Measuring mobile voice and data quality of experience

Call for Input

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Contents

Section 1

Introduction

Purpose of this document

1.1   Consumers and citizens are growing increasingly dependent on mobile networks to make phone calls and access data services. The performance of these networks can vary between operators, by location and time of day and may not always meet the expectations of consumers. In this document we use the phrase 'quality of experience' ('QoE') to describe the technical performance[1] of the services delivered to consumers.

1.2   As an economic and competition regulator Ofcom primarily relies on market mechanisms to drive performance improvements in networks (thereby improving QoE). However, the market can only operate effectively when consumers are able to compare the quality of the services on offer and this in-turn requires the availability of accurate and comparable QoE information.

1.3   For fixed broadband services, Ofcom has, for several years, collected information on broadband speeds. This information has enabled consumers to improve their purchasing decisions, and appears to have driven improvements in service quality by operators. In this Call for Input, we wish to explore whether there is similar information that we might provide in the mobile arena. Specifically, we want to identify what network and/or service performance information Ofcom could gather which accurately reflects the consumer QoE and which we could publish in a way that would assist consumers in making informed choices about the mobile service they purchase.

1.4   We are seeking views from all interested stakeholders on:

- What information would be valuable to consumers when purchasing mobile services;

- What data would be required to produce this consumer information, and

- How we could best collect it.

1.5   Alongside this Call for Input, where appropriate, we will seek to engage directly with the mobile network operators to ensure that any other relevant information can be taken into account.

Ofcom's role and market context

1.6   As the regulator for the communications sector, our principal duty is to further the interests of consumers and citizens in relation to communications matters.[2]

1.7   We also have general duties to consider, amongst other things:

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[1] By technical performance, we are referring to the operation of the network and services (i.e. the coverage, speed, capacity and reliability) rather than customer service related aspects of a mobile service such as billing, call centres and sales.
[2] Section 3 of the Communications Act 2003

- the desirability of encouraging the availability and use of telecommunications services throughout the UK;

- the desirability of promoting competition in relevant markets; and

- the interests of consumers in respect of choice, price, quality of service and value for money

1.8   Our 2012 Communications Market Report[3] found that 94% of UK adults use a mobile phone and through the rise in smartphones and tablets, consumers increasingly rely on mobile networks to provide a mobile data connection as well as a voice and text service. Our Infrastructure Report 2012 Update found that the capacity of the UK's communications infrastructure is changing quickly. This is in response to a rapid increase in consumers' take-up and use of communications services and the resulting investment by operators.[4] Data via mobile devices more than doubled between 2011 and 2012.

1.9   In a time of such rapid change, it is all the more important that consumers have access to timely and accurate information on the quality of services available in the market.

1.10   There is also increasing Government interest in ensuring that UK consumers are able to access mobile services which meet all their needs and expectations. The UK already has a high level of mobile signal coverage; based on figures derived from operator predicted coverage models[5] we estimate that 99.7% of UK premises receive an outdoor 2G signal[6] from at least one operator and 93.6% of premises receive a signal from all operators. The government has announced an initiative aimed at extending existing mobile voice coverage further still through its mobile infrastructure project[7] in recognition of the importance of mobile services to citizens and the economy.

1.11   Expressed as a percentage of geographical area, coverage figures are lower, because mobile masts are more commonly installed near centres of population. At present, we estimate 12.8% of the UK landmass is not covered by any 2G signal. Extending coverage to these more remote areas is challenging because the costs of doing so are high relative to the potential revenues.

1.12   Coverage of 3G services is lower than 2G, but improving, with a recently increased (outdoor) coverage obligation placed on operators to reach 90% of UK premises due to be met by June 2013. Furthermore, Vodafone and Telefónica (O2) have recently begun to share their radio access networks, a development which has the potential to reduce materially the number of partial not spots[8] in the UK.

1.13   Additionally, we will require that one of the 800MHz licensees in the current 4G spectrum auction deliver a high speed, mobile data service indoors to 98% of UK premises and 95% of premises in each of the Nations by the end of 2017. We

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[3] Figure 5.55 - http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr12/CMR_UK_2012.pdf
[4] http://stakeholders.ofcom.org.uk/binaries/research/telecoms-research/infrastructure-report/Infrastructure-report2012.pdf
[5] Each mobile operator uses planning tools to predict signal strength in different areas.However, as with any planning tool, these predictions are subject to an error of margin and do not necessarily account for all the factors that can affect the quality of a mobile voice call or data session.
[6] i.e. the signal is predicted to be sufficiently strong to make and sustain a call while outside.
[7] http://www.culture.gov.uk/what_we_do/telecommunications_and_online/8757.aspx
[8] We define partial notspots as areas with coverage from 1 or more MNOs, but not all MNOs

anticipate that the resulting outdoor coverage will be materially higher than the indoor requirements.

1.14   These developments are expected to bring about significant mobile coverage improvements for consumers over the next few years, but it will be important to keep track of how these improvements progress.

Coverage vs quality

1.15   The reach and coverage of mobile signals is just one part of delivering a mobile service. Consumers sometimes experience misalignment between predicted coverage and their day-to-day experiences of using their mobile phones. Concerns about consumers' ability to make and receive calls or use the internet on their mobile phones have been expressed directly by consumers. These complaints have been received by Ofcom[9] as well as by MPs, our own Advisory Committees and through reports in the media.

1.16   We know that a number of factors can affect consumers' QoE. This can sometimes be the result of localised low signal quality caused, for example, by 'signal shadowing' by buildings, how many people are using the network in a particular area or the performance of a particular handset. While some of these factors may be outside the control of the mobile operators (for example, handset performance), the technical performance of each operator's network does represent the key differentiator in the consumer QoE delivered by different networks.

1.17   There are signs mobile network operators (MNOs) are increasingly competing on issues of service quality and reliability, particularly as they ready themselves to offer new 4G services (subject to the outcome of the 4G auction in 2013). For example, Orange provides a Network Performance Promise[10] which compensates consumers for dropped calls, and Vodafone recently referred to the depth of its network as 'deep pan' pizza[11] - able to provide service deeper into buildings.

1.18   The extent to which operators are incentivised to improve their consumers' QoE is in part related to the competitive advantage that they can gain from offering the higher quality. However, unless consumers are able to take the QoE offered by different operators into account when making purchasing decisions, there is less incentive for operators to invest in improving it.

4G Auction

1.19   2013 is likely to see rapid change in the mobile market as the 4G auction concludes and operators roll out 4G networks. We are currently considering the potential scope of initial research into 4G QoE with a likely initial focus on connection speeds and coverage.. The lessons from any 4G-specific research will be combined with the feedback we receive to this Call for Input and will inform Ofcom's longer term research objectives in the area of mobile QoE across 2G, 3G and 4G networks."

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[9] We estimate that mobile coverage and quality issues represent approximately 5% of all mobile complaints received by Ofcom
[10] http://help.orange.co.uk/orangeuk/support/personal/480099/2
[11] https://www.vodafone.co.uk/our-network-and-coverage/what-makes-a-great-network/index.htm

Structure of this document

1.20   In section 2, we examine the results of recent consumer research we commissioned to update our understanding of consumers' QoE. We then consider what information would be most useful to consumers in making purchasing decisions.

1.21   In section 3 we set out the type of data that would be necessary to produce the relevant consumer information and how this data could be collected.

Next steps

1.22   We welcome feedback from all stakeholders on this Call for Input. We intend to review responses in April before deciding on how best to proceed.

1.23   We are particularly keen to get the views of stakeholders representing the needs of consumers in different parts of the UK to ensure we have a clear view of the information that consumers would find useful when purchasing mobile services. If there is sufficient interest from stakeholders, we propose to host a workshop in March to facilitate the development of ideas and options. To register your interest in a workshop, please contact us by 15 February 2013.

1.24   Details on how to contact us and how to respond to this Call for Input are provided in Annex 1.

Section 2

Understanding the consumer experience

How and why we gather information

2.1   Ofcom has a statutory duty under the Communications Act 2003 ("the Act") to collect and publish certain types of data.

2.2   Under section 14 of the Act we are required to make arrangements to find out about the experiences of consumers using electronic communications services and the way they are provided, and we do this by carrying out research into their experiences of these services. Under section 15 of the Act we have a duty to publish the results of our research and to take account of it in carrying out our functions; for example we do this through our annual Communications Market Reports, and our Consumer Experience Reports.

2.3   We may also inform our thinking by conducting economic or technical research, and/or by engaging with consumer groups and industry. We gather data directly from industry on a regular basis.

2.4   In addition, and in keeping with our duty to consider the interests of consumers and citizens, we also seek to provide advice and information to help consumers make better and more informed decisions about their telecommunications services. Consumer information plays a critical role in ensuring competitive communications markets, and we noted this in our Customer Service Satisfaction report in December 2012[12]. A lack of information may lead consumers to make poor purchasing decisions, or inhibit them from switching provider. If such information is not readily available or is presented in a complex way, there may be a case for Ofcom to intervene to address issues in the interests of and to protect consumers.

Research findings on the consumer QoE

Methodology

2.5   To update our understanding of consumers' experience of using their mobile phone and to help us keep track of improvements in consumers' QoE, we carried out a consumer survey in November 2012. We expect to conduct research of this kind annually. This research helps us understand whether and to what extent mobile phone reception issues affect consumers and, if so, what types of problems are most prevalent and of most concern.

2.6   Our research also sought to examine whether there are differences in consumers' QoE in urban and rural areas and in each of the Nations. We have published a report of our findings alongside this Call for Input[13] and provide highlights of the results relevant to consumers' QoE below.

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[12] http://media.ofcom.org.uk/2012/12/04/latest-customer-service-satisfaction-levels-revealed-2/
[13] Mobile Coverage Report: http://stakeholders.ofcom.org.uk/binaries/consultations/mobile-voice-data-experience/annexes/usage.pdf

Quality of mobile experience is important to consumers

2.7   The ability to make or receive calls or texts is consistently selected as the most important feature when thinking about their mobile operator, followed closely by the price of the service (38% and 34% respectively for the UK as a whole – Figure 1). In Wales and Northern Ireland, and in rural areas, the ability to make or receive calls is particularly important when selecting an operator. Mobile users in Wales (53%) and Northern Ireland (47%) are significantly more likely than those in England (37%) or Scotland (34%) to say that this is the most important factor when choosing a provider and users living in rural areas are significantly more likely than those in urban areas to say this (45% v. 37%). This may be a reflection of a poorer consumer experience in those locations, although we do not have sufficient information to determine this for certain.

Figure 1: Most important element when considering mobile provider, by nation and urban/rural

Source: Kantar Media omnibus, (14th – 20th November 2012)
Base: All who use a mobile phone (N=2136/1743/195/95/103/1757/379)
Q.10 And which is the ... important to you when thinking about your mobile operator? Most important.

2.8   Mobile users were also asked about the importance of the ability to make or receive calls alongside other aspects of mobile reception (Figure 2). The ability to make and receive calls remains the most important for mobile users when thinking about their mobile provider by a considerable margin (50% of UK mobile users). This is particularly so for those in Northern Ireland (68%). Quality of voice calls is the next most frequently cited aspect among UK users, with 16% saying this is most important.

Figure 2: Importance of different elements of mobile reception, by nation and urban/rural locations

Source: Kantar Media omnibus, (14th – 20th November 2012)
Base: All who use a mobile phone (N=2136/1743/195/95/103/1757/379)
Q15: Which of the following aspects is most important to you when thinking about your mobile operator?

The majority of consumers are satisfied with their mobile service

2.9   Our survey found that in the UK as a whole overall satisfaction with mobile providers was 81%[14] (6% reported they are dissatisfied). There are no differences in levels of overall satisfaction by urban or rural location or by nation.

2.10   When considering mobile functions and services, illustrated in figure 3, the highest level of satisfaction is with the handset, with 78% of users either somewhat or very satisfied. This is followed by satisfaction with the ability to make or receive calls or text messages (74%).

2.11   The number of people satisfied with the speed or reliability of internet is lower, with 47% either somewhat or very satisfied. However, when filtered by those who use the internet on their mobile phone the proportion saying they are either somewhat or very satisfied increases to 70%.

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[14] Another recent Ofcom survey found that overall satisfaction with mobile phone services was higher than this http://stakeholders.ofcom.org.uk/market-data-research/market-data/consumer-experience-reports/consumer-experience/ at 89%. The difference may be explained by question ordering; in our November 2012 survey the question about overall satisfaction was positioned immediately after several questions about individual aspects of service, which may have has some influence over what the respondent was considering when rating the 'overall' service.

Figure 3: Satisfaction with different elements of mobile phone functions or services (percent)

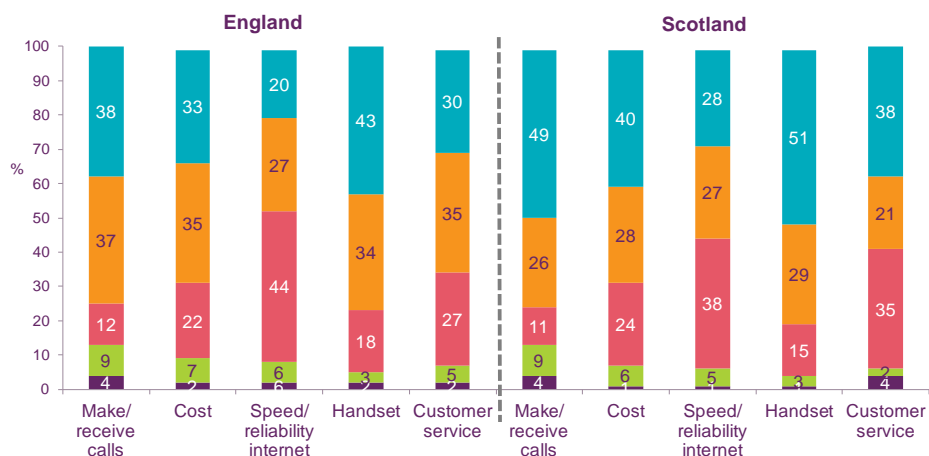|	Very dissatisfied	Somewhat dissatisfied	Neither satisfied /dissatisfied	Somewhat satisfied	Very satisfied
Ability to make/receive voice calls/ text messages	5	9	13	35	39
Cost of service/ contract	2	7	22	34	35
Internet reliability	6	6	45	27	20
Handset	2	3	17	33	45
Customer service	3	5	28	33	32

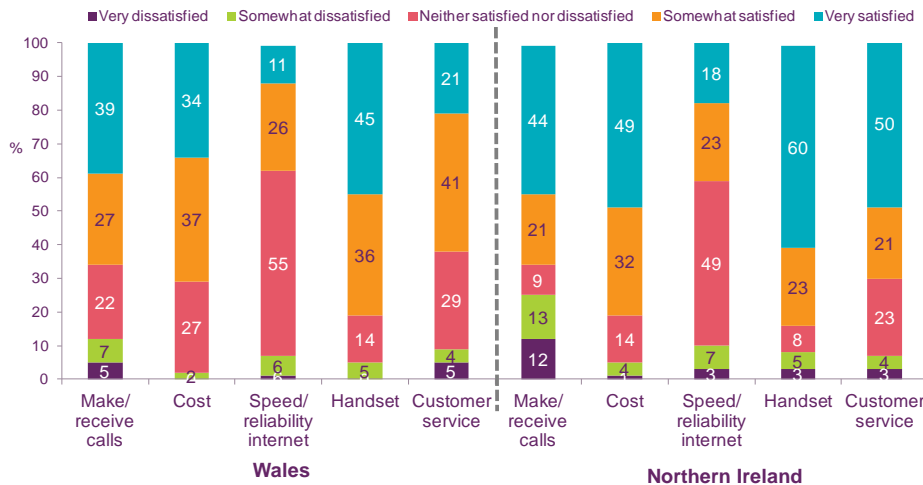*Source: Kantar Media omnibus, (14th – 20th November 2012)*
Base: All who use a mobile phone (N=2136)
Q.11: Thinking about these functions, how satisfied do you feel with each in relation to your mobile phone and mobile services with ...?

2.12   There are also some differences between the nations, shown in Figure 4, below.

2.13   Users in Scotland are the most satisfied with speed or reliability of the internet (55%), with those in Wales being the least likely to be satisfied (37%).

2.14   Users in Northern Ireland are the most likely to report dissatisfaction with their ability to make or receive calls or text messages. This is almost double the proportion who are dissatisfied with this aspect of service in England (13%).

Figure 4: Satisfaction with mobile phone functions or services, by nation

Legend: Very dissatisfied | Somewhat dissatisfied | Neither satisfied nor dissatisfied | Somewhat satisfied | Very satisfied

Wales / Northern Ireland

The majority of consumers are satisfied with different aspects of mobile reception

2.15   We also asked respondents about their satisfaction with various aspects of mobile reception (Figure 5). The element with the highest level of satisfaction among UK mobile users is good quality voice calls (78%). This is followed by calls not getting cut off (75%), mobile reception (74%) and text messages sent/delivered without delay (also 74%). Figure 5 shows that just under half (48%) said that they were satisfied with using the internet, though this rises to 71% when filtered to include only those who use the internet on their mobile.

Figure 5: Satisfaction with different aspects of mobile reception (percent)

	Very dissatisfied	Somewhat dissatisfied	Neither satisfied /dissatisfied	Somewhat satisfied	Very satisfied
Ability to make/receive voice calls	3	8	15	38	36
Good quality voice calls	2	6	14	39	39
Texts sent / no delay	2	5	19	35	39
Calls not cut off	2	7	15	32	43
Ability to use internet	2	5	44	26	22

Satisfaction with aspects of mobile reception is lower in rural areas and of the four UK nations is lowest in Northern Ireland

2.16   There are some differences between urban and rural users. Rural users are more likely than those in urban areas to be very dissatisfied with their ability to make or receive calls (6% vs. 3%). Figure 6, below, shows differences in satisfaction between

the nations. Users in Northern Ireland appear to be the least satisfied with their ability to make or receive calls (18% report that they are dissatisfied). They also have the highest levels of dissatisfaction with the quality of voice calls (12%) and calls not getting cut off (12%).

Figure 6: Satisfaction with different aspects of mobile reception, by nation

Source: Kantar Media omnibus, (14th – 20th November 2012)
Base: All who use a mobile phone (N=1743/195/95/103)
Q16: How satisfied do you feel with each in relation to your mobile phone reception in the UK with ...?

Over half of UK mobile users say they have experienced problems with reception – this rises to six in ten in Wales and three-quarters in Northern Ireland.
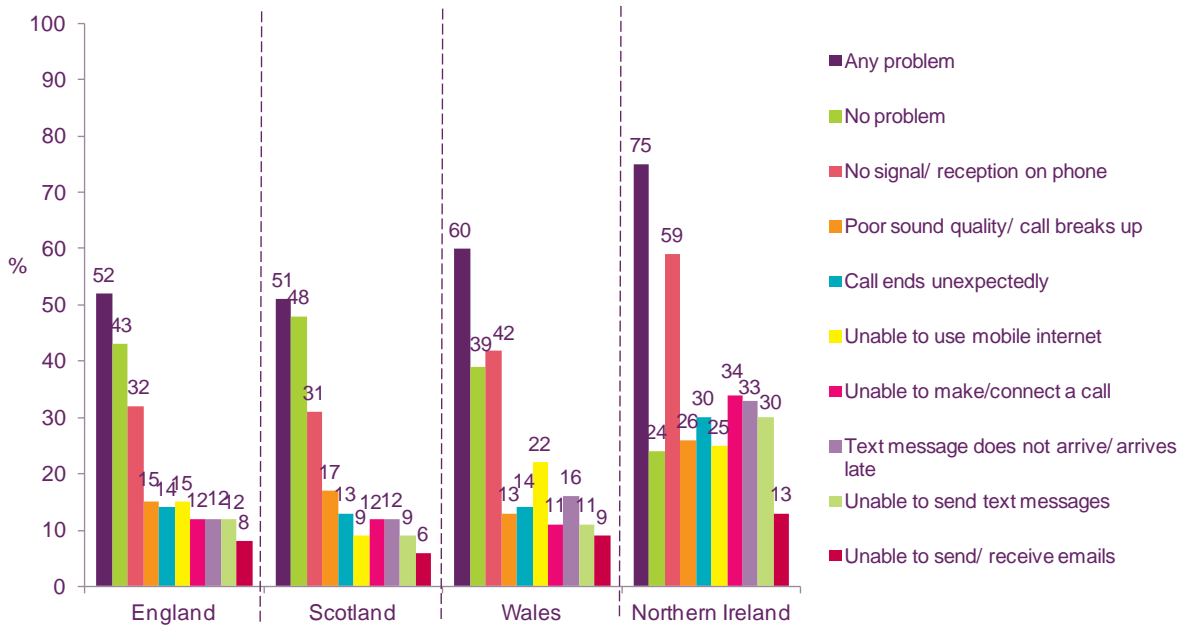
2.17   Just over half (53%) of UK mobile users have ever experienced any issues with mobile reception with 12% experiencing four or more problems.

2.18   The most common problem is having no signal/reception on phone (34%), followed by poor sound quality/sound breaks up, call ending unexpectedly and being unable to use the mobile internet (all 15%), being unable to make/connect a call even though

the phone shows "bars" present and text messages not arriving or arriving late (both 13%), being unable to send text messages (12%), and being unable to send or receive emails (8%).

2.19   There are no statistically significant differences between users living in rural and urban locations. However, among the nations (Figure 7), mobile users in Northern Ireland are significantly more likely than those in England, Scotland and Wales ever to experience a problem (75% vs. 52%, 51% and 60%). Around a third (32%) of people in Northern Ireland say they have experienced four or more of these problems.
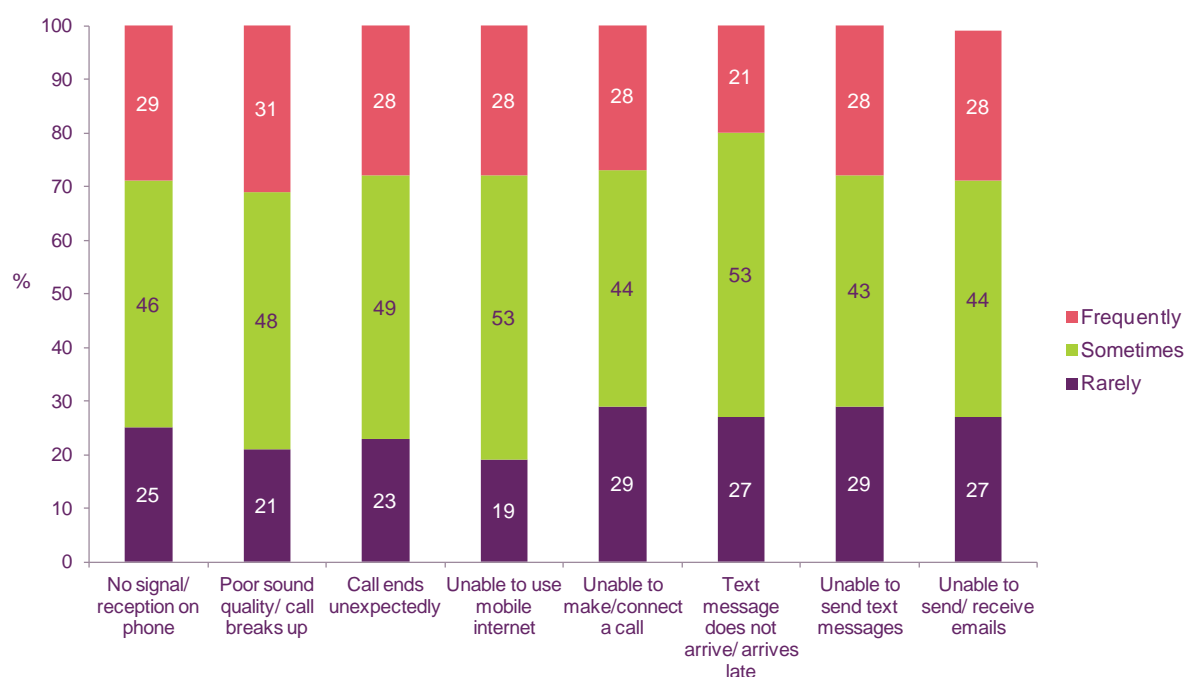
Figure 7: Mobile phone users who have ever experienced problems with reception, by nation

Source: Kantar Media omnibus, (14th – 20th November 2012)
Base: All who use a mobile phone (N=2136/1743/195/95/103)
Q13: Thinking about your mobile reception with ... in the UK, do you ever experience any of the following issues?
Some respondents answered 'don't know' so the total of those reporting any problem and those reporting no problem, does not add to 100%.

2.20   Figure 8 shows the frequency with which problems are experienced. Having no signal or reception on the phone is experienced most frequently, with 10% of mobile users saying they experience this frequently. The frequency across the other problems we asked about is lower, with between two and five per cent of mobile users frequently experiencing these.

Figure 8: Frequency of mobile reception problems, all mobile users

Source: Kantar Media omnibus, (14th – 20th November 2012)
Base: All who use a mobile phone (N=2136)
Q14: And how often do you experience these issues with mobile reception?

2.21   There are no statistically significant differences in frequency of reported problems between users in urban and rural areas. Among the nations the only difference is that mobile users in Northern Ireland are more likely than those in Scotland to frequently have no signal/reception on the phone (24% vs. 5%)

Conclusions

2.22   These results show us that, as one might expect, being able to use your phone to make and receive calls is very important to consumers. Many mobile users say that they experience no problems at all[15] and the majority of UK mobile users are satisfied with their mobile service overall (81%). However, a significant minority of consumers (most notably in Northern Ireland) experience a range of recurring problems when they try to use their mobile phones (see paragraph 2.20 and figure 7 above).

2.23   The mobile reception issue consumers are most dissatisfied about is their ability to make and receive calls (12% in England, 8% in Scotland, and 11% in Wales are dissatisfied), with those in Northern Ireland most likely to be dissatisfied (18%). No mobile signal or reception (in order to make or receive calls or texts) is also the most common problem consumers say they have experienced (more than twice as many people have ever experienced that problem compared to each of the other problems we asked about – see Figure 7 and paragraph 2.20 above).

2.24   The research clearly indicates that some consumers are not wholly satisfied with the QoE of their mobile service but consider that various aspects of QoE are important to them. This suggests that if appropriate information were available to allow consumers

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[15] 43% in England, 48% in Scotland, 39% in Wales and 24% in Northern Ireland stated they had never experienced a problem.

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to compare operator's QoE then they would use this information when purchasing mobile services and select packages / providers that better suited their needs.

2.25   We have considered similar matters in the past in the 2010 Quality of Service research report[16]. This research found that consumers particularly valued information on price and network quality of service. Ofcom's accreditation scheme for price comparison websites encourages clear and accurate consumer information on price. As a result of the research report, we also considered the information provided to consumers on fixed line broadband speeds. This initiative has brought about improvements in both the information provided by broadband providers as well as the speeds consumers can expect from their broadband service.

2.26   Adopting a similar approach to the technical performance of mobile networks has the potential to bring about further improvements for those who have a poor experience with mobile performance. Ofcom has a number of existing publications where this information could be published, including (but not limited to) the Communications Market Report, Infrastructure Report and Consumer Experience Report.

2.27   Publishing information on QoE will enable consumers to make better informed purchasing decisions and drive competition between operators. This in turn will result in improved network performance for the benefit of consumers.

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[16] http://stakeholders.ofcom.org.uk/consultations/topcomm/qos-report/

Section 3

Technical performance metrics

3.1 In the previous section we set out why publishing information on mobile QoE will benefit consumers. This section sets out our initial thoughts on the type and granularity of information that might of use to consumers, what data we would need to collect to produce the information and we then consider some of the potential sources of this data.

What information do consumers need?

3.2 Consumers use mobile services in different ways and this may influence the importance they place on different aspects of QoE. For example, a sales representative may value the ability to make and receive calls across the UK motorway network, whilst a teenager may be more interested in the performance of text and internet access in her home town.

3.3 Although it is likely that QoE information will need to be presented and tailored to meet the needs of different consumers groups, there are a number of core characteristics to QoE information that we think will be universally applicable. These include:

- **Operator specific information** which allows the performance of rival networks to be compared. There may be merit in publishing information on both MNOs and MVNOs to identify whether consumers receive differing levels of service from operators using the same network.

- **Granular geographic information.** Consumers will wish to know how mobile services perform in the places they wish to use them. Mobile operators already provide on-line coverage checkers which set out information typically down to a 100mx100m grid.

- **The consumer 'use case'**. For any given location, QoE can also vary depending on whether the consumer is indoors or outdoors and whether they are on the move (whether on foot, in a motor vehicle or on a train).

- **Network performance by time of day and day of week**. Our experience from measuring fixed broadband is that performance can degrade at peak usage times. For mobile broadband (and potentially voice calls) similar effects may be present and consumers may wish to know which operator provides the highest network capacity in the areas they wish to use their mobile service.

3.4 For those consumers who particularly value the quality of voice and text services, we consider that there are a number of important QoE metrics:

- Locations in which they are able to reliably make and receive a call under different use cases

- Probability that a call will complete successfully

- Probability that a call will not be blocked or dropped

- Clarity of the call

- Time for a SMS text message to be delivered

3.5   For mobile data services, the following information may be of use to consumers:

- Probability that an internet connection can be established

- Speed, stability and responsiveness of applications and data transfers.

    o   For a mobile device, this would typically include activities such as browsing web pages, using online maps, accessing location services, streaming video, using voice over IP services or downloading music.

    o   For a laptop with a broadband dongle, the range of activities is likely to be similar to normal fixed broadband.

3.6   For each of the metrics above, given that performance may vary in different parts of the UK, under different use cases and at different times, there may be merit in providing information at a local level, by use case and by time of day.

3.7   As a result of the differing information needs of different consumers groups, we recognise that it may be necessary to aggregate and simplify information when communicating to these different groups. We envisage that this could be achieved by making a more granular 'superset' of information/data publically available which can be aggregated ahead of publication to specific groups, potentially by third parties such as comparison websites.

3.8   We welcome views on whether there is additional or alternative information that would be useful for consumers to that set out above. We also welcome views on the granularity (geographic and time) which would be most appropriate to form the superset of information that could be subsequently tailored for different consumer groups.

3.9   It is clearly important that published information is accurate and up-to-date if the market for mobile service is to operate effectively. Given the rapid rate of change in the market (particularly with the advent of 4G services) regular updates to the information will be required. We currently collect coverage data annually, but we welcome views on how often information should be refreshed to ensure that mobile markets work effectively.

Proxies for QoE metrics

3.10   The QoE metrics that we have set out above have been chosen because we consider that they most closely reflect what consumers' consider important about their mobile services – although we welcome alternative views.

3.11   The data for some of these metrics may be readily available from MNO operation systems at the granularity required – in which case the data can be directly converted to the information provided to consumers. For example, MNOs may already collect data on dropped calls.

3.12   Where suitable data is not available to produce particular QoE metrics, then it may be necessary to use proxies. For example, data on actual network coverage may not be readily available from the MNO operational systems, but can be estimated using

planning models (potentially validated with field measurement). This is the approach we currently use when reporting network coverage – predicted signal strengths produced from MNO planning tools are used as a proxy of actual coverage.

3.13   Although proxies may be less accurate than actual data (and hence may be of less use to consumers who wish to know whether they can use a specific service in a specific location and use case) if defined correctly they can be used by consumers to make comparisons between MNOs.

3.14   Under our Infrastructure Reporting duty we are required to report on the state of communications networks in the UK as well as the services they carry. As such, the network data we collect for the Infrastructure Report may also be useful for deriving QoE proxies.

Predicted vs. actual performance

3.15   When collecting data on performance of networks and services, two broad approaches can be considered:

- **Predicted performance**: The network and service performance the operator expects to deliver based on coverage and capacity planning tools. This is the 'designed performance'. This information would be gathered from MNOs.

- **Actual performance**: Data on the actual performance of the network – such as signal strength, dropped calls and speed or latency of mobile broadband experienced by end users. This data could be collected from a third party commissioned by Ofcom and/or directly from MNOs.

3.16   There are advantages and disadvantages for each approach. Actual performance data will typically better represent the consumer experience in that it provides information based on consumers' actual usage and location. However, the disadvantage of actual performance data is that it will only provide data where the tests are carried out (i.e. it will not cover 100% of a geographic area). It will, for example, provide no data in not spots (by definition) and in areas where little data is available (such as highly rural areas) it may not be possible to derive statistically robust comparisons between operators.

3.17   Predicted performance is likely to offer far more granular geographic data (as operator planning tools can operate down to a high level of geographic granularity) but accuracy of predictions will be subject to error margins given the complexity of predicting radio propagation in cluttered environments and inside buildings. In addition planners cannot always predict how heavily a network will be used. As such predicted performance will not always reflect actual performance.

3.18   Predicted and actual performance metrics can be complementary. Predicted performance can offer relatively low cost, highly granular data and the quality of the predictions can then be validated by correlating with actual performance data. For this reason we see there is merit in collecting data on both predicted and actual performance.

Predicted performance

3.19   We already collect data from MNOs on predicted signal strength for 2G & 3G networks. We use this to estimate geographic and premises coverage across the UK.

This data is collected at a granularity of 200mx200m and is the basis of the coverage information we publish in the CMR and Infrastructure Reports.

3.20 In addition to signal strength, there may be other metrics generated by MNOs' planning tools that it would be appropriate for us to gather. For example, for a given location (e.g. a 200mx200m pixel) or cell site footprint the data types shown in figure 7 may provide additional valuable information.

Figure 7: Possible predicted performance metrics available from MNO planning tools

Metric	Benefit in collecting the data
Signal to noise and interference ratio	Potentially a better indicator than signal strength alone in estimating network coverage
Network technology e.g. 2G, 3G, HSDPA, LTE etc. and which 3GPP software revision has been rolled out	Would allow the roll out of different technology types to be tracked. This could be used as a proxy for mobile broadband performance.
The radio spectrum band and number of carriers in use	Provides insight into spectrum utilisation and network capacity
The backhaul arrangements for a given cell site	Provides insights into speed, capacity and potentially latency of mobile broadband
The geographic area, number of premises, vehicles per day and/or predicted number of calls /day	

3.21 We will seek to engage directly with the MNOs to explore which metrics are produced by their planning tools which might be useful in deriving proxies of QoE.

Actual performance

3.22 Whilst predicted performance data is generally only available from MNOs' planning tools, actual performance data can be provided by MNOs or third parties.

3.23 Typically actual performance metrics are collected by third parties (often on behalf of MNOs) by placing test calls and data on the networks in different locations. Often referred to as 'drive testing' this approach seeks to mimic end user behaviour and so provides a good insight to consumer QoE. The main disadvantage of drive testing is the high costs required to cover a representative sample of the UK, particularly if it has to be repeated at regular intervals.

3.24 As an alternative to drive testing, MNOs are likely to have very rich data from their operational systems which could provide very granular information on service quality – effectively analysing the performance data associated with the millions of calls and data sessions made each day on their networks, rather than relying on a small number of drive tests. The advent of "big data" tools has made it possible to process this data cost effectively and it may be possible to produce suitable proxies of QoE.

3.25 We intend to explore with the MNOs what actual performance data they collect, but we also welcome the views of other stakeholders on the types of actual performance data that are available.

Collection approaches

3.26   There are several alternative methodologies for collecting the underlying data that is needed to provide consumer information. Each will have different merits with respect to the granularity of the data collected, the costs of collection and the quality of the data.

3.27   Broadly, we envisage that the data will come from either the MNOs themselves, from third parties or from a hybrid approach.

MNO sourced data

3.28   As outlined above, MNOs may be able to extract a wide range of relevant data from their existing planning tools and operational systems. We recognise that the information available may vary between MNOs and so work would be required to identify a common set of metrics that would allow MNO performance to be compared fairly.

Third party sourced data

3.29   Ofcom has previously commissioned research into mobile network performance from third parties[17] and as described in paragraph 1.19 is considering research into 4G QoE in 2013. Ofcom also undertakes research using third party data to measure fixed broadband[18]. By commissioning a third party contractor to undertake this work we are not reliant on the service providers to extract data from their systems and we have been able to collect data that is not available in their systems. It also ensures that data is collected across operators in a consistent way and is truly independent of the operators.

3.30   There are a number of approaches third parties adopt to collect data. These include:

- **Crowd sourcing:** recruiting a large panel of consumers to collect data, for example by the installation of a measurement application on their smartphone.

- **Drive/walk testing:** where a small number of measurement devices are driven or walked around a pre-defined area by a third party commissioned by Ofcom. Each device would take measurements of the network either at set intervals, or in specific places, in order to measure performance.

- **Fixed probes:** measurement devices can be installed in fixed locations, such as shopping centres or in blocks of flats, to measure performance at regular intervals of time.

3.31   Each approach has its merits. Crowd sourcing can be a cost effective way to gather large quantities of data, and it reflects actual user locations and use. However it does not cover all locations, it is not always clear where the device is located when the test is made (so it could be indoors or outdoors, in a bag or in the users' hand) and sufficient quantities of volunteers are needed for robust results. It also may not be possible to gather all the metrics required. This raises potential challenges in

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[17] http://media.ofcom.org.uk/2011/05/26/mobile-broadband-speeds-revealed/
[18] http://stakeholders.ofcom.org.uk/market-data-research/other/telecoms-research/broadband-speeds/broadband-speeds-may2012/

gathering statistically robust results and specific important information. There may also be costs associated with recruiting the crowd sourced volunteers.

3.32   Drive testing and/or walk testing measurements are taken in a far more controlled environment because the location of the tests is chosen and the location of the test device is known. Tests can be repeated in specific locations as required. However, the cost of data collection can be higher, mainly because of travel costs and, potentially, call and data charges. Drive testing may be more appropriate if targeted data collection is required. For example, concentrating tests in areas which are predicted to have poor performance or are otherwise of specific interest and/or in sample areas to allow predicted performance to be validated with actual performance data.

3.33   Fixed probes are likely to give robust, comparable data because tests are completed in the same place at regular intervals. However, only these locations are sampled. Data costs can be high because of the high volume of traffic sent.

3.34   In our mobile broadband research in 2011, we used all three of the measurement approaches discussed above – measurement devices in fixed location, drive testing in a small number of case study areas and an application downloaded to volunteers' smart phones. We wish to explore through this CFI and through our planned work in 2013 the most effective approaches to third-party collection of mobile QoE information.

Other approaches

3.35   **Hybrid approaches**, where third parties collect data from mobile operators' systems, may provide a good balance of cost vs. independence and quality/depth of data. Such an approach could ensure that data were comparable between operators and consistently analysed. Potentially, the third party could also aggregate data before it is provided to Ofcom.

3.36   **Industry led initiative.** Our primary objective is to ensure consumers have access to accurate and comparable information on mobile performance and this does not necessarily require Ofcom to collect and publish all the relevant data (although we do have duties to collect and publish certain data). An industry led initiative could achieve a similar outcome, possibly in conjunction with comparison websites or consumer information bodies. However, the absence of such an initiative to date suggests that the necessary incentives or coordination are not in place.

3.37   We recognise that the collection of any data will incur costs, whether for Ofcom or operators. It is therefore important that we are proportionate when collecting data – balancing the benefits that are derived from providing information to consumers against the costs of collecting it.

3.38   We believe that Ofcom has a role to play in collecting some form of third party data to ensure information is independent and accurate. We would welcome comments from respondents on Ofcom taking this role and also whether respondents consider the role should be more focused on validating data from operators or collecting the data.

3.39   In choosing a solution we need to balance the quality of information provided to consumers against the costs of collection and publication and the time to implement. We are seeking stakeholder views on the merits of the various possible approaches in order that we can make this judgement.

How to make submissions

A1.1   We welcome views from all stakeholders on any of the points raised in this Call for Input.

A1.2   We invite written views and comments on the issues raised in this document, to be made by **5pm on 1 April 2013**.

A1.3   We are particularly keen to get the views of stakeholders representing the needs of consumers in different parts of the UK to ensure we have a clear view of the information that consumers would find useful when purchasing mobile services. If there is sufficient interest from stakeholders, we propose to host a workshop in March to facilitate the development of ideas and options. **To register your interest in a workshop, please contact us by 15 February 2013**.

A1.4   We strongly prefer to receive responses electronically as this helps us to process the responses quickly and efficiently. Responses can be submitted by:

- email (with accompanying attachments as necessary) to MobileQoE@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response cover sheet (see last page).

- using the online web form at https://stakeholders.ofcom.org.uk/consultations/mobile-voice-data-experience/howtorespond/form.

- post to the address below, marked with the title of the consultation 'Measuring mobile quality of experience' (and a completed consultation response cover sheet – see last page).

    Ruth John
    Ofcom
    Riverside House
    2A Southwark Bridge Road
    London SE1 9HA

    Tel: 020 7981 3000

A1.5   Note that we do not need a hard copy in addition to an electronic version. We will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.

Confidentiality

A1.6   We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether all of your response should be kept confidential, and specify why. Please also place such parts in a separate annex.

A1.7   If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.8   Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Our approach on intellectual property rights is explained further on its website at http://www.ofcom.org.uk/about/accoun/disclaimer/

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing ☐   Name/contact details/job title ☐

Whole response ☐   Organisation ☐

Part of the response ☐   If there is no separate annex, which parts?

If you want part of your response, your name or your organisation not to be published, can Ofcom still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

DECLARATION

I confirm that the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand that Ofcom may need to publish all responses, including those which are marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard e-mail text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part), and you would prefer us to publish your response only once the consultation has ended, please tick here. ☐

Name   Signed (if hard copy)