made further from the mast and towards the 'edge' of cell areas, where the signal strength is weaker, as well as content being cached – and therefore quicker to retrieve – in areas where more people are using the network. The overall averages for mobile response time by mobile technologies in 2020 were similar to those for the same period in 2019, with no statistically significant differences.

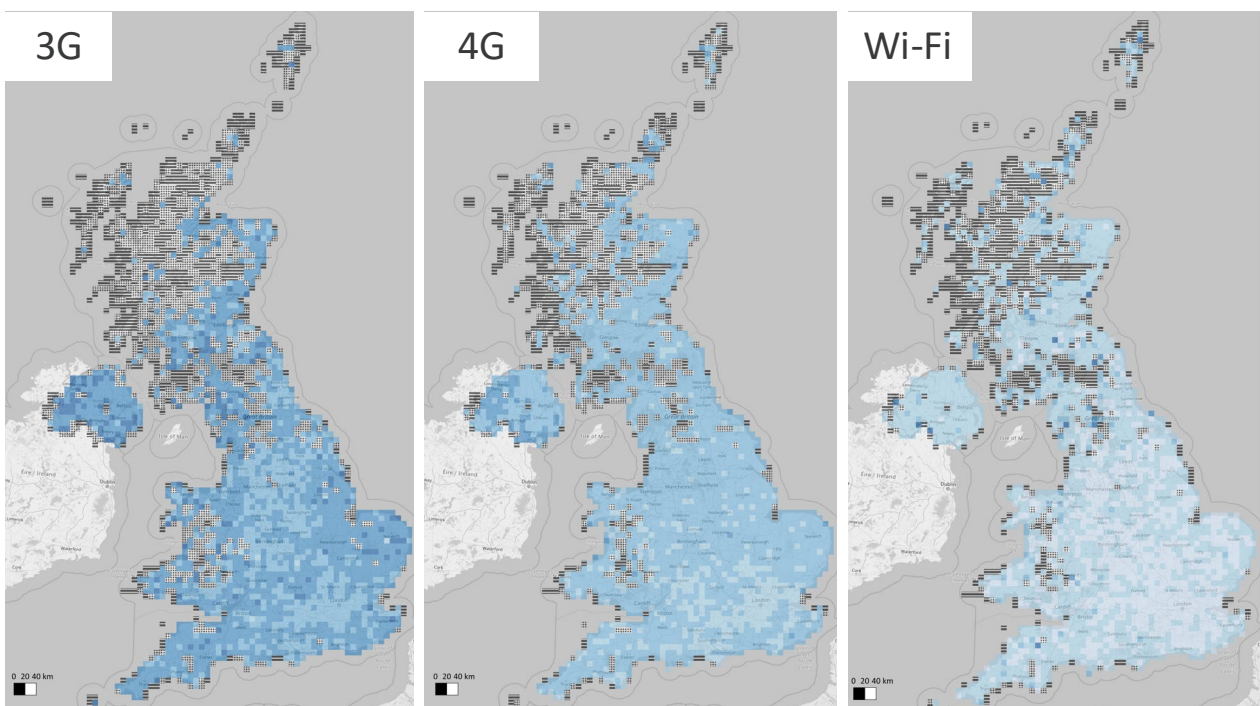**Figure 9: Average response time by network technology in ms**

Source: Ofcom analysis of crowdsourced Android data
Notes: data refer to 1 January to 22 March 2020, excluding the 17-19 March outage period to be more representative of the average performance year-round

To look more closely at variations in response time by technology and location, we divided the UK into 10x10km squares and calculated the median average response time for 3G, 4G and Wi-Fi connections made in each square. The dotted squares in the diagrams below had fewer than 50 samples and were excluded from the analysis. The dashed squares had no recorded 3G, 4G or Wi-Fi latency tests between 1 January and 22 March, which might be because there was no coverage, or because nobody on our panel visited that area during the period. Slower response times appear darker and faster response times appear lighter.
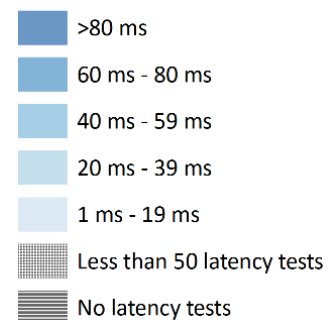
The maps below show that while Wi-Fi connections are quicker than 3G and 4G connections, there is variation in performance within each technology depending on location, with response times in urban areas typically faster than those in rural areas. Interactive versions of these maps are available here.

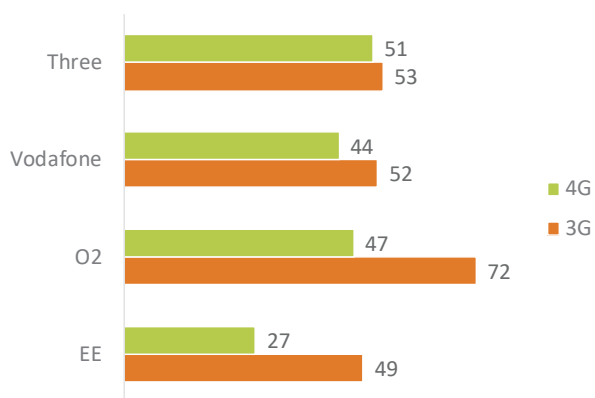**Figure 10: Median response time by network technology (lighter is better)**

Source: analysis of crowdsourced Android data
Notes: data refer to 1 January to 22 March 2020, excluding the 17-19 March
outage period to be more representative of the average performance year-round;
Interactive versions of these maps are available here

Legend:
- >80 ms
- 60 ms - 80 ms
- 40 ms - 59 ms
- 20 ms - 39 ms
- 1 ms - 19 ms
- Less than 50 latency tests
- No latency tests

Average response time was significantly faster on the EE network for both 3G and 4G connections, while 3G connections on the O2 networks were the slowest. However, all response times were below the 100ms threshold and any differences are unlikely to be noticeable unless the user is using their phone for services which require very fast response times for optimal performance, such as video calling or gaming.

Figure 11: Average response time by network operator and technology in ms (lower is better)

Source: Ofcom analysis of crowdsourced Android data
Notes: data refer to 1 January to 22 March 2020, excluding the 17-19 March outage period to be more representative of the average performance year-round

How people are using mobile networks

Data use

Our research shows that, during the working day, data use is fairly evenly split between mobile and Wi-Fi technologies. From around 6am, the split of hourly traffic shifts from around 70% on Wi-Fi and 30% on mobile to a near 50:50 split across the technologies, as people commute to work and go about their day. From around 4pm the gap widens again and returns to the 70:30 split when people get home and are more likely to use their home Wi-Fi connection. A similar pattern can be seen at weekends, but the share of traffic on Wi-Fi remains higher throughout the day, only dropping to around 60%.

**Figure 12: Weekday data use per hour by wireless technology, pre-lockdown**
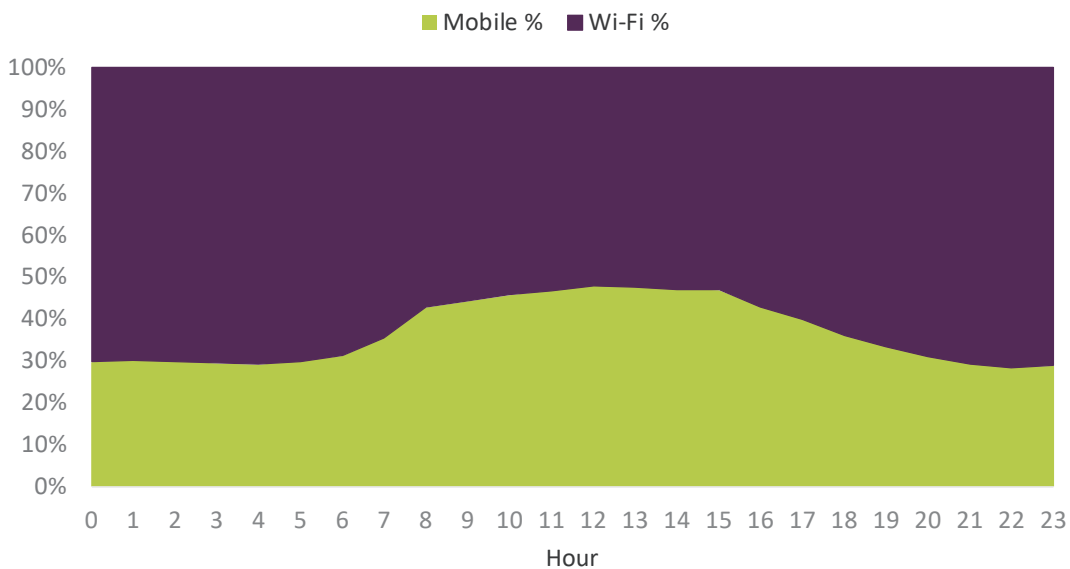
Source: Ofcom analysis of crowdsourced Android data
Notes: data refer to 1 January to 22 March 2020; to exclude panellists with very low data use, analysis was run on a subset of heavy data users (those with higher than the mean average of the total panel)

This pattern changed during lockdown, as people were in their homes and able to connect easily to their home Wi-Fi network. The share of hourly data use over Wi-Fi barely dropped below 70% throughout the day.

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Figure 13: Weekday data use per hour by wireless technology, post-lockdown
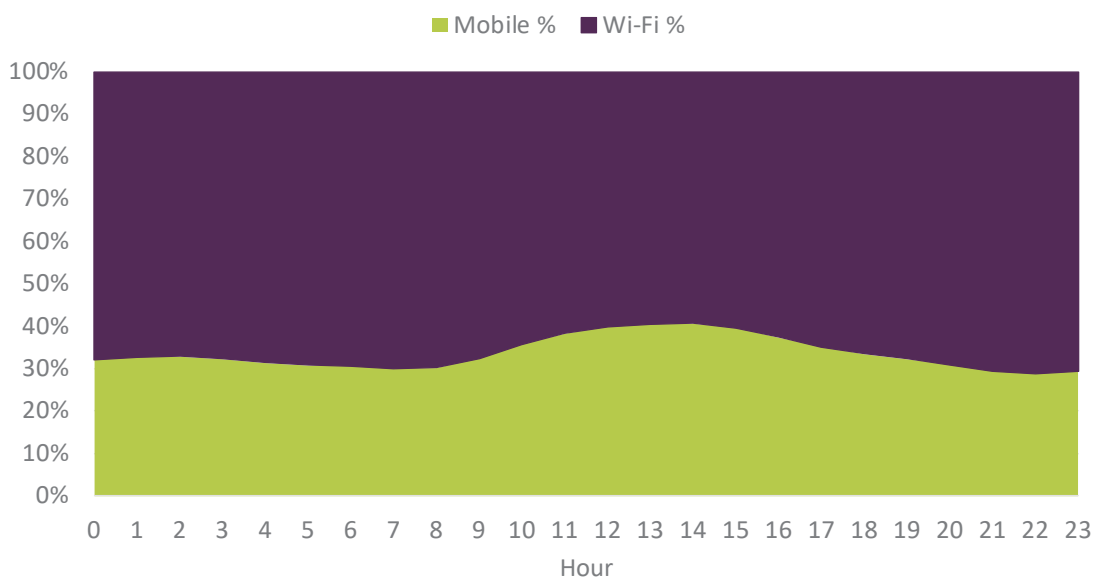
Source: Ofcom analysis of crowdsourced Android data
Notes: data refer to 23 March to 30 April 2020; to exclude panellists with very low data use, analysis was run on a subset of heavy data users (those with higher than the mean average of the total panel)

Mobile phone calls

Mobile calls remain an important means of communication for most but not all people, as a minority of people only use data services on their mobile phones (potentially including VoIP calls using services such as Skype or WhatsApp). Our crowdsourced data showed that 75% of panellists made a call in the first 11 weeks of the year, and 78% of panellists made or received a call. There was no significant change in these proportions between pre- and post-lockdown, suggesting that people who weren't making or receiving phone calls before did not start to during lockdown, or used social media and/or VoIP services instead to stay connected.

The average length of a mobile call increased by almost two minutes during the Covid-19 lockdown. Our data show that the average length of a mobile-originated call increased from just over three and half minutes (3m40s) to around five and a half minutes (5m26s) in the six weeks following the start of lockdown, as people who were confined to their homes used their mobiles to stay in contact with friends, family and work colleagues.

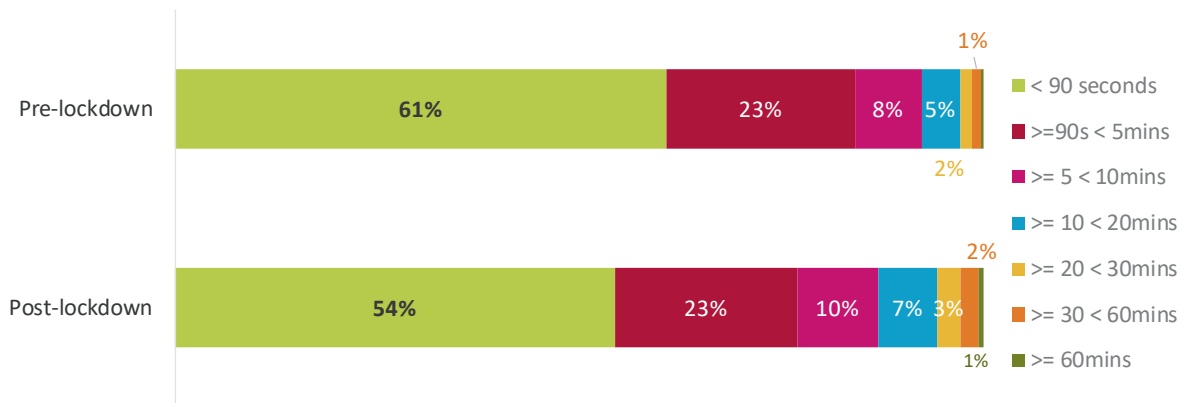**Figure 14: Average call duration (mins:secs) pre- and post-lockdown**

Source: Ofcom analysis of crowdsourced Android data
Notes: analysis of outgoing mobile voice calls lasting longer than 10 seconds; 'pre-lockdown' refers to 1 January to 22 March 2020; 'post-lockdown' refers to 23 March to 30 April 2020; More granular analysis of how this varies by location is available in the interactive report

Pre-lockdown, more than 80% of calls lasted for less than five minutes, with 61% less than ninety seconds, suggesting that people typically make frequent but relatively short mobile calls. Post-lockdown, the proportion of mobile calls that were shorter than five minutes fell to 77%, and the percentage that lasted longer than 20 minutes doubled, from 3% to 6%, again probably due to people phoning friends and family, as well as an increase in the number of people working from home.

Figure 15: Proportion of outgoing calls by average duration, pre- and post-lockdown
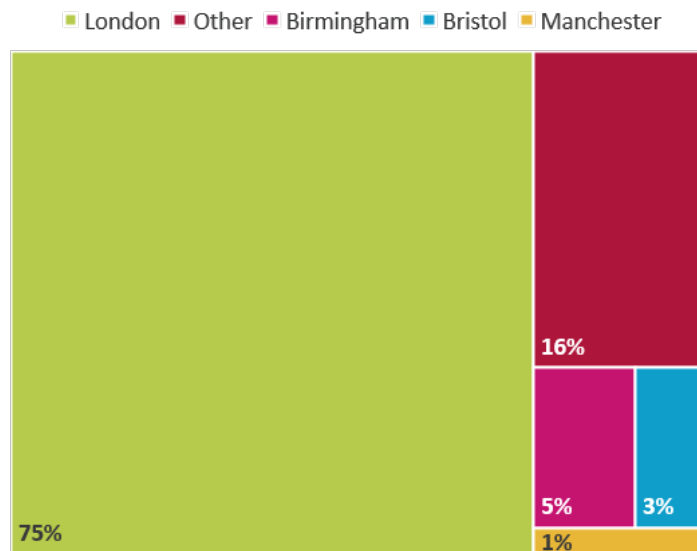

Source: Ofcom analysis of crowdsourced Android data
Notes: analysis of outgoing mobile voice calls lasting longer than 10 seconds; 'pre-lockdown' refers to 1 January to 22 March 2020; 'post-lockdown' refers to 23 March to 30 April 2020

5G services: pilot analysis

A small number of panellists had 5G-enabled devices and tariffs, allowing us to look at where these services were being used and how they were performing. From our total panel of c.200,000 people, 272 (0.1%) had 5G-enabled Android handsets, the most popular of which was the Samsung Galaxy Note 10. Between January and April these handsets generated 9.5k 5G records, 99% of which were in urban areas. Two-thirds were recorded in London, with the rest spread across other UK cities. This concentration of 5G users is not surprising, as deployment has been primarily focused in towns and cities. It is still early days for the roll-out of 5G, and there are significant developments on the horizon, with more spectrum being released through an auction early next year and the release of more flagship 5G smartphones, which will contribute to coverage and take-up of 5G services.

**Figure 16: Breakdown of 5G records by location**

Source: Ofcom analysis of crowdsourced Android data
Notes: data refer to 01 January to 30 April 2020; cities displayed had over 100 valid 5G records

Using the same approach that we use to analyse network share, we looked at the proportion of time that 5G users spent connected to 5G networks. On average in the first four months of the year, 5G users spent 14% of their time connected to 5G networks, and 81% connected to 4G networks. 5G users' 4G network share was the same as the UK average overall (81%), but they spent much less time connected to 3G than other mobile users (5% vs. 18%). This may be because 5G users were more likely to be in urban areas.

Figure 17: Average mobile network share for 5G users
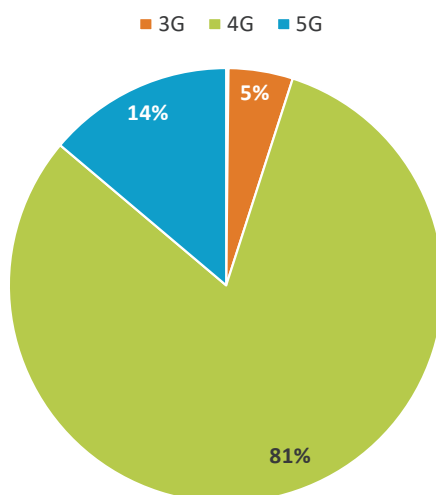
Source: Ofcom analysis of crowdsourced Android data
Notes: percentages refer to the proportion of mobile connection tests run every 15 minutes; data refer to 01 January to 30 April 2020

We found that these 5G connections were just as reliable as 4G, successfully connecting to the network on 97.4% of occasions (compared to 97.3% for 4G). They were also quicker to respond to data requests, with an average response time of 37ms vs. 44ms for 4G connections.

Changes during lockdown

Network use in urban areas

Mobile use in the UK's capital cities decreased during the Covid-19 lockdown, while the number of connections to Wi-Fi networks increased in more residential areas. Central areas typically experienced the largest reduction in mobile activity, and there was also evidence of increased mobile use in suburban areas and open spaces, as people limited their movement to their local area, nearby parks and other recreational areas.

The maps below compare the number of connection tests in Belfast, Cardiff, Edinburgh and London during a baseline week in January and in the last week of April. Mobile activity (2G, 3G, 4G and 5G connections) is on the left and Wi-Fi activity is on the right. By looking at the difference in connection tests[6] in each 1x1km square, we can assess the impact of lockdown on specific areas and see where people were – and were not – roaming in the first six weeks of lockdown.

As expected, some areas saw a dramatic decrease (between 50% and 100%) in the number of mobile connection tests, as people were not commuting or socialising and were more likely to be connected to Wi-Fi while working from home. These decreases appear as red, while increases appear in blue. However, there were a number of areas where people went during the lockdown but not before it. This may be because they were seeking out new, or quieter places to walk or exercise.

Interactive versions of these maps are available here; it is possible to zoom in on certain areas and see the underlying data.

Figure 18: Key for the maps below

	>100%
	75 to 100%
	50 to 74%
	25 to 49%
	1 to 24%
	0%
	-25 to -1%
	-50 to -26%
	-75 to -51%
	-100 to -76%
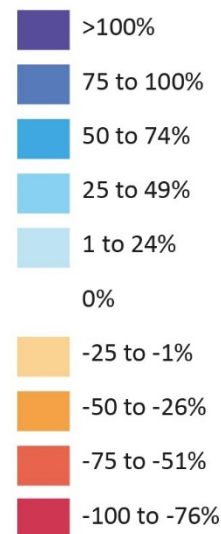
Notes: Percentages refer to the change in the number of connection tests[6]

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[6] Umlaut's software records the type of network that the handset is connected to every 15 minutes (a 'connection test'). More details on the data collection and analysis can be found in Annex 1: Technical Methodology and Annex 2: Statistical Methodology.

Figure 19: Percentage change in mobile and Wi-Fi connection tests during 20-26 April compared to 13-19 January: Belfast
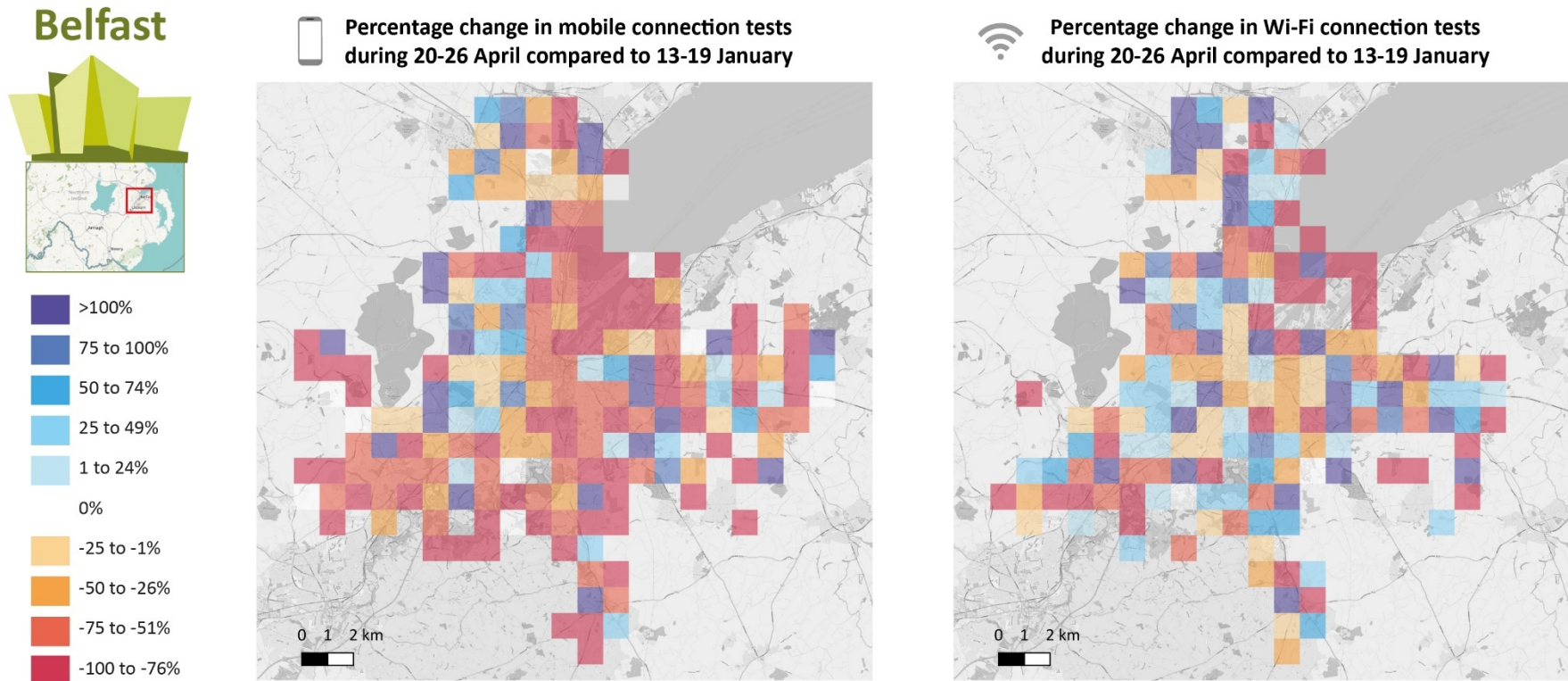
Source: Ofcom analysis of crowdsourced Android data

Notes: left-hand map percentages refer to the difference in the number of 2G, 3G, 4G and 5G-only connection tests made during 20-26 April compared to 13-19 January; right-hand map percentages refer to the difference in the number of Wi-Fi connection tests made during the same period; decreases shown in red; increases shown in blue; an interactive version of the mobile map is available here; an interactive version of the Wi-Fi map is available here

Most of Belfast experienced a decrease in the number of mobile connections, showing the vast reduction in mobility across the city, especially in central areas. Most of the transport hubs, such as Great Victoria Street and Lanyon Place railway stations, the Europa Buscentre, Belfast City Airport and Belfast Harbour had a reduction in mobile activity during the lockdown. Similar declines occurred in the areas around Belfast's main student campus sites, such as Queen's University,

and around the main shopping centres, Victoria Square and Castle Court. In several areas outside central Belfast there was also a steep reduction in the number of mobile connection tests; these included areas around the Boucher Road that are close to a commercial estate and normally very busy, and around the Derriaghy industrial estate.

Areas with a notable increase in mobile activity were mostly non-central residential districts, often close to parks or open spaces. This may be due to the presence of people in these neighbourhoods who would normally be in central Belfast during the day for work or study, and who instead were working at home and trying to get some exercise nearby. These areas include the Shandon Park golf course, the Upper Malone area, parks such as the blue trail and the Sir Thomas and Lady Dixon Park, and the areas around Ligoniel Road.

Wi-Fi use was more stable overall compared to mobile data use, even increasing at times. Wi-Fi connections increased especially in residential non-central areas, for example around Glengormley, Dundonald, and Ardoyne, which may be further evidence of more people being at home and using Wi-Fi for data. The largest decreases in the number of Wi-Fi tests were registered in the city centre and in non-central areas home to industrial or office districts; for example, just north of the Derriaghy and around the Castlereagh industrial estates, and the commercial districts in Belfast Harbour Estate.

Figure 20: Percentage change in mobile and Wi-Fi connection tests during 20-26 April compared to 13-19 January: Cardiff
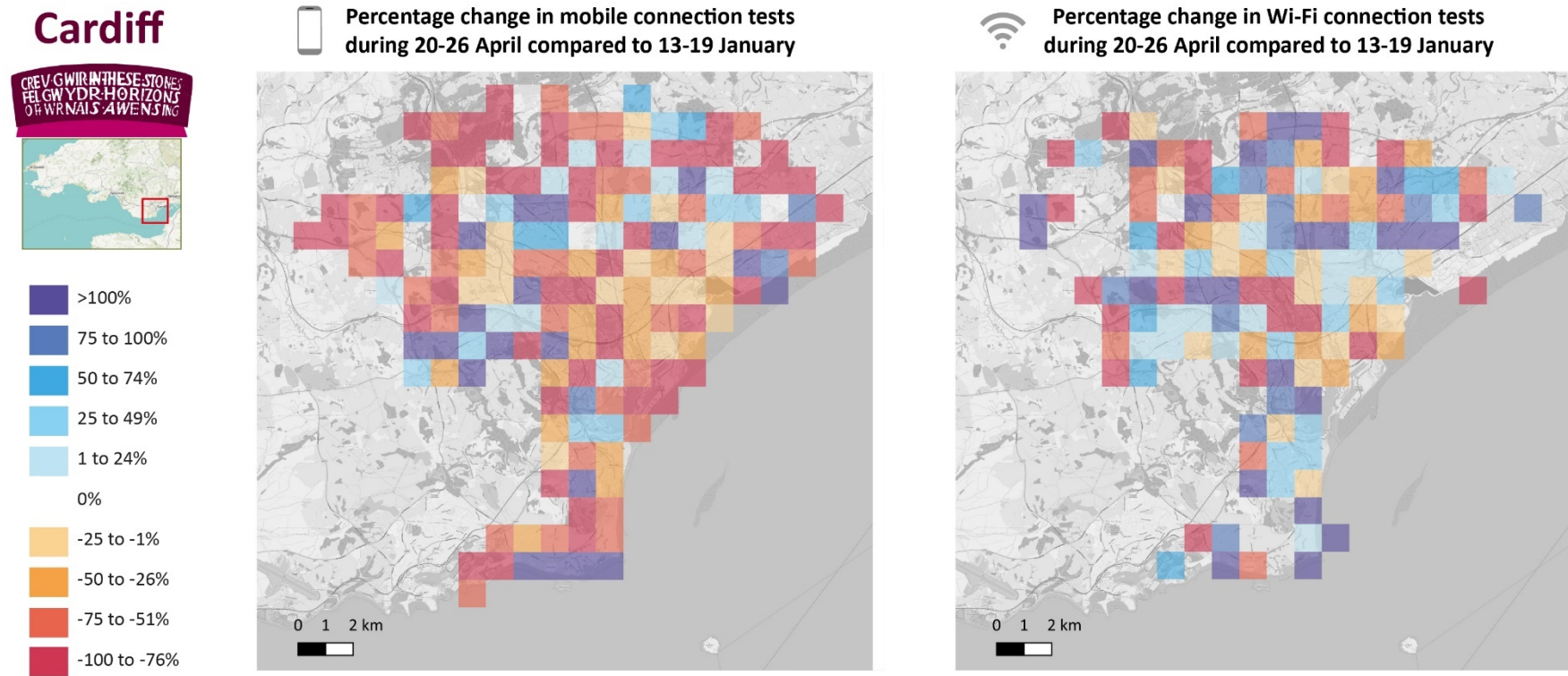
Source: Ofcom analysis of crowdsourced Android data

Notes: left-hand map percentages refer to the difference in the number of 2G, 3G, 4G and 5G-only connection tests made during 20-26 April compared to 13-19 January; right-hand map percentages refer to the difference in the number of Wi-Fi connection tests made during the same period; decreases shown in red; increases shown in blue; an interactive version of the mobile map is available here; an interactive version of the Wi-Fi map is available here
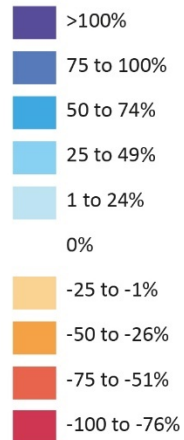
Most of Cardiff's central areas, including connection hubs such as Cardiff Central Station, Cardiff Queen Street Station and Cardiff bay, experienced a reduction in mobile activity during the lockdown, with the closure of offices, commercial facilities and tourist venues. Similarly, there were reductions in mobile activity in areas near Cardiff University and the University of South Wales, in Cardiff's civic centre, where most Welsh Government civil servants are based, and around Cardiff's main shopping centres, such as St David's Dewi Sant and Queen's Arcade. Non-central areas showing a strong reduction in the number of mobile

connection tests included areas around Llanishen, Llandaff North, Coryton, and Saint Mellons. This is probably due to the presence of schools, supermarkets, commercial and industrial premises, all of which were greatly affected by the lockdown.
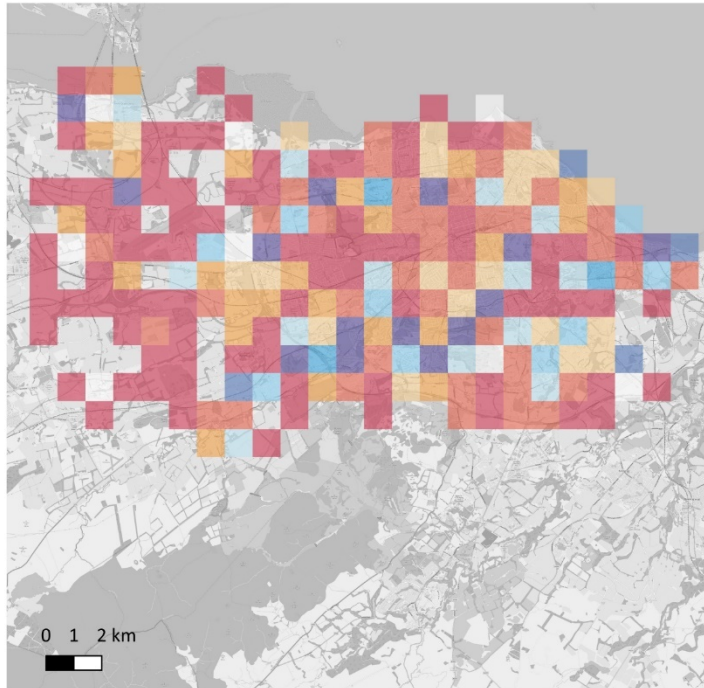
As in the other capital cities, increases in mobile activity were seen mostly in non-central residential areas of Cardiff, often around parks, open spaces or along the coast. These include areas around Llandough, Birchgrove, Ely, and between Sully and Lavernock on the south coast; the latter is a popular destination for walkers. Wi-Fi connections in central Cardiff mostly decreased during the lockdown, although areas immediately adjacent to the central areas showed a large increase, probably because people were at home in those areas. The simultaneous reduction in the number of both mobile and Wi-Fi connections was also evident in some non-central areas, although often at a much-reduced scale compared to central areas. These include areas around St Mellons, where there are many large offices, Splott, and Llanishen, which are all close to business parks or small industrial estates. Wi-Fi connections increased particularly in residential non-central areas of Cardiff, for example in Llandaff, Cyncoed, Llanrumney, Thornhill, and Penarth.

Figure 21: Percentage change in mobile and Wi-Fi connection tests during 20-26 April compared to 13-19 January: Edinburgh
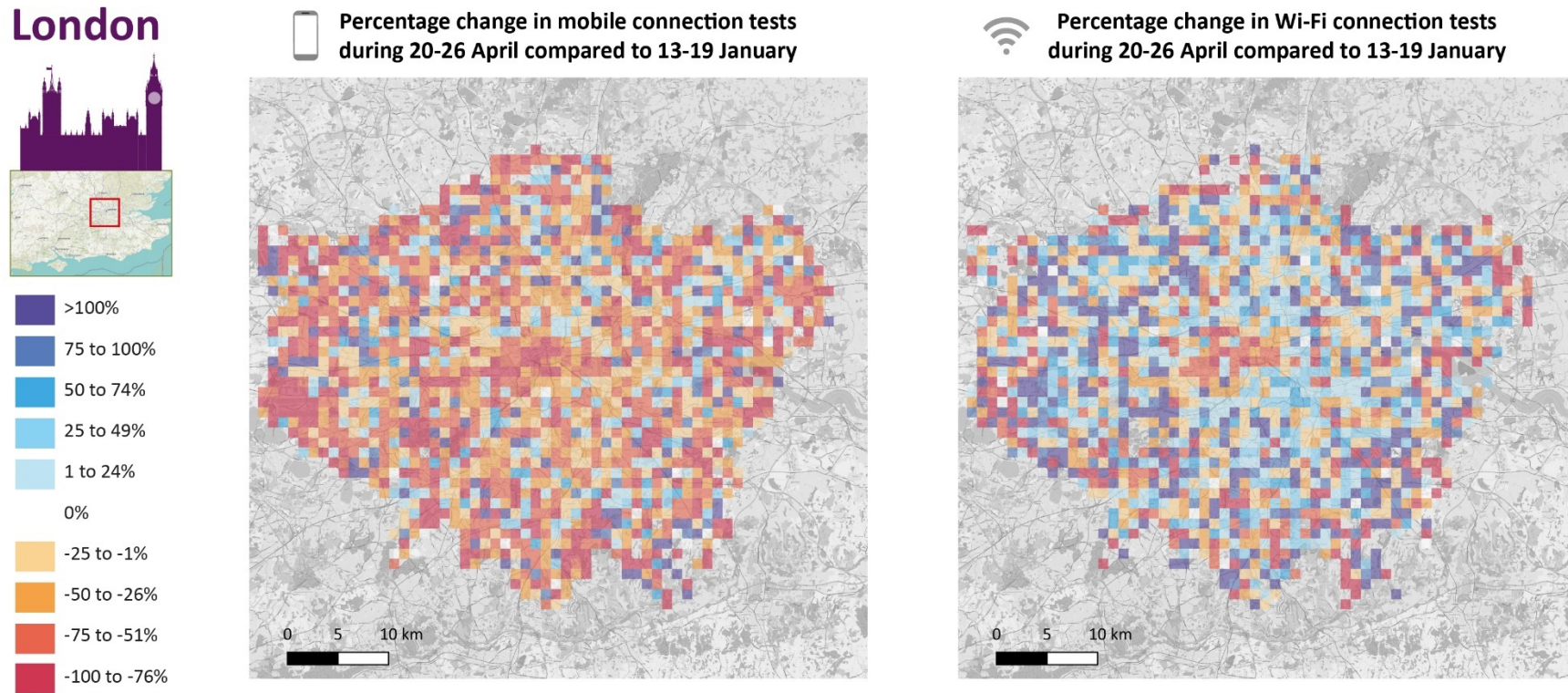

Source: Ofcom analysis of crowdsourced Android data

Notes: left-hand map percentages refer to the difference in the number of 2G, 3G, 4G and 5G-only connection tests made during 20-26 April compared to 13-19 January; right-hand map percentages refer to the difference in the number of Wi-Fi connection tests made during the same period; decreases shown in red; increases shown in blue; an interactive version of the mobile map is available here; an interactive version of the Wi-Fi map is available here

As expected, the centre of Edinburgh experienced a significant decrease in the number of people using mobile networks, as most offices, shops and restaurants were forced to close during the initial phase of lockdown. In the West End and Tollcross areas there was a 90% decrease in mobile activity during 20-26 April compared to pre-lockdown, as people were not commuting into town or shopping in the same way as before. Areas where activity increased included Inverleith Park, where the number of mobile connection tests was up by 160% between the middle of January and the end of April, and Blackford Hill, up by 271% during the same period. This is unsurprising, as these are residential areas with green spaces for walking and exercise. Use of Wi-Fi networks

decreased in central areas during lockdown, with fewer people connecting to public and office Wi-Fi networks. The same happened in areas with large shopping centres, including the Gyle in south-west Edinburgh and Ocean Terminal in Leith. Meanwhile, residential areas such as South Queensferry, Barnton and Bruntsfield all experienced an increase in Wi-Fi connections (shown in blue on the right-hand map) indicating that more people were connecting to Wi-Fi at home.

Figure 22: Percentage change in mobile and Wi-Fi connection tests during 20-26 April compared to 13-19 January: London

Source: Ofcom analysis of crowdsourced Android data

Notes: left-hand map percentages refer to the difference in the number of 2G, 3G, 4G and 5G-only connection tests made during 20-26 April compared to 13-19 January; right-hand map percentages refer to the difference in the number of Wi-Fi connection tests made during the same period; decreases shown in red; increases shown in blue; an interactive version of the mobile map is available here; an interactive version of the Wi-Fi map is available here

Most of Greater London, both central and non-central areas, experienced a large decrease in mobile activity during the period. While the largest reductions were in central areas, the number of tests in non-central areas also fell. These included Croydon, which has a strong office presence and a busy railway station, Westfield shopping centre in Shepherd's Bush, Heathrow airport, Clapham Junction railway station, Woolwich Pier, and Canary Wharf, home to many financial institutions.

The areas showing a notable increase in mobile activity during lockdown were mostly residential, often with parks or open spaces, as people spent more time at home and in parks during the lockdown. These included Chalk Farm and areas in Greenford. In areas with even more open spaces, such as parts of Orpington, west of Sidcup railway station, around the Lea and Brent rivers and in Richmond Park, there was also an increase in mobile connections.

Wi-Fi connections increased in most residential areas of non-central constituencies, including Orpington and Sidcup, Wembley, Barnes, Putney, Wimbledon and Morden, but decreased strongly in many central London areas. This is likely to be because people were at home and accessing data through Wi-Fi rather than mobile networks.