A2. Statistical methodology

This report analyses findings collected from panellists who had the Ofcom mobile research app downloaded for at least seven days during the second fieldwork period. Panellists were included in the analysis if they had valid demographic details; such as age, gender and location, were users of the EE, O2, Three or Vodafone networks and had access to 4G mobile technologies. The overall panel that matched these criteria comprised of 5,315 users who were distributed as follows:

- by mobile network

  - 1,761 users on the EE network
  - 945 users on the Three network
  - 990 users on the Vodafone network
  - 1,619 users on the O2 network

- by nation

  - 4,327 panellists with a home postcode in England
  - 195 panellists in Northern Ireland
  - 310 panellists in Wales
  - 483 panellists in Scotland

- by rurality

  - 813 panellists with a home postcode in a rural area
  - 4,502 panellists in urban areas

The demographics of recruited panellists were close to being nationally representative so we were able to include nearly all panellists in the analysis with some weightings applied. The data were weighted by wholesale mobile market share, nation and rurality.

In addition to the overall panel, to compare the performance of mobile networks, we used a sub-panel comprising a random selection of 800 panellists per operator, giving a total panel size of 3,200. Although these panellists were randomly chosen, we kept the proportions of those in urban and rural areas, and in each nation, nationally representative.

The second fieldwork reporting period for this research includes data collected from 23 September until 23 December 2017. During this time, more than 43 million rows of anonymised data were collected passively, with very little interaction needed.

Data were collected on data service availability and performance, reliability of voice calls, service importance and consumer satisfaction.

Sampling methodology

This is Ofcom's first mobile research app downloadable from Google's Play Store. The research app was advertised on the Ofcom website and through social media. Although recruitment for the research app was primarily crowd-sourced, the research project is panel-based, with sampling

targets for each of the four mobile networks (EE, Three, O2 and Vodafone) and for different demographic and geographic groups.

In addition to the crowd-sourced panellists, Ofcom hired research agency BDRC Continental to recruit additional panellists. The agency was given a target of 3,000 and set target quotas on mobile networks, nation and rurality; the agency let the quotas fall out naturally during the recruitment process. This meant that although the initial recruitment was not targeted towards certain areas or different demographic groups, the progress of panellist recruitment against quotas was regularly monitored during the process. A limited targeting towards certain groups could have been asked for if necessary, but this was not needed. Panellists recruited in this way were given an incentive of £10 to download and keep the app for at least seven days. Due to the selection criteria and anonymisation of the data, it is not possible to determine the exact proportion of our final panel which was recruited. But looking at the overall number of panellists recruited by the agency, we estimate it to be approximately 60%.

Metrics and analysis methodology

For *The Consumer Mobile Experience* report, the following metrics were analysed:

- Data network share
- Data service availability
- Data performance – download speeds and response times
- Voice performance
- App use
- Satisfaction with network performance
- Service importance

For details on how these metrics are measured please see *Annex 1: Technical Methodology*[1].

A very large number of readings were collected during the fieldwork period. The number of panellists contributing readings to each metric was checked to make sure that the sample size was large enough to be statistically robust. For all the metrics, the sample size for the smallest sub-group analysed was at least 100.

Data network share

This is presented at the UK level, and comparisons are also made by rurality, nation and mobile network. Network share is thought to be driven by consumer behaviour as well as by the performance of the mobile network. We looked at the results for all panellists with access to 4G technology. There were 5,315 panellists whose app usage readings were included in the rurality and nations' comparison, and 3,200 panellists included in the comparison by mobile network.

---

[1] Annex A1: https://www.ofcom.org.uk/__data/assets/pdf_file/0014/113036/consumer-mobile-experience-2018-technical-methodology.pdf

Data service availability

Results for this are presented in the report at the UK level, looking at differences for users with access to 4G mobile technology by rurality and by mobile network technology. 5,315 panellists were included in this analysis.

Analysis was carried out directly on the number of readings (not averaged to panellist level), which meant that comparisons were carried out on hundreds of thousands of readings. Because of the very large number of readings, it was essential to look at the size of any differences and not just at whether findings were significantly different, as determined by running statistical tests.

When there is such a large number of readings, even very small differences between averages or proportions can be statistically significant. But this may not equate to a noticeable or practical difference for the consumer in their experience of using their phone, until the difference is much larger. When running a statistical test, the effect size shows the size of the difference between groups. Differences are only reported if they are statistically significant and the effect size is shown to be at least 'a small but noticeable difference' (of at least 0.1).

By time of day

In addition to looking at data service availability overall, we carried out a correlation to see if differences in the total number of connection tests at different times of the day could be linked to data service availability. To test this, the number of screen-on tests per hour was first correlated against the number of failed tests per hour, then the correlation was tested using a two-tailed test of statistical significance.

Data performance – download speeds and response times

Performance for Chrome, Facebook, YouTube, Google Play Store, Gmail, Instagram, Twitter and WhatsApp was looked at in terms of the average speeds that users could access when downloading data. The median download speed was calculated with the inter-quartile range also presented (the 25th and 75th percentile). This range shows the middle 50% of download speeds received by panellists while using an app and is not affected by outlier values. These outlier values are very high or very low speeds that may have been experienced because of using an app for a very short amount of time, or possibly a speed experienced by a very small minority of panellists.

The median was used as the measure of the average speed, as it was found that the download speeds did not follow a normal distribution. The median (the middle value) was therefore chosen as a more accurate representation of the average speeds that panellists were receiving.

Findings from users with access to 4G mobile technology from the UK performance panel were analysed. Readings when accessing 3G, 4G and wifi technologies were compared.

The number of panellists contributing readings for each app were:

- YouTube: 3447 panellists
- Chrome: 4,445 panellists
- Facebook: 4,103 panellists

- Twitter: 1,902 panellists
- WhatsApp: 2,343 panellists
- Instagram: 1,876 panellists
- Gmail: 2,316 panellists
- Google Play Store: 4,189 panellists

A correlation was also carried out to see if there was a link between the average (median) download speeds and the total number of app usage sessions at different times of the day. This correlation was tested using a two-tailed test of statistical significance.

Response times, which is the delay between a consumer making a request to their mobile network for information and the network providing this information to the device, were compared by the technology used. A two-tailed test of median response times was carried out comparing 3G data access with 4G data access for users with access to 4G mobile technology.

Voice performance

Findings from all panellists were used to look at calls dropped due to loss of service. As calls can be made using any mobile data technology, results from all 5,315 users with access to 4G mobile technology were included in this analysis. This was reported at the overall UK level, as no statistically significant differences were found with a large enough effect size by rurality, nation or mobile network.

App use

Two metrics were analysed for app use in this report. The first was the average length of time, in minutes, that users spent within the application when it was actively being used in the foreground. Each app usage session length for every app session (where the app was in the foreground) was recorded. The average (mean) session length for WhatsApp, Facebook, Chrome and YouTube was compared by data access technology.

The second metric looked at the average (mean) number of times that an app was opened in a day, per panellist, during the fieldwork period. Comparisons were made for YouTube, Facebook and WhatsApp, and for mobile technology compared to wifi. Readings were included from 4,160 panellists for Facebook, 4,170 panellists for YouTube and 4,175 panellists for WhatsApp.

For both these metrics, a two-tailed test comparing the mean averages was carried out comparing 3G, 4G and wifi technologies for users with access to 4G mobile technology.

Satisfaction and importance surveys

For the results of the satisfaction pop-up surveys, the number and percentage of panellists who were 'fairly' or 'very' satisfied with the network performance of their mobile provider were compared by rurality and nation.

Overall, 3,471 panellists who had access to 4G mobile technology, and had valid demographics, answered the overall satisfaction surveys:

- 470 panellists in rural areas and 3,001 in urban areas
- 2,868 panellists in England, 337 in Scotland, 100 in Northern Ireland and 166 in Wales

Statistical significance tests were carried out on the findings, and differences were reported if they were found to be significant by running a two-tailed 5% test of statistical significance.

For the results of the importance surveys, the number and percentage of panellists who found a mobile activity to be 'extremely' or 'very' important were compared by rurality, age and gender. 2,512 panellists who had access to 4G mobile technology and valid demographics answered the importance survey.