Mobile not-spots

An update on our research

Research

Publication date: 5 November 2010

Contents

Section 1

One page overview

1.1 Mobile usage has changed dramatically in the last decade and is still evolving. There are increasing numbers of mobile-only households and for most consumers, mobile access is now regarded as a necessity rather than a premium service. As devices become 'smarter', offering new applications, expectations about the availability of mobile services will rise further.

1.2 'Mobile not-spots' are areas where people cannot access mobile services. Investigating this issue is one of our 2010-11 Annual Plan priorities. We prioritised it due to consumer and stakeholder concerns. Our aim in this work is to develop an evidence base and to clarify the scope for any solutions. This report sets out our findings so far. It draws on two new pieces of research, published today. We will carry out more work over the coming months.

1.3 The issue of 'mobile not-spots' is a multifaceted one. Our report identifies five distinct types of problems - complete not-spots (no coverage at all), 3G not-spots (no mobile broadband coverage), partial (operator-specific) not-spots, interrupted coverage on the move and indoor coverage. Distinguishing these issues is important, because the potential for commercial solutions to them varies, as does the nature and potential benefit of actions we might take.

1.4 The data we have shows that some parts of the UK have lower levels of mobile coverage than others. We also examined the impacts of not-spots and found these varied - from daily effects of missing calls, to a loss of social connection or business efficiency, to undermining efforts to deal with emergencies.

1.5 We also looked at case-studies to examine why these not-spot issues occur. This research suggests that commercial considerations are the main cause, although planning factors also appear to be important for lack of coverage on the railways.

1.6 We looked at whether mobile operators' plans could potentially address these issues. We found that some problems may reduce in scale as a result of market developments - particularly 3G not-spots, partial not-spots and indoor coverage problems – but none will disappear entirely. In particular 'complete not-spots', which exist mostly in rural areas, seem likely to persist to some degree.

1.7 We considered what Ofcom could do to help progress this issue. Our role is to promote effective competition and help communications markets to work for consumers. However, mobile not-spots also raise important wider policy issues because of the reliance that our society now places on mobile phones. As decisions arise, Ofcom will continue to take these considerations into account in accordance with our duties. We can also seek to contribute to and implement public policy on relevant issues that Government may wish to consider.

1.8 Our work in this area will continue. In addition to our ongoing research, there are two new areas where we will prioritise further work: examining the scope for improving coverage information (to help consumers choose the best provider, which may also enable operators to compete more to improve coverage); and facilitating railway coverage through discussions with stakeholders. We will also continue to engage with the wide range of stakeholders with an interest in this issue.

Section 2

Executive Summary

Mobile not-spots are a priority area for Ofcom

2.1 Mobile not-spots have been raised frequently by stakeholders as an issue of concern, warranting further Ofcom investigation. As a result, we identified mobile not-spots as an area for further work in *Mobile Evolution* – our 2009 statement on our Mobile Sector Assessment[1]. More recently we identified this issue as one of our priority areas in our 2010/11 Annual Plan[2].

2.2 We have undertaken new research which helps inform our understanding of mobile not-spots. This research report sets out the results of our work so far. Our work in this area is ongoing, so we also explain the next steps in our efforts to make progress on this issue.

2.3 Our aim in undertaking this research is to develop insights into mobile not-spots and establish an evidence base to ensure mobile coverage issues are well understood across the UK.

Ofcom has duties to secure availability of communications services

2.4 Ofcom is undertaking this work because our principal duty under the Communications Act 2003 is to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate by promoting competition. In carrying out our functions, we are required to secure a range of things. Those most relevant to mobile not-spots are the need to secure: the availability throughout the UK of a wide range of electronic communications services; and the optimal use of spectrum.

2.5 We have various powers which enable us to fulfil our principal duty. In relation to mobile not-spots, we may consider intervening in a proportionate way to help the market function more effectively. For example, we could consider ways to improve information available to consumers so they can make better decisions. We may also consider intervening to ensure consumers are protected. We also have specific powers to issue spectrum licences subject to conditions.

2.6 In performing our duties we must also have regard to a range of issues that appear to us to be relevant in the circumstances. These include the desirability of promoting competition and encouraging investment and innovation. They also include considerations such as encouraging the availability of high-speed data-transfer services and meeting the different interests of people in different parts of the UK.

Wider public policy goals may also be relevant

2.7 Mobile not-spots also raise important wider policy issues because of the reliance that our society now places on mobile phones. As decisions arise, Ofcom will continue to take these considerations into account in accordance with our duties. However, even

[1] Ofcom *Mobile Evolution – Ofcom's Mobile Sector Assessment* 17 December 2009 http://stakeholders.ofcom.org.uk/consultations/msa/statement/ .
[2] Ofcom *Annual Plan 2010-11* http://www.ofcom.org.uk/about/annual-reports-and-plans/annual-plans/annual-plan-2010-11/ .

in using our regulatory powers, it is still likely that there could be areas left without mobile coverage (that is, it is unlikely there will be 100% geographic coverage).

2.8 Here, we can also seek to contribute to and implement public policy on relevant issues that Government may wish to consider. For example, Government may wish to consider whether it is appropriate to ensure all people have access to mobile coverage to help them participate in society on digital inclusion grounds. We can help inform this consideration. One way we can do this is through the report to Government that we will undertake for the first time next year on the state of the UK's communications infrastructure.[3]

Coverage levels vary across different parts of the UK

2.9 It is difficult to set out the precise scale of coverage issues as current coverage information has significant limitations[4].

2.10 Figures from our most recent Communications Market Report[5] (CMR) show that approximately 97% of the UK population and 91% of the UK land mass has 2G (voice and text) coverage. These represent areas where at least one mobile operator provides a service[6].

2.11 3G coverage is less extensive in the UK covering around 87% of the population and 76% of the land mass. Partial not-spots, where some operators do not provide a service, exist within these areas. For example, 5% of the population can access only one operator network in their area[7].

2.12 We also know from our CMR that 2G and 3G coverage levels are lower in Scotland, Wales and Northern Ireland compared to English regions. For example, Scotland has the lowest levels of 2G coverage at 87% population coverage. Northern Ireland has the lowest 3G population coverage at just 40%.

Our research findings help define five core mobile coverage issues

2.13 Having considered the research findings so far, it is clear that mobile not-spots manifest themselves in a number of ways. We identified five core coverage issues, set out in Figure 1. These are not mutually exclusive.

2.14 It is important to consider each issue distinctly because each can have different causes and also different impacts on consumers (individuals and businesses) and citizens. Moreover, separating the issues in this way provides a clearer understanding of the particular nature of the not-spot problem, those issues that the

[3] The Digital Economy Act 2010, which came into force in June of this year, gives Ofcom a new duty to report to the Secretary of State every three years on the UK's communications infrastructure.
[4] For example, the figures we quote in our Communications Market Reports are subject to error margins, due to the way the operators provide their data and the need to round up figures to standardise data across operators.
[5] Ofcom *Communications Market Report* 19 August 1010 http://stakeholders.ofcom.org.uk/binaries/research/cmr/753567/CMR_2010_FINAL.pdf .
[6] Based on a postcode district analysis which found that 97% of the UK population live in postcode districts where there is more than 90% coverage – see Section 4 for more details on the methodology.
[7] All the coverage figures quoted are approximations and are subject to error margins. The methodology may also overestimate geographic coverage especially in rural areas as it reflects the percentage of total postcode districts within which mobile services are at least 90% available, but postcode districts do vary in size with rural postcodes being very large geographically.

market is addressing and those where there may be scope for us to help the market function better. This helps us in prioritising our future work.

Figure 1: The five key types of coverage issues for our analysis of mobile not-spots

Key types of issue	Description
Complete not-spots (No 2G or 3G coverage)	Where there are no networks at all - no 2G nor 3G coverage. No voice, text or low level data availability. Can be: • Large areas; or • Local (small) not-spots
3G not-spots (No mobile broadband)	Where there is no 3G coverage but 2G coverage exists Perceived as 'mobile broadband' not-spots, although data rates vary
Partial not-spots	Operator-specific not-spots – areas where there is 2G or 3G coverage by some, but not all, operators.
Interrupted coverage 'on the move'	Not-spots experienced when travelling - 'in transit'
Indoor coverage	Where there is no (or very poor) coverage inside buildings

We commissioned case studies to understand these issues further

2.15 Given the limitations of current nation-wide and regional coverage data we commissioned new case-study research from PA Consulting into not-spot areas to help understand the nature of not-spots at a more localised level and to uncover the specific reasons why some not-spots exist. The PA research, published alongside this report today[8], looks at the causes of not-spots on two national railway routes and in fourteen selected local not-spot areas across the UK. This research is not intended to be a statistically significant sample, but provides qualitative insight. Three key findings emerged from this work:

- In the vast majority of case study areas, not-spots existed because it was not a commercial priority for mobile operators to extend their coverage, influenced by low levels of traffic discouraging investment. However, this issue is complex: operators do not appear to make investment decisions on a site-by-site basis, and we also know that coverage can be a differentiator in marketing campaigns. This suggests that wider strategic drivers may often be at play.

[8] PA Consulting Group 'not-spots research' http://stakeholders.ofcom.org.uk/binaries/research/telecoms-research/not-spots/PA_Consulting_main_report.pdf

- Historically, planning and technical issues have been cited as key obstacles to network deployment for providing coverage to communities. However, we did not find evidence of this in our case studies in fixed locations.

- Nevertheless, planning related issues were found to be important in providing coverage on trains. Mobile operators often needed to gain the cooperation and consent of track and train operators in order to provide coverage. We found noticeable differences when comparing the levels of coverage along the UK's two key rail routes – the East Coast and West Coast Main Lines (with the West Coast Main Line having significantly better coverage than the East Coast)[9].

2.16 The PA research also demonstrated that complete and partial not-spots featured in the one case study of roads - around the Mournes area of Northern Ireland[10]. We are exploring road coverage as part of our current research testing mobile signal strength across Devon and we are exploring coverage along arterial routes elsewhere in the UK (we touch on this work again at paragraph 3.21).

Impact of not-spot issues on citizens and consumers

2.17 Our new consumer qualitative research, also published today, has helped us understand that these issues have differing impacts on the lives of individuals, businesses and society. This new research, conducted for us by Illuminas, helps progress the debate by bringing personal insights from different part of the UK[11]. This research is not intended to be a statistically robust analysis of consumer detriment, but provides qualitative insight.

2.18 We have grouped the key findings from the Illuminas research around the issues and impacts of most relevance to particular groups:

- **For individuals,** concerns cited included not being able to make or change plans on the move or not being able to access news and social networking sites.

- **For businesses,** concerns cited included loss of workforce efficiency, a growing problem given the innovations in mobile data services and applications.

- **For society,** some respondents were concerned by an inability to contact the emergency services. Other impacts cited included lack of social connection.

- **Rural/urban issues**, rural businesses expressed significant concerns about local coverage issues. These were felt in terms of both conducting day-to-day business activities and ensuring the safety of staff working in isolated jobs such as farming.

[9] This represents a comparison of 2G coverage, which enables mobile voice and text services. The probability of being able to call for 2 minutes was around 90% or above on the West Coast Main Line for all the four 2G mobile operators' networks, while on the East Coast Main Line the equivalent figure dropped to around 50% to 70% for the two lowest performing operators.
[10] This is a similar finding to a 2008 Ofcom study on mobile coverage along the A470 in Wales – first quoted in Ofcom *The Communications Market 2008 Nations and Regions - Wales* 22 May 2008 http://stakeholders.ofcom.org.uk/binaries/research/cmr/wales1.pdf .
[11] Illuminas 'not-spots research' – qualitative research report http://stakeholders.ofcom.org.uk/binaries/research/telecoms-research/not-spots/Illuminas_final_report.pdf .

2.19 This new research is indicative only of the types of impact felt by different user groups and adds to the existing mix of qualitative and quantitative work that has already been done in this area, such as the work by the Communications Consumer Panel[12].

Market developments are addressing some not-spot issues

2.20 Market developments should help address some not-spot issues to some degree.

- **3G not-spots:** The mobile operators (Vodafone, O2, Orange/T-Mobile and 3) are continuing to extend their 3G networks.

- **Partial coverage:** Operator partnerships, for example, through the T-Mobile/Orange merger and through the Vodafone/O2 mast sharing arrangement, should reduce the number of areas with partial coverage. However, different operator footprints (which are the cause of partial coverage) will continue to exist to some degree.

- **Indoor coverage:** Other ways of dealing with poor indoor coverage seem increasingly plausible. Vodafone is the only provider currently offering residential consumers 'femtocells' (indoor equipment that looks like a wireless router and connects via a fixed line broadband connection) as a potential solution to improve indoor coverage. There are other possible solutions, such as Wi-Fi[13], in the market, although these require specific handsets and sometimes additional applications in order for voice services to be used on mobile devices[14].

2.21 On the other hand, developments seem to be slow in two areas.

- **Complete not-spots:** The commercial scope to address complete not-spots is more limited. 2G operators (Vodafone, O2 and Orange/T-Mobile) do not have significant plans to extend their 2G networks, as their focus is on extending 3G coverage. It is conceivable that in the longer term, commercially driven improvements in 3G coverage may eventually help improve complete (2G) not-spots[15]. However, complete not-spots are likely to continue to persist to some extent, particularly in rural areas.

- **Interrupted coverage on the move:** Some mobile operators are looking to install 'repeaters' on newer trains to help carry mobile signals into train carriages, but progress is slow. Some of the market developments improving partial coverage cited above may help and commuters may see improvements.

---

[12] See for example, Communications Consumer Panel *Mobile Coverage – The Consumer Perspective Research Report* October 2009 http://www.communicationsconsumerpanel.org.uk/Mobile_coverage_consumer_perspective.pdf .

[13] In very simple terms, Wi-Fi is a technology that uses radio waves to allow devices to connect to the internet without wires. It requires a wireless router connected to a fixed line broadband connection.

[14] For example, consumers need a Wi-Fi enabled device - not all mobile handsets have this capability. Consumers may also have to access and configure particular applications, e.g. Truphone, in order to use services - such as Voice over Internet Protocol (VoIP, which is internet telephony) - over Wi-Fi.

[15] For example, a few operators have stated targets on 3G coverage – Everything Everywhere has suggested they will reach 99.6% coverage by 2014. See Everything Everywhere *Creating a new mobile champion* – slide 68 in the Investor briefing given 28 September 2010 at http://www.download-telekom.de/dt/StaticPage/92/75/30/100928-investor-event-everything-everywhere_927530.pdf .

This helps us develop our approach to further work

2.22 To date, our approach has been to progress work to understand mobile not-spots in greater detail. A broad understanding of all the factors above – the causes of not-spots, their impact, and the way the market is developing – has helped us identify the potential areas which we could consider in greater detail.

2.23 We believe the possible areas where we, as a regulator, can help make progress are those that may improve consumer information; and potential failures in co-ordination, such as on the railways. The next paragraphs explain these new areas of work, and where our ongoing work continues.

We are carrying out work in several areas

We will continue research to further develop an understanding of these issues

2.24 We are undertaking research to measure mobile signal strength across Devon. This involves a fleet of vehicles driving across the majority of roads, measuring the network coverage of all operators there. We will analyse findings to help us understand the accuracy and comparability of mobile operator coverage information. This work may also help us to understand better the scale of not-spot issues in a rural region and on its roads, providing more detail than we have at present through our nation-specific coverage figures. We will explore coverage on selected major arterial roads elsewhere in the UK.

2.25 We are also undertaking research to get a better understanding of the quality of mobile broadband services delivered to consumers across the UK. We envisage that insights from this research will inform our further work on consumer information.

We will consider whether there is a need to improve consumer information

2.26 In a complex and evolving market like the mobile sector, there is a higher risk that consumers may not have sufficient information to make effective decisions. So we plan to do further work to consider whether there is a need to improve the availability and accuracy of consumer information about mobile services and so help ensure the effectiveness of competition.

2.27 However, this is not a straightforward task. For example, information about mobile coverage is technically complex and difficult to compare. We also need to do more work to consider if and how information can be provided in a form that might be more helpful to consumers.

We will try to facilitate an improvement in railway coverage

2.28 Our work so far on railway coverage shows that mobile operators face problems accessing sites along railway tracks and train stock, in order to improve rail coverage. Discussions between relevant industry players are underway, but the slow speed of improvements in this area indicates there could be some coordination issues. We intend to consider this further, in discussion with relevant stakeholders, to understand whether potential improvements in coordination could help improve railway coverage.

We will take forward work to release spectrum suitable for mobile broadband

2.29 We aim to make progress with our related annual plan priority to take forward plans for the release of spectrum suitable for mobile broadband[16], which includes 800 MHz. We note in this regard that we expect to be consulting on the design for the auction of 800MHz, following Parliamentary approval of the Government's proposed Direction to us on the award of this low-frequency spectrum, which is suitable for the provision of mobile broadband services.

2.30 Furthermore, we recently advised the Government that mobile operators should be able to use their 2G (voice and text) spectrum to carry 3G (mobile broadband) services[17]. This is likely to bring significant benefits to consumers leading to faster mobile broadband speeds, improved indoor coverage and wider mobile coverage in rural areas[18]. This is subject to the Government's expected Direction to Ofcom on mobile spectrum, which amongst other things requires Ofcom to vary the existing 2G licences in this way.

We will continue to engage with Government and stakeholders

2.31 Finally, it is clear from our work that the commercial scope to address complete not-spots is more limited. As we noted above, even in using our regulatory powers it is still likely that there could be areas left without mobile coverage.

2.32 Here, we can also seek to contribute to and implement public policy on relevant issues that Government may wish to consider. For example, Government may wish to consider whether it is appropriate to ensure all people have access to mobile coverage to help them participate in society on digital inclusion grounds. We can help inform this consideration.

2.33 The use of coverage obligations (attached to the auction and award of spectrum licences) is one mechanism that has been used in the past to help ensure a level of mobile service availability, though not to the extent of 100% geographic coverage. Such obligations could again be considered as further spectrum is released. As noted above, we expect to consult on the design for the auction of 800MHz.

2.34 We also note there may be potential links between mobile availability and Government policies, such as their commitment to universal coverage of 2Mbps to all by 2015[19].

2.35 We have already stated that mobile coverage will be one of the areas we will focus on in our first infrastructure report to Government - where we have a formal role to make recommendations on the UK's communications infrastructure including on issues relating to mobile coverage[20]. We will therefore consider in this context

[16] The Government's proposed direction to us is on a package of spectrum management measures that will support the deployment of high speed mobile broadband services. The draft statutory instrument is available at http://www.opsi.gov.uk/si/si2010/draft/pdf/ukdsi_9780111500767_en.pdf .
[17] 3G networks can enable the provision of mobile broadband services in addition to the voice, text and low-level data services provided by 2G networks.
[18] Ofcom *Notice of proposed variation of 900 MHz and 1800 MHz Wireless Telegraphy Act licences* 28 October 2010 http://stakeholders.ofcom.org.uk/consultations/900-1800mhz-wireless-telegraphy/ .
[19] See http://interactive.bis.gov.uk/comment/bduk/ for more details of the UK Government's policies on broadband.
[20] Our consultation on our infrastructure report noted that we planned to highlight 2G mobile coverage and broadband in our first report to Government. See Ofcom *The UK Communications Infrastructure Report - Ofcom's proposed approach to its new reporting duty* 22nd July 2010

whether there are any practical recommendations we might make to Government in relation to mobile not-spots.

2.36 Other stakeholders also play important roles in making progress on this issue. Notably, mobile operators continue to progress commercial improvements to coverage issues. We will continue to engage with stakeholders on the issues.

http://stakeholders.ofcom.org.uk/binaries/consultations/uk-comms-infrastructure/summary/uk-comms-infrastructure.pdf .

Section 3

Context for our work

3.1 In this Section we explain the background and context for this work and the reasons why it is a priority area for Ofcom. We set out our key duties and regulatory principles that guide any intervention we might make. We also reference the key pieces of research that we have used to date and those we have underway.

Mobile not-spots are a priority area for Ofcom

3.2 Inadequate mobile coverage has been raised by many as an issue of concern to citizens and consumers (including business consumers).

3.3 In 2008 we commenced an assessment of the UK mobile sector to identify whether and how regulation needs to adapt to a changing market. We carried out two phases of assessment, with stakeholder engagement and consultation at each stage. In December 2009 we published our statement, Mobile Evolution[1]. We concluded that competition in the mobile sector has delivered high levels of customer satisfaction and high levels of affordability. But we also pointed out that some groups of consumers have still not fully benefited from competition in the UK mobile sector, specifically consumers in not-spots.

3.4 More recently we identified the issue of mobile phone not-spots as one of our priority areas in our 2010/11 Annual Plan[2]. This was based on our analysis of market developments, our progress against our 2009/10 Annual Plan, and following consultation with our stakeholders.

3.5 In putting together the Annual Plan we engaged with our Advisory Committees in England, Northern Ireland, Scotland and Wales to discuss their priorities. The availability of mobile telephony signals in all areas was identified as a priority for all the Advisory Committees. Therefore a vital part of our work on mobile coverage is to consider how issues affect consumers and citizens in different parts of the country.

3.6 Since then, we have undertaken new research which helps inform our understanding of mobile not-spots. This includes a number of case studies in each UK nation. This research report sets out the results of our work so far. As our work in this area is ongoing, we also set out our next steps for our continuing efforts to make progress on this issue.

Ofcom has duties to secure availability of communications services

3.7 Ofcom is undertaking this work because our principal duty under the Communications Act 2003 is to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate by promoting competition.

3.8 In carrying out our functions, we are required to secure a range of things. Those most relevant to mobile not-spots are the need to secure: the availability throughout the UK of a wide range of electronic communications services; and the optimal use of spectrum.

We have specific regulatory powers to enable us to fulfil our duties

3.9 We have various powers which enable us to fulfil our principal duty.

3.10 Our goal as an economic regulator is to promote effective competition and make help communications markets to work for consumers. We may intervene to help the market function more effectively and in doing so we will consider interventions which are proportionate actions for us to take, in accordance with our duties.

3.11 There are a number of ways we can seek to do this, for example, through improving consumer information so that they can make better decisions, helping the functioning of the market.

3.12 We may also help facilitate stakeholder coordination where 'transaction costs' – for example those relating to negotiations - impede an efficient industry outcome.

3.13 In light of our duty to secure the optimal use of spectrum, we consider carefully the nature of obligations to be included in awarded spectrum licences, including, where appropriate, coverage obligations[21].

3.14 In addition, Ofcom may consider intervening in fulfilment of our broad statutory duties to further the interests of consumers, by ensuring consumers are protected. For example, we might intervene to ensure consumers have appropriate information to inform their decisions.

3.15 In performing our duties we must also have regard to a range of issues that appear to us to be relevant in the circumstances. These include the desirability of promoting competition and encouraging investment and innovation. They also include considerations such as encouraging the availability of high-speed data-transfer services and meeting the different interests of people in different parts of the UK.

Wider public policy goals may also be relevant

3.16 Mobile not-spots also raise important wider policy issues because of the reliance that our society now places on mobile phones. As decisions arise, Ofcom will continue to take these considerations into account in accordance with our duties. However, even in using our regulatory powers, it is still likely that there could be areas left without mobile coverage (that is, it is unlikely there will be 100% geographic coverage).

3.17 Here, we can also seek to contribute to and implement public policy on relevant issues that Government may wish to consider. For example, Government may wish to consider whether it is appropriate to ensure all people have access to mobile coverage to help them participate in society on digital inclusion grounds. We can help inform this consideration. We explain our new duty to report on the UK's communications infrastructure further below.

[21] We note that, in 2009, all the mobile phone operators met their initial 3G coverage requirements - to obtain at least 80% population coverage - that were set when their 3G spectrum licences were granted by the Government. The Government recently proposed a statutory instrument which amongst other things would, if it is approved, vary these 3G licences' coverage obligations – and would require holders of the licences – by 30th June 2013 – to provide "mobile telecommunications services to an area within which at least 90% of the population of the United Kingdom lives". See http://www.opsi.gov.uk/si/si2010/draft/pdf/ukdsi_9780111500767_en.pdf.

We have drawn from a range of existing research

3.18 In preparing this report we have drawn from a range of existing research:

- **Mobile Evolution:** As referenced above, we undertook an assessment of the UK mobile sector, publishing our statement, *Mobile Evolution* at the end of 2009.
- **Ofcom's Consumer and Business Experience Reports**: To help assess the experience of consumers in communications markets, we publish an evaluation of our work[22] and key findings and trends emerging from our detailed research.[23] In a complementary document, we examine the experience of business consumers and set out our work programme in this area.[24]
- **Ofcom's Communication Market Reports:** The 2010 publication[5] is Ofcom's seventh annual Communications Market report. The report provides context for the work that Ofcom conducts in furthering the interests of consumers and citizens in the markets we regulate. We have also published a series of Communication Market reports specifically for each UK nation to aid our understanding of communication matters across the UK.
- **The Communications Consumer Panel**: established under the Communications Act 2003 as an independent, evidence-based, advisory body to protect and promote communications interests of consumers and citizens – has also published research to ask consumers[25] and small businesses[26] about their experience of 2G mobile coverage.

We have also commissioned new research to support our work on not-spots

3.19 To inform an understanding of mobile not-spots, Ofcom has completed two new pieces of research so far which are published alongside this report:

- We commissioned analysis to understand the **nature of the 'mobile not-spot'** problem, and the reasons 'not-spots' exist (PA research[8]); and
- We interviewed consumers and businesses across the UK to better understand the **impact of not-spot areas** on their lives (Illuminas qualitative research[11]).

3.20 We have also held discussions with the mobile network operators to supplement our research and help inform our understanding of where improvements in mobile coverage are underway.

3.21 We have more work underway that we will report on in due course:

- We are undertaking a pilot study to **measure mobile signal strength**[27] in one rural region of the UK - Devon. This is a pilot study to measure mobile 2G and 3G signal strength by operator across the majority of roads in the Devon region. This

[22] http://stakeholders.ofcom.org.uk/binaries/research/consumer-experience/tidb.pdf.
[23] See http://stakeholders.ofcom.org.uk/binaries/research/consumer-experience/research09.pdf.
[24] http://stakeholders.ofcom.org.uk/binaries/research/consumer-experience/bce.pdf.
[25] www.communicationsconsumerpanel.org.uk/Mobile_coverage_consumer_perspective.pdf.
[26] http://www.communicationsconsumerpanel.org.uk/Mobile_coverage_small_business_perspective.pdf.
[27] This pilot will measure the presence of a signal for 2G and 3G for each mobile operator, which is taken as a proxy that a service is available. This is not however an indicator of the reliability, capability or bandwidth of that service provision.

should allow us to compare actual coverage levels with those reported by the operators in their postcode coverage checkers. We will use the results of the trial to help assess the accuracy of postcode checkers. We will also explore coverage on selected arterial routes, elsewhere in the UK.

- We have commissioned research on **how consumers use mobile broadband**. This will give us a picture on how consumers are using this service and also the influence of other factors – such as demographics and devices.
- We are also undertaking technical research to measure mobile broadband performance through **testing key network statistics,** providing indicators on speeds and reliability.

Related Ofcom work

We also have a new duty to report on the UK's communications infrastructure

3.22 The Digital Economy Act 2010, which came into force in June of this year, gives Ofcom a new duty to report to the Secretary of State every three years on the UK's communications infrastructure. We have set out our initial views on the types of technical data we think we will need to collect for the first report. http://stakeholders.ofcom.org.uk/consultations/uk-comms-infrastructure/summary. We are considering consultation responses at present.

3.23 The Digital Economy Act gives Ofcom discretion over which networks and services to include in the report. Among these areas, we intend to focus on one or two topics of particular consumer or policy interest in each report. For the first report, due in 2011, we are considering highlighting broadband and mobile coverage. We expect our work on mobile-not-spots to feed directly into this infrastructure report. We will consider in this context whether there are any practical recommendations we might make to Government in relation to the issue.

This remainder of this report is structured as follows:

- **Section 4: The types of coverage issues and their scale.**
  We set out five key types of issues and discuss the extent to which they exist in the UK, based on available data.

- **Section 5: The reasons for coverage issues.**
  We set out our findings on why mobile not-spot issues persist.

- **Section 6: The impacts of coverage issues on consumer and citizens.**
  We contextualise and set out the varying impacts issues have on consumers, businesses and wider society.

- **Section 7: Market developments to address coverage issues.**
  We discuss if and to what degree the issues are being addressed commercially.

- **Section 8: Developing our further work.**
  We set out how we have developed further work areas on the issues we raise in this report.

- **Section 9: Next Steps.**
  Finally, we explain the initial actions we will take following this research report.

Section 4

The types of coverage issues and their scale

Introduction

4.1 There are a variety of mobile coverage issues that affect consumers and citizens. We believe it is useful to split these issues into five key types.

4.2 Separating out the issues in a typology helps us to understand and convey the particular nature of the not-spot problem in different areas, to highlight those issues that the market is addressing and those where there may be a potential problem with how the market functions – and therefore helps us consider what, if anything could potentially be done.

4.3 In this Section, we focus on two key topics:

- We set out a fuller explanation of our typology of mobile coverage issues; and
- Where possible, we discuss the scale of these issues in the UK.

We believe there are five key types of coverage issues

4.4 The various types of coverage issues experienced by consumers and citizens can be broken down into the following five categories as noted in Figure 1 in Section 2:

i) Complete not-spots

ii) 3G not-spots

iii) Partial not-spots

iv) Interrupted coverage on the move

v) Indoor coverage

4.5 These coverage issues are not totally distinct and several of them could be experienced during the course of a day by individual consumers.

Qualifications around available data on the scale of not-spots

4.6 In the rest of this Section, we discuss each coverage issue in turn. We define the issue and we use available data to set out what we currently know about its scale in the UK.

4.7 In doing this, we would stress that it is currently difficult to judge the precise extent of each coverage issue – as robust, comparable mobile coverage statistics are not available at either a national or local level.

4.8 The UK-wide and nation-specific mobile coverage statistics we publish in our Communications Market Reports provide *indicators* for population coverage i.e. the

coverage levels for populated areas and for geographic coverage i.e. the coverage levels for total land mass (including both populated and non-populated areas).

4.9 The data is supplied by the GSM Association and collated for us by a third party, Europa Technologies. These postcode-based statistics are subject to a number of methodological limitations – see the box below for details[28]. However, while these figures are not completely accurate, they do give us some picture of relative (population and geographic) mobile coverage across different parts of the UK.

How we measure the availability of mobile services for our Communications Market Report

To evaluate the availability of mobile telephony services across the UK, we collect information via a third party on the number of mobile networks with second-generation (2G) and third-generation (3G) coverage in each UK postcode district. For an operator to be counted as having geographic coverage in any postcode district, its network footprint has to cover at least 90% of the postcode district. By using this data in conjunction with population figures, we then calculate the proportion of people living in postcodes that fall within this coverage threshold – this gives us figures for population coverage.

It is important to note that even where a postcode district does not meet or exceed the 90% threshold, it does not mean that mobile services are not available there; rather, it means that none of the mobile operators meet the 90% threshold that we have set for the analysis. Likewise, it is also important to note that even if a postcode meets the threshold, it does not mean that mobile services exist across the entirety of the postcode – *localised not-spots* may exist for some of the resident population in that district or for some of the geography in that postcode district.

These figures are likely to overestimate geographic coverage – as they reflect the *percentage of total postcode districts* within which services are at least 90% available. However, postcode districts vary greatly in size with rural postcodes being very large geographically. This means the CMR figures will not be a true reflection of the actual land mass that has mobile coverage.

The data is also subject to large error margins. This is due to differences in the ways operators collect data and also because of the data is rounded up from postcode to postcode to allow some standardisation across operators.

Complete not-spots

4.10 Complete not-spots are areas where there is no mobile coverage at all – from any network (2G or 3G) or from any provider[29]. In other words, consumers cannot use any mobile service – whether that is making or receiving a voice call, using text messaging, or using mobile broadband.

4.11 The 2G footprint is currently greater than the 3G coverage footprint and 3G networks are also not generally present in areas where there is no 2G coverage. This means

[28] Mobile operators sometimes estimate and provide their own figures of percentage population coverage and then use these as part of their marketing campaigns. Given they can estimate their coverage different ways, a comparison of their figures is not fully 'like for like'.
[29] Both 2G and 3G networks provide voice and SMS (text messaging) services. The main difference in the two networks is that 3G networks can enable an additional service - broadband.

that the scale and location of 'complete not-spots' effectively equates to the scale and location of 2G not-spots[30].

4.12 When people experience complete not-spots, their phone will normally show 'no bars' or 'no network' – indicators of insufficient signal strength to use a mobile service[31].

4.13 Complete not-spots can vary in size, often depending on location. They can exist in:

- Large geographic areas – this subset of the problem occurs mostly in rural areas and in areas of no resident population.

- Localised (or smaller geographic areas) – this tends to be a problem in semi-rural or even in urban areas. For example, there may be no network coverage from any provider in part of a village – or in an urban area, part of a road or street may have no coverage at all.

4.14 In most cases, if there is no coverage outdoors across a larger geographic area, then there will also be no cellular coverage indoors in that area too – unless for example an indoor femtocell has been deployed[32]. It may also be the case that some indoor coverage exists adjacent to or within very small, localised not-spots. For instance, while a particular street may lack coverage, some parts of the buildings on that street (e.g. those areas at the back or perhaps higher up the buildings) might obtain some coverage.

Most populated areas of the UK have outdoor coverage but complete not-spots exist, particularly in the devolved nations

4.15 Figure 2 below shows that the UK has 97% population coverage for 2G networks and 91% geographic coverage. All English regions have greater than 90% population – and geographic – coverage. The devolved nations of the UK – Northern Ireland, Wales and particularly Scotland have the greatest scale of complete not-spots. In Scotland, there is 87% population coverage and 64% geographic coverage.

[30] 2G networks can provide voice and SMS (text) services. They also give low speed data throughput suitable for emails (e.g. on a blackberry or other device) and some level of internet browsing e.g. through WAP (Wireless Application Protocol). 2G networks do not provide mobile broadband services – 2G networks can, at best, support data rates of up to 400kbit/s with rates in the region of 100-200kbit/s. This rate is the highest possible and in practice a lower rate is more likely.

[31] Mobile users living particularly in the border areas of Northern Ireland may experience complete not-spots for UK networks but still may be able to roam to networks in the Republic of Ireland, even though they are still in Northern Ireland. While such 'inadvertent roaming' enables mobile users in Northern Ireland to continue to use their phones, if they wish to do so, there has been a long-standing concern that such customers face higher bills because of roaming charges. We understand a few operators in Northern Ireland, most notably O2, have responded by roaming tariffs which may help people avoid excessive charging roaming charges. In addition, practical advice has also been given to customers. For instance, they have been advised to check the network shown on their mobile before making a call.

[32] This means that coverage is actually being provided via a fixed line broadband connection and not the wider mobile network – these indoor solutions are discussed in detail in Section 6.

Figure 2: 2G mobile population and geographic coverage

Source: Ofcom/ GSM Association / Europa Technologies; Q2 2010
Note: Figures show the percentage of postcode districts and percentage of population within postcode districts where at least one operator had at least 90% 2G area coverage.

3G not-spots

4.16 These are areas where there is 2G coverage but there is no 3G coverage. 3G networks can enable the provision of mobile broadband services in addition to the voice, text and low-level data services provided by 2G networks.

4.17 This means we can, for simplicity, also equate 3G not-spots as 'mobile broadband not-spots' although we recognise that the bandwidth provided will vary considerably e.g. across different locations[33]. We are currently undertaking research to establish the indicative speed and reliability of mobile broadband services in the UK. This work should give us a better view of the performance of current mobile broadband networks in the UK.

4.18 If consumers are in areas where their mobile provider does not have 3G coverage, their mobile device will generally default to – 'trip onto' – their network provider's 2G coverage if that is available[34]. In this situation, consumers would be able to make and receive voice calls and use basic data services such as text messaging but would not be able to access mobile broadband services.

3G not-spots are currently more extensive than complete not-spots

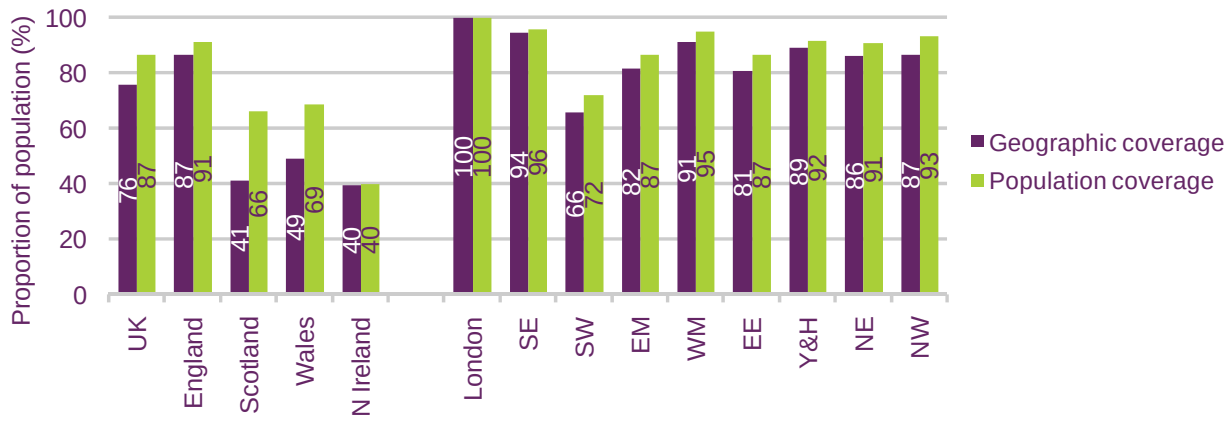
4.19 3G coverage is currently less extensive than for 2G in most parts of the UK, although unlike 2G, 3G is still being rolled out by all the operators. Figure 3 shows that there is 87% 3G population coverage in the UK and 76% geographic coverage.

4.20 However, Scotland, Wales, the Southwest of England and Northern Ireland (with a high proportion of rural areas) obtain far lower 3G coverage than other parts of the

[33] The 3G network (which was previously capable of providing speeds of up to 384kbps) has been upgraded by operators - in part or completely - with new evolutions of 3G technology to either a HSDPA (High Speed Downlink Packet Access) and/or a HSPA (High Speed Packet Access) network. These upgrades can enable faster data rates.
[34] Since '3' is a 3G network only, they currently have a 2G roaming deal with Orange which means their customers will generally default to Orange's 2G coverage in areas where '3' do not have 3G coverage.

UK. There is only 40% 3G population and geographic coverage in Northern Ireland where network deployment has so far been restricted to key urban areas only.

Figure 3: 3G mobile population and geographic coverage

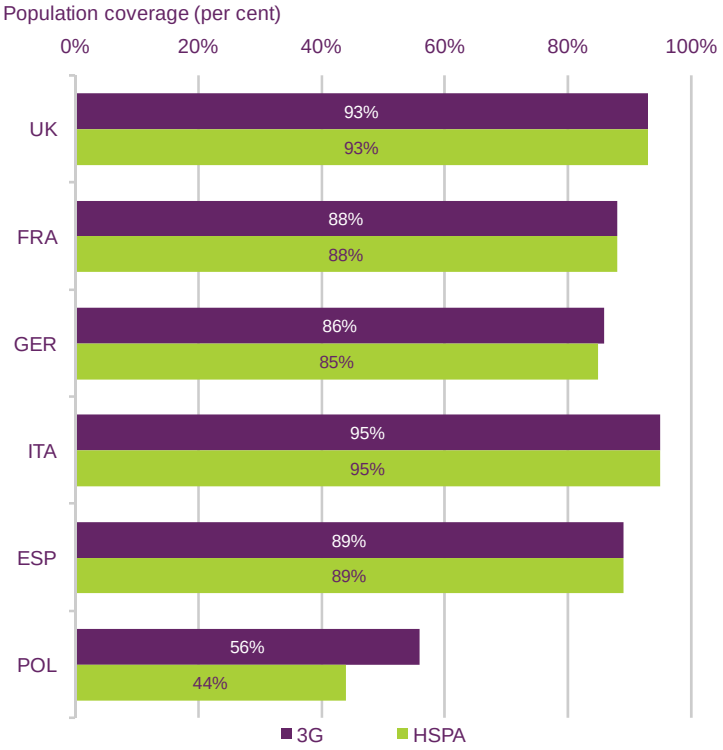


Source: Ofcom/ GSM Association / Europa Technologies; Q2 2010
Note: Figures show the percentage of postcode districts and percentage of population within postcode districts where at least one operator had at least 90% 3G area coverage; data not directly comparable to that published in the 2009 report.

4.21 It is difficult to benchmark how the UK compares on mobile coverage with other similar countries. This is due to the fact that there is no information which compares operators on a like-for-like basis and the few international data sources which compare nations on mobile coverage have major limitations.

4.22 The only data we have at this stage which shows some international variance between developed nations largely draws on operators' own claims of their coverage levels as the basis for comparison and pertains to 3G as well as HSPA coverage (HSPA – High Speed Packet Access - is an evolution of 3G networks that enables mobile to deliver even faster data rates). It shows that the UK was faring relatively well in 2009, when compared to other similar sized/populated European Union nations – see Figure 4.

Figure 4: 3G and HSPA mobile availability in 2009 in some larger EU nations



Source: iDATE

FRA = France, GER = Germany, ITA = ITALY, ESP = Spain, POL = Poland

Partial coverage

4.23 From a customer-facing perspective, there are currently four 2G network operators (T-Mobile, Orange, O2 and Vodafone) and five 3G network operators (the previous four plus H3G – known to its customers as just '3').

4.24 This market position will change over time since the UK arms of T-Mobile and Orange have now been merged into a company called 'Everything Everywhere'. They are currently keeping their branding separate for T-Mobile and Orange but indicated they have plans in the longer-term to fully merge their networks – this commercial development is discussed further in Section 7.

4.25 There are also various service providers – mobile virtual network operators (called MVNOs) – who take wholesale offerings from the network operators in order to provide retail services. For example, Virgin Mobile uses the T-Mobile network and Tesco Mobile uses the O2 network. The customers of these MVNOs will have a similar experience of coverage as the customers of the 'host' network e.g. Tesco's subscribers will experience not-spots where O2's customers do[35].

4.26 The mobile network operators tend to build out in similar areas – areas of higher population density across the UK. However, for strategic, commercial and other

[35] There may be some differences though – for example, we understand the recent roaming deal between T-Mobile and Orange is specific to their subscribers and does not currently extend to the MVNOs which utilise either of these two networks.

reasons, such as differences in mobile operators' spectrum holdings[36], their coverage is not always the same. In some areas, a few operators will have coverage, while others will not. Such areas can be defined as having 'operator-specific' coverage, or as being 'partial' not-spots.

4.27 People living in partial not-spots will have a more limited choice of mobile operators and MVNOs for their mobile service. Like complete not-spots, partial not-spots can extend to a wide geography (especially in rural areas) or be more localised (particularly in urban areas).

4.28 When people experience a partial not-spot, their phone will sometimes show an 'emergency calls' or 'emergency service' icon. Following the enabling of an emergency roaming solution last year, it is now possible to call the emergency services on 999 in areas of partial coverage. This was launched on 14 October 2009 and was a joint initiative between Ofcom, the mobile operators, the emergency authorities and fixed operators (who act as call handling agents).

The scale of partial not-spots differs across the UK nations

4.29 The scale of partial not-spots is proportionately greater in the devolved nations, relative to England.

4.30 We can gain a broad feel for the scale of this issue, from a breakdown of statistics we collect on mobile coverage for our Communications Market Report. Figure 5 shows that 92% of the UK population have at least some choice i.e. they can access at least 2 operators. Furthermore, 79% of the UK population can obtain 2G coverage from 3 or 4 operators – however, only 42% of the Welsh population are in this position. Only 15% of the Northern Ireland population can access coverage from all four 2G operators.

Figure 5: Proportion of population with 2G mobile coverage from zero to 4 operators

MNOs	UK	England	Scotland	Wales	N. Ireland
0	3%	1%	13%	11%	11%
1	5%	3%	8%	18%	17%
2	13%	12%	19%	28%	26%
3	37%	38%	32%	25%	31%
4	42%	46%	28%	17%	15%

Source: Ofcom/ GSM Association / Europa Technologies; Q2 2010

Interrupted coverage on the move

4.31 There are usually some gaps in mobile coverage for each network across larger geographic areas – in other words, coverage is not 'seamless'. This means that consumers will, at some point, move in and out of their network provider's coverage

[36] For example, some operators currently use 900MHz and some 1800MHz for 2G provision – these frequencies vary in their propagation characteristics.

footprint when they travel. These intermittent gaps may be experienced frequently during longer journeys.

4.32 This coverage problem can also be classed as 'interrupted coverage'. When people are in transit, this problem is really the accumulation of other coverage issues e.g. someone might experience interrupted coverage because they are passing through a partial not-spot and/or a complete not-spot.

4.33 People can experience interrupted coverage when they travel by foot but are generally more likely to do so when travelling longer distances in private vehicles or by public transport e.g. buses, trains or during ferry crossings.

4.34 The issue of interrupted coverage on the move can also make consumers more prone to the experience of 'dropped calls' because people may be travelling at speed across large geographic areas. This means they are more likely to encounter complete or partial not-spots in a short space of time such as during a phone call.

4.35 Dropped calls during travel can also be the result of any problems with network 'call handover' – that is the passing of a user's call/traffic from one cell (mast) site to the next cell[37].

The extent of interrupted coverage on the move varies for different routes

4.36 We discuss the scale of this issue for UK roads and railways below.

Roads

4.37 Coverage will be highly varied for different arterial routes and it is likely that roads cutting through rural areas will lack coverage relative to urban routes. At this stage, we have two case studies on road coverage. One of these – on roads in the rural Mournes area of Northern Ireland around the four towns of Hilltown, Bryansford, Kilkeel and Rostrevor[38] – was undertaken as part of research we commissioned into the 'causes of not-spots', which is set out more fully in the next Section. It found complete and partial not-spots prevalent on some parts of the roads there. This is a similar finding to a previous Ofcom study on mobile coverage on the A470, one of Wales' main trunk routes running the full length of the nation from Llandudno in the north to Cardiff in the south which was cited in detail in our CMR for Wales in 2008[39].

4.38 We will have more evidence on coverage levels on roads via the findings of our current signal strength trial in Devon. This involves a drive survey across the majority

[37] It is worth noting that mobile handsets will tolerate a lack of coverage for a few seconds while they attempt to re-establish a call, but if a lack of coverage occurs for over around 5-10 seconds then the call will be dropped. Even if the call is re-established, users will notice a break in their conversation. Hence, depending on the speed of travel, not-spots of tens of metres could result in a call dropping and not-spots of hundreds of metres will almost certainly result in calls dropping.

[38] In areas like the Mournes, which are close to the border with the Republic of Ireland, gaps in coverage from the UK networks are often filled by signals from the Republic of Ireland's mobile networks which can spill over the border. While such 'inadvertent roaming' enables mobile users in Northern Ireland to continue to use their phones, if they wish to do so, there has been a long-standing concern that such customers face detrimental impacts through higher bills because of roaming charges even though they have not left Northern Ireland. This issue was highlighted in Ofcom's 'Mostly Mobile' publication in July 2009.

[39] The research was undertaken in early 2008. Sections of the road – including those around a forest park and the Brecon Beacons – were particularly problematic for some operators.

of the roads in the region to measure 2G and 3G signal strength for all mobile operators' networks. We will also explore coverage across selected arterial routes elsewhere in the UK.

Railways

4.39 Levels of mobile coverage for the UK's main rail routes are likely to vary considerably depending on the geography and population density covered by specific routes. Nevertheless, as part of our 'causes of not-spots' research, we examined the level of coverage along the UK's two key national rail routes – the East Coast and West Coast main lines – at the turn of 2010. Our consultants used measures of signal strength to derive estimates of the probability of making / sustaining a mobile phone call on both rail routes[40][41].

4.40 Our key research finding- noted in the box below - is that while neither of these routes has full coverage, the West Coast mainline has better 2G coverage than the East for all the 2G mobile operators and there appear to be significant differences between mobile operators' coverage levels[42].

Findings on mobile coverage for the UK's key two national rail lines

The probability of being able to call for the duration of 2 minutes was estimated to be around 90% or above on the West Coast mainline for all four 2G networks, while on the East Coast the equivalent figure dropped for **all** four operators – one operator was still above 90%, one between 80-90% while the figure dropped to 50% to 70% for the two lowest performing operators.

The differences were also stark for longer call durations - on the West Coast the best performing mobile operator could still achieve an almost 90% probability for a 10 min call and the lowest performing around 65% whereas, on the East Coast the equivalent figure was around 75% for the best operator and less than 10% for the lowest performing operator.

Indoor coverage

4.41 Even where coverage exists outdoors, it can be problematic indoors i.e. inside buildings – homes, offices, public buildings, etc.

4.42 In some instances, only 2G coverage is available indoors and no 3G coverage. But sometimes coverage is so bad indoors that it is virtually impossible to make or receive any calls or texts on mobile networks. While in other cases, coverage only extends to a fraction of the building such that people stand (or leave their phone/device) near windows or in a very specific part/room of their home or office to

[40] Note that this probability is based only on assessing the coverage and assuming that a call would drop if the coverage fell below a particular level. However, since calls may drop for other reasons such as failed call handovers or network congestion, this approach provides an optimistic representation.
[41] These findings were taken prior to the Orange and T-Mobile roaming deal which they offered to their subscribers in early October 2010.
[42] We also note that Wi-Fi services are provided on selected train routes in the UK. These are either at additional cost or within the ticket price - the latter often the case for first class ticket holders. On these routes, these may provide possible substitutes for mobile, for example, for data usage on the move.

ensure they can make or receive a call, send or receive a text or use a mobile broadband service.

Indoor mobile coverage levels will be lower than those outdoor coverage

4.43 Operator statistics (and hence the data we receive for our CMR reports) tend to use figures for outdoor mobile coverage. Indeed, given that signal strength will fade to different degrees depending on the particular construction/layout of buildings, the percentage of indoor coverage is difficult to specify. We can state that figures for indoor mobile coverage will be lower those we have cited for outdoor coverage.

Mobile coverage is unlikely to be perfect across every location

4.44 Finally, we would note in discussing the scale and gaps of different coverage issues, we do not expect mobile coverage is likely to ever be perfect. In other words, it will not be available across every UK location (outdoors and indoors), consistently and seamlessly at all times.

4.45 Even setting aside the commercial issues, the nature and complexities of cellular technology itself make ubiquitous, reliable coverage virtually impossible to achieve. A range of daily factors influences mobile networks, including climate (as coverage can fade with severe weather such as during heavy rain showers) and temporary 'line of sight' obstacles.

4.46 The variety of factors that can influence mobile services means that even where mobile infrastructure is deployed, consumers can still experience unreliable coverage, such that they can obtain perfectly good reception in a specific location on some occasions but that at other times no service will be available there. For example, consumers could find their experience of mobile services is worse in some areas in the summer because foliage on trees and bushes can absorb some of the mobile signal.

4.47 While some unreliable coverage issues are attributable to the inherent nature of cellular transmission, capacity-related issues can also cause them. For example, the signal strength of 3G networks can fade depending on the number of users on the network (this is known as 'cell breathing') with the result that some consumers served by a cell (base station) may experience intermittent coverage. It may also be the result of temporary congestion at very busy times e.g. the large number of calls in city centres at weekends or during big events like concerts can occasionally result in a temporary loss of service which will sometimes be indicated with a 'network busy' icon on a user's device.

Conclusion

4.48 In this Section, we outlined our typology of the five key mobile coverage issues. From the available data, we have shown they exist to varying degrees in the UK. We also recognise that all of these issues exist to a proportionately greater extent in the devolved nations of the UK[43].

[43] We do not currently have UK-wide statistics for mobile coverage on road and rail routes, so cannot estimate the proportion of the population potentially affected by interrupted coverage on the move.

4.49 In the next Section, we move on to discuss why these coverage issues exist, drawing on recent research findings.

Section 5

The reasons for coverage issues

Introduction

5.1 In this Section, we discuss why coverage issues exist. In the past, we received anecdotal evidence citing various factors – commercial, planning and technical challenges – as the reasons particular areas did not have mobile coverage. We wanted to understand this in more detail to build an evidence base about the key factors behind coverage issues.

Background and methodology for PA research

5.2 We therefore commissioned research into the 'causes of not-spots' which was undertaken by PA Consulting[44].

5.3 We selected 16 case studies across different nations of the UK. These were a mix of rural locations (including two remote islands), urban areas and the UK's two main national rail routes. The locations included complete not-spots and partial not-spots.

5.4 We took a case study approach as this allowed us to investigate the issues in these areas in detail. The sample allowed our consultants to fully understand the extent and cause of the issues in those areas and provided a means for reaching useful conclusions in each of these cases. We recognise that this means the research does not provide a statistically large sample.

5.5 Ofcom's National Advisory Committees, who had received reports that there was insufficient signal strength to make a call on any or some operators' networks in those areas, largely nominated the case study locations. PA tested mobile signal strength in order to establish both the size and the particular nature of the not-spot issues in the case study locations e.g.to pinpoint where the gaps were and whether these gaps were complete not-spots or partial not-spots.

5.6 In this Section, we draw from the PA research findings to explain the main causes of not-spots. We supplement the PA research findings with other information, for example from our CMR and from our own discussions with mobile operators, to help illustrate why coverage issues exist.

Most coverage issues are mainly the result of low commercial drivers for further investment in network coverage

5.7 The PA research has shown that the extent of mobile coverage is fundamentally determined by the overall business case. In other words, most coverage issues – whether they are complete not-spots, partial coverage or interrupted coverage on the move – will largely reflect each mobile operator's commercial drivers for further investment in network coverage[45]. PA did not identify planning or technical issues to

[44] PA Consulting Group 'not-spots research' – main report http://stakeholders.ofcom.org.uk/binaries/research/telecoms-research/not-spots/PA_Consulting_main_report.pdf

[45] Mobile operators had to meet specific coverage obligations (minimum levels of coverage) attached to the award of their spectrum licences for 3G. They each had to achieve at least 80% 3G population coverage and they all met this condition in 2009. However, in July this year, the Government

be the key reasons for the lack of coverage in the non-rail case study sites they investigated – see the box below for more details.

PA case-study research findings on the 'causes of not-spots'

PA Consulting engaged with the mobile operators in order to ascertain what caused the not-spots to exist in the first place – to establish whether the areas were uneconomic for investment, if there were specific insurmountable technical problems inhibiting deployment or whether planning or access issues inhibited rollout.

PA also liaised with local stakeholders including planners, public sector agencies as well as people affected in the case study sites. In the vast majority of cases, not-spots were caused by the lack of commercial drivers. This meant there was not a sufficient business case or strategic driver for deploying a mast/antenna or other mobile solution to improve coverage in the area affected. In one of the rural case studies, it also appeared to be the case that coverage would have required the installation of costly new backhaul as well as the provision of a mast.

Although planning approval is required for mobile masts and has historically been cited as problematic (and so a potential barrier to deployment), the evidence revealed by the case study research did not support the theory that planning issues were the reason why the mobile operators did not rollout their infrastructure in any of the static case study sites.

Planning was not a key obstacle in our case-study research

5.8 The fact that planning was not a key obstacle for non-rail sites in our case study research was a surprising finding given it had been cited in previous responses to consultations touching on coverage issues (such as to our Mobile Sector Assessment).

5.9 PA Consulting therefore considered the planning issue further by undertaking quantitative analysis of 1,000 mobile related planning applications to 8 diverse councils in the last 10 years, to establish whether there were any wider trends (suggesting an increase or decrease) in planning application approval rates.

5.10 However, PA found it difficult to establish any correlation because there are so many factors which might affect planning outcomes - including changes in local network deployment strategies, tactics or in the specific type of sites being deployed. They found that refusal rates for planning varied by a factor of four or more, with both location and time. There were no specific conclusions from their quantitative analysis of planning applications other than it would be difficult to presume that planning consent would or would not be granted at any particular percentage of sites across the UK.

5.11 This analysis suggests there are inherent challenges in using quantitative analysis to establish whether planning is a key obstacle to coverage, or that its influence has changed over time. It demonstrates that proving planning has blocked improvements to coverage requires an in-depth site-by-site analysis (similar to the detailed case

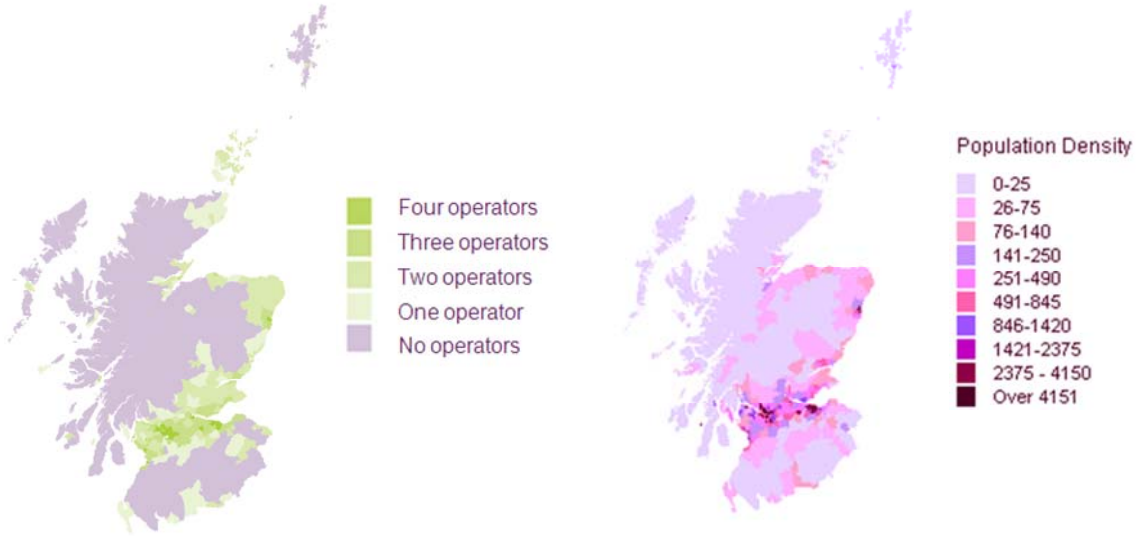
proposed a statutory instrument which amongst other things would, if it is approved, vary the 3G licences' coverage obligations – and would require holders of the licences – by 30th June 2013 – to provide "mobile telecommunications services to an area within which at least 90% of the population of the United Kingdom lives". See http://www.opsi.gov.uk/si/si2010/draft/pdf/ukdsi_9780111500767_en.pdf.

study approach we have taken to examining the 'causes of not-spots') which could be impractical to undertake on a large scale[46]. Based on all the evidence we have looked at, this indicates planning is likely to be less of an issue than we considered previously, although this is not a statistically significant conclusion.

Commercial issues were key factors driving rollout

5.12 What is evident from wider statistics is that, as would be expected, mobile operators do tend to invest in areas where they expect most revenues and profits, in areas of higher population density. Figure 6 below illustrates this correlation as there is a noticeable match between the areas that have the most population and 2G coverage in Scotland. In other words, it is generally the most sparsely populated areas that lack coverage.

Figure 6: 2G mobile coverage map and population density, by postcode district



Source: Ofcom / GSM Association / Europa Technologies; Q2 2010, and National Statistics website: www.statistics.gov.uk 2001 Census data. Crown copyright material is reproduced with the permission of the Controller Office of Public Sector Information (OPSI).
Note: Map shows the number of 2G operators with at least 90% area coverage; not directly comparable to data published in the 2009 report. Population density shows number of people divided by area (km2) of postcode district.

5.13 Mobile operator investment decisions might also consider additional revenue opportunities in areas where there are a high number of tourists and commuters but relatively few residents. They will also consider costs – and these can vary significantly in certain locations.

5.14 In some rural areas, backhaul to the telecoms network may be more expensive and this may deter investment. Other ongoing operational costs may also be higher in remote locations – for example, for power supplies and also for maintenance (often due to accessibility issues i.e. it can take longer and cost more for engineers to travel to a rural mast site than an urban one).

[46] We note that refusal of a particular planning application does not mean coverage was blocked completely in a specific area as it is sometimes possible for operators to seek other nearby site locations which are then deemed acceptable by planning authorities.

5.15 However, as the PA research also noted, operators may not always make decisions to invest on a site by site, incremental revenue/cost basis. Making investment decisions for each individual site may not always be favoured because of the complexities of estimating potential additional revenues from consumer behaviour and switching. For instance, many existing customers buy contracts/packages which contain 'bundles of minutes' and these customers will not necessarily provide incremental call revenues following investment in a particular mast in their vicinity[47/48].

5.16 Decisions on investment are thus often based on wider national commercial strategies and drivers and may include:

- *Marketing and competition based on nationwide coverage levels*– Operators may tie network investment to marketing campaigns. For instance, they may want to increase their UK-wide network coverage to a level beyond their competitors if they believe that this will help them differentiate their network and secure more customers (i.e. revenues) nationwide. In this case, their decisions to invest in coverage are based on a notion that it may be used to increase their total national market share rather than on the specific potential revenues or market share in a locality.

- *Particular customer base* – For instance, some operators may have particular target markets such as business consumers and therefore may place greater emphasis than other mobile operators on improving coverage in-transit.

- *Network Evolution and Priorities* – Operators face competing demands for investment in their network and this may modify the business case to invest in any particular area. For instance, all operators have generally shifted their investments from 2G to 3G networks and moreover, also to dealing with the huge growth in data traffic (from mobile broadband usage).This means that rather than simply increasing the coverage of their network, they are also shifting more of their efforts to increasing the capacity of that network too.

5.17 Finally, while we recognise there are ongoing commercial drivers increasing the levels of 3G coverage, we note that due to different propagation differences in the current spectrum bands used for 2G (900MHz and 1800MHz) and 3G (2.1GHz) – more base stations are currently needed to deliver 3G coverage compared to 2G – and this may also partially explain why the scale of 3G not-spots are currently greater than those for 2G.

5.18 The lower frequency spectrum bands used for 2G have greater geographic range than those currently used for 3G. However, plans for potential spectrum liberalisation should help resolve some of this differential between 2G and 3G coverage as they would permit 3G services to be deployed using some of the spectrum currently used for 2G[49]. Furthermore, proposals to auction 800MHz by the end of the financial year 2011/12 may also help provide mobile broadband services using lower frequencies.

[47] Note that even people who live in complete not-spots may already have a mobile phone service because they will be able to use it when travelling or when at work.
[48] For residents and visitors who are on pay-as-you-go tariffs, the revenue may align with the additional call volume but for those on contracts (who do not use all their monthly allowance), then there may be no extra revenue.
[49] We recently provided advice to Government on the consumer and competition issues relating to the liberalisation of 900MHz and 1800MHz for 3G (UMTS) at http://stakeholders.ofcom.org.uk/consultations/spectrumlib/advice-to-government/ . We noted that

There are unique challenges on rail routes

5.19 Providing coverage in transit along arterial roads and railways can be particularly challenging along medium to long-distance routes – given the geographic area that must be covered in both populated and non-populated areas[50]. Coverage on rail routes also requires consideration of bespoke solutions for difficult topography such as deep cuttings and overcoming the existence of long tunnels as these may require the use of specific 'leaky feeder' technology to enable coverage[51].The uses of leaky feeders and tunnel coverage are obvious considerations in providing coverage on subways and have recently been suggested as an option to deliver mobile coverage on the London Underground[52].

5.20 As the PA research indicated, mobile operators may also have particular difficulties in gaining access trackside (to site their base stations/antennae and to maintain them), including solutions for tunnels. Some of the difficulty may be due to interference concerns with the railway's own communications infrastructure, safety issues or possibly contractual problems to obtain access[53].

5.21 More recently mobile operators have also needed to secure access to train stock too in order to install and maintain equipment called 'repeaters', which are placed directly on trains themselves. These additional solutions are needed due to the way newer trains are built which means they tend to significantly block signals from masts - an unintended consequence of using metal coatings on windows for both safety reasons and thermal management purposes[54].

5.22 Repeaters will require a rail operator's consent and cooperation. Repeaters can be fitted at the time of train build or afterwards. See Section 7 for further details on repeaters and a description of how they work.

5.23 We understand the greater coverage on the West Coast mainline for all the mobile operators may be partly due to the installation of repeaters on Virgin trains (which we understand were installed by one mobile operator but made accessible on a commercial basis to all the other mobile operators). It may also be the result of greater commercial drivers to deploy more masts along the West Coast line. Furthermore, differences between mobile operator coverage levels on both routes could also reflect their respective strategies for improving coverage 'on the move' – for example, some mobile operators have prioritised railway coverage.

---

liberalisation is likely to bring significant benefits to consumers in some or all of the following ways: greater network capacity allowing more customers to be served and to enjoy higher mobile broadband speeds (both 900MHz and 1800MHz spectrum); improved quality of coverage allowing customers to use mobile broadband in more locations with greater consistency (900MHz spectrum); improved in-building coverage (900MHz spectrum); and wider coverage of rural areas (900MHz spectrum).

[50] The network also has to be configured appropriately to manage multiple, rapid 'call handovers' – experienced when travelling at very high speeds.

[51] A leaky feeder is basically a coaxial cable, which emits and receives radio waves. The cable is 'leaky' in that it has gaps or slots in its outer conductor to allow signal to leak into or out of the cable.

[52] See recent articles like that in the Telegraph 18 September 2010 - http://www.telegraph.co.uk/finance/newsbysector/mediatechnologyandtelecoms/telecoms/8010804/Boris-Johnson-forces-phone-firms-to-share-Tube-costs.html

[53] Network Rail owns and operates Britain's rail infrastructure including the tracks, signalling system, rail bridges, tunnels, level crossings, viaducts and 18 key stations.

[54] Repeaters on trains are devices that are installed in carriages with an antenna outside the carriage to pick up existing mobile signals and a second antenna within the carriage to re-broadcast these signals. These are particularly effective where the carriage has a high penetration loss – that is where it strongly attenuates signals passing through windows.

Indoor coverage suffers due to building penetration difficulties

5.24 Although the PA research did not look at the issue of indoor coverage in depth, both we (and mobile operators themselves[55]) recognise that delivering mobile coverage indoors from outdoor-based infrastructure is often difficult given that mobile signals will be blocked by walls and sometimes windows. It is hard to predict such losses accurately as they will ultimately vary with the unique construction and layout of each individual home or premise. It is also not always the case that older, stone buildings are worse for mobile coverage than newer developments; some new steel based buildings with thicker, metallic windows can create significant degradation of mobile signals too.

5.25 Indoor coverage can be improved by the use of indoor femtocells (which are available but not yet deployed across all operators). This solution is essentially a mini-base station within a building (which looks like a wireless router) – which then links to the telecoms network via a fixed line broadband connection. In addition, the potential use of fixed Wi-Fi connections for transferring data traffic – or for making VoIP calls – on Wi-Fi enabled mobile devices could potentially help mitigate some mobile coverage issues too[56]. We discuss these points further in Section 7.

Mobile handset design can affect mobile reception too

5.26 Finally, we note that some element of coverage issues experienced by consumers may in part be due to device issues rather than the lack of base station deployments. Some handsets and other mobile devices are better at receiving weak signals than others and so a not-spot on one device might not exist for another device.

5.27 As indicated by the PA research, some manufacturers aim for attractive products with high functionality and it may be that their newer, 'sleeker' phones may trade off some element of their reception capabilities for appearance. For example, current handsets have integral antennas and these can be less effective than earlier, external stub ones. However, we also recognise that consumers value the functionality provided by newer handsets.

Mobile not-spot solutions have been subsidised in a few countries

5.28 As part of their research on the 'causes of not-spots' PA considered whether subsidy may be a solution where commercial drivers inhibit investment. They found that public funding had been made available in France and Norway to reduce mobile not-spots[57]. See the box below for brief details and the PA research for a fuller summary.

[55] For instance, see Vodafone's explanation of the technical factors that lead to not-spots on their website page "Why can't I get a signal at home" at http://suresignal.vodafone.co.uk/blackspots-explained.aspx .

[56] Fixed Wi-Fi also provides a basis to extend coverage (through creating 'hot-spots') indoors and to some degree outdoors too.

[57] Local roaming is basically the enabling of roaming across networks on a localised rather than nationwide basis. Site-sharing means sharing base stations and is mentioned again in Section 7.

International case studies of subsidised coverage

In France, 3,000 complete not-spots were identified in 2003 and a collaborative approach was taken to improve mobile coverage since then in not-spot areas. France has three mobile network operators who jointly contributed around three-quarters of the total cost with the balance made available from public and central funds. The total cost of the project was €600 million and funded mostly by the three French mobile operators with central Government and local councils each contributing €65 million. The solution deployed by the operators involved a mix of local roaming arrangements and site-sharing.

In Norway, a scheme was introduced to fund mobile infrastructure in areas which were not deemed commercial for investment. The overall aim (not mandated) was to support initiatives along major roads, in the Oslo tube, in airport, shopping centres and larger hotels as well as communities of >200 homes (if they could be covered by a single base station). PA noted that approach is bottom-up i.e. the community affected request coverage by seeking a government grant to fund half the basic infrastructure cost. There are believed to be a number of qualifying criteria including a stated commitment from the local community itself.

Source: PA Consulting

5.29 We recognise that it is possible local councils, bodies or communities could themselves try to subsidise deployments. At this stage, we are only aware of one 'live' mobile initiative in the UK – which is a community based one - where it has been reported that locals are trying to lever mobile operator coverage. This is in Ceredigion in Wales where the community is hoping to access public funding to deploy masts in their area[58]. Ultimately, any such initiative would need the support and co-operation of the mobile operators as mobile services can only be delivered by holders of relevant spectrum licences.

Conclusion

5.30 In summary, although the precise reasons for coverage issues will ultimately vary in each case, we have illustrated with the support of our research findings that most mobile not-spots persist because it is not a commercial priority for operators to extend their coverage footprint. And while other factors such as planning and access issues can be relevant too, our research noted that these seemed to be a more important factor in providing coverage on trains, than for non-rail locations.

5.31 In the following Section, we discuss of what it means for people if they encounter mobile not-spots.

[58] See article at http://www.bbc.co.uk/news/uk-wales-mid-wales-11141987 . It was reported that the community are set to apply for a £150,000 grant from the Welsh Assembly Government, which will help pay for the first mast.

Section 6

The impacts of coverage issues on consumers and citizens

6.1 In Section 4, we set out our typology of the five main coverage issues. In this Section we consider the potential impacts from each of these coverage issues on citizens and consumers. To this end we commissioned some qualitative research[59] to help understand how coverage issues can affect consumers in different ways.

6.2 This new research is only indicative of the types of impacts that might be felt by different user groups and, given the sample size, it adds to the existing mix of qualitative and quantitative work that has already been done in this area, such as the work by the Communications Consumer Panel[60].

6.3 Whatever approach is taken, it is very difficult to measure the impact of coverage issues with any certainty. This new research brings personal insights from real users in different part of the UK. However, assessing the relative impacts to different groups is very subjective. Impacts are often seen through the eyes of those directly affected and the issues they face are personally very significant and central to their home and working lives.

6.4 Before we discuss impacts we briefly set out the context of mobile use today and the importance and satisfaction of coverage for consumers and businesses.

Context: mobile use today and satisfaction with coverage

Mobiles have moved into the mainstream and are now seen as essential

6.5 We now live in a society where the mobile phone is ubiquitous. Research from our 2010 Communications Market Report shows that household take-up of mobiles now stands at 92% and exceeds fixed telephony which has fallen from 91% in 2005 to 85% in 2010. Amongst businesses, mobile usage has now overtaken fixed lines.

6.6 Vodafone made the UK's first mobile call at a few minutes past midnight on the 1st of January 1985. But it wasn't until the 1990s, that the 'second generation' (2G) mobile phone systems emerged and heralded the era of mass ownership. Coinciding with the introduction of 2G systems was a trend away from the larger "brick" phones of the 1980s toward the relatively small 100–200g hand-held devices - enabled primarily through more advanced batteries and more energy-efficient electronics.

6.7 What was initially a device to contact others in exceptional circumstances became the preferred means for many to stay in contact with friends and family. And by the turn of the millennium mobile phones were moving away from just providing core communication functionality. The mid 90s saw the launch of SMS - the Short

[59] Illuminas 'not-spots research' – qualitative research report http://stakeholders.ofcom.org.uk/binaries/research/telecoms-research/not-spots/Illuminas_final_report.pdf .

[60] See for example, Communications Consumer Panel *Mobile Coverage – The Consumer Perspective Research Report* October 2009 http://www.communicationsconsumerpanel.org.uk/Mobile_coverage_consumer_perspective.pdf .

Message Service - enabling text messages to be exchanged between mobiles and in 1999 we witnessed the first mobiles able to send email and use the web.

6.8 Today, smartphones are becoming increasingly prevalent - offering a multi-purpose device for gaming, music, sharing pictures, checking emails and online news and social networking. The number and variety of smartphone applications (apps) are changing almost daily. Business users are able to access a wide range of office functions on the move.

6.9 Mobile phones have become an increasingly important part of our lives and our expectations of them have risen markedly.

There are a growing number of mobile only households

6.10 Four in five households continue to have both a fixed and mobile connection indicating that while consumers are increasingly substituting mobile for fixed calls, the large majority of households continue to have a fixed line. But there are growing numbers of mobile-only households with significant differences emerging amongst certain groups. Our research shows a clear correlation between mobile-only households and socio-economic groups, with 26% of DE households relying on mobile for all their telephony needs, compared to 9% of ABC1 homes and 14% on average[5].

6.11 Looking at differences across the devolved nations, there is a greater proportion of mobile-only households in Wales and Scotland than anywhere else in the UK (19% of the total vs. 14% on average), closely followed by Northern Ireland (18%). The figure is lower in England, at 13% of the total.

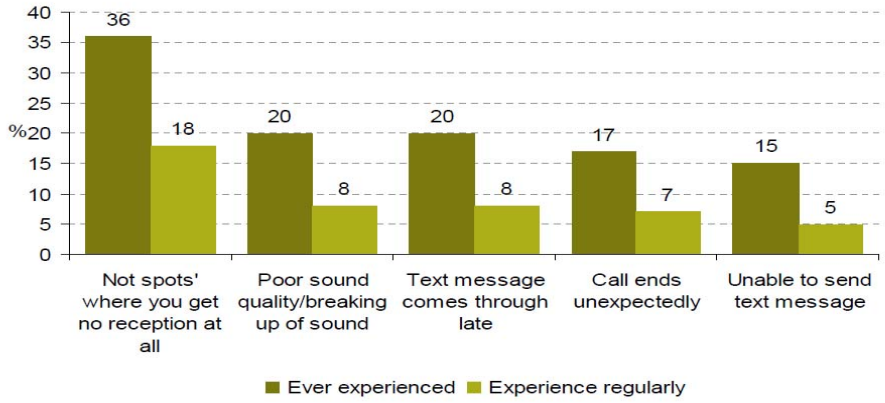
But coverage is still a particular issue for many users

6.12 In our Mobile Sector Assessment statement[61], we noted that overall consumer satisfaction levels with mobile services were high. Furthermore, our technology tracker from Q1 2010 shows that most (87%) adults who have a mobile phone are satisfied with 'accessing the network' with 57% being very satisfied. In urban areas 89% are satisfied with 7% dissatisfied whereas in rural areas satisfaction rates fall to a degree with 76% being satisfied and 19% dissatisfied[62]. In addition, our 2009 business consumer experience survey showed that 89% of respondents reported that they were satisfied with the geographical availability of mobile services[63].

6.13 While overall satisfaction levels are high, our consumer tracking survey has repeatedly found that signal/reception problems remain the key unprompted concern for mobile consumers[64]. On a similar theme the Communications Consumer Panel's research in 2009 found that over half (56%) of UK adults with a mobile phone have experienced problems with coverage, and a third (33%) experienced problems regularly. Furthermore, as shown by Figure 7 below, their research also identified that a third (36%) of UK mobile users had experienced not-spots, with 18% experiencing them regularly.

[61] Fig.16 http://stakeholders.ofcom.org.uk/binaries/consultations/msa/statement/MSA_statement.pdf.
[62] See http://stakeholders.ofcom.org.uk/binaries/research/statistics/tech-tracker-q1-2010.pdf .
[63] See Fig. 35. http://stakeholders.ofcom.org.uk/binaries/research/consumer-experience/bce.pdf .
[64] See figure 7 of our Mobile Sector Assessment statement - referenced above.

Figure 7: Types of problems experienced with coverage



Question: Which of the following problems, if any, have you had in the past in terms of your mobile reception…? Which of them, if any, do you experience regularly?
Base: All those who use a mobile for personal use (n = 1716)

6.14 Although the majority of business consumers are satisfied with reliability, geographic availability and the range of products and services, overall levels of satisfaction are lower than for residential consumers. Around half or more residential consumers reported being very satisfied with their telecoms service, but among businesses the figure is below four in ten for each service type[65].

6.15 Across the UK as a whole, businesses' dissatisfaction with the geographical availability of mobile services is much higher (12%) than for fixed lines (5%). And dissatisfaction with availability is significantly higher than the national average among businesses in Wales (17%) and in the Midlands (18%). Dissatisfaction with the geographic availability of internet/data services is also double the national average (3%) in rural areas (6%) and higher in Scotland (8%) and the South of England (7%)[66].

6.16 The Communications Consumer Panel recently published research on the views of small businesses (i.e. ten employees or fewer) on the subject of mobile coverage. They found almost all (91%) of small business respondents had experienced problems with reception, nearly a third of them (32%) regularly. The most common problem for small businesses is not-spots where there is no reception at all: 82% of respondents say they have experienced this, 25% regularly.

Coverage is increasingly important to enable participation in society

6.17 Mobile devices are increasingly used for social networking, to receive content, to access public services and even to directly engage in the democratic process. As such, mobile take up and the effective use of mobile services are becoming more important for digital inclusion, both from a social and economic perspective. Improving coverage is a key enabler to participate in society and the following discussion focuses on how we can better understand the problem of poor coverage and how it impacts consumers and businesses.

Framing the impact of coverage issues

6.18 In this sub-section we focus on the consumer and citizen effects of mobile not-spots. When considering the impact of these not-spots it is helpful to consider both the

[65] Fig. 35 http://stakeholders.ofcom.org.uk/binaries/research/consumer-experience/bce.pdf.
[66] We are publishing our next Business Consumer Experience research later this year.

direct and indirect effects on consumers (both individuals and businesses) and the broader impacts on society (citizens). This will help understand how significant the impacts of coverage issues are. It also helps guide us in how we pursue further work in this area.

6.19 We recognise that it is very difficult to quantify the impact of poor coverage in a precise manner. The impact from coverage issues for each user will vary depending on who they are (whether they are acting as individual consumers, businesses or citizens), where they are, how they move around, the frequency with which they want to use their mobile and the availability of 'workarounds' which might mitigate some element of some impacts.

6.20 We commissioned Illuminas to undertake qualitative research to help us understand and illustrate how coverage issues can affect consumers and citizens in different ways.

Consumer research on impacts

6.21 The Illuminas research focused on those users experiencing coverage issues regularly, particularly those who lived in not-spots or areas of poor mobile coverage. The research was concerned with outdoor not-spots as well as coverage issues on transport links, but did not cover indoor not-spots.

6.22 This new research is indicative only of the types of impacts that are felt by different user groups and it adds to the existing mix of qualitative and quantitative work that has already been done in this area[67].

Illuminas research methodology

50 telephone interviews to understand individual experiences and needs across specific not-spot areas in UK

- *38 individual consumers; 12 small-medium businesses*
- *20 rural; 10 urban; 12 transport network users; 8 small-medium mobile business owners*
- *Regional spread: England (14); Scotland (13); Wales (12); NI (11)*
- *These locations overlapped with some of the sites used in the separate PA research on the causes of not-spots.*

The interviews were complemented by:

- *20 interviews along with a 1 week diary capturing mobile phone usage*
- *10 respondents selected to do a self-film video & vox pops[68]*
- *16 face to face interviews conducted (4 per location)*

[67] We set out our set of broad research publications relating to mobile coverage in Section 2. As we said earlier in this Section, assessing the detriment from coverage issues at a national level is particularly challenging given the scale and complexity of analysis that would be required. However it is possible to do more tightly defined studies, such as in looking at the economic impact and benefits from improving coverage on particular train routes. (As an example, we refer the reader to: SQW *Wireless on the Move Study - Final Report to the Glasgow-Edinburgh Collaboration Project* 2007 http://www.glasgow-edinburgh.co.uk/assets/files/Wireless_on_the_Move_Study.pdf.)

[68] *Vox populi* - a Latin phrase that literally means voice of the people, and is a term often used in to describe interviews with members of the general public. Usually the interviewees are conducted in public places give spontaneous opinions.

6.23 There were two broad types of coverage issue used by Illuminas to explore the problems faced by consumers.

i) **'No coverage'**: Generally large areas where there is no mobile signal received: In these areas respondents would claim it is a well-known not-spot with absolutely no coverage for large parts of the area.

ii) **Intermittent or very patchy coverage:** Areas in which respondents experienced lack of coverage in a certain street or area of the house; and where respondents would describe coverage as generally OK but that it would sometimes 'drop out' for periods.

The research identified five main types of impacts

6.24 The impact of coverage issues were found to be wide ranging – from the day-to-day effects of missing calls, to a loss of social connectedness and business efficiencies, and to undermining efforts to deal more effectively with emergencies.

General day-to-day effects

6.25 Lack of coverage affects a number of aspects of daily life. The most common experience of living / working in an area of poor coverage is frustration and inconvenience to everyday living and working arrangements. For example, one respondent said:

> "Sometimes I'm needed to work on a night shift and of course they ring my work phone and leave a message. The signal suddenly kicks in when I am picking the kids up from school but if I had known I would have had a sleep but I can't as I am due in work 2 ½ hours later." (Female, Older family, Scotland).

> "It's just stressful when you can't get hold of someone and you are forced to keep trying". (Male, Younger family, England).

6.26 The consumer detriment caused from these general day-to-day impacts can be significant to those involved and taken together these impacts, which by their nature occur frequently, could possibly affect large parts of the population.

Social connectedness

6.27 The ways in which people communicate are constantly changing and technology has become instrumental in that. Many communities want to use texting, email, Facebook and Twitter to exchange information. There is also a very real concern from parents about the ability for their child to socialise in the same way as many other children do through similar mediums. For example, one respondent said:

> "My eldest daughter is at university now but when she brings her friends home, they can't believe how disconnected they are. It causes great angst initially." (Female, Older family, Wales).

Business efficiencies and the impact in the local economy

6.28 The mobile phone for many is considered an indispensible business tool resulting in great dissatisfaction when coverage problems become an issue. Businesses/organisations requiring a degree of mobility (estate agents, sales,

nurses, photographers etc) are perhaps the worst affected by local coverage issues. For example, one respondent said:

> "There is a hill in North Uist that has tradesman's vehicles parked on top of it at all the time, all trying to get signal to enable them to continue the day's appointments". (Male, younger family, Scotland).

6.29 Some people fear coverage issues may impact on tourism, putting people off visiting.

Citizen safety

6.30 Coverage impacts the safety of children, family and friends such as knowing whereabouts or impacts of severe weather on arrangements. For example, one respondent said:

> "I am a bus driver and I do 100 mile round trip every day picking up and dropping off school children. I have no means of contacting anyone if anything should happen." (Female, Wales).

6.31 Coverage also impacts the safety of staff working in more isolated jobs such as farming.

> "When there was severe snow, a neighbour of ours came off his quad bike and died out on his farm while attending to the animals. He wasn't found for nearly 2 days and you just wonder if having a phone with signal might have saved him." (Older family, Scotland).

Health and saving lives

6.32 There are significant impacts from not being able to deal effectively with accidents or long term health issues. These occur less frequently relative to other types of impacts. For example, one respondent said:

> "My son is diabetic and our neighbour's kid is awaiting a liver transplant. We had to consider very carefully what our contact plan was if we are not near a land line." (Female, Young family, Scotland).

6.33 As we set out in Annex 1 on mobile trends, this is a particular area where mobile innovation could bring significant benefits to society. Coverage will be an important element in facilitating uptake of new services.

There seem to be marked differences between urban and rural locations

6.34 Illuminas looked at a number of regional case studies in order to help illustrate the impacts of not-spots across the UK - in the Highlands in Scotland, Cardiff in Wales, Kilkeel (Co. Down) in Northern Ireland and rural England. These were previously published in Ofcom's 2010 Communications Market Reports for Scotland, Wales and Northern Ireland.

6.35 The research highlighted some generalisations about coverage issues that are likely to be experienced in different locations.

- Respondents living in rural Scotland and Wales perceived 'large areas of no coverage'. Extremely remote communities in these areas were more adept to the

type of communication issues remoteness brings. There was a degree of both acceptance and annoyance from rural communities.

- Respondents in England and Northern Ireland perceived 'spots of no coverage' to be relatively contained. The not-spot areas identified in England and Northern Ireland were relatively specific and less remote, relative to Scotland and Wales, often within a short drive to a local town or village with relatively good coverage. Respondents would frequently talk about driving in and out of not-spots but rarely remained in a not-spot for long periods.

6.36 City based mobile users that were interviewed, by contrast, demanded a high quality of service and were unlikely to accept any degree of disruption. They expect to be able to communicate during any 'dead time' such as train/car journeys and queuing. Many rely on this as an extension of work time and would become stressed if unable to make/take calls, email, or be on conference calls that clearly log out when the connection drops.

6.37 Rural businesses expressed significant concerns about local coverage issues. These were felt in terms of both conducting day-to-day business activities and ensuring the safety of staff working in isolated circumstances in jobs such as farming.

These impacts will tend to vary in their frequency

6.38 Impacts tended to vary in their frequency, depending on each user's individual circumstances and location:

- Whether they have coverage in the places where they live or work. If not, they will potentially experience the impacts of coverage issues more as they will not be able to benefit from mobile services as others do in society.

- Whether they travel a lot. Where consumers have coverage in the static locations where they live and work, they may still regularly face coverage issues if they travel a lot.

- How often people contact others on a mobile device. Even if people have good coverage where they live or work or in the areas in which they travel, they may be indirectly affected by coverage issues if the person they want to contact is not able to access a mobile service.

User behaviour seems to depend on the type of coverage issue experienced

6.39 The consumer research from Illuminas found that usage patterns tended to depend on the type of coverage issue experienced.

- For example, residents would not rely on their mobile phone and would rarely have it on them if likely to be within an area of **no coverage**.

  > "I would rarely take it out with me around here but if I was going down to London or something I would" (Older couple, England).

- In contrast those living with **intermittent coverage** were more likely to be relatively frequent users. The mobile tends to be carried everywhere and is switched on.

> "My phone is with me all the time. I use it when picking the kids up from school. That's the most frustrating as there is no coverage around the school and there is always a panic." (Young family, Northern Ireland).

6.40 The research also highlighted that the frustration vented by those experiencing **intermittent coverage** was more evident due to their greater reliance on the mobile and their higher expectations of coverage. Those living in areas of **no coverage** seemed less likely to be frustrated on a *day-to-day* basis as they are generally less reliant on the mobile and may be more adept at making arrangements and planning without it, although clearly they still felt the wider impacts from having no coverage.

6.41 Some users interviewed had developed forms of adapting behaviour in attempts to mitigate some of the adverse impacts.

- **For complete not-spots**: Consumers living in areas with no coverage at all seemed more adept at working round some problems. Typical behavioural changes include; reliance on landline or broadband rather than mobile, making calls outside the home, using texts (which sometimes get through when a phone call does not), or making plans in a different way without reliance on mobile phones.

- **For intermittent / partial coverage**: If the signal is poor, respondents talked about trying a different part of house or garden, texting or just trying to call back.

- **For interrupted coverage when travelling and in transit:** Behavioural mechanisms on commuter routes such as trains and roads cited by consumers included: calling back once the signal has improved, texting where possible, making important calls during times of good coverage or waiting until a landline is available.

> "I know where there are no reception areas, so I tend to make a call before I enter this area."(Self-employed male and regular commuter on the roads, Northern Ireland).

6.42 As noted above, the consumer harm caused from these impacts can be significant to those involved. This remains the case even if users have adapted their behaviour in attempts to mitigate some of the adverse impacts.

Conclusions

Different groups of society are affected in different ways

6.43 The Illuminas consumer research has helped illustrate using a qualitative approach the differing impacts on the lives of individuals, businesses and citizens, and we have grouped some of the issues raised as relevant to the main group of society.

- **For individuals,** concerns cited included not being able to make or change plans on the move or not being able to access news and social networking sites.

- **For businesses,** concerns cited included loss of workforce efficiencies, a growing problem given the innovations in mobile data services and applications.

- **For society,** some respondents felt concerned by an inability to contact the emergency services. Other impacts cited included lack of social connectedness.

6.44 However we should be clear that this summary is indicative only of the types of impacts that are felt by different user groups and it adds to the existing mix of qualitative and quantitative work that has already been done on this topic.

Assessing the significance of coverage issues is challenging

6.45 Whatever approach is taken, it is hard to measure the impact of coverage issues with any certainty as it is so dependent on an individual's experience.

6.46 Mobile devices are, by their nature, highly personal and used mainly on an individual basis. As our summary (Table 1) below shows, the impact from coverage issues will vary depending on the type of issue, user type and the significance of the issue.

6.47 Reaching definitive conclusions is difficult; any such exercise is subjective and will depend on personal viewpoints about what issues and impacts cause the most harm to society. The purpose of the following table is to draw out some of the likely impacts and issues experienced by different groups.

Table 1: Summary of impacts from coverage issues

Type of issue	Potential impacts			Summary
	On individuals	On businesses	On society	
1. Complete not-spots **No 2G or 3G coverage**	• Lack of ability to call or text (or receive calls or texts) • Also impacts tourists • Indirect impact on anyone trying to contact these individuals	• Business inefficiencies and lost sales • Indirect impact on anyone who cannot call these businesses	• Citizen safety – emergency calls not possible • Social connectedness – participating in online communities not possible • Economic – local businesses cannot effectively operate	• Issue experienced by users located in these not-spots(as well as those passing through) • Knock on effects on citizens and the broader economy
2. 3G not-spots **No mobile broadband coverage**	• Consumers unable to access mobile broadband and some data–intensive applications • Likely to affect their use of social media and entertainment services	• Business inefficiencies – workers unable to use data-rich services	• Social connectedness – loss of value derived from mobile access to public services • Quality of life – constraining mobility & work/life balance • Economic – local businesses cannot effectively operate	• Issue affects large body of users outside 3G footprint • Growing issue as more users come to rely on data services on the move, and for mobile only households
3. Partial coverage **Operator-specific not-spots**	• Impacts as per complete not-spots– but to a lesser extent	• Impacts as per complete not-spots– but to a lesser extent	• Impacts as per complete not-spots– but to a lesser extent (Emergency calls possible with 999 roaming)	• Issue likely to affect large numbers of the population across large parts of the UK semi frequently
4. Interrupted coverage **When travelling/on the move**	• Consumers experience poor scope to make, receive and sustain calls • This type of issue likely to lead to frustration	• Business inefficiencies – higher incidence of dropped calls, and intermittent data services	• Citizen safety – potential for emergency calls to be dropped • Economic – lost value from time spent un-contactable and offline	• Impacts dependent on individual travel arrangements • Likely to impact on businesses
5. Poor coverage indoors	• Consumers may not be able to make or receive calls or texts and experience poor quality sound. • May not be able to use mobile broadband indoors	• Many business have a fixed landline	• For mobile only households, social connectedness and citizen safety issues	• A particular issue for mobile only households – growing in number and likely to be lower income and younger cohorts

Section 7

Market developments to address coverage issues

7.1 In the previous Section we discussed the impact of the different not-spot issues on consumers and citizens. Given the constant evolution of the market, we have considered the extent to which the market is addressing the not-spot issues we outlined previously. So we now turn to each of the five not-spot issues and consider if and how current and expected commercial developments may help to resolve them.

Developments relating to complete not-spots

7.2 As discussed in Section 4, where complete not-spots exist, mobile phone users are unable to make or receive voice calls or texts as they have no 2G or 3G coverage from any of the operators in an area.

7.3 In recent years, the mobile operators' 2G networks have maintained a fairly constant level of coverage and the mobile operators are not investing significantly to increase the coverage of their 2G networks. Conversely, the operators have invested significantly in increasing the coverage and capacity of their 3G networks, and appear to view this as a priority for future network investment.

7.4 We also recognise there are some market developments on site-sharing which could possibly lead to increased coverage levels. Site-sharing (or mast-sharing as it is also known) is where operators use the same base station/mast and each installs their own antenna. We know that sharing base stations on a site by site basis has been in existence for a many years. However, these deals, discussed at paragraphs 7.14-7.18, which formalise site-sharing bring a greater degree of pooling and consolidation in sites.

7.5 Site-sharing has the potential to make some areas profitable to serve that were previously unprofitable for either operator, by sharing the costs associated with rolling out and maintaining a base station. However, the effect of these sharing arrangements on complete not-spots is unclear and they may or may not lead to a decrease in the scale of this issue. At this stage, we believe site-sharing is more likely to mitigate the partial not-spot issue, which is discussed in more detail below.

7.6 It is also possible that if operators' claims on 3G coverage targets of around 98% and 99% population coverage are met (again, see below), then 3G networks may make inroads into some complete not-spot areas. However this is currently speculative[69].

7.7 Operators have generally been competing on their (3G) mobile broadband footprints – rather than on 2G – as perhaps because it is seen as a greater competitive differentiator by the operators. However, Everything Everywhere has stated it

[69] We also note the effects of inadvertent roaming felt by mobile users in the border areas of Northern Ireland as a result of complete not-spots could be mitigated if the UK mobile networks improved their coverage in these areas. However, given the nature of mobile signals some gaps are likely to remain and instances of inadvertent roaming are likely to still occur.

intends to achieve 99.6% 3G population coverage by 2014. If this target is met, then this could mean that there is some infilling of complete not-spots[70].

7.8 At this stage, the overall finding from our work is that the commercial scope to address complete (2G) not-spot areas is more limited.

Developments relating to 3G coverage

7.9 As discussed in Section 4, 'mobile broadband not-spots' are areas where there is 2G coverage, but no 3G coverage. This impacts consumers' ability to use mobile broadband services.

7.10 In the short term, the availability of 3G is being improved with the deployment of additional infrastructure – such as macrocells and/or microcells[71]. '3' has committed to substantially extending its 3G coverage by the end of this calendar year which if actually achieved, would place its 3G coverage on an almost comparable basis with current UK 2G levels[72]. It states:

> *"Our aim is to increase cover of the UK population from 92.5 % (in 2009) to over 98% by the end of this year."*[73]

7.11 In publishing its interim results in September 2010, Everything Everywhere also stated that it intended to expand its 3G coverage to 99.6% of the population by 2014 based on 18,000+ sites[74].

7.12 Other operators have also indicated that they will continue to invest in their 3G networks both in improving coverage and increasing capacity. With dramatically increased usage of 3G data, operators have a clear incentive to enhance their networks. The economics of increased coverage are also being improved through site-sharing between some operators.

7.13 In the longer term it is likely that different spectrum bands will be used for 3G (or mobile technologies that are expected to follow beyond 3G). Recent Government proposals for the "digital dividend" spectrum at 800MHz suggest that this could be auctioned before the end of financial year 2011/12 along with spectrum at 2.6GHz. Overall, we expect competition and increased spectrum availability could result in

[70] We note that operators have claimed their 2G UK-wide population coverage to be around 99% while our own statistics - based on the postcode district methodology set out in Section 4 – cites 97% UK 2G population coverage.
[71] Macrocells consist of antennae mounted on ground-based masts, rooftops and other existing structures (at a height that provides a clear view over the surrounding buildings and terrain). They provides the main radio coverage infrastructure for a mobile network and have a varying geographic range depending upon the frequency used and the surrounding natural and built environment. Smaller structures called microcells are normally mounted at street level typically on the external walls of existing structures, lamp-posts and other street furniture (usually below the surrounding buildings and terrain). They generally provide infill radio coverage and additional capacity where there are high numbers of users within urban and suburban macrocells. Microcells provide radio coverage over distances up to, typically, between 300m and 1000m.
[72] We note that these figures pertain to operators' own claims of their current or projected coverage levels – and they are not Ofcom figures.
[73] From the '3' website at http://www.three.co.uk/Help_Support/Coverage .
[74] See Everything Everywhere *Creating a new mobile champion* – slide 68 in the Investor briefing given 28 September 2010 at http://www.download-telekom.de/dt/StaticPage/92/75/30/100928-investor-event-everything-everywhere_927530.pdf .

growing mobile broadband coverage over the coming years, although it is unclear quite how far this coverage will extend.

Developments relating to partial not-spots

7.14 Partial not-spots are areas where at least one mobile operator has coverage, but at least one does not. We have referred to indicative figures which highlight the extent of partial coverage in Section 4, Figure 5.

7.15 Beyond the ongoing rollout by all operators of their 3G networks, there are two main further developments in the market that may help to mitigate the problems of operator-specific not-spots. These both relate to mobile operators sharing sites and/or additional elements of their network either through a formal deal or in one case, a merger[75]. (We described in more detail how mobile network components can be shared within our Mobile Sector Assessment publications[76]).

7.16 *Cornerstone* is one site-sharing agreement between Vodafone and O2. This allows Vodafone to roll out its network using O2's existing sites and vice versa. This is likely to reduce the number of areas where only one of these operators has coverage.

7.17 Secondly, the merger between Orange and T-Mobile is likely to lead to a consolidation of their respective networks. They have claimed that the merged entity, Everything Everywhere:

> "*is creating the country's biggest and best mobile network. The ambition is to combine both the Orange and T-Mobile networks, cut out duplication, and create a single super-network. For customers it will mean bigger network and better coverage*."[77]

7.18 Everything Everywhere plan to operate a single network available eventually to both Orange and T-Mobile customers[78]. In time, they suggest there will not be any areas that an Orange customer will receive coverage, where it will not be available to a T-Mobile customer, and vice versa.

7.19 Until their networks are fully consolidated, customers on Orange will be able to roam onto the T-Mobile network where only T-Mobile has coverage, and vice versa. They

[75] The formal agreement in the UK between Vodafone and O2 (which is owned by Telefónica) is called *Cornerstone* which includes both 2G and 3G site sharing. Please see http://www.o2.com/media/press_releases/press_release_14381.asp?archive=yes . However, it is also important to note that mast sharing is a common practice across all the UK mobile operators – that is, they often share individual masts where it is appropriate to do so i.e. from a technical, commercial and planning perspective. There has also been a joint venture in place between '3' and T-Mobile for the past few years which relates to their 3G access networks (the mobile masts and infrastructure that connects to each operator's separate core network). The venture is known as MBNL - see http://www.mbnl.co.uk/ .

[76] For example, see paragraphs 3.10-3.17 in *Mobile Evolution – Ofcom's Mobile Sector Assessment* 17 Dec 2009 http://stakeholders.ofcom.org.uk/binaries/consultations/msa/statement/MSA_statement.pdf .

[77] http://everythingeverywhere.com/2010/05/11/orange-and-t-mobile-unveil-joint-venture-name-team-vision-and-plans/. - Everything Everywhere News Release on 11 May 2010.

[78] It is our understanding that the merged entity will maintain separate Orange and T-Mobile brands.

launched the first phase of roaming for 2G (voice and text) services in early October and their joint customer base are being invited to register for this service[79].

7.20 While the aggregate (nationwide) impact of the abovementioned site-sharing and merger should improve coverage by resolving some partial not-spots, at a very local level there may be some degradation in coverage. This is because there is a possibility that operators may reduce partially 'overlapping' sites in some areas. In other words, where two operators have base stations near each other, they may mast-share at one site and remove the other base station, thereby causing a small 'complete not-spot' in part of the area served by the redundant mast.

7.21 Overall, while the developments in the market are likely to lead to some reduction in the number of operator specific not-spots, it is likely that some differences in the coverage provided by different operators will remain.

Developments relating to coverage on the move

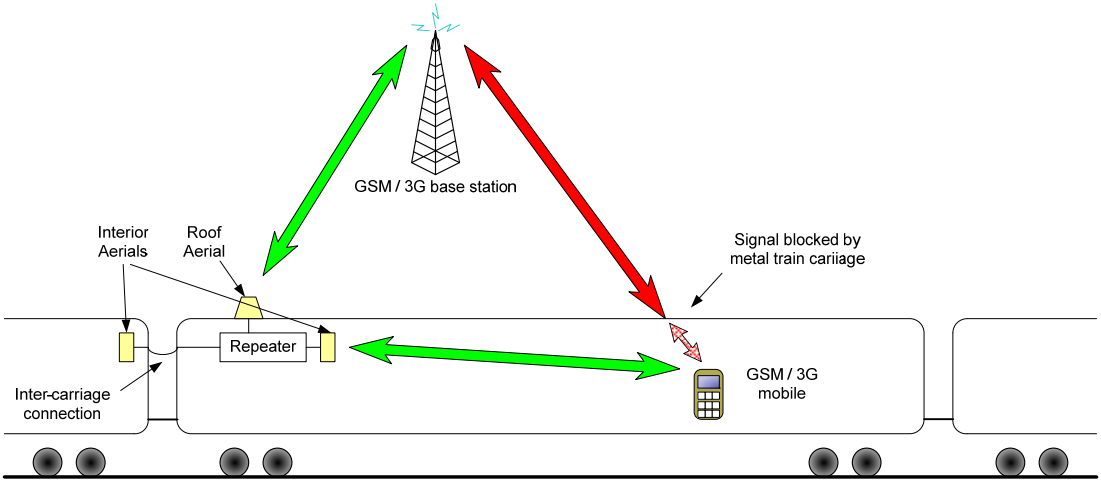
7.22 It is likely that different road and rail routes experience different levels of coverage, and that any improvements to the issue of complete not-spots, mobile broadband not-spots and partial not-spots will help in alleviating some of the problems of coverage in-transit.

7.23 Fundamentally, both road and railway coverage can be improved by the operators deploying additional antennae – on existing masts (through site sharing) or on new masts – along road and rail routes. We focus in this Section on railway developments because our research to date has included relevant findings on coverage on trains - although we are planning to look into road coverage in some more detail over the coming months.

7.24 As mentioned in Section 5, another way of boosting the signal within train carriages – especially since new train designs can act to inhibit mobile reception – is through a repeater. These are devices that are installed in carriages with an antenna outside the carriage to pick up existing mobile signals and a second antenna within the carriage to re-broadcast these signals. These are particularly effective where the carriage has a high penetration loss – that is where it strongly attenuates signals passing through windows. Even where the penetration loss is low, repeaters can bring some benefit as an antenna mounted on the train roof will typically receive a stronger signal than a mobile within the train – see Figure 8 below.

[79] See 11 October 2010 news release from T-Mobile website at http://www.t-mobile.co.uk/services/about-t-mobile/media-centre/

Figure 8: Use of repeaters on trains to improve in-carriage mobile coverage



7.25 Repeaters have been installed on many Virgin trains operating on the West Coast Mainline and this has resulted in improvements in coverage for passengers. However, installation of repeaters requires the cooperation of the train operating companies who typically need to schedule carriages being delivered to a maintenance depot where they may be out of action for some days.

7.26 To date, it appears only a few train operating companies have installed repeaters. Looking ahead, even if new trains had repeaters installed when they were built, given that the life of rolling stock can exceed 30 years, it would still take a long time before repeaters provide a solution to the coverage issues that exist within trains. This suggests repeaters may need to be retrofitted to some existing train stock too.

7.27 Longer railway tunnels (for overground as well as underground trains, or even in road tunnels) and potentially deep cuttings too alongside railway scan often require a specific solution called a leaky feeder[80]. In this regard, recent suggestions that mobile coverage might be achieved on the London Underground are encouraging. The Mayor of London is in discussions with the mobile operators to encourage them to share the circa £100 million cost of setting up mobile coverage on the London Underground with the aim of enabling commuters to use their mobile phones there by the time of the London 2012 Olympic Games and Paralympic Games[81].

[80] This is a cable with small holes carefully cut into the outer casing at regular intervals allowing radio signals to "leak out". Laying such a cable along the length of a tunnel can provide good signal throughout. Such deployments are somewhat expensive, but the key issue preventing deployment to date has typically been rail concerns about possible interference and access to the tunnel (with related safety concerns). Again, it may be that improved co-ordination might facilitate access to tunnels for the deployment of such a solution.

[81] We note that some rail operators also offer Wi-Fi connectivity to their customers, which can allow alternative access to data and voice services on the move – see for instance http://www.eastcoast.co.uk/about-us/Latest-News1/Wi-Fi-is-changing/ . This requires some equipment to be put on the trains. This facility can be free (within the ticket price to all or first class travellers) or charged at a premium. There are also a small number of bus operators providing a Wi-Fi service – see for example http://www.icomera.com/road/solutions/ . However these solutions are often a mixed a mix of technologies, and can incorporate cellular/3G mobile for connection to the core telecoms

7.28 However, given that the issue of interrupted coverage is the accumulation of other not-spot issues – i.e. travelling through complete not-spots and/or partial not-spots – it is likely to persist to some degree.

Developments relating to coverage indoors

7.29 We identified in Section 4 that customers are often unable to receive reliable mobile coverage indoors. There are a number of potential developments in the market that could go some way towards mitigating this issue.

7.30 Vodafone currently offers its customers the option of purchasing a femtocell to improve their coverage indoors. This is a device that acts as a mini base station in the customer's house/premise, connected via the customer's fixed broadband connection, which allows registered users (who are Vodafone customers) to access Vodafone's network within and around the home. It may have a range sufficient to provide coverage in most UK homes[82].

7.31 Vodafone is the only mobile operator currently offering femtocells to residential consumers in the UK, although other operators may offer them in the future. The Vodafone offering is generally marketed at £5 per month. The premium charged means customers who place a particular value on indoor coverage pay extra for it[83].

7.32 Another potential solution to indoor coverage issues is for customers to use their home Wi-Fi networks, for example to send/receive data and/or make voice over IP (VoIP) calls. It is also possible to access Wi-Fi in other non-domestic indoor locations such as airport buildings, inside train stations, offices, libraries, universities/colleges, hotels, shopping centres, coffee shops and other food/retail outlets[84]. Wi-Fi was also recently made available on all of Glasgow's underground (subway) stations and platforms[85].

7.33 While Wi-Fi is a technically feasible solution for many customers, there may be a number of potential barriers to take up by households, such as the need to have a Wi-Fi enabled handset; the need to have a home Wi-Fi network and the potential need to configure access to some services such as using additional applications like Truphone[86].

7.34 There is also a technical standard called Universal Mobile Access (UMA) which provides full mobile functionality using Wi-Fi. UMA requires potentially less configuration for mobile services than standard Wi-Fi although a UMA-enabled

---

network which effectively means that these Wi-Fi services will also be depend on the level of mobile coverage along their particular routes.

[82] We note that in selling the product – called Sure Signal – Vodafone state that a minimum fixed line broadband speed of 1Mbps is required.

[83] This may be seen as an example of non-uniform pricing to provide extended network coverage.

[84] We also recognise that Wi-Fi connectivity is also available outdoors too in some city areas like the Square Mile of London by The Cloud and for example, via the BT 'Fon' network – see http://www.btfon.com/ .

[85] See http://www.thecloud.net/en/about-us/News-and-PR/The%20Cloud%20Says/Glasgow%20Subway-%20latest%20news.aspx

[86] There are an increasing number of mobile only households in the UK, for which Wi-Fi would not be viable without purchasing a fixed broadband subscription – an additional expenditure. Many poorer households are mobile only, so these solutions are unlikely to be feasible for this group. It is also possible that areas that do not receive good indoor mobile coverage are more likely to be areas that are unable to receive fixed broadband. Where this is the case, solutions for unreliable indoor coverage that rely on fixed broadband connections may not be feasible.

handset is needed. However, it is currently only supported on a limited number of handsets than Wi-Fi and by fewer mobile operators (for example we understand Orange offers the service, mostly on Blackberry models).

Conclusion

7.35 In conclusion, there are a number of developments in the market that are likely to go some way towards mitigating the not-spot issues identified in previous Sections. However, there are likely to be residual issues, especially where 2G coverage is concerned.

- **Complete not-spots:** It is unlikely that operators will invest significantly in their 2G networks and thus extend their coverage significantly in these areas[87]. It is conceivable that commercially driven improvements to 3G coverage may, in the longer-term, help improve some complete not-spots. However, complete not-spots are likely to continue to persist to some extent, particularly in rural areas.

- **3G not-spots:** Conversely, the mobile operators are continuing to build out their 3G networks, and we expect this to continue. While a few operators have set targets for their 3G coverage levels, it is not possible at this stage to know precisely how much coverage these networks will provide when complete.

- **Partial not-spots:** There is likely to be some reduction in the number of operator specific not-spots as a result of site sharing deals like Cornerstone and the T-Mobile/Orange merger and also from improvements in 3G coverage, although some differences in the coverage provided by operators will remain.

- **Interrupted coverage on the move:** Interrupted coverage on the move may be mitigated to some extent by the reduction in the number of partial not-spots. In terms of the railways, there have been some developments that have mitigated the problem of poor coverage on a few train routes (such as adding repeaters). However, further developments on this issue could be slow.

- **No mobile coverage indoors:** There are two main solutions currently available in the market – femtocells and Wi-Fi. There are, however, limitations to both of these technologies as solutions. Femtocells are currently available only from Vodafone (although it is possible other providers may offer them in future) and Wi-Fi requires specific handsets and sometimes additional applications in order for voice to be used on mobile devices. Both femtocells and Wi-Fi also rely on households having fixed broadband connections[88].

[87] Although we recognise that a few operators are claiming they will reach extensive 3G population coverage levels, we need to monitor developments to establish whether it would actually leads to 3G coverage levels exceeding those of 2G over time – such that 3G brings mobile service availability into areas which currently have no mobile network presence at all.

[88] The only other technological option which is not currently on the mass market is the use of *repeaters* placed on the outside of buildings by mobile operators which are then connected to equipment inside the premise to bypass the propagation losses from a building's outer layer. This solution would not require the use of a fixed broadband connection as it would run purely on the mobile (cellular) network.

Section 8

Developing our further work

8.1 This Section builds on our analysis of the causes of not-spots, their impact on citizens and consumers, and market developments that we set out earlier in the report. This broad understanding helps us assess the potential areas of market failure and where it may be proportionate for us to consider intervening. To this end, this Section sets out our proposed main work areas and the reasons why we are pursuing them at this stage.

Our economic framework for intervention

We may consider intervening to ensure effective competition

8.2 The 2003 Communications Act (the Act) gave Ofcom principal duties to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate by promoting competition.

8.3 We will seek the least intrusive regulatory method of achieving our objectives in keeping with our regulatory principles. Section 47 of the Act also says that any conditions that we might impose should be proportionate to what we are intending to achieve through our intervention.

We have identified four potential areas relating to mobile coverage and the functioning of the market

8.4 In considering where it might be proportionate for us to undertake further work, we have identified four areas where there may be potential failures in the functioning of the market that could arise relating to mobile coverage:

- **Lack of coverage information**: Consumers may be unaware of the coverage offered by each mobile network operator when choosing their provider, and as a result may not make optimal decisions. This may also mean there are fewer incentives for network operators to invest in coverage.

- **Coordination issues**: The high 'transaction costs' faced by the mobile operators when discussing coverage issues with the railways may make it unprofitable to progress these issues, despite potentially significant benefits.

- **Externalities (wider costs or benefits)**: An operator providing coverage in a given area creates value for its customers, which it should be able to recoup through call charges. However, such coverage may also bring wider benefits (i.e. a positive externality). For example, friends, family and business contacts on other networks and in other areas may also benefit if they can now reach those users in the given area. This may result in some areas that would be efficient to serve not receiving coverage if the operator is unable to capture these wider benefits.

- **Uniform pricing**: Mobile users do not use their mobile phones in a single geographic location. This makes it difficult for firms to charge different prices to customers in different areas. It is possible that this constraint on how operators

set prices could lead to an inefficient level of coverage, as they may be unable to recoup the costs of efficient investment in higher cost areas[89].

8.5 These potential sources of 'market failures' are not mutually exclusive. It is probable that all will be present in the market place to differing degrees (as they can be in any sector of the economy). If we were to address the different market failures, different remedies would likely be needed – and some (such as those to address externalities and uniform pricing) may be more interventionist than others.

Developing our further work

We have considered where further work may be proportionate

8.6 There are a number of factors we would need to consider in determining whether an intervention is proportionate, including taking into account the balance between benefits and costs. More detail on how we would consider the proportionality of an intervention and conclude that an in-depth impact assessment is necessary is set out in Annex 2.

8.7 As we set out below, we believe that interventions aimed at addressing coverage information and coordination issues might bring the most net benefits. We also believe that there is a low probability that these interventions will have adverse effects on the market and we intend to focus our work here in the first instance.

8.8 Addressing other potential market failures (externalities, uniform pricing) at this stage may require a more interventionist approach, could pose greater regulatory risks, and could require significant resource.

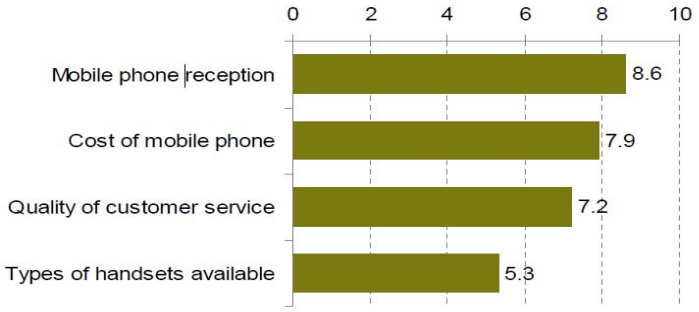
8.9 We would also want to see the impact of our proposed work on coverage information and coordination issues before considering whether it would be necessary to take a more interventionist approach.

Work area 1: Improving consumer coverage information

8.10 Coverage matters and is one of the most important factors in consumer decision making. The Communications Consumer Panel research asked respondents about the relative importance of a number of different factors when choosing a mobile phone provider[90]. The responses illustrated in Figure 9 show that mobile coverage is very important to people, and in this survey was the most important factor when choosing a provider.

[89] This potential source of market failure is caused by the commercial decisions of the operators to charge uniform prices, rather than a factor that is intrinsic to the industry.

Figure 9: Relative importance of mobile coverage when choosing a network provider



Question: Thinking about choosing which network to use, how important are each of the following factors on a scale of 1-10?
Base: All those who use a mobile for personal use (n = 1716)

8.11 Where individuals do not have access to accurate coverage information, they may make inefficient decisions when choosing a mobile network. When consumers choose their mobile network they may be unlikely to have an accurate perception of the coverage levels available on different networks, because they have not yet had the experience of using them all.

8.12 If consumers are unable to distinguish between accurate and inaccurate information - or there is a risk of 'information overload' – then operators may face limited incentives to provide accurate coverage information, which may result in consumers making inefficient decisions. A lack of accurate coverage information may also reduce operators' incentives to invest in coverage.

8.13 Here we believe that Ofcom can do further work to consider whether there is potential to improve the information available to consumers about the availability of mobile services. We would want to consider:

- First, whether to act to improve the availability and accuracy of consumer information and improve the efficiency of consumer decision making. We would also want to investigate whether any other further steps are necessary to ensure consumers are protected.

- Second, how this could help ensure the effectiveness of competition, aiding the functioning of the market through improved consumer decision making and potentially incentivising operators to compete more on coverage levels and quality.

8.14 This is not a straightforward task. Information about mobile coverage is more complex technically than information about availability of fixed services particularly given mobile not-spots are a multi-faceted issue. As we mentioned earlier, we have a measurement trial underway in Devon which could help us understand coverage information in more detail and thus help inform our work in this area. In addition, previous consumer information initiatives such as TopNet[91], have demonstrated the

[91] Network service information for mobile services was provided by TopNetUK (www.topnetuk.org), an independent website run on a voluntary basis by O2, Orange, T-Mobile and Vodafone. It allowed consumers to compare network performance and call quality. The first results were published in August 2006, however the website received few visitors and in 2009 the contract for sourcing the raw data was not renewed.

challenges in collecting information on coverage and presenting the results in a way that is meaningful and comparable to consumers.

8.15 We will also need to understand, from a behavioural perspective, what information will actually be helpful to consumers. If we consider it necessary to act to ensure that consumers are sufficiently empowered and protected, we need to be careful that the additional and/or revised information is presented in the most effective way and so we will do more work to understand this further.

Behavioural economics

Behavioural economics uses insights from psychology to develop a better understanding of how individuals make decisions. It builds on traditional economics by incorporating the possibility that individuals can make systematic mistakes.

Behavioural economics can help develop a better understanding of how consumers make decisions, their drivers of switching behaviour, and how we might develop effective remedies. Remedies that work well for fully rational consumers may not work as effectively when consumers are biased.

For example, providing additional information to help consumers make better choices risks confusing consumers and leaving them worse off. Behavioural economics highlights the importance of consumer research to better understand how consumers behave. It can also help us know how best to present information to consumers quickly and simply. For example, some consumers may welcome information being presented in the form of a diagram rather than the written word.

8.16 The Communications Consumer Panel has noted that 'try before you buy' options can be appropriate alternatives to providing consumers information about mobile coverage because these can give consumers greater protections when committing to long term mobile network contracts[92]. We will consider the relationship between 'try before you buy' and the provision of consumer information as we progress our work.

8.17 We set out our proposed next actions in relation to the provision of consumer information in Section 9.

Work area 2: Helping facilitate an improvement in coverage on the move

8.18 Rail lines are known to be difficult for mobile coverage, partly because of the long distances they run in rural areas, and partly because the rail carriages provide a barrier to signal penetration. We set out the PA research findings on the rail routes in Section 4 which illustrated that the West Coast line had better 2G coverage than the East. This difference is partially due to the close coordination of Virgin Trains and the mobile operators to install repeaters on trains along the West Coast route.

8.19 The PA research highlighted that not-spots on trains are mainly attributed to technical, safety and commercial challenges:

- **Technical**: High signal attenuation due to the carriage body or topography – tunnels and cuttings – require additional measures. Typically this may mean a 12

[92] See for example Communications Consumer Panel *Mobile Coverage and Contract Cancellation* July 2010 http://www.communicationsconsumerpanel.org.uk/Can%20I%20cancel_main%20report_FINAL.pdf .

fold increase in the number of base stations or specialist technology – both of which are technically feasible but have potential safety and cost implications.

- **Safety**: Although a large number of masts, around 450, have been installed track-side safety remains a paramount and overriding priority that can limit deployment options. In particular, track-side access is subject to unique safety constraints.

- **Commercial**: In-train mobile coverage is currently not regarded as sufficiently value-adding that passengers would be willing to pay a premium[93] which perhaps means there is less incentive for *train* operators themselves to invest in repeaters.

8.20 We have found that, in general, there appears to be some interest from mobile operators to improve coverage on railways but technical, safety and commercial factors specific to train routes appear to be hindering efforts.

8.21 Discussions between relevant industry players are underway, but the slow speed of development in this area demonstrates there could be some coordination issues – in accessing train tracks and in the design/fit-out of rolling stock – creating an impasse and inhibiting improvements.

8.22 So we intend to undertake further discussions with Government and industry to understand whether there is potential to facilitate stakeholder coordination to help improve railway coverage.

Some stakeholders have suggested the option of mandated national roaming

8.23 The introduction of mandated national roaming[94] for the purpose of increasing coverage has been suggested by some stakeholders. In the context of this report, we have considered it at a high level as a potential means of improving coverage.

8.24 We note – as we did in our Mobile Sector Assessment - that mobile operators are already free to enable roaming arrangements on a commercial basis if they wish to do so[95]. There is also a range of complex technical issues to consider in mandating such a solution through regulation.

8.25 The objective of introducing roaming is to increase the effective coverage for UK mobile subscribers; that is, to increase the availability of services if a subscriber is located in an area that is not covered by their home mobile network operator.

8.26 In theory, roaming may mitigate against the impacts of partial not-spots; where a user has no coverage on their home network, they may be able to roam onto another

[93] Passenger Focus identified that one of the key benefits for using rail was the ability to work on the train which will invariably involve some form of mobile communications. However there are also polarised views with some passengers wanting quiet carriages in which mobile phones are banned.
[94] Roaming is defined as the ability for mobile customers to automatically make and receive voice calls, send and receive data, or to access other services, outside the geographical coverage area of their home network, by using a network in the area they are visiting. If the visited network is in the same country as the home network and the commercial arrangement covers an entire country, this is known as national roaming. (If the visited network is outside the home country, this is known as 'international roaming').
[95] See paragraph 8.54 in Ofcom *Mostly Mobile* 8 July 2009 http://stakeholders.ofcom.org.uk/binaries/consultations/msa/summary/msa.pdf .

network. Mandated roaming will therefore not directly address complete not-spots or 3G not-spots, as it requires at least some operator coverage to be present.

8.27 Even if technically possible, a full roaming solution could restrict operators' ability to compete and differentiate their service offerings in relation to coverage. This might in the long term reduce their incentives to build out their network. We also want to consider the extent to which improving coverage information could help increase these incentives to compete and potentially mitigate partial not-spots.

8.28 In addition, market developments indicate that partial coverage could be improved by operator partnerships being pursued commercially (such as the merger between T-Mobile and Orange and the site-sharing deal between Vodafone and O2)[96]. For these reasons, we do not propose to consider the option of mandating national roaming further at this stage as a potential means of improving coverage.

We will continue to advise Government on the nature of mobile not-spot issues

8.29 Finally, it is clear from our work that the commercial scope to address complete not-spots is more limited. As we noted above, even in using our regulatory powers it is still likely that there could be areas left without mobile coverage.

8.30 Here, we can also seek to contribute to and implement public policy on relevant issues that Government may wish to consider. For example, Government may wish to consider whether it is appropriate to ensure all people have access to mobile coverage to help them participate in society on digital inclusion grounds. We can help inform this consideration.

8.31 In the past, coverage obligations attached to the award of spectrum licences have been one mechanism to help ensure a level of mobile service availability across the UK, pursuing public policy goals, although never to the extent of 100% geographic coverage.

8.32 We note that there are potential costs associated with attaching coverage obligations to spectrum awards. Obligations perceived as onerous could make spectrum less commercially attractive. These costs would need to be balanced against any potential wider benefits, for example to society, to establish the proportionality of such an approach. Such obligations may also have an impact on competition, in particular new entry, since it may be particularly challenging for new entrants to meet such obligations.

8.33 Such obligations may again be considered as further spectrum is made available. We note that we expect to consult on the design for the auction of 800MHz, following Parliamentary approval of the Government's proposed direction to us on the award of this low-frequency spectrum, which is suitable for delivering mobile broadband services[97].

[96] The operators would need to overcome some technical challenges to implement national roaming with associated costs.

[97] In Spending Review 2010, the Government stated its intention to hold an auction in 2011‑12 for 800MHz and 2.6GHz spectrum, suitable for delivering the next generation of mobile broadband. They also announced that at least 500MHz of public sector spectrum below 5GHz will be released over the next ten years for new mobile communication uses, including mobile broadband. HM Treasury *Spending Review 2010* October 2010

8.34 We have also discussed with BDUK[98] (Broadband Delivery UK - created within the Department for Business, Innovation and Skills as a delivery vehicle for its broadband policies) the potential for synergies between mobile coverage issues and the delivery of broadband projects and commitments supported by the public sector.

8.35 We note that the Government announced in its Comprehensive Spending Review that "£530 million will be invested over the Spending Review period to support the UK's broadband network and to incentivise the roll out of superfast broadband in areas that the private sector would not otherwise reach". The Government also stated this project "will benefit around 2 million households, including in some of the most remote areas of the UK"[99].

8.36 Finally, Ofcom will also consider highlighting mobile availability in our first infrastructure report to Government - where we have a formal role to make recommendations on the UK's communications infrastructure, including on issues related to mobile coverage. Our first report is due in 2011. We have already stated that mobile coverage will be one of the areas we focus on in this report. We will be considering in this context whether there are any practical recommendations we might make to Government in relation to mobile not-spots.

http://www.direct.gov.uk/prod_consum_dg/groups/dg_digitalassets/@dg/@en/documents/digitalasset/dg_191696.pdf .

[98] BDUK has four aims - to ensure delivery of the 2Mbps Universal Service Commitment within the lifetime of this parliament (2015); to ensure this country has the best superfast broadband in Europe by the end of this parliament (2015); to ensure the efficient use of funding to deliver Universal Service Commitment and Superfast Broadband and to assist other Government initiatives which are dependent upon customers ability to access Broadband based services. See http://www.bis.gov.uk/BDUK .

[99] As part of this investment, the Government announced it will pursue superfast broadband pilot projects in North Yorkshire, Cumbria, Herefordshire, and the Highlands and Islands.

Section 9

Next Steps

We will continue work in a number of areas

9.1 We discussed the key work areas we propose to progress in Section 8. We summarise these in Figure 10 with the specific actions we will take on each step.

Figure 10: Summary of our next steps on mobile not-spot issues

Next Steps	Actions
Consider need to improve coverage information	• Look at how coverage information is provided to consumers, how accurate it is, how consumers use it and the impact on consumers • Drawing on evidence including outcomes of signal strength survey in Devon and our investigation of arterial route coverage, as well as our research on mobile broadband performance • Identify whether there is any potential for improvements to be made • Publish a consumer guide on "Maximising your mobile signal"
Continue research to further develop our understanding of issues	• Progress the trial measuring coverage in Devon, cross-checking to operator data to understand accuracy of their postcode checkers • Progress our new research testing the speed and reliability of mobile broadband networks in the UK
Examine scope to facilitate coverage on the move	• Engage further with industry and Government on whether we can facilitate stakeholder co-ordination to improve railway coverage • Investigate road coverage on selected UK arterial routes
Take forward spectrum release	•Subject to Government's expected direction, progress the release of lower frequency spectrum suitable for mobile services
Continue to engage with Government on the issues	• Engage with Government departments and potentially highlight issues on coverage as part of our new infrastructure reporting duty • Discuss any links to spectrum and wider public policy such as broadband interventions

9.2 We expect these work areas will progress over the coming months and into 2011.

9.3 We recognise that not all of these steps will be straightforward. For example, information about mobile coverage is technically complex and difficult to compare. We also need to do more work to make sure that this approach will be helpful to consumers. In addition, we will also need to consider whether the resource required to pursue this approach is proportionate to the potential outcome that could be achieved.

9.4 In the interim, we are completing one specific action which is our publication today of a **consumer guide on '*Maximising your mobile coverage*'**. This guide is available at ofcom.org.uk/files/2010/11/maximising-coverage.pdf and sets out a package of self help measures that consumers can consider drawing upon to try to improve their experience of coverage.

We will continue stakeholder engagement

9.5 Across all this work, we will also be working closely with stakeholders. For example, we will be working closely with the mobile operators in relation the Devon trial and in discussing the scope to improve coverage information. We will also continue to liaise with Government on our findings and also discuss potential linkages to public policy and projects.

Annex 1

Trends in mobile usage

Emerging Trends

The mobile platform has evolved beyond voice and text

A1.1 Since the launch of 3G technology, take-up of mobile data services was initially slow. This has changed over the past few years, with two main areas for growth.

Mobile broadband

A1.2 Since its launch in 2007, sales have now taken off, with more than two million new connections in the year from February 2009[100].

A1.3 In the early stages of mobile broadband take-up, most people used it as a complement to an existing fixed broadband service. However, by Q1 2010 there are some indications that more households are using mobile broadband as their only internet connection – Ofcom research finds that 60% of mobile broadband users also had a fixed-line connection in Q1 2010, compared to 75% a year previously[101].

A1.4 Much of the growth in take-up of mobile broadband since Q1 2009 has been among households in lower socio-economic groups. The largest increase in take-up has occurred in C2 households (where it has increased by six percentage points, to 14% of all C2 households). Two-thirds of DE households that use mobile broadband do not have fixed broadband.

A1.5 Take-up is also skewed towards younger consumers, with nearly one in four 15-24 year olds and one in five 25-34 year-olds claiming to use the mobile broadband service and half of these using it as their only internet connection[102].

A1.6 Levels of satisfaction with mobile broadband services continued to be lower than for fixed services. In Q1 2010 83% of mobile broadband users said that they were satisfied or very satisfied with their service compared to 90% for fixed broadband.

Mobile data services on handsets

A1.7 In the two years to March 2010, the number of people in the UK accessing the internet on their mobile more than doubled, with data from Nielsen finding that around 13.5 million adults, or around 28% of UK adults with a mobile phone, reported that they visited at least one site on their mobile in March 2010[103].

[100] Figure 4 in Ofcom *Mostly Mobile* 8 July 2009
http://stakeholders.ofcom.org.uk/binaries/consultations/msa/summary/msa.pdf
[101] Figure 5.15 Ofcom *Communications Market Report 2010* 19 August 2010
http://stakeholders.ofcom.org.uk/binaries/research/cmr/753567/CMR_2010_FINAL.pdf
[102] Figure 5.96 Ofcom *Communications Market Report 2010* 19 August 2010
http://stakeholders.ofcom.org.uk/binaries/research/cmr/753567/CMR_2010_FINAL.pdf
[103] Figure 5.18 Ofcom *Communications Market Report 2010* 19 August 2010
http://stakeholders.ofcom.org.uk/binaries/research/cmr/753567/CMR_2010_FINAL.pdf

A1.8 The take-up in the use of the internet on mobile phones has mirrored the increase in take-up of smartphones. Research from ComScore Inc. finds that in May 2010, 26.5% of UK mobile phone users claimed to have a smartphone[104].

A1.9 In our Mobile Sector Assessment, we suggested that the usage of mobile data services is stimulated by a virtuous circle of increasing consumer demand, development and launch of new applications, and increased technical capabilities of devices and networks. This is creating new opportunities for consumers and citizens to participate in online networks and new forms of location based services. It is also creating opportunities for businesses to connect with their customers, workforce and suppliers, driving efficiencies, sales, and growth in the wider economy.

A1.10 Mobile devices are increasingly being used to receive content and applications – including access to public services,[105] direct democratic engagement, accessing health information remotely and engaging with social networks.

But the mobile sector has become more complex

A1.11 The mobile market generally works well for consumers. But when asked to compare the mobile market with other markets, consumers tend to say that mobile performs badly in comparison. This may in part be due to the complexity of the market. As we set out in the Mobile Sector Assessment, there are a number of specific features of communications markets which may mean that consumers find if more difficult to get the best deal:

- **Contracts**. Customers in telecoms markets usually decide to buy before they use the service. There has been a marked trend towards longer contract lengths. In Q2 2010 around 80% of all new pay-monthly contracts sold with handsets were for two years, this compares to less than one in three the year before, and less than one in thirty in Q2 2007[106]. This may reduce the ability to switch to a different provider and can cause problems if users discover coverage limitations after purchase.

- **Innovation**. In a market with frequent product and service innovation mobile devices are becoming increasingly varied and sophisticated and smartphones are making up a growing segment of the market.

- **Bundling**. Consumers may find it more difficult to compare the relative merits of bundled products (e.g. a mobile service that includes a ‘free’ handset) in the same way as for services sold on a stand-alone basis.

---

[104] Figure 5.19 Ofcom *Communications Market Report 2010* 19 August 2010 http://stakeholders.ofcom.org.uk/binaries/research/cmr/753567/CMR_2010_FINAL.pdf Although there is no generally agreed definition of a smartphone, the use of an advanced operating system that facilitates the development and installation of third party applications is commonly accepted as differentiating smartphones from ‘feature’ phones. In most cases, smartphones have other characteristics such as a large colour screen, a touchscreen or full QWERTY keyboard, access to fast internet through Wi-Fi or 3G connection, or large memory storage.

[105] The trend towards increasing public services delivered online was highlighted in the Digital Britain final report. Mobile will become increasingly like the internet, and inevitably, as public services move online they will also become mobile.

[106] Figure 5.24 Ofcom *Communications Market Report 2010* 19 August 2010 http://stakeholders.ofcom.org.uk/binaries/research/cmr/753567/CMR_2010_FINAL.pdf

- **Complex tariffs**. These are often combined with non-transparent charges and multiple terms and conditions making it hard for consumers to ascertain the true cost of calls, text and data transfers.

Future usage

A1.12 Today, mobile applications and other innovations are driving changes in our idea as to what a phone is actually for. Voice and text still account for the significant proportion of revenues but phones are now being used for a much broader array of uses. Innovative suppliers are seeking to offer and monetise such opportunities.

A1.13 One could characterise the communications market by a series of tipping points – points of inflexion where a nascent market reaches critical mass. The take-up of twitter, Facebook and mobile applications seem to have followed this path.

A1.14 We now look forward to assess a number of the most relevant mobile trends and to see where the next tipping points might be. There are many sources of such predictions and they are all somewhat different so this exercise is meant to be illustrative rather than anything more concrete[107]. We explore these in a more detail below. Our aim here is to take an early view on the future coverage requirements and to identify any potential bottlenecks that might warrant further investigation now.

Social communications

A1.15 Social media are already mainstream services but mobiles may soon become the default way to log onto a social network. Lack of coverage is likely to become increasingly annoying, preventing social interaction. However, websites and user communities will likely find ways to work around this, including a range of access options and out of coverage messages. Phones will also make use of other wireless systems, such as Wi-Fi, placing less of an emphasis on the need for universal cellular coverage.

Location

A1.16 Location based services[108] are already common place in the mobile market, but it seems we are still on the cusp of a wave with a long way to go in this field. Most services currently rely on GPS to locate the handset but it is not a complete technical solution. More advanced services also need additional data feeds to enable a richer user experience – such as augmented reality and location based advertising or promotions. Whilst Wi-Fi is a partial alternative an increasing reliance on the mobile as a navigation tool will put more emphasis on cellular coverage.

[107] Our main source for this discussion has been *Being Mobile: Future Wireless Technologies and Applications* by William Webb, Cambridge University Press, October 2010.

[108] Location based services essentially identify a location of a person or object, such as discovering the nearest cash machine or the whereabouts of a friend (the latter facility is offered by foursquare and now facebook). Similarly, personalized weather services are now increasingly common for smartphones and the services can also take the form of coupons or advertising directed at customers based on their current location.

Healthcare and assisted living

A1.17 This is a growth area that in theory offers significant benefits to the health and general wellbeing of society. In the home, services might include applications to monitor the individual. In the hospital, mobile technology might enable monitoring of the movement of people and equipment and facilitate more timely access to information. Out and about, mobile technology may allow deployment of body-based sensors that monitor vital signs in at-risk patients.

A1.18 Some healthcare services, especially outside of the home, will rely on cellular coverage. However Wi-Fi availability should be able support most of these new services, especially in the home and in the hospital. The real benefits from cellular coverage are already available to us – in the simple use of the phone to call the emergency services. Our recent work on 999 roaming has helped make the most of the existing networks, but there are still complete not-spots where no networks are available and where coverage is the main impediment.

Transport

A1.19 This field captures an array of possible services including systems built into new cars to enable route guidance, congestion avoidance services, and car-to-car alerts. However, transport systems often need to work internationally and many would require harmonisation across manufacturers, operators and countries. If there were requirements for mobile operators to support in-car emergency call systems, this would lead to a need for better coverage on roads and key transportation routes.

Summary

A1.20 The mobile will become more useful, in innovative ways that stretch the boundaries of our imagination. This is likely to make poor coverage issues more pronounced. But the increased value delivered from the mobile should translate to some additional operator revenues enabling more spend on infrastructure to improve coverage and capacity. Some services will also be safety-critical (health, some transport) which may put add particular political pressure to incentivise operators to achieve better coverage. However other networks and forms of coverage such as Wi-Fi may also become more relevant – and if so, could potentially reduce reliance on cellular for solutions to coverage.

Annex 2

Economic framework for intervention

Our regulatory principles

A2.1 Our principal statutory duties as set out in the Act, and summarised in Section 3 of this report are "(a) to further the interests of citizens in relation to communications matters; and (b) to further the interests of consumers in relevant markets, where appropriate by promoting competition".

A2.2 While we aim to further the interests of consumers and citizens, any intervention needs to take account of the costs it may impose on industry. Section 47(2) of the Communications Act states that when imposing a condition on operators, it must be – among other things – "proportionate to what the condition is intended to achieve".

A2.3 On this basis, we may seek to intervene where we believe that the market is failing to provide the best outcome for society. The rest of this annex sets out the economic framework for assessing whether the market is providing the optimal outcome from society's perspective, and therefore sets out how to assess whether further intervention would be proportionate. We would always need to determine how this framework applies depending on the facts of a particular case.

Sources of economic value

A2.4 The concept of economic welfare is often used to examine which outcomes lead to the greatest benefit to society. *Total welfare* can be divided into the following broad categories:

- **Consumer welfare (direct)**: When consumers purchase goods or services for less than the value they place on them, they derive consumer surplus. For example, a consumer who places a value of £30 per month on the mobile telecoms services they receive, but pays only £20 for them derives consumer surplus of £10 per month.

- **Consumer welfare (externalities)**: Sometimes the consumption of a service can have impacts on individuals who are not consuming them. For example, the fact that an individual has a mobile phone means that their friends and family can contact them. As a result, the friends and family may place a value on increased mobile coverage.

- **Producer welfare (direct)**: Firms selling telecoms services derive producer surplus providing the price they charge exceeds the cost of serving a given customer. For example, if it costs £15 per month to serve a customer, and they charge £20 per month, the operator makes producer surplus of £5 per month. Fixed costs (e.g. investments) also need to be considered as part of the assessment of producer welfare: when a firm makes an investment, there is a decrease in producer welfare as a result of the fixed cost (but the firm hopes to offset this by increasing producer surplus, through increased prices, expanding output or reducing marginal costs).

- **Producer welfare (externalities)**: Similar to indirect consumer welfare, the provision and consumption of a service can have impacts on businesses which

are not providing them. This may benefit other telecoms companies (e.g. fixed operators), for example, if they experience increased call volumes as a result.

Applying this framework to mobile coverage

A2.5 All other things being equal, with higher levels of coverage we may expect that those already subscribing to mobile services would place a higher value on them. This increased value would increase the total level of direct consumer welfare, provided the mobile operators did not increase their prices as a result. In a competitive market, we would only expect prices to increase if it increased total welfare. However, in the absence of perfect competition, if operators are forced to increase coverage, they could increase prices, meaning that an intervention to increase coverage could have either a positive or negative impact on consumer welfare. Conversely, applying this reasoning to the reverse situation, the presence of mobile not-spots may result in a lower level of consumer welfare than would be observed if these areas received coverage.

A2.6 There may be externalities that affect the level of consumer welfare associated with increased levels of coverage. As described above, friends and family may place a value on being able to contact and be contacted by mobile users living in areas that are not currently covered. Increasing coverage could therefore benefit the friends and family of mobile consumers living in (or passing through) these areas.

A2.7 Offering coverage in these areas, however, may be costly to mobile operators. If an operator invests in additional coverage but does not recoup this investment (through higher prices, lower costs, or an increase in the number of customers/calls), direct producer welfare would decrease. Increasing coverage above the currently observed levels could therefore have a negative impact on producer welfare. If this was not the case, producers would have already increased coverage, as the market would reach equilibrium at this increased level of coverage absent intervention.

A2.8 There may also be externalities that could affect the level of producer welfare, as other firms may also benefit from increased levels of mobile coverage. For example, firms providing fixed line voice services may benefit from increased call volumes, as people could call and be called by those located in areas where there was not previously coverage.

A2.9 The supply and consumption of telecoms services results in a range of direct and indirect benefits for both consumers and firms. In the case of not-spots, total welfare will depend on a number of factors.

A2.10 It is important to note that the most *efficient* outcome for a given area may be for there to be no coverage at all.[109] In areas with a particularly low population density, the costs to operators of rolling out networks could exceed the total benefits, making investment in these areas economically inefficient.

Potential sources of market failure

A2.11 As discussed above, the Act sets out that we would seek to intervene only where it is proportionate to do so. Given this, we would expect any intervention to have a

[109] An “efficient” investment is one that has a positive net impact on total welfare – i.e. the benefits to society exceed the costs of the investment. An “efficient” outcome is therefore one that results in the optimal outcome from society’s perspective.

positive impact on total welfare. When the market does not provide an outcome that maximises total welfare, this is known as a market failure. The first stage of determining whether an intervention is necessary is to consider how the market could fail to provide the total welfare-maximising (or efficient) outcome.

A2.12 We have identified four mechanisms through which we believe the market could fail to provide the optimum outcome from society's perspective: lack of coverage information, coordination failure, externality and uniform pricing. Below we set out each mechanism in turn:

Lack of coverage information

A2.13 Issues around the provision of information could lead to a market failure in a number of ways. Where individuals do not have access to accurate coverage information, they may make inefficient decisions when choosing a mobile network. Telecoms services can be considered to be experience goods. That is, consumers are unaware of the quality of the service until they have experience of using it. As a result, when consumers choose their mobile network they are unlikely to have an accurate perception of the coverage levels available on the different networks.

A2.14 If consumers are unable to distinguish between accurate and inaccurate information, operators may face limited incentives to provide accurate coverage information, which may reinforce the effect of consumers making inefficient decisions. For example, some consumers choose a mobile network in the belief that the value of the service is greater than the price they pay (so will choose that operator). It is possible that their true valuation of the service – if they had accurate coverage information – is below the cost to the operator of providing it, which would make it inefficient to consume.

A2.15 Since consumers are often tied in to long mobile contracts, there are significant barriers to switching in the event that they are not happy with the coverage they receive. As such, if consumers make their decisions based on inaccurate information, they may be unable to switch to another operator for a considerable period of time. This may reduce further the incentives for operators to provide accurate information.

A2.16 A lack of accurate coverage information may also reduce operators' incentives to invest in coverage. If consumers do not have access to accurate coverage information, they may place lower weight on coverage when choosing a mobile network (and in some cases may choose the wrong network). Given this lower weight on coverage from consumers, mobile operators may face reduced incentives to invest in coverage.

A2.17 For example, while consumers may place a high valuation on mobile coverage, if they are unable to identify which mobile network's coverage best suits their needs, they may place less weight on the value of coverage relative to other properties (such as price of the contract and the quality of handset). However, if they had accurate information, they may be more prepared to trade off higher prices for better coverage. In this example, the lack of accurate coverage information results in the market providing an inefficiently low level of coverage.

A2.18 The field of behavioural economics has demonstrated how consumers often do not make rational decisions based on the information they have available to them. It is possible that the lack of coverage information could result from consumers' inabilities to process this complex information. If this is the case, operators may

face reduced incentives to provide accurate coverage information. There may also be other reasons why operators may face incentives to provide poor information on coverage, such as incentives to exaggerate coverage levels because consumers are unable to distinguish between accurate and inaccurate information.

A2.19 The choice of remedy for this market failure (if any) depends to some extent on the cause of the lack of information. If consumers are systematically unable to process information due to behavioural biases, providing more coverage information may not be an effective remedy. On the other hand, if consumers are ill-informed because of operators' lack of incentive to provide accurate information, there may be more scope for providing additional coverage information to remedy this potential market failure.

Coordination failure

A2.20 In Section 5, we identified that there are a number of barriers to increasing coverage on railways. It is possible that these barriers could lead to the market failing to provide the efficient level of coverage along railway routes.

A2.21 If a mobile operator wants to increase the level of coverage along railways, there are a number of parties that it must engage with. These include the train companies, Network Rail and potentially the rolling stock owners (in the case of installing repeaters).

A2.22 When a number of different parties need to coordinate their actions in order for a welfare-enhancing outcome to be realised, it is possible that the market will fail to provide it. It is possible, for example, that any of these parties wanting to initiate negotiations with the others may face considerable transaction costs. If these transaction costs are sufficiently high, no party will face incentives to engage in discussions, even though there is a potential for a welfare-enhancing outcome.

Externality

A2.23 As set out above, there are a number of ways in which individuals and firms are affected by coverage levels, even when they are neither consuming nor supplying mobile services. For example, when mobile coverage is increased, the friends and family of those living in the areas now covered may benefit from being able to call and be called by these customers. Likewise, other telecoms providers might benefit from the increased call volumes to and from customers in these areas. Also, there may be broader social value associated with the provision and consumption of mobile services.

A2.24 Economists often express value to individuals in terms of willingness to pay – in this case friends and family may be willing to pay a certain amount for there to be coverage in the area in question. However, the mobile operator is unlikely to be able to capture the willingness to pay from these individuals if they are on other networks, and this may result in an inefficiently low level of coverage, as they will not factor these externalities into their investment decisions.

A2.25 For example, consider the case where a mobile operator would need to receive £30 per month to cover the costs of serving an additional household, and the individual living in this location is prepared to pay £25 to have mobile coverage.[110] As a result,

[110] This is a purely hypothetical example – it is highly unlikely that a mobile operator would be able or willing to consider coverage at such a localised level in reality.

the mobile operator will not invest, as the revenue it could receive (£25 per month) is below the cost (equivalent to £30 per month).

A2.26 If the friends and family place a value of £10 per month on this individual receiving coverage, the benefits to society of providing coverage (£35 per month) would outweigh the costs (£30 per month). As such, the failure of the mobile operator to recoup all individuals' willingness to pay for coverage could result in an inefficiently low level of coverage.[111]

Uniform pricing

A2.27 Another potential source of market failure is the practice of uniform pricing.

A2.28 Because mobile phone users generally do not use their mobile phones in a single geographic location, it is difficult for mobile operators to charge different amounts for customers using their mobile phones in different areas. As a result, operators charge uniform prices across the UK – those using their phones in central London pay the same monthly fees and per-minute charges as those using them in rural areas.

A2.29 The revenue a mobile operator can capture from a given customer is therefore bounded by the uniform prices it sets. It is possible that this makes it unprofitable to serve some areas, even when consumers value coverage more than it would cost to provide.

A2.30 For example, a mobile operator may decide that its profit maximising strategy is to set a uniform price for a given bundle of line rental and calls at £25 per month. In a given area, it may cost £30 per month to extend coverage to an additional household, and that household may place a value of £35 per month on receiving coverage. In this example the operator would not able to recoup the full cost of extending coverage by charging the uniform price yet providing coverage in this area would be efficient.

A2.31 It is worth noting that operators make a commercial decision to charge uniform prices across the UK. As such, it is possible that they have concluded that the costs of charging differently based on location exceed the benefits of doing so. Indeed it is possible that total welfare would be lower if operators charged different prices in different areas.

Framework for evaluating the case for intervention

A2.32 Our impact assessment guidelines set out that: "A key principle is that an Impact Assessment should be proportionate to the likely impact of our decision. This means that the more substantial and/or wide-ranging the impact on stakeholders, the more comprehensive the Impact Assessment should be"[112]. The scale of analysis required when assessing the impact of a potential intervention, therefore, depends on the likely impact on the market and the risk of regulatory failure.

[111] In practice, the mobile operator will receive some extra revenue from their customers' friends and family in the form of termination charges. However, if the friends and family place a significant value on being able to contact the individual in question, it is likely that the per-minute termination rates would not allow the mobile operator to capture all of this willingness to pay for coverage, and an inefficiently low level of coverage may result.

[112] Ofcom *Better Policy Making – Ofcom's approach to Impact Assessment* 21 July 2005 http://stakeholders.intra.ofcom.local/binaries/consultations/better-policy-making/Better_Policy_Making.pdf .

A2.33 Where we consider that there is a low probability of an intervention having an adverse effect on the market, it may be proportionate not to undertake a wide-ranging analysis of the costs and benefits.

A2.34 Where we conclude that an in-depth impact assessment is necessary, there are a number of factors that we would need to consider when assessing the impact of a given intervention on the market. As set out at the start of this Annex, total welfare can be separated into a number of broad categories: consumer welfare (both direct and externalities) and producer welfare (both direct and externalities). When considering whether a given intervention is proportionate, we would consider each of these in turn.

Consumer welfare

A2.35 When assessing whether to intervene in the market, we would need to consider the impact on consumers. The intended consequence of an intervention would likely be to increase consumer welfare, as we have a statutory duty to protect the interests of consumers and citizens, so it is important to assess the extent to which any option would achieve this.

A2.36 In order to do this, it is necessary to assess the value that consumers place on the service, and more specifically, the incremental value that they would derive as a result of the intervention under consideration.

A2.37 It is also necessary to consider whether take-up of the service would be affected by the intervention. For example, an intervention to ensure increased mobile coverage would likely lead to increased take-up and/or usage of mobile services, which could be expected to result in a corresponding increase in consumer welfare.

A2.38 It is possible that an intervention could also impact individuals who do not consume the services in question. For example, as discussed above, if coverage levels increase, the friends and family of those living in the areas now covered may also benefit.

A2.39 It can be difficult to quantify the impact that a given intervention would have on consumers, although there are market research techniques that aim to quantify consumers' willingness to pay for a service (and therefore the value they place on it).

Producer welfare

A2.40 Some potential interventions relating to mobile coverage may impose high costs on operators. In such cases, we would likely undertake a cost modelling exercise to understand the scale of the burden that an intervention would have on the operators. The reduction in producer welfare would need to be weighed against the benefits to consumers described above. It is difficult to say what form any cost modelling would take, as this could vary considerably depending on the specific intervention being considered.

A2.41 As with consumer welfare, an intervention could impact producers that do not provide the service in question. We would also take these impacts into consideration where possible.

A2.42 More generally, when considering the impacts on consumers and citizens – especially the less direct impacts, where large numbers of individuals may be

affected in a number of ways – it may be difficult to quantify the magnitude of these impacts with any degree of accuracy. Where it is possible to identify the specific groups impacted by an intervention, it may be possible to undertake market research to understand better individuals' and firms' willingness to pay for increased coverage. Some impacts, however, are likely to be difficult (and potentially not proportionate) to quantify.

A2.43 In cases where large numbers of individuals are affected to a small degree, it becomes more difficult to undertake robust market research to quantify these benefits. It is very difficult to quantify small impacts with any degree of accuracy, so any quantitative result will likely have very wide confidence intervals. In many cases, therefore, it will be more appropriate to assess these impacts qualitatively.

Dynamic effects

A2.44 The categories discussed above all take a static view of welfare: for example, the operators' networks are assumed to be constant (except where the intervention under consideration involves a change in the network itself). It is possible, however, that intervening in markets can affect the future structure of the market in question. For example, some interventions may affect firms' incentives to invest in their network.

A2.45 It is very difficult to quantify the impact of this type of dynamic effect. In line with our bias against intervention, where we believe there is the potential for an intervention to reduce incentives for future investment and/or innovation, we would need robust evidence that there are considerable benefits to consumers to offset the potential negative dynamic impacts.

In summary

9.6 There are a number of factors – both static and dynamic – that would need to be considered when assessing whether it would be appropriate to intervene. Any intervention would likely be aimed at increasing consumer welfare, so it is important to assess the extent to which this would be achieved. Some interventions could also place a cost on operators, and it is important to weigh these costs against the consumer benefits. In some cases, there may also be impacts on individuals and firms that are not consuming or supplying the services, and these should also be taken into consideration. Finally, it is important to recognise that in some cases an intervention could affect the market in a dynamic way. Where we thought this would have an adverse effect, we would need evidence of the consumer benefit before intervening.