Statistical methodology

This report analyses findings collected from panellists who had the Ofcom mobile research app downloaded for at least 7 days during the first fieldwork period. Panellists are included if they have valid demographic details, such as age, gender and location, are users of the EE, O2, Three and Vodafone networks and have access to 3G and/or 4G mobile technologies. The overall panel who match these criteria comprises of 4,288 people. The panellists are distributed as follows:

- By Mobile Network Operator
  - 1,385 users of EE
  - 1,005 users of Three
  - 857 users of Vodafone
  - 1,041 users of O2
- By Nation
  - 3,440 panellists with a home postcode in England
  - 226 panellists in Northern Ireland
  - 350 panellists in Wales
  - 272 panellists in Scotland
- By Rurality
  - 787 panellists have a home postcode in a rural area
  - 3,501 panellists in urban areas

The first fieldwork reporting period for this research includes data collected from 27 September until 23 December 2016. During this time, over 40 million rows of anonymised data were collected passively with very little interaction needed.

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

1.1   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, in the Technology press and through social media. Although the app is crowd-sourced, the research project is panel based with sampling targets for each of the four Mobile Network Operators (EE, Three, O2 and Vodafone) and for different demographic and geographic groups.

1.2   Reporting panels

At the inception of the research it was decided that Ofcom would not report findings on the whole panel, but that it would report on three sub-panels that selected panellists to be representative by Mobile Network Operator (MNO), demography and geography. The two sub-panels' used for this report are:

- Provider Performance Panel

- UK Performance Panel

There is also a Behavioural sub-panel with 1,200 panellists selected to be representative by demographics and MNO market share. The results for this panel will be used to look at how consumers use their mobile phones. This data will be analysed and reported on in subsequent reports.

Both the provider performance panel and the UK performance panel are defined below. The location for membership to each panel is defined by home postcode, however, any analysis carried out is based on the location of where readings are taken.

1.2.1 Provider Performance Panel

This panel was designed to allow comparisons of consumer experience across mobile providers. The panel has an equal number of panellists per MNO (650 panellists), who are deemed to have access to 4G technology, and then representative[1] by UK nation and rurality. If a panellist has any readings where 4G technology was accessed, then that panellist is deemed to be a '4G panellist'.

Readings for 2G, 3G and 4G mobile technologies (and Wi-Fi) are analysed. For the metrics covered in this report, we found no statistically significant differences in the pilot fieldwork data by MNO either because of the low number of panellists or because of the current statistical methodology.

Provider panel sample proportions and numbers

MNO:	EE: 650	Three: 650	Vodafone: 650	O2: 650

Of which -

Nation:	Scotland: 8%	Wales: 6%	Northern Ireland: 3%	England: 83%

Rurality:	Rural: 14%	Urban: 86%

1.2.2 UK Performance Panel

The purpose of the UK performance panel is to monitor consumer experience at a UK level. The panel was designed to be representative by MNO market share, UK nation and UK rural/urban location. As with the provider performance panel, 2G, 3G and 4G readings (and Wi-Fi) are analysed.

The 4G UK performance panel (where panellists are deemed as having access to 4G technology) comprises of 2,904 panellists. The panel is representative by MNO market share and geography. Data is analysed at the overall UK level, by rurality and/or by nation.

UK performance panel sample proportions

MNO:	EE: 39%	Three: 16%	Vodafone: 21%	O2: 25%

Nation:	Scotland: 8%	Wales: 6%	Northern Ireland: 3%	England: 83%

Rurality:	Rural: 14%	Urban: 86%

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[1] ComScore MobiLens Plus Audience Profile May 2016 data for Android users was used to estimate geographic representativeness across MNOs. UK census 2011 data was used to estimate rural and urban percentages across all MNOs.

1.3 Metrics and analysis methodology

For the *Consumer mobile experience* report, the following metrics were analysed:

- Overall Satisfaction and Importance

- Network Share

- Data Service Availability

- Data Performance – download speeds and response times

- Voice Performance

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

There were a very large number of readings 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 as to be statistically robust. For all the metrics, the sample size for the smallest sub-group analysed was at least 100.

1.3.1 Satisfaction and Importance Surveys

For the results of the satisfaction pop-up surveys, the number and percentage of panellists in the UK performance panel who were 'fairly satisfied' or 'very satisfied' were compared for rural vs. urban areas, by nation and 3G maximum technology vs 4G maximum technology.

Overall, 2,694 panellists in the UK performance panel answered the overall satisfaction surveys:

- 424 panellists in rural areas and 2,270 in urban areas

- 329 panellists with 3G as their maximum technology and 2,365 with 4G as their maximum technology

- 2,228 panellists who live in England, 224 in Scotland, 108 in Northern Ireland and 134 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.

Because of the number of responses received to the importance survey, answers from all users (and not one of the nationally representative panels) who responded to this survey were included to get an overall sense of what functions are important to users.

1.3.2 Data Network Share

This is presented at the UK level as it is thought to be driven by consumer behaviour as well as the performance of the mobile network. Results were looked at for all 4G maximum technology users from the UK performance panel. There were 2,887 panellists who had readings included in this analysis.

1.3.3 Data Service Availability

Results for this are presented in the report at the UK level looking at differences between 3G and 4G maximum technology users from the UK performance panel. There were 353 3G maximum technology users included in this analysis and 2,189 4G maximum technology users.

For this pilot phase of the mobile research app, analyses were 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 are statistically significantly different.

When there are such a large number of readings, even very small differences between averages or proportions can be found to be statistically significant. However, this may not actually be a noticeable or practical difference for consumers' experience of using their phones unless the size of the difference is large enough. 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 medium (at least 0.3).

Data Service Availability by Time of Day

In addition to looking at the data service availability overall, a correlation was carried out to see if differences in the total number of users at different times of the day could be linked to data service availability. This correlation was tested using a two-tailed test of statistical significance.

1.3.4 Data Performance – Download Speeds and Response Times

A correlation was also carried out to see if there was a link between download speeds and the total number of users at different times of the day. Again this correlation was tested using a two-tailed test of statistical significance.

Performance for YouTube and Chrome was looked at in terms of the speeds that users could access and the average length of time in minutes that users spent within the application. Findings from 4G maximum technology users from the UK performance panel were analysed. Readings when accessing 3G, 4G and Wi-Fi technologies were compared. 3G readings for 3G maximum technology users were not found to be significantly different to 3G readings for 4G maximum technology users. Therefore, 3G findings for 4G panellists were used as the 4G panel size was much larger and allowed direct comparisons for the different technologies for the same users.

There were 1,177 users with 3G data access technology readings and 1,441 users with 4G data access technology for Chrome. There were 506 users with 3G data access technology readings and 837 users with 4G data access technology readings for YouTube.

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 4G maximum technology users.

1.3.5 Voice Performance

Findings from the UK performance panel were used to look at calls dropped due to loss of service. As calls can be made using any mobile data technology, results from both 3G and 4G maximum technology users were included in this analysis and readings from 3,310 panellists were included. This was reported at the overall UK level as no statistically significant differences were found with a large enough effect size.

1.4 Future developments

As the mobile research app panel numbers continue to grow and the number of readings increases, the statistical methodology will be kept under review to investigate the most appropriate way to analyse such a large number of readings.