

A2. Statistical methodology

This report analyses findings collected from panellists from the P3 crowdsourced data between 1 January and 31 March 2019. Overall panellists' records were included in the analysis if they met the following criteria (other records were filtered out):

- the wholesale mobile network was either EE, O2, Three or Vodafone
- the location was in the UK and the UK nation was either England, Northern Ireland, Wales or Scotland
- the location was also classified as a rural or urban area¹
- the data technology was known – either 2G, 3G, 4G or Wi-Fi, depending on the metric

To estimate the number of panellists, and to check that there were a sufficient number of people behind each sub-group analysis, the distinct number of unique ids were counted for each dataset, each metric and sub-group analysed. We wanted to make sure there were at least 100 unique ids for the smallest sub-group. The actual number of unique ids for the smallest sub-group was much higher than this for every metric.

For an overall count of the number of people in the data that had records that met the criteria above, the count of unique ids in the connection test dataset were looked at. The distribution of those counts are as follows:

- Panellists with mobile records: 129,627
- Panellists with either mobile and/or Wi-Fi records: 155,083
by nation (those with mobile records)
 - 113,398 panellists with records in England
 - 4,137 panellists with records in Northern Ireland
 - 12,609 panellists with records in Scotland
 - 9,658 panellists with records in Wales
- by rurality (those with mobile records)
 - 81,320 panellists with records in rural areas
 - 127,457 panellists with records in urban areas
- by nation and rurality (those with mobile records)
 - 69,797 panellists with records in rural England
 - 111,384 panellists with records in urban England
 - 2,900 panellists with records in rural Northern Ireland
 - 3,964 panellists with records in urban Northern Ireland
 - 8,652 panellists with records in rural Scotland
 - 12,076 panellists with records in urban Scotland

¹ These locale classifications are derived from [Bluewave Geographics](#), which harmonises the rural and urban classifications between ONS (for England and Wales), Northern Ireland Statistics and Research Agency (NISRA, for Northern Ireland) and the National Records of Scotland (for Scotland).

- 6,911 panellists with records in rural Wales
- 8,733 panellists with records in urban Wales
- by mobile network (those with mobile records)
 - 50,127 panellists on the EE network
 - 45,624 panellists on the O2 network
 - 21,821 panellists on the Three network
 - 19,690 panellists on the Vodafone network

Metrics and analysis methodology

For the Mobile Matters report the following metrics were analysed:

- Network share
- Data service availability
- Response time
- Data use
- Voice call use

Network share

The data in the connection test dataset enabled us to look at what percentage of the time panellists were connected to each technology – 2G, 3G, 4G and wifi. Of particular interest is the comparison between the amount of time panellists are connected to cellular technologies versus wifi.

This was simply calculated by totalling the count of records for each technology and looking at this by day of week, nation and rurality. Comparisons were carried out by using a two-tailed test to look for statistically significant differences which are shown in the report.

Mobile networks comparison

An analysis of network share was also carried out looking at any potential differences between mobile networks. However, before the analysis was run, to ensure a more equal comparison between networks, the data was additionally filtered to look at just the most popular 75 handsets within the data across the four networks. Analysis was then run on this subset of data with the following number of panellists for each network:

- 32,169 panellists using the EE network
- 34,131 panellists using the O2 network
- 14,523 panellists using the Vodafone network
- 14,182 panellists using the Three network

Data service availability

Every 15 minutes, a test is run which attempts to download a small file and logs whether this can be completed successfully. By using records where the mobile screen was active during this test, we can

assess the percentage of cases when the user was able to connect to data services when the device was in use.

To analyse this data, the filters stated above were applied to the data, plus an additional filter which selects records where the screen state is on. This is an indication of when panellists' phones are in use² and therefore when connection to a data service would be more important to them. Analysis was carried out directly on the number of readings. Due to the millions 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. However, 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. Differences were only reported in the PDF report if they were statistically significant and the difference between sub-groups was at least two per cent.

The percentage of successful tests was calculated, and comparisons were made, using two-tailed statistical tests. Analysis was carried out comparing data access technology, nation and rurality to look for any statistically significant differences where the data service was better or could be improved.

The correlation between the number of connection tests and the percentage of failed tests by the time of day was also looked at to see if there was a statistically significant relationship between the two indicators. The results of this can be seen in the interactive tool.

As with network share, comparisons between mobile networks were carried out on data filtered for the top 75 most popular handsets in the data. The same analysis for data service availability was then carried out on this subset of data.

Response time

Response time, which is the delay in milliseconds between a consumer making a request to their mobile network for information and the network providing this information to the device, were compared by data access technology, rurality and nation. A two-tailed test of median response times was carried out on all sub-group comparisons.

Comparisons by mobile network were carried out using the same methodology to filter the data as for data service availability (analysis was run on the most popular top 75 handsets). A two-tailed test of the median response times was carried out on this subset of data.

Data use

We looked at data usage during the day and across sub-groups of users by looking at the amount of data downloaded. This data was present in the network throughput record dataset. We applied an additional filter to look at the records where data was downloaded only (and not uploaded). The

² This can include consumers actively using their phones, receiving notifications or updates running on the phone with the screen on.

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average amount of data downloaded by time of day was looked at and plotted in graphs to see if there were any peak hours of usage. This was carried out for mobile and wifi technologies.

An average monthly data usage per person was also produced. This was calculated by first working out the per person per day average, by summing the amount of data downloaded per day and dividing by the distinct count of unique person ids. The result of this was then multiplied by 30 to estimate the monthly average. This was then also calculated for sub-groups in order for analysis to be carried out by location (rurality and nation) and by data access technology.

The average and range of data downloaded by each data access technology (mobile and wifi) was investigated to look at the distribution of these values.

Comparisons between sub-groups were then analysed by carrying out two-tailed tests to see if any differences were statistically significant.

Voice call use

We analysed data on the number of voice calls made and voice call duration. This data is captured in the voice call dataset. Data for each voice call made, by panellists in the crowdsourced data during the fieldwork period, was analysed.

We calculated the average number of calls made per person per month. This was calculated by first working out the per person daily average with the result then multiplied by 30 to estimate the monthly average (as was carried out to work out monthly data use). The distribution of these averages was then grouped to show the spread of values. The percentage of panellists who make up each group are shown in charts within the report.

The average call length for the fieldwork period was calculated and these averages were also then grouped to show the distribution of values by the percentage of calls. Differences in average call length were looked into by rurality, nation, city and day of the week. Comparisons were analysed by running two-tailed tests to see if any differences were statistically significant.