



Assessment of future mobile
competition and award of
800 MHz and 2.6 GHz
Statement

Statement

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Section 1

Executive Summary

- 1.1 This Statement sets out our decisions for the Auction of wireless telegraphy licences for the use of 790 to 862 MHz (the 800 MHz band) and 2500 MHz to 2690 MHz (the 2.6 GHz band). The decisions set out in this statement will be given effect to by auction regulations, a draft of which is published with this Statement. In making the decisions in this Statement we have had regard to our statutory duties and the Government's Direction to Ofcom¹ (the Direction).
- 1.2 This Statement follows a number of consultations by Ofcom. We have consulted twice on the Auction: first in March 2011² (the March 2011 consultation) and again in January 2012³ (the January 2012 consultation). We have also consulted specifically on technical licence conditions in June 2011 (the June 2011 TLC consultation) and on the co-existence of the Digital Terrestrial Television (DTT) with mobile use of 800 MHz spectrum, first in June 2011 and again in February 2012.
- 1.3 We received responses to all these consultations from stakeholders expressing a wide range of views on issues on which we consulted, and providing considerable analysis and evidence in that regard. In reaching the decisions set out in this document, we have considered all these stakeholder responses.
- 1.4 The Statement covers:
- i) our assessment of likely future competition in markets for the provision of mobile electronic communication services after the conclusion of the Auction of 800 MHz and 2.6 GHz bands and our analysis of whether we should put in place appropriate and proportionate measures in the Auction to promote competition;
 - ii) our consequent decisions as to rules in the Auction and other aspects of the auction design;
 - iii) the reserve prices that we propose will apply in the Auction;
 - iv) our coverage decisions in relation to measures to promote the widespread availability of next generation mobile broadband services, by which we mean high quality mobile data services, throughout the UK; and
 - v) our decisions on the technical and non technical licence conditions that will be included in the licences to be granted. These include a set of conditions designed to ensure that mobile use of the 800 MHz band can co-exist with neighbouring DTT use.
- 1.5 This document also contains an update on our likely approach to the revision of annual licence fees payable after the Auction in respect of existing 900 MHz and

¹ The Wireless Telegraphy Act 2006 (Directions to OFCOM) Order 2010 (S.I.2010 No. 3024) which can be found at: <http://www.legislation.gov.uk/ukxi/2010/3024/contents/made>

² "Consultation on assessment of future mobile competition and proposals for the auction of 800 MHz and 2.6 GHz spectrum and related issues", dated 22 March 2011.

³ "Second consultation on assessment of future mobile competition and proposals for the auction of 800 MHz and 2.6 GHz spectrum and related issues", dated 12 January 2012.

1800 MHz licences (in respect of which we will not be making any decisions until after the Auction).

- 1.6 We are also publishing an Information Memorandum which provides information for potential bidders in the Auction.

Our Statutory Duties and the Direction

- 1.7 We have taken the decisions outlined in this Statement pursuant to our statutory duties and the Direction.
- 1.8 Our principal duties under the Communications Act 2003 are to further the interests of citizens, and the interests of consumers, where appropriate by promoting competition. In doing so, we are also required (amongst other things) to secure the optimal use of spectrum, as well as to have regard to the desirability of securing the availability and use of high speed data transfer services through the United Kingdom, the desirability of encouraging investment and innovation, and the interests of consumers in respect of choice, price, quality of services and value for money.
- 1.9 The Direction requires us:
- to assess likely future competition in markets for the provision of mobile electronic communication services after the conclusion of the Auction of 800 MHz and 2.6 GHz bands;
 - in the light of that competition assessment, where we think fit, to put in place appropriate and proportionate measures (which may include rules governing the Auction) which will promote competition in those markets after the conclusion of the Auction;
 - to hold an Auction of the 800 MHz and 2.6 GHz bands as soon as reasonably practicable after concluding the competition assessment; and
 - to revise the annual licence fees paid for 900 MHz and 1800 MHz to reflect full market value having particular regard to the sums bid for licences in the 800 MHz and 2.6 GHz Auction.

Promotion of competition in mobile markets following the Auction

Decisions on promotion of competition

- 1.10 In our January 2012 consultation we set out our revised proposals on the measures we should take in the Auction to promote competition. Having considered the responses, we continue to believe that the main level in the value chain at which we should promote competition is the national wholesale level. This is because it supports retail competition both directly, as national wholesalers are also major competitors supplying retail mobile services to consumers and; indirectly, via wholesale access provided to other retailers such as Mobile Virtual Network Operators (MVNOs). As a result, we have decided that:
- UK consumers will be likely to benefit from better services at lower prices in future if following the Auction there continue to be at least four credible national wholesalers of mobile services, Therefore, we would be concerned if as a result

of the Auction fewer operators had access to sufficient spectrum to compete credibly at the wholesale level in the future than is currently the case in the UK;

- it is likely that this would be the case if neither Hutchison 3G UK (H3G) nor a new entrant acquires at least a minimum amount of spectrum in the Auction.⁴ Absent intervention, there is a material risk that neither H3G nor a new entrant would acquire this minimum amount of spectrum in the Auction;
- given the nature and extent of their current spectrum holdings, we do not have the same level of concern in regard to Everything Everywhere, Telefónica or Vodafone, even though they may well be able to offer better or a wider range of services and compete more aggressively if they acquire additional spectrum through the Auction;
- therefore it is in our view appropriate to reserve some of the available spectrum in the Auction for a fourth national wholesaler, by which we mean a bidder other than Everything Everywhere, Telefónica or Vodafone;
- bidders for the reserved spectrum have to compete with each other, but provided that there is at least one such bidder that is willing to pay the reserve price for this spectrum, that bidder is guaranteed to win it. The exact quantities of spectrum that we consider to be proportionate to reserve are set out below;
- because of the level and nature of their current spectrum holdings, and/or the much lower risk that these national wholesalers would fail to acquire further spectrum in the Auction, we do not consider it necessary to reserve any spectrum for Everything Everywhere, Telefónica or Vodafone;
- we also consider that it would be appropriate and proportionate to impose limits on the amounts of spectrum that each bidder can acquire in the Auction, such that their overall holdings of 'mobile spectrum' in general, and sub-1GHz 'mobile spectrum' in particular, do not exceed certain safeguard caps. This is in order to mitigate the risk of highly asymmetric spectrum holdings after the Auction leading to lower competitive intensity.

Specific measures to promote national wholesale competition

1.11 In the January 2012 consultation, we proposed the following safeguard caps:

- an overall spectrum cap of 2 x 105 MHz; and
- a sub-1GHz spectrum cap of 2 x 27.5 MHz.

1.12 In the light of the responses to the January 2012 consultation and our further analysis, we continue to believe that these caps are appropriate and proportionate. We have therefore decided to set the safeguard spectrum caps at these levels.

1.13 These caps cover all the spectrum in the Auction and existing mobile spectrum holdings (i.e. holdings at 900 MHz, 1800 MHz, and 2.1 GHz, excluding the 2.1 GHz unpaired spectrum as there is currently no commercial use of that spectrum in the UK or, as far as we are aware, elsewhere in Europe).

⁴ Unless they acquired sufficient spectrum by other means before the auction.

- 1.14 In the January 2012 consultation we also considered a number of alternatives for the amount and frequencies of spectrum that should be reserved for the fourth national wholesaler. We then set out the specific groups of portfolios that we considered to be proportionate.
- 1.15 Having considered the responses to the January 2012 consultation and undertaken further analysis we have decided that we should make some modifications to these portfolios. The portfolios we have decided to reserve for the fourth national wholesaler are set out in Table 1.1 below.

Table 1.1: Spectrum portfolios for the fourth national wholesaler

Portfolio	800 MHz	1800 MHz	2.6 GHz
1	2 x 15 MHz		
2	2 x 10 MHz		2 x 10 MHz
3	2 x 5 MHz	2 x 15 MHz	
4		2 x 15 MHz	2 x 20 MHz

- 1.16 We consider that any one of these portfolios would be likely to be sufficient for a fourth national wholesaler to be capable of being a credible competitor.
- 1.17 It is important to note that we do not consider the portfolios to have the same value in terms of prices in the Auction. Different values for the portfolios are likely to be expressed in the Auction partly because the costs of deploying networks will be different in each case. Similarly we do not consider the portfolios necessarily imply precisely the same business model by which a national wholesaler could compete. Rather, our position is that if a fourth national wholesaler held any one of these portfolios it would have sufficient spectrum holdings to be capable of being a credible national wholesaler.

Promoting new entry by sub-national operators

- 1.18 In our January 2012 consultation we said that we were minded to favour reservation of 2x10 MHz of 2.6 GHz spectrum for low power shared use by operators of sub-national Radio Access Networks, but we noted that this was a difficult judgement.
- 1.19 In light of the responses to the January 2012 consultation and our further analysis we have decided not to reserve spectrum for such use, because of the relatively certain and significant costs compared to the more uncertain benefits of doing so. While it is possible that entry by sub-national operators could deliver substantial benefits to consumers this remains uncertain. By contrast there seems to be a more certain cost to reserving spectrum which is the cost of denying access to the spectrum for standard power use for increased capacity and higher average data rates and, possibly in some cases, deployment of LTE networks (if other spectrum is unavailable to a particular national wholesaler).
- 1.20 We have therefore decided that those who wish to acquire spectrum for low power use will have to compete against those who wish to use it for standard power use. We are putting in place specific rules in the Auction to allow for this competition to take place through aggregation of the bids made by low power bidders.

Promoting the wide availability of future mobile services for citizens and consumers

- 1.21 In both the March 2011 and January 2012 consultations we recognised that the Auction of 800 MHz and 2.6 GHz spectrum had an important role to play in promoting the wide availability of future mobile services in the UK. We suggested that our proposals to promote competition were likely to drive wide availability but felt that they should be underpinned by a minimum coverage obligation to ensure that a future mobile broadband service would be provided to a significant proportion of citizens and consumers on a reasonable timescale.
- 1.22 In the light of the consultation responses we received and the further analysis we have conducted, we have decided to include a coverage obligation in one of the 800 MHz licences. The obligation will relate to 2 x 10 MHz of spectrum. It will require the licensee to provide a mobile broadband service for indoor reception to users in an area within which 98% of the UK population live⁵. We anticipate that this would be likely to lead to outdoor coverage in an area within which over 99.5% of the UK population live.
- 1.23 In addition to imposing the above requirement in relation to UK-wide coverage, we have also decided to require that the same licensee provide the same service to an area within which at least 95% of the population of each of the nations live. We consider that a network meeting this obligation would be likely to provide outdoor coverage to an area within which 98%-99% of the population of each of the nations live.
- 1.24 Both obligations will need to be met by 31 December 2017. We believe that they will ensure that virtually all consumers and citizens of the UK have some access to next generation mobile broadband services within a relatively quick timeframe, which will create substantial citizen and consumer benefits.
- 1.25 We have decided that it would be proportionate to include these coverage obligations in only one licence. While we recognise there is value to consumers from having a choice of provider we do not regard it as proportionate in this context to bring this about through regulation. We consider it entirely possible that competition amongst providers will mean that operators not subject to the coverage obligation will nevertheless build networks with similar coverage. Further, even if such competition does not develop for some time or completely, we do not consider there is a serious risk that consumers in the areas only served by the holder of the coverage obligation will face unreasonably high prices, given the prevailing practice of national pricing for mobile services.
- 1.26 We have also decided that it would not be proportionate to impose an access obligation on the holder of the coverage obligation, as we believe this could be damaging to the incentives to invest and would be difficult to specify, given the need to identify areas where it applied. It could also lead to a poor consumer experience without tightly specified and potentially costly and complex technical obligations.

⁵ The obligation should enable consumers in the vast majority of homes within the coverage area to receive a 2Mbps indoor service. However, the quality of indoor reception depends significantly on the type of building construction, and in a few cases where buildings are both of a challenging construction type and in particularly hard to reach locations, it may not be possible to receive an indoor service of the specified quality.

Other issues

Spectrum packaging and auction design

- 1.27 This Statement also sets out our decisions on both how the spectrum will be packaged, and the rules of the Auction.
- 1.28 In the January 2012 consultation we set out two options for the lot structure for the 800 MHz band and indicated a preference for the simpler of the two, but noted that its adoption depended upon our decisions regarding DTT co-existence. In light of the decisions set out in this Statement regarding DTT co-existence, we have decided to adopt the simpler lot structure such that there will be two types of lot for spectrum in the 800 MHz band in the Auction; one for the 2 x 10 MHz lot with the coverage obligation and the other for the remainder of the spectrum (in lots of 2x5 MHz).
- 1.29 As regards the 2.6 GHz band we have decided to adopt the approach we set out in the January 2012 consultation for which there was broad support in the responses. Accordingly the paired spectrum will be packaged in 2 x 5 MHz lots and the unpaired spectrum in 5 MHz lots.
- 1.30 In line with our proposals in the March 2011 and January 2012 consultations we have decided to use a combinatorial clock auction to auction the spectrum. In this Statement we set out detailed decisions in relation to the auction rules. In light of consultation responses and our further consideration of the issues, we have made some modifications to the detailed rules set out in the January 2012 consultation, many of which simplify the Auction.

Reserve prices

- 1.31 In this Statement we set out our proposed position on reserve prices. We will make a final decision on reserve prices when we make the auction regulations.
- 1.32 Table 1.2 below sets out our proposals for each type of lot in the Auction.

Table 1.2: Proposed Reserve Prices

Lot Category	A(i)	A(ii)	B	C	D(i)	D(ii)	E
	800 MHz 2x5 MHz	800 MHz 2x10 MHz (with coverage obligation)	1800 MHz 2x15 MHz (Divestment)	2.6 GHz 2x5 MHz (standard power)	2.6 GHz 2x10 MHz (shared low power)	2.6 GHz 2x20 MHz (shared low power)	2.6 GHz 5 MHz (unpaired)
Ofcom's proposal	£225m	£250m	£225m	£15m	£3m per bidder, £30m threshold	£6m per bidder, £60m threshold	£0.1m

- 1.33 In determining these reserve prices we have taken into account a number of risks including (i) the risk that a fourth national wholesaler would not obtain the spectrum when it would be in the interest of consumers that they did so, (ii) the risk that the spectrum is unsold so preventing it from being put to productive use, and (iii) various risks that bidders engage in behaviours that could reduce the efficiency of the Auction e.g. by tacitly colluding or artificially reducing their demand.

- 1.34 We have based our proposed reserve prices on the evidence of prices paid in auctions in other countries for the same or similar spectrum. To assist us in this task we commissioned Dotecon and Aetha to carry out a study to value the spectrum and make recommendations on reserve prices. We are publishing a non-confidential version of their report alongside this Statement.

Licence conditions

- 1.35 The Statement sets out our decisions on the licence conditions that will apply to the use of the 800 MHz and 2.6 GHz spectrum. These decisions take into account the responses we received to our March 2011 consultation and the June 2011 TLC consultation.
- 1.36 We have decided that the licences will be UK-wide and technology and service neutral. All types of spectrum trading will be permitted for individual standard-power licences, subject to a review of the impact of the proposed trade on competition. In the case of concurrent low-power licences at 2.6 GHz (if any), only those types of trades that do not increase the number of licensees in the band will be permitted. The licences will be of indefinite duration, continuing in force until surrendered or revoked. During an initial period of 20 years our powers to revoke a licence will be limited to specific circumstances, and will not include the power to revoke for spectrum management reasons. Thereafter we will be able to revoke a licence for spectrum management reasons on five years' notice.
- 1.37 The technical conditions reflect the European harmonised conditions supplemented by additional provisions to deal with particular interference issues, namely risk of interference to radars operating in the 2.7 GHz band and interim arrangements to manage the risk of interference to DTT use of the 800 MHz band before digital switch over and clearance is completed. There are also conditions to manage the ongoing risk of interference to DTT use in the neighbouring band as explained below.

DTT Co-existence

- 1.38 New mobile services in the 800 MHz band have the potential to cause interference to the reception of existing DTT services in the adjacent band. This issue is not unique to the UK. Other European countries which have DTT services in bands adjacent to the 800 MHz band face the same issue and are adopting a variety of approaches to mitigate the interference risk. For the UK, our technical analysis indicates that up to 2.3m households might be affected. Approximately 900,000 of these households rely solely on DTT for reception of digital television.
- 1.39 On 2 June 2011, we published a consultation setting out our initial proposals for managing coexistence between existing and new services. We noted that some decisions raised questions of public policy that were properly for Government to take rather than Ofcom.
- 1.40 In February 2012, Government took decisions on how coexistence should be managed. These included decisions on the level of support that would be provided to consumers and on the body that would manage this work, referred to here as MitCo. In the same month, we published our second consultation on coexistence setting out proposals for how these decisions should be implemented. We received 30 responses to this consultation. While respondents were generally supportive of the broad approach, a number of respondents thought the level of consumer support should be increased. We also received detailed comments on the proposals for

establishment and governance of MitCo, as well as the framework for managing MitCo's performance.

- 1.41 In July 2012, Government published a document⁶ which confirmed the decisions taken in February and provided further clarifications on areas of detail. Among other things, they have now decided to make an additional provision to assist those households that are likely to find it most difficult to self-install a filter. 800 MHz licensees will be required to set aside £12m of the £180m total allocated for managing coexistence to provide installation support for these households. Additionally, Government has further decided that any under spend of the £180m should be returned in full to the 800 MHz licensees, rather than being split equally between licensees and Government.
- 1.42 Taking into account responses and further discussions with stakeholders and the Government, we have now made decisions on the framework that will be used for implementing Government decisions. This includes the final set of key performance indicators (KPIs) and associated conditions that will be used to manage MitCo's performance. These are set out in the licences that will be issued following the Auction.

Annual licence fees for 900 MHz and 1800 MHz spectrum

- 1.43 The Direction requires us to revise the level of annual licence fees for 900 MHz and 1800 MHz spectrum after the Auction to reflect full market value, having particular regard to the sums bid for licences in the Auction for the 800 MHz and 2.6 GHz bands.
- 1.44 We will consult on our approach to implementing this aspect of the Direction after the Auction and make decisions following that consultation. However, we believe that stakeholders are likely to find some discussion of possible approaches ahead of the Auction helpful. Therefore we provide an update on our thinking on the matter in this Statement.

Next steps

- 1.45 Alongside this policy Statement we are publishing a draft of the auction regulations that give effect to our decisions and which Ofcom must make in order to hold the Auction. We are also publishing an Information Memorandum and the draft licences which will be granted following the Auction. We intend to update both the Information Memorandum, and, as appropriate, the draft licences, before the Auction commences, in order to ensure that potential bidders have the most up to date information available to them at that time. We will also consult on and make further statutory instruments amending (i) the mobile spectrum trading regulations, (ii) the limitations order, and (iii) the register regulations, to give effect to the decisions in this Statement in advance of the Auction.
- 1.46 The consultation on the draft auction regulations will close on 11 September 2012. Following consideration of the responses we plan to make the regulations in the Autumn. We expect to invite applications to take part in the Auction before the end of 2012.

⁶ <http://www.culture.gov.uk/images/publications/letter-dcms-ofcom-10072012.pdf>

Section 2

Introduction

- 2.1 This Statement sets out our decisions for the award of wireless telegraphy licences for the use of 790 to 862 MHz (the “800 MHz band”) and 2500 MHz to 2690 MHz (the “2.6 GHz band”) (the “Auction”). This Statement follows on from our consultations on the Auction of March 2011⁷ (the “March 2011 consultation”) and January 2012⁸ (the “January 2012 consultation”).
- 2.2 The decisions set out in this Statement directly concern our functions under the legal framework to manage the radio spectrum in the UK⁹, including allocating and authorising spectrum (which may be implemented, among others, by way of auction).
- 2.3 In reaching the conclusions set out in this Statement, we have acted in accordance with our statutory duties, including our principal duty to further the interests of citizens in relation to communications matters and of consumers in relevant markets, where appropriate by promoting competition.

Ofcom proposals for the Auction

- 2.4 On 23 March 2011 we published a consultation setting out proposals for the Auction. Having modified our proposals in light of consultation responses, on 12 January 2012 we published a second consultation setting out our revised thinking.
- 2.5 The decisions in this Statement follow on from the proposals set out in these consultations, taking into account stakeholder responses. The document also contains information on the following topics:
- 2.5.1 the decisions we have taken in relation to the technical licence conditions which will form part of the licences to be auctioned as part of the combined award (these decisions follow on from the proposals set out in our 2 June 2011 consultation on technical licence conditions, taking into account stakeholder responses);
 - 2.5.2 the decisions we have taken in relation to how coexistence between new mobile services in the 800 MHz band and existing DTT in the adjacent band will be managed (these decisions follow on from the proposals set out in our 23 February 2012 consultation on this topic, taking into account stakeholder responses); and
 - 2.5.3 an update on our provisional thinking to date on the revision of annual licence fees payable after the Auction in respect of existing 900 MHz and 1800 MHz licences.

⁷ “Consultation on assessment of future mobile competition and proposals for the award of 800 MHz and 2.6 GHz spectrum and related issues”, dated 22 March 2011.

⁸ “Second consultation on assessment of future mobile competition and proposals for the award of 800 MHz and 2.6 GHz spectrum and related issues”, dated 12 January 2012.

⁹ Except in respect of some bands where the Ministry of Defence is the spectrum manager.

Impact assessment

- 2.6 This Statement, together with its annexes, as a whole comprises an impact assessment, as defined in section 7 of the Communications Act 2003. A summary of the impact assessment is set out in Annex 1.
- 2.7 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy-making. This is reflected in section 7 of the Communications Act 2003, which means that generally Ofcom has to carry out impact assessments where its proposals would be likely to have a significant effect on businesses or the general public, or when there is a major change in Ofcom's activities. However, as a matter of policy Ofcom is committed to carrying out and publishing impact assessments in relation to the great majority of its policy decisions. For further information, see our guidelines, 'Better policy-making: Ofcom's approach to impact assessment'.

Equality Impact Assessment

- 2.8 Ofcom is separately required by statute to assess the potential impact of all our functions, policies, projects and practices on race, disability and gender equality. Equality Impact Assessments (EIAs) also assist us in making sure that we are meeting our principal duty of furthering the interests of citizens and consumers regardless of their background or identity. Unless we otherwise state in this Statement, it is not apparent to us that the outcome of our decisions is likely to have any particular impact on race, disability or gender equality. Specifically, we do not envisage the impact of any outcome to be to the detriment of any group of society.
- 2.9 Nor have we seen the need to carry out separate EIAs in relation to race or gender equality or equality schemes under the Northern Ireland and Disability Equality Schemes. This is because we anticipate that our regulatory intervention will affect all industry stakeholders equally and will not have a differential impact in relation to people of different gender or ethnicity, on consumers in Northern Ireland or on disabled consumers compared to consumers in general. Similarly, we are not envisaging making a distinction between consumers in different parts of the UK or between consumers on low incomes. Again, we believe that our intervention will not have a particular effect on one group of consumers over another.

Structure of this document

- 2.10 The rest of this document is structured as follows:
- 2.10.1 In section 3 we set out the background to the 800MHz and 2.6GHz spectrum and the legal framework pursuant to which we are taking the decisions set out in this Statement.
 - 2.10.2 In section 4 we explain our assessment of future competition in mobile markets and our decisions for measures to promote competition in those markets after the conclusion of the Auction.
 - 2.10.3 In section 5 we explain the decisions we have made in relation to coverage obligations in 800 MHz licences.
 - 2.10.4 In section 6 we set out the decisions we have taken in relation to spectrum packaging.

- 2.10.5 In section 7 we explain the decisions we have taken in relation to the detailed auction rules.
 - 2.10.6 In section 8 we explain our proposed position in relation to reserve prices.
 - 2.10.7 In section 9 we set out the non-technical licence conditions which will form part of the licences to be auctioned.
 - 2.10.8 In section 10 we explain the decisions we have taken in relation to the technical licence conditions which will form part of the licences to be auctioned.
 - 2.10.9 In section 11 we explain the decisions we have taken to manage the risk of interference into Digital Terrestrial Television in the neighbouring band.
 - 2.10.10 In section 12 we provide an update on our provisional thinking to date on how we will set the revised annual licence fees for 900 MHz and 1800 MHz spectrum after the Auction.
- 2.11 This document should be read together with the annexes that provide supplementary information and supporting analysis on a number of issues.

Section 3

Background and legal framework

Introduction

- 3.1 In this section we set out:
 - 3.1.1 the background to the 800MHz and 2.6GHz spectrum; and
 - 3.1.2 the legal framework pursuant to which we are taking the decisions set out in this Statement.

Background

Radio Spectrum

- 3.2 The radio spectrum comprises one part of the wider electro-magnetic spectrum, which includes all forms of electro-magnetic waves (such as visible light, infrared and X-rays). The significance of the radio spectrum is that it includes waves that can travel over significant distances, and in some cases through objects such as walls and over hills. Radio waves can be modified by human action so that they can carry information. This allows human beings to communicate with each other reliably without the need for wires.
- 3.3 Radio waves are defined by their frequency, which is the number of times that the wave oscillates per second. The unit of frequency is a “Hertz” (Hz), which is one oscillation per second. A thousand oscillations per second is referred to as a kiloHertz (kHz), a million as a MegaHertz (MHz), and a thousand million as a GigaHertz (GHz). Other types of electro-magnetic wave, such as light, have frequencies that are many orders of magnitude higher than radio. A group of radio frequencies that is contiguous is often referred to as a spectrum or frequency “band”.
- 3.4 Radio spectrum is a finite resource. Its importance for numerous services and applications means that it is also a very valuable resource, whose use creates significant benefits for the UK’s citizens and consumers.
- 3.5 Within the radio spectrum, different frequencies have different physical properties:
 - 3.5.1 Broadly speaking, at lower frequencies, signals travel further and are generally better at going round hills and at penetrating objects such as buildings. This is referred to as having better “propagation”. But the capacity (also known as “bandwidth”) available at these frequencies to carry information is limited.
 - 3.5.2 At higher frequencies, signals may only travel a short distance from a transmitter and may not be able to penetrate obstacles such as buildings, trees or even in some cases rain. But there is very high capacity available to carry information.
- 3.6 The most valuable radio frequencies are generally regarded as those above 200 MHz and those below 3GHz. This range includes the 800MHz and the 2.6GHz bands. These frequencies are more valuable than others because they offer both good propagation characteristics and enough bandwidth to make them useful for

sending large quantities of information. Many of the most valuable uses of radio spectrum are located in this range (including mobile communications and terrestrial television broadcasting).

- 3.7 Frequencies above 200MHz and below 1GHz are still more valuable than the generality of frequencies up to 3GHz. This is because for many purposes these frequencies have the best possible physical properties. In particular, the lower frequency means that, for any given number of transmitters, it is possible to provide a service over a larger area, because the signals travel further and penetrate better. It is therefore usually possible to deploy services more cheaply and more quickly at these frequencies.

Consumer demand for data services

- 3.8 The radio spectrum is subject to a variety of uses including broadcasting, navigation and wireless communications, including mobile communication services. This Statement concerns the auction of spectrum for mobile communication services, and in particular mobile data services.
- 3.9 There has been an explosion in the use of mobile data services in the last couple of years, both through the take-up of dongles connecting PC/laptops to the internet and through the increasing use of data services on mobile handsets.¹⁰ This rapid growth in data services is expected to continue in at least the short term.¹¹
- 3.10 The Government has recognised the importance of data services, including mobile broadband and has set out an ambition to provide superfast broadband to at least 90 per cent of premises in the UK and to provide universal access to standard broadband with a speed of at least 2Mbps¹².
- 3.11 As we noted in the March 2011 consultation and the January 2012 consultation, the Auction will result in a significant increase in the supply of spectrum available for mobile communication services. Given this, and set against the increasing demand for mobile data, we anticipate that the auctioned spectrum will be used for LTE (4G) which is specifically designed to provide high speed mobile data services.

Licensing position in other spectrum bands that are currently used for national mobile communications

- 3.12 Wireless mobile communications are one of the services that are provided using radio spectrum. The bands licensed for public wireless communications services are used to provide voice and data services using both GSM (2G) and UMTS (3G) technology.
- 3.13 The UK has three bands allocated for 2G and/or 3G mobile services:
- 3.13.1 880 to 915 MHz paired with 925 to 960 MHz (the “900 MHz band”);

¹⁰ In our Communications Market Report: UK of 4 August 2011, we estimate that data volume increased by a factor of 38 in the three years to the end of 2010.

¹¹ For further discussion see: <http://stakeholders.ofcom.org.uk/market-data-research/other/technology-research/2011/4G-Capacity-Gains/>

¹² As part of this, in addition to the substantial funds that the Government is investing to support the provision of fixed broadband services, the Government has also announced that it will invest up to £150 million to improve mobile coverage in the UK for the five to ten per cent of consumers and businesses that live and work in areas where coverage is poor or non-existent. See http://www.culture.gov.uk/what_we_do/telecommunications_and_online/7763.aspx

- 3.13.2 1710 to 1785 MHz paired with 1805 to 1880 MHz (the “1800 MHz band”); and
- 3.13.3 1890 to 1980 MHz paired with 2110 to 2170 MHz (the “2.1 GHz band”).
- 3.14 The 900 MHz and 1800 MHz bands were originally licensed for 2G services only and the 2.1 GHz band for 3G services only. The 900 MHz and 1800 MHz bands are now licensed for both 2G and 3G services. The 2.1 GHz band is still licensed only for 3G services.
- 3.15 Three operators hold licences for the 900 MHz and 1800 MHz bands – Everything Everywhere, Telefónica and Vodafone. Everything Everywhere has spectrum only in the 1800 MHz band (2 x 60 MHz) whereas Telefónica and Vodafone have spectrum predominately in the 900 MHz band but also have a small assignment of 2 x 5.8 MHz each in the 1800 MHz band.
- 3.16 The same three operators plus Hutchison 3G (H3G) hold licences for the 2.1 GHz band. All four operators have duplex FDD assignments. In addition Everything Everywhere, Telefónica and H3G have TDD assignments, though to date they have not used them. Table 4.1 below shows the frequency assignments of each operator.

Table 4.1: Licensing position in the 900 MHz, 1800 MHz and 2.1 GHz bands

	Everything Everywhere (T-Mobile and Orange)	Telefónica	Vodafone	H3G	Total
900 MHz Paired	-	2x17.4	2x17.4	-	69.6
1800 MHz Paired	2x60*	2x5.8	2x5.8	-	143.2
2.1 GHz Paired	2x20	2x10	2x15	2x15	120.0
2.1 GHz Unpaired	1x10	1x5	-	1x5	20.0
Total	170	71.4	76.4	35	352.8

*Note that this includes 2x15 MHz of 1800MHz spectrum that Everything Everywhere is required to divest (either by way of private sale or in the Auction) under the commitments given to the European Commission as part of the merger control review at the time of the creation of Everything Everywhere.

The spectrum to be auctioned

800 MHz band

- 3.17 The 800 MHz band forms part of the UK’s digital dividend, which is the spectrum freed up for new uses by the switchover of terrestrial television transmissions from analogue to digital. The band, together with the so-called 600 MHz band, is that part of the digital dividend to be cleared of television use. This so-called ‘cleared spectrum’, under the original plan for the digital dividend awards, comprised two bands - 550 to 630 MHz and 806 to 854 MHz, and in June 2008 we published a consultation on the detailed design for these bands. That consultation raised a number of complex issues, particularly on technical licence conditions, spectrum packaging and auction design, and we anticipated a further consultation later in 2008. At that time we expected the Auction to begin in summer 2009.
- 3.18 During this process it became increasingly clear that a critical mass of European countries were also creating a digital dividend, but with a single larger upper band of cleared spectrum than we had been planning. This extended band comprised 72

MHz at 790 to 862 MHz. On 2 February 2009 we published a consultation¹³ that considered the costs and benefits for the UK of aligning the upper band of our digital dividend with that of other European countries. We expected very substantial net benefits to UK citizens and consumers from making this change. However, making the change had important implications, in particular from the need to clear planned DTT and PMSE use from channels 61 to 62 and channel 69 respectively (i.e. the channels at the bottom and top of the 800 MHz band). We considered the cost of clearing these channels would be modest compared to the expected benefits and proposed to proceed with their clearance.

- 3.19 The responses to the consultation broadly supported or accepted the proposal and in June 2009 we published a statement¹⁴ setting out our decision to clear channels 61, 62 and 69 and to award the 800 MHz band separately from the lower band of cleared spectrum. In looking at the next steps, we said we would need to consider the timetable for the Government's Digital Britain process (see paragraph 3.24) and expected to be in a position in late autumn 2009 to set out how we proposed to proceed with the award of the 800 MHz band.
- 3.20 All relevant documents on the previously proposed award of the 800 MHz band can be found at <http://stakeholders.ofcom.org.uk/spectrum/project-pages/ddr/>.

2.6 GHz band

- 3.21 In January 2005 we set out our proposal to award the 2.6 GHz band in the Spectrum Framework Review: Implementation Plan.¹⁵ In 2006 we started detailed work on the award of the band, inviting stakeholders to submit evidence and views in preparation for the publication of detailed consultation proposals. We developed and refined our proposals on the award - in terms of our general approach, the technical and non-technical licence conditions and the auction rules - through three consultations (in December 2006, August 2007 and December 2007) and a series of seminars and meetings with interested parties. At that time there were continuing discussions at a European level on possible harmonisation measures and we intended to prepare detailed proposals for the award of the band when the European discussions had been concluded.
- 3.22 This work culminated with the publication of a statement¹⁶ on 4 April 2008 that set out our decisions on the award of both the 2.6 GHz band and the 2010 to 2025 MHz band and explained the way in which the award would be structured and the conditions that would be attached to the licences. We expected the application date for the award to be in July or August 2008. Two operators, T-Mobile (now part of Everything Everywhere) and O2 (now Telefónica) appealed our decisions. In hearing these appeals, a preliminary point arose on jurisdiction. Shortly after this point had been determined (by the Court of Appeal¹⁷), Ofcom withdrew its decision to hold the award at that time in light of publication of the Government's Digital Britain report which changed the underlying position.
- 3.23 All relevant documents on the previously proposed award of the 2.6 GHz band can be found at http://stakeholders.ofcom.org.uk/spectrum/spectrum-awards/awards-in-preparation/award_2010/.

¹³ <http://stakeholders.ofcom.org.uk/binaries/consultations/800mhz/summary/800mhz.pdf>

¹⁴ <http://stakeholders.ofcom.org.uk/consultations/800mhz/statement/>

¹⁵ <http://stakeholders.ofcom.org.uk/consultations/sfrfp/>

¹⁶ <http://stakeholders.ofcom.org.uk/binaries/consultations/2ghzrules/statement/statement.pdf>

¹⁷ *Telefónica O2 UK Limited and T-Mobile (UK) Limited v Office of Communication* [2008] EWCA Civ 1373

Government direction to Ofcom

- 3.24 In January 2009 the Government published its interim Digital Britain report¹⁸ setting out a series of actions designed to maximise the opportunities for the UK in the digital age. It identified a complex set of challenges that it considered were hindering the release of spectrum for next generation broadband services and appointed an independent spectrum broker (“ISB”) to examine possible solutions to these challenges. The ISB’s report was published in May 2009 and in the Government’s final Digital Britain report¹⁹ it indicated it was minded to implement the ISB’s proposals, subject to further work designed to address a number of issues. One of the proposals was that Ofcom should conduct a combined auction of 800 MHz and 2.6 GHz spectrum. The ISB also proposed that the 2G and 3G licences should be liberalised in the hands of existing licensees.
- 3.25 The Government noted that there was an option to direct Ofcom to implement any decision to take forward the proposals and that it would be obliged to consult on any such direction. Following the ISB’s final report it decided to proceed in this way.
- 3.26 On 16 October 2009 it published its consultation²⁰ on a direction to Ofcom to Implement the Wireless Radio Spectrum Modernisation Programme. This consultation proposed that a combined auction for 2.6 GHz and 800 MHz be conducted without delay after the direction was in place. In March 2010, the Government published its response to the consultation²¹ and subsequently laid a draft statutory instrument before Parliament in March 2010 directing Ofcom to undertake a number of measures including the auctioning of 2.6 GHz and 800 MHz. The direction was however not considered by Parliament prior to the General Election.
- 3.27 Following the General Election the coalition Government decided to make a revised direction comprising a sub-set of the proposals set out in the previous draft. A revised draft direction was laid before Parliament in July 2010. The Wireless Telegraphy Act 2006 (Directions to OFCOM) Order 2010 (the “Direction”) was made on 20 December 2010 and came into force ten days after being made (see paragraph 3.46 below).

Legal framework

- 3.28 The legal framework for the Auction derives from our duties under both European and domestic legislation, specifically from:
- 3.28.1 the Common Regulatory Framework²² for electronic communications networks and services, in particular, the Framework Directive and the Authorisation Directive;

¹⁸

http://webarchive.nationalarchives.gov.uk/20100511084737/http://www.culture.gov.uk/what_we_do/broadcasting/5944.aspx

¹⁹ <http://www.bis.gov.uk/assets/biscore/corporate/docs/d/digital-britain-final-report.pdf>

²⁰ <http://www.bis.gov.uk/consultations/ofcom-wireless-modernisation-programme>

²¹ <http://www.bis.gov.uk/assets/biscore/business-sectors/docs/10-737-government-response-consultation-ofcom-implement-spectrum-modernisation>

²² The Common Regulatory Framework comprises the Framework Directive (Directive 2002/21/EC), the Authorisation Directive (Directive 2002/20/EC), the Access Directive (Directive 2002/19/EC), the Universal Service Directive (Directive 2002/22/EC) and the Directive on privacy and electronic

- 3.28.2 the Communications Act 2003 (the “Communications Act”) and the Wireless Telegraphy Act 2006 (the “Wireless Telegraphy Act”) which transpose the provisions of those directives into national law; and
- 3.28.3 the Wireless Telegraphy Act 2006 (Directions to Ofcom) Order 2010 (the “Direction”).

European Regulatory Framework

- 3.29 Article 8 of the Framework Directive sets out the objectives which national regulatory authorities must take all reasonable steps to achieve. These include:
 - 3.29.1 the promotion of competition in the provision of electronic communications networks and services by, amongst other things ensuring there is no distortion or restriction of competition in the electronic communications sector and encouraging efficient use of radio frequencies; and
 - 3.29.2 contributing to the development of the internal market by, amongst other things, removing obstacles to the provision of electronic communications networks and services at a European level, encouraging the interoperability of pan-European services.
- 3.30 In pursuit of these policy objectives, Article 8 requires national regulatory authorities to apply objective, transparent, non-discriminatory and proportionate regulatory principles by, among others:
 - 3.30.1 ensuring that, in similar circumstances, there is no discrimination in the treatment of undertakings providing electronic communications networks and services; and
 - 3.30.2 promoting efficient investment and innovation in new and enhanced infrastructures.
- 3.31 Article 8 also requires Member States to ensure that in carrying out their regulatory tasks, national regulatory authorities take the utmost account of the desirability of making regulations technologically neutral.
- 3.32 Article 9 of the Framework Directive requires Member States to ensure the effective management of radio frequencies for electronic communications services in accordance with Article 8, and to ensure that spectrum allocation used for electronic communication services and issuing general authorisations or individual rights of use of such radio frequencies are based on objective, transparent, non-discriminatory and proportionate criteria. Article 9 also requires Member States to promote the harmonisation of use of radio frequencies across the Community, consistent with the need to ensure effective and efficient use of frequencies. It further requires Member States to ensure technology and service neutrality.
- 3.33 Article 5 of the Authorisation Directive provides that where it is necessary to grant individual rights of use of radio frequencies, Member States must grant such rights through open, objective, transparent, non-discriminatory and proportionate procedures, and in accordance with the provisions of Article 9 of the Framework

communications (Directive 2002/58/EC), as amended by the Better Regulation Directive (Directive 2009/140/EC).

Directive. When granting those rights, Member States are required to specify whether they can be transferred by the holder, and if so, under which conditions.

- 3.34 Article 7 of the Authorisation Directive provides that where Member States decide to limit the number of rights of use to be granted for radio frequencies, they must, among others, give due weight to the need to maximise benefits for users and to facilitate the development of competition.
- 3.35 The legal duties imposed on the UK by the Framework and Authorisation Directives are transposed into UK law and given effect to by the Communications Act and the Wireless Telegraphy Act (see below).

Commission decisions on 800 MHz and 2.6 GHz spectrum

- 3.36 In 2008, the European Commission adopted the text of a decision that aims to harmonise the technical conditions for the availability and efficient use of the 2.6 GHz band. This was followed in 2010 by the adoption of an equivalent decision in respect of the 800 MHz band. These decisions are binding on Member States and require the bands to be made available on a non-exclusive basis for terrestrial systems capable of providing electronic communications services, subject to a number of specified technical parameters relating to harmful interference.
- 3.37 We note also that subsequent to the January 2012 consultation, on 15 February 2012, the European Parliament and the Council adopted a Decision implementing the first Radio Spectrum Policy Programme²³. In particular, this requires that by 1 January 2013 Member States shall carry out the authorisation process in order to allow the use of the 800 MHz band for electronic communications services. It further requires in relation to, among others, the 2.6GHz band, that subject to market demand, Member States shall carry out the authorisation process by 31 December 2012 without prejudice to the existing deployment of services, and under conditions that allow consumers easy access to wireless broadband services.

The duties imposed by the Communications Act

- 3.38 Section 3 of the Communications Act sets out Ofcom's general duties including its principal duty:
- 3.38.1 to further the interests of citizens in relation to communications matters;
and
- 3.38.2 to further the interests of consumers in relevant markets, where appropriate by promoting competition.
- 3.39 In carrying out its functions, section 3(2) provides that Ofcom is required, amongst other things, to secure the optimal use for wireless telegraphy of the electro-magnetic spectrum, the availability throughout the UK of a wide range of electronic communication services and the availability throughout the UK of a wide range of television and radio services.
- 3.40 Section 3(3) of the Communications Act provides that in performing its duties, Ofcom must in all cases have regard to the principles of transparency, accountability, proportionality and consistency, as well as ensuring that its actions are targeted only at cases in which action is needed.

²³<http://register.consilium.europa.eu/pdf/en/11/st16/st16226.en11.pdf>

- 3.41 Section 3(4) of the Communications Act requires Ofcom in performing its duties, to have regard to a number of factors as appropriate, including the desirability of promoting competition, encouraging investment and innovation in relevant markets, encouraging the availability and use of high speed data transfer services throughout the UK, the different interests of persons living in rural and in urban areas and the different needs and interests of everyone who may wish to use the spectrum for wireless telegraphy.
- 3.42 In performing our duty under section 3 of furthering the interests of consumers, we must have regard, in particular, to the interests of those consumers in respect of choice, price, quality of service and value for money.
- 3.43 Section 4 of the Communications Act requires Ofcom to act in accordance with the six Community requirements, which give effect to the requirements of Article 8 of the Framework Directive.

The duties imposed by the Wireless Telegraphy Act

- 3.44 Section 3 of the Wireless Telegraphy Act imposes a number of further duties relating to spectrum management. Amongst other things, in carrying out its spectrum functions Ofcom is required to have regard to the extent to which spectrum is available for use, and the demand, both current and future, for the use of spectrum.
- 3.45 Section 3 of the Wireless Telegraphy Act also requires Ofcom to have regard to the desirability of promoting the development of innovative services and competition in the provision of electronic communications services.

The Wireless Telegraphy Act 2006 (Directions to OFCOM) Order 2010 (the Direction)

- 3.46 On 20 December 2010, the Secretary of State made a Direction pursuant to section 5 of the Wireless Telegraphy Act. The Direction requires Ofcom to:
- 3.46.1 as soon as reasonably practicable, assess likely future competition in markets for the provision of mobile electronic communications services. That competition assessment must be in respect of the future competitiveness of those markets after the conclusion of the Auction, taking into account the possible effects of the Auction, and including consideration of the potential for new entry in those markets;
 - 3.46.2 in light of that competition assessment we must, where we think fit, put in place appropriate and proportionate measures (which may include rules governing the Auction) which will promote competition in those markets after conclusion of the Auction;
 - 3.46.3 as soon as reasonably practicable after concluding our competition assessment, exercise our powers to make regulations to provide for an auction of licences to take place for use of frequencies in the 800MHz and 2.6GHz bands and any other frequency bands we think fit; and
 - 3.46.4 after completion of the Auction, revise the 900MHz and 1800MHz licence fees so that they reflect the full market value of the frequencies in those bands. In revising these, we are required to have particular regard to the sums bid for licences in the Auction.

Application of our duties to the Auction

- 3.47 Taking into account each of the above duties and the relevant facts and circumstances, we consider that our principal duty to further the interests of citizens, and the interests of consumers where appropriate by promoting competition, is of particular importance to the Auction.
- 3.48 We also consider that our duties relating to
- 3.48.1 the optimal use for wireless telegraphy of the electro-magnetic spectrum;
 - 3.48.2 the desirability of encouraging investment and innovation;
 - 3.48.3 the desirability of encouraging the availability and use of high speed data transfer services throughout the United Kingdom; and
 - 3.48.4 having regard to the interests of consumers in respect of choice, price, quality of service and value for money;
- are particularly relevant.
- 3.49 In carrying out our competition assessment, in particular, we have taken account of the need for our proposals to be objectively justifiable, not unduly discriminatory, transparent, and proportionate. As we set out in this document, there are uncertainties surrounding a number of key factors which are relevant to our competition assessment. In light of those uncertainties, we have sought to explain why we consider that the decisions that we make are appropriate in light of our aims and duties, and comprise the least restrictive measures which we consider are reasonably capable of meeting the aims that we have identified as being of most importance.
- 3.50 Further specific duties are relevant to individual elements of the Auction, and we address them at the relevant sections of this document as they arise.

Section 4

Competition assessment of future mobile markets

Introduction

- 4.1 As set out in Section 3, there has been a substantial increase in the use of mobile data services in the last couple of years, which is expected to continue. The Government has recognised the importance of data services, including mobile broadband and issued the Direction to Ofcom for the purposes of ensuring the release of additional spectrum for use by providers of next generation wireless mobile broadband, allowing early deployment and maximising the coverage of those services and creating greater investment certainty for operators.
- 4.2 Our primary duty under section 3 of the Communications Act 2003, which implements Article 8 of the Framework Directive, is to further the interests of citizens in relation to communications matters, and the interests of consumers in relevant markets, where appropriate by promoting competition.
- 4.3 The Direction requires us to assess likely future competition in markets for the provision of mobile electronic communications services. This assessment must be in respect of the future competitiveness of those markets after the conclusion of this award, taking into account possible effects of this award. Our assessment must also include consideration of the potential for new entry into those markets.
- 4.4 In light of our assessment, the Direction requires us, where we think fit, to put in place appropriate and proportionate measures, which may include rules governing the award, which will promote competition in those markets after the conclusion of the award.

Competition assessment: future national wholesale competition

Terminology

- 4.5 As set out in the March 2011 consultation and in the January 2012 consultation, we distinguish between three types of competitor who provide mobile services and use the following terminology to describe those types of competitor:²⁴
- national wholesaler;
 - sub-national radio access network (“RAN”) operator; and
 - other retailers.
- 4.6 We envisage that all three of these types of competitor will operate in the retail market in the future, as occurs today.

²⁴ For more explanation of this terminology see paragraphs 2.1 to 2.4 in Annex 6 of the March 2011 consultation and 2.14 to 2.17 in Annex 6 of the January 2012 consultation.

- 4.7 We use the term “national wholesaler” in this section to refer to companies that control wholesale access to national RANs.²⁵ We use this term rather than the more widely used “Mobile Network Operator” (MNO), since owners of sub-national RANs are also network operators, albeit on much smaller scale. Additionally, national wholesalers could share or contract for access to national RANs and still be in a position of controlling wholesale access but not operating the network.
- 4.8 National wholesalers supply access to their RANs to their own downstream retail operations and a variety of other downstream retail operations, including “mobile virtual network operators” (MVNOs), and operators of smaller sub-national RANs. National wholesalers include, in this context, parties who are already actively supplying third parties in a wholesale market, and also those who could do so but do not and only supply to their own retail operation. It also includes those who engage in RAN sharing but maintain independence as a wholesaler on a national basis. On the basis of the above characterisation, there are currently four national wholesalers in the UK: Everything Everywhere, H3G, Telefónica and Vodafone.
- 4.9 In our competition assessment we use the term “fourth national wholesaler” to refer to an existing or potential new national wholesaler other than the three current largest wholesalers i.e. Everything Everywhere, Telefónica or Vodafone.
- 4.10 We use the term “sub-national RAN operators” to refer to operators who own RANs but who are not national wholesalers in that they operate only in a limited part of the UK. In particular in this section we identify potential competitors of this type who have access to certain sites (typically indoors) and operate some low-power radio access equipment.
- 4.11 We use the term “other retailers” to refer to any competitor who provides mobile services to consumers but is not a national wholesaler or a sub-national RAN operator. The main category of such competitors is MVNOs. These retailers compete by buying network services from a national wholesaler, so that the national wholesaler agrees to supply the mobile services used by the retailer’s customers. The retailer may manage other functions itself (including signing up customers, billing and so on) or buy these services on a wholesale basis.

Policy aim

- 4.12 In light of our primary duty and the requirements of the Direction, one of our aims in this award is to promote competition in future mobile markets to the benefit of consumers. We have decided that this should be done largely by promoting competition at the national wholesale level. This underpins the promotion of competition at the retail level because effective retail competition depends on retailers either being national wholesalers (i.e. vertically integrated), or relying on access provided by national wholesalers.
- 4.13 In markets without competition at the wholesale level (in some fixed telecoms markets, for example), regulation has had to be used to mimic this competitive pressure (which can produce outcomes that are better than no regulation at all, but not necessarily as good as competition in terms of furthering consumers’ interests). Accordingly, we believe that promoting competition at the national wholesale level is key to achieving our policy aim, as this should promote competition at the retail level without the need for regulated access.

²⁵ In practice this means RANs that provide coverage to a significant portion of the UK – see also paragraph 4.78 in the January 2012 consultation.

- 4.14 We consider that the mobile markets in the UK are serving UK citizens and consumers well and in our view, competition between national wholesalers is driving this success²⁶. The past decade has seen competition at the wholesale level in mobile markets in the UK between five national wholesalers, reducing to four current national wholesalers following the joint venture between Orange and T-Mobile creating Everything Everywhere. We consider that each of these four national wholesalers today exerts a strong competitive force on the others.²⁷
- 4.15 Access to spectrum is a key input to the provision of mobile services. As set out in Section 3, spectrum is a finite resource, particularly at frequencies most suited to the efficient provision of mobile services. As such, access to suitable spectrum can have a significant impact on the nature of competition in the market, and the services that can be offered.
- 4.16 This Auction will make available a large amount of spectrum suitable for the provision of mobile services. Given the scarcity of this type of spectrum, it is likely to be particularly important for future competition in mobile markets, and the extent to which individual national wholesalers are able to compete credibly with each other.
- 4.17 The present market is already highly concentrated according to standard classifications, and a consolidation from four national wholesalers to three would represent a significant increase in concentration.²⁸ Further, there are high barriers to entry in national wholesale mobile services, including infrastructure costs and the limited availability of spectrum.²⁹
- 4.18 We recognise that the intensity of competition overall will depend on a range of factors including the relative strength of national wholesaler competitors and barriers to entry, and not simply on the number of competitors. However we consider that in such a concentrated market with high barriers to entry the presence of more rather than fewer competitors will tend to promote competition.
- 4.19 When consumers have a greater choice between independent providers of a service, providers will typically have to work harder to win and retain customers. This process of rivalry can constrain firms from increasing prices or lowering quality, give them sharper incentives to invest and innovate, and make it more difficult to coordinate their prices and services so as to avoid competition.³⁰

²⁶ See for example paragraphs 2.44 to 2.56 of Annex 6 to the January 2012 consultation.

²⁷ See paragraphs 2.57 to 2.59 of Annex 6 to the January 2012 consultation.

²⁸ The Hershman-Herfindahl index (HHI), a measure of market concentration, is calculated by adding together the squared values of the percentage market shares of all firms in the market (in this case we have used the shares of mobile subscribers). A value of the HHI above 2,000 is taken to be highly concentrated – see OFT / CC Merger Assessment Guidelines. In this case, the HHI is well above 2,000. A consolidation from four to three, e.g. from the exit of the smallest player (H3G), would increase the HHI by around 410 points, well above 150 points which is the threshold for potential competition concern in merger control in highly concentrated markets (this calculation is based on subscription numbers reported in Figure 5.4 of our January 2012 consultation; in paragraph 2.62(a) of that consultation we reported an increase of 450 which was based on different estimates of subscriber numbers by IDATE).

²⁹ As we recognise in Annex 2, the release of spectrum in the 700 MHz, 2.3 GHz and 3.5 GHz bands could occur in the medium term, but there is uncertainty about what spectrum will be released, the timing of release, and/or the availability of user devices for this spectrum. In principle this could create an opportunity for new entry, but given the surrounding uncertainties this does not change our view that barriers to entry are high.

³⁰ The benefits of greater competition may need to be weighed against other considerations, such as potential economies of scale enjoyed by larger firms. As regards economies of scale, in the present

- 4.20 We consider that competition between the four existing national wholesalers operating in the UK currently delivers a wide range of benefits for consumers of mobile services.³¹ As a matter of policy, we would be concerned if as a result of this Auction fewer operators had access to sufficient spectrum to compete credibly at the wholesale level in the future than is currently the case in the UK, as in our view this is likely to lead to a reduction in competitive intensity to the detriment of consumers.³²
- 4.21 We have considered the impact on consumers of a reduction in competitive intensity. A reduction in competition in a market can allow firms (in this case the remaining national wholesalers) profitably to set higher prices, to invest less in new services, and to be less innovative, than would be the case in a more competitive market. This would be likely to be to the advantage of those remaining national wholesalers. However, the result of such a change is likely to be worse outcomes for consumers, such as in higher prices, reduced choice and delayed access to improved or new services. This would not be consistent with our duty under section 3(5) of the Communications Act 2003 in furthering the interests of consumers to have regard, in particular, to their interests in respect of choice, price and quality of service.
- 4.22 The market for mobile services is large, with revenues of £15.1 billion in 2010. The great majority of UK adults (and many children) use these services, with 1.3 active mobile connections per head of population, and one active 3G mobile connection for every two people. Estimates of the consumer surplus generated from the consumption of mobile services (defined as the value of a service to a consumer, minus the price paid by the consumer for the service) are also large (an estimated £24 billion in 2010). This suggests that even relatively small reductions in the intensity of competition could have a substantial economic impact. For example if the reduction in competitive intensity reduced consumer value by 1% that would be equivalent to a £0.2 billion loss of surplus over one year, and if it were sustained over five years the loss of consumer surplus would have a net present value of £1.1 billion.³³
- 4.23 In light of the risk of reduced competitive intensity, we have considered in accordance with the Direction whether we should put in place appropriate and proportionate measures through rules governing the award which will promote competition in such markets after the conclusion of that award. Specifically we have considered whether we should put in place measures to seek to ensure that at least four operators have access to spectrum to enable them to be capable of being credible national competitors at the wholesale level after the Auction³⁴.

case, we note that having more national wholesalers rather than fewer does not preclude the realisation of such economies through network or spectrum sharing, subject to competition law.

³¹ See paragraphs 2.44 to 2.49 of Annex 6 to the January 2012 consultation.

³² It should be noted that we are not concerned with the identity of the competitors in the market: our intention is to promote competition, rather than to protect individual competitors.

³³ See the analysis in paragraphs 2.65 to 2.69 of Annex 6 of the January 2012 consultation.

³⁴ We have also considered whether we should go further and take measures to promote more than four national wholesalers. We consider that there could be greater benefits to consumers and citizens through increased competitive intensity with five national wholesalers compared to fewer but this would in our view also carry a greater risk of inefficiency. We have not received any clear evidence of interest from stakeholders in becoming a fifth national wholesaler. Taking this, and the relative scarcity of the spectrum concerned, into account (in particular the amount of spectrum that a fifth wholesaler would be likely to need to win in the Auction to be capable of being a credible national wholesaler), we do not consider that it would be objectively justified and proportionate to seek to promote more than four national wholesalers.

- 4.24 We note in this context that operators may seek further consolidation (whether by merger or co-operative joint venture) in the future, and any such proposed consolidation would be considered by the relevant competition authorities at the time. Our intention here is to avoid the effects of consolidation (i.e. a reduction in the current number of competitors) as a result of the Auction outcome.

Credibility

- 4.25 By credible, we simply mean that a competitor exerts an effective constraint on its rivals, in terms of factors such as the provision of high quality services, competitive prices, choice and innovation, and as such contributes to the overall competitiveness of the market.
- 4.26 Given the complex and multi-faceted nature of mobile services, consumer demand, technology, and the characteristics of different spectrum holdings, there is in our view no unique set of capabilities or spectrum portfolio that allows a national wholesaler to be a credible competitor.
- 4.27 A national wholesaler could be a credible competitor even though it is not in a strong position in some dimensions of service, or in delivering particular services or to particular customers. For example, a national wholesaler might be credible if it were able to provide good quality of service (such as high data rates and latency) in most indoor locations, even if it could not compete as strongly for customers that particularly valued having a connection in the most difficult to serve locations.
- 4.28 Such differentiation between rivals, whether driven by differences in capabilities or not, is a feature of many competitive markets, and is not necessarily a cause for concern. It can be to the benefit of consumers for rivals to seek to exploit their advantages compared to competitors and engage in various ways to mitigate their disadvantages, some of which may be creative or open up new possibilities for consumers.
- 4.29 While differentiation may therefore have some benefits, we consider that consumers currently benefit from competition across a wide range of services and customers. In addition to our primary concern that the Auction may result in less than four credible national wholesalers, we therefore also have a lesser concern that, even if there were at least four credible national wholesalers, competition could be weaker because the spectrum holdings of one or more of them could mean they were at a disadvantage in competing for some services and customers. For example, a national wholesaler without sub-1 GHz spectrum may be at a disadvantage in serving customers who have a strong demand for deep indoor coverage.
- 4.30 Whilst in our view the position of individual competitors only really matters to the extent that it affects the overall competitiveness of the market and the interests of consumers, we consider two types of advantage or disadvantage to individual national wholesalers arising from spectrum holdings: (i) whether the national wholesaler is capable of being a credible competitor, and (ii) whether the national wholesaler (despite being credible) is disadvantaged in competing across some services/customers. Although the sources may be similar between these two types of competition concern, there is a difference in the degree of importance of each to competition and to consumers. In our analysis we first consider the larger competition concern arising from the number of national wholesalers with sufficient spectrum to be capable of being credible. Thereafter we also consider the lesser competition concern about competition for certain segments of services or customers.

- 4.31 As regards the larger competition concern, we have developed a broad analytical framework to assess the spectrum that a national wholesaler is likely to need to be capable of being a credible national wholesaler so as to promote the competitiveness of the markets for mobile services. As we set out in further detail below, we consider that a national wholesaler may need to achieve at least a minimum level of capability on certain service dimensions in order to be credible. But even if a national wholesaler met the minimum level of capability on a particular dimension, it could be at a relative disadvantage to other national wholesalers on that dimension. We are also concerned that a national wholesaler which had disadvantages in respect of too many dimensions of service, and too few or insufficiently important strengths in other dimensions, would not be a credible competitor. In determining whether or not a particular national wholesaler is likely to be capable of being a credible competitor we have considered all relevant factors to reach a balanced assessment overall.

Overview of our approach to analysing our concerns

- 4.32 The approach we follow for considering the two potential competition concerns we have identified is set out below. It consists of four steps:
- i) Step 1: we consider what Auction outcomes, i.e. post Auction distributions of spectrum holdings, might give rise to competition concerns without measures in the Auction to promote competition (in light of certain technical and market conditions which we identify).
 - ii) Step 2: we consider how likely it is that those outcomes would arise as a result of bidders' behaviour in the Auction in the absence of any measures in the Auction to promote competition.
 - iii) Step 3: we bring together the analysis in step 1 and step 2 to set out our views on the competition concerns that we consider we should be most concerned about. We do this by considering the magnitude of the detriment to consumers of an Auction outcome, the likelihood of the technical and market conditions arising for the detriment to occur, and the likelihood that the national wholesaler in question would fail to acquire the required spectrum in the Auction to avoid the outcome.
 - iv) Step 4: we consider what measures we should take to address our concerns and set out our conclusions on what would be an appropriate and proportionate approach. As part of this, we explicitly consider the implications of our measures for other national wholesalers, and whether they are still likely to obtain any spectrum they may need to be capable of being credible given the measures we are taking.
- 4.33 We use the phrase "technical and market conditions" to capture a particular set of conditions that might make up a future scenario for the provision of mobile services. Such a scenario will be affected by technical conditions (such as how the capabilities of different mobile technologies evolve and how the relative advantages of different frequencies and combinations of frequencies in deploying future mobile networks pan out). But it will also be affected by the prevailing market conditions which reflect how consumers value different attributes of mobile services in the future.
- 4.34 In undertaking our competition assessment we consider a wide range of evidence, recognising that the assessment is about future competition in the provision of mobile services. In particular we have looked at: technical modelling of the capabilities of macrocell LTE networks; technical research on evolution of the standards for mobile technologies LTE and HSPA; technical research on the availability of future mobile

handsets; research on the potential use of small cells; consumer survey evidence on mobile consumers' behaviour; and evidence from the experience in other countries on outcomes of similar auctions and spectrum holdings amongst competitors. We refer to the particular evidence we have taken account of in the relevant sections below.

- 4.35 In all cases this evidence is not definitive and needs careful interpretation. This is, for example, due to the inherent limitations of the analysis of the technical modelling, the fact that some research is either conditioned by the current position or current expectations, and in some cases, such as availability of handsets, decisions by national wholesalers are likely to have an important influence on what happens in the future. That said we believe that, despite these limitations, this evidence does allow us to make more informed judgements in our competition assessment.

Step 1: What Auction outcomes might raise competition concerns?

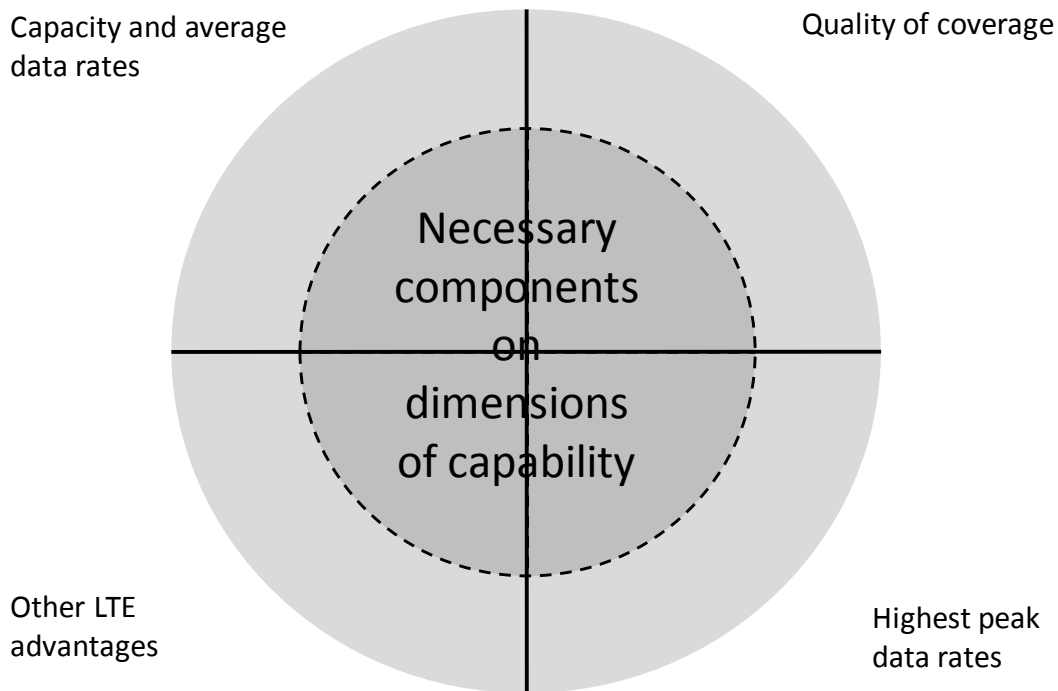
- 4.36 Our first step is to consider what outcomes from the Auction could be detrimental to competition.
- 4.37 Given our larger competition concern that the intensity of competition in mobile services is likely to be lower with fewer than four credible national wholesalers, we focus on what distributions of spectrum could result in fewer than four national wholesalers capable of being credible. This involves identifying a number of dimensions to the capability of a national wholesaler that are affected by the spectrum those wholesalers hold and how they relate to one another, including the trade-offs between them. We then conclude on what may be necessary for a national wholesaler to be credible and what may contribute to a national wholesaler having sufficient capability to be credible. In forming this judgement, we consider the extent to which national wholesalers need to hold particular types and quantities of spectrum in order to deliver different quality dimensions or whether there are alternative approaches or mitigation techniques available to a national wholesaler to deliver those quality dimensions.
- 4.38 Using that assessment of the importance of the different capabilities, we assess in the round whether each of the existing national wholesalers is likely to be capable of being credible if it did not acquire any additional spectrum in the Auction, and also consider what spectrum a new entrant might need. Where we conclude that there is some concern that each might not be credible, we go on to consider what additional spectrum it might require to be credible. This analysis also enables us to identify the sources of risk for our lesser competition concern – that competition is weaker because one or more credible national wholesalers may be at a disadvantage in competing for certain service and customer segments.

Dimensions of capability of a national wholesaler

- 4.39 In line with the main issues raised in responses to the March 2011 consultation, we have identified four dimensions of quality of a mobile service to consumers and dimensions of capability to national wholesalers which are affected by spectrum holdings, that could be important to the credibility of a national wholesaler in the future. These are:
- the capacity that the national wholesaler has to provide services, and the average data rates it can provide (whether delivered by UMTS or LTE);
 - the quality of coverage it can provide;

- whether it can provide the highest peak data rates (using large bandwidths of spectrum with LTE); and
 - whether it can offer services based on LTE technology and so gain from other LTE advantages, such as better latency and the ability to better prioritise traffic.
- 4.40 We have assessed how likely it is that having these capabilities could be important to competition and to consumers, taking account of responses to the January 2012 consultation relating to these four dimensions. For each of the four dimensions, we have considered the evidence available to us about the extent to which particular spectrum holdings are necessary to be able to have a certain capability or whether there are alternative ways of achieving such capability which are not dependent on a certain type or quantity of spectrum. We have also considered whether any technical advantages associated with holding particular spectrum portfolios are likely to translate into a significant competitive advantage, taking into account the extent to which consumers might value the service characteristics that the capability would allow the national wholesaler to offer.
- 4.41 While we have initially considered these dimensions of capability separately, we recognise there can be important interactions between them. When we assess particular portfolios we take into account the interactions between the dimensions, especially between (i) capacity and average data rates and (ii) quality of coverage.
- 4.42 There can also be a time dimension involved with each dimension of capability, in the sense that their importance may change over time, and also the national wholesaler's ability to provide the capability with different spectrum may change over time.
- 4.43 It might be that there are necessary minimum components in these four dimensions that a national wholesaler needs to have to be credible, but that only having this bare minimum may not be sufficient. A national wholesaler might need to have more capability in at least one dimension to be credible.
- 4.44 We illustrate this in Figure 4.1 below. The dark inner circle represents the necessary minimum requirements. A national wholesaler must have these to be credible, but they may not be sufficient on their own. To be credible, a national wholesaler may also need to have more capability than this necessary minimum in at least one of the four dimensions in the lighter shaded outer circle.

Figure 4.1: Framework for how dimensions of quality can affect credibility



- 4.45 Figure 4.1 helps to illustrate our view that there is potentially more than one way that credibility can be achieved. We consider that the assessment of credibility must be considered in the round. For example, one national wholesaler may have the necessary components together with much more than the necessary minimum capability in some dimensions, while another may have the necessary requirements and much more in different dimensions. Alternatively, sufficient overall capability might be achieved through having a little more than the minimum necessary in each of the dimensions. When we assess this for particular portfolios, we also consider the interactions between the dimensions of capability.
- 4.46 Another way of viewing this is in terms of risk. Starting with the inner circle, if a national wholesaler does not have the necessary minimum capability in any of the four quadrants, it is unlikely to be capable of being credible. However, as we discuss below, it is not straightforward to specify these necessary minimum requirements with precision. We make a judgement in the light of the available evidence, in the form of a range rather than a single threshold figure. Taking into account the uncertainty associated with our judgement, we consider that if a national wholesaler's capabilities are towards the weak end of the range we identify for the necessary minimum in any of the dimensions, there is a risk that it would not be capable of being credible, and the more dimensions to which this applies (or the more important the dimension), the greater the risk.
- 4.47 Moreover, even if a national wholesaler meets the necessary minimum requirements in the inner circle in all dimensions, this may not be sufficient capability to be credible in the round. Having only the necessary minimum capabilities in the inner circle in all dimensions but no strength in capability in any of the quadrants in the outer circle (or in the quadrants for the dimensions of capability on which we place most weight) may mean that a national wholesaler is still at risk of not being capable of being credible. This is because a national wholesaler that only has the minimum capability in all dimensions may well struggle to compete against competitors that have either a materially greater capability in one or more key dimensions or are in the round

materially stronger. Consequently the more capability that a national wholesaler has in the outer circle, the lower the risk that it will not be capable of being credible.

- 4.48 Our assessment of credibility involves a relative assessment, as rivals need to be able to compete with one another for there to be strong competition. But we consider that a national wholesaler may be credible even if it is disadvantaged in some dimensions relative to its rivals. This is provided the disadvantages are not too large or are compensated by sufficient strengths in other quality dimensions. A national wholesaler may even be credible if it is at a relative disadvantage to its competitors in all dimensions, provided these relative disadvantages are not too large. It is not in our view necessary that all companies are equally strong for them all to be credible.
- 4.49 Below we consider in turn each of the four dimensions of quality we have identified. We consider the spectrum holdings that are likely to be the necessary minimum requirements for each of the four dimensions and how other or more spectrum might contribute to making a national wholesaler's spectrum holdings sufficient to enable it to be credible and so exert an effective constraint on its rivals. In both cases we also consider other ways of providing capability other than spectrum.
- 4.50 This analysis is by its nature uncertain for a number of reasons. It is about the capability of technology in the future; the complexity and wide variation of the real world situations in which networks will have to operate make it difficult to model reliably or comprehensively; and consumers' preferences and behaviour in the future are by definition unknown. As it is not certain, any decisions we make in this regard involve the application of regulatory judgement. That said we consider that it is possible to draw on evidence available now to make such judgements about the future.

Capacity and high average data rates

- 4.51 Capacity in a mobile network can be defined as a network's ability to supply a given traffic demand at a specified level of quality. Capacity can therefore impact both the number of customers that can be served and the quality of services that can be delivered to them. For a given number of customers, the greater the capacity, the higher the data rates those customers will tend to receive. For this reason we consider average data rates alongside our analysis of capacity.
- 4.52 There is growing demand for data services and we expect this to continue. Because of this, it will be increasingly important for national wholesalers to be able to provide capacity, especially in the longer term.³⁵
- 4.53 We therefore consider it necessary for national wholesalers to have sufficient capacity relative to rivals to serve enough customers with sufficiently high data rates for them to be capable of being credible.
- 4.54 In the January 2012 consultation, our provisional conclusion was that there is material risk that a national wholesaler would not have enough capacity to be credible after the Auction if it held less than 10-15% of the total paired spectrum available after the Auction for the provision of mobile services.
- 4.55 There was no strong disagreement in responses with the view that average data rates matter to consumers. Responses focussed on our conclusion on the minimum share of spectrum to be credible. For example, Everything Everywhere considered

³⁵ See paragraphs 3.15 to 3.21 of Annex 6 of the January 2012 consultation.

that the share of spectrum was not relevant, and that we had anyway not provided sufficient evidence to justify the conclusion we had reached. As we are concerned with competition between rivals, we consider that the relative share of spectrum between competitors is relevant. This is because we consider capacity and average data speeds to be important factors for competition, and spectrum is a key input into capacity.³⁶

Methods of delivering capacity

- 4.56 Before considering the share of spectrum directly, we consider in general terms how capacity can be delivered. Capacity is determined by three key factors:
- i) Spectrum – the quantity and type of spectrum allocated to a national wholesaler;
 - ii) Topology and network – the number of cells, the mixture of cell sizes and their locations; and
 - iii) Technology – the cell spectrum efficiency that can be realised by the given features of a technology.
- 4.57 In terms of spectrum, there are the existing mobile bands already used by national wholesalers (at 900 MHz, 1800 MHz and 2.1 GHz) and the spectrum in the Auction (at 800 MHz and 2.6 GHz). There are also potential future releases (including at 700 MHz, 2.3 GHz, and 3.5 GHz). We discuss the other potential releases and the likely availability of user devices for these bands in Annex 2.
- 4.58 In terms of topology and networks, capacity can be added by investing in macrocells (including additional macrocells and also other types of macrocell investment such as increased sectorisation), deploying small cells, and heterogeneous networks (Hetnets).
- 4.59 We consider that small cells may be particularly important for adding capacity in the future.³⁷ Small cells are cells with a smaller coverage area than conventional macrocells, by virtue of lower antenna heights and typically lower power. These include Wi-Fi in unlicensed bands and femtocells. Because of their lower construction cost, small cells may be a more cost effective way of adding capacity in some areas than macrocells.³⁸ Heterogeneous networks (or hetnets) enable deployed networks using a mix of different cell types, frequencies, technologies (3G, 4G) and network architectures to be dynamically managed as a single network. This enables management of interference and power levels automatically, enables the network to respond to rapid changes in customer demand, and potentially for the network to make significant performance gains.
- 4.60 In terms of technologies, for a given amount and type of spectrum, different technologies can deliver different levels of capacity and data rates. Therefore the frequency of spectrum held can also have an indirect impact on capacity given that

³⁶ Responses on capacity and average data rates, alongside our view of the issues raised, are summarised from paragraph A3.151 in Annex 3.

³⁷ In our UHF strategy consultation of March 2012, we estimated that offloading mobile data onto fixed networks using Wi-Fi and femtocells could serve over half of the predicted increased demand for mobile data capacity by 2030. See paragraph 3.40 in

<http://stakeholders.ofcom.org.uk/binaries/consultations/uhf-strategy/summary/spectrum-condoc.pdf>

³⁸ See also paragraphs 3.41 to 3.43 of Annex 6 of the January 2012 consultation. We also discuss the different small cell technologies in the context of delivering improved coverage from paragraph 3.95 in the same document.

the timing of the technologies that can be deployed can depend on the frequency of spectrum held. Investment in the latest technologies is clearly one way in which national wholesalers can add capacity. Refarming the 900 MHz and 1800 MHz spectrum currently used for 2G services to HSPA/LTE an important example of this.³⁹

Equal share of spectrum unnecessary

4.61 With four national wholesalers, equal shares of spectrum would imply 25% each. But we do not consider that national wholesalers need the same, or close to the same, shares of spectrum in order to act as credible national wholesalers. This is for a number of reasons:

- Spectrum is not the only way of adding capacity, as we have described above. National wholesalers with smaller spectrum shares than their competitors may be able to deliver comparable levels of capacity by relying on other approaches.⁴⁰
- As well as deploying capacity themselves, national wholesalers may be able to buy capacity to some extent. For example, national wholesalers currently buy off-load capacity from operators with Wi-Fi networks (such as BT).
- In any case, in our view it is not necessary for national wholesalers to have the same capacity as the largest national wholesaler in order to be capable of being a credible competitor at the national wholesale level. A national wholesaler that faces some constraints on capacity or that is more capacity constrained than its competitors may still be able to act as an effective constraint across a large proportion of the market (provided that they have sufficient capacity). In addition, national wholesalers can, for example, choose commercial strategies to avoid providing services to the heaviest data users⁴¹, such as using relatively low data caps or by discouraging tethering.⁴²

But a very small share of spectrum may be inadequate

4.62 Given the different ways of providing capacity, to a significant extent national wholesalers can make choices about the mix between the various different approaches. For example, a national wholesaler can choose whether to invest in spectrum (with the costs highly dependent on the frequency, e.g. see the analysis of auction prices in Section 8) and thereby reduce its network or technology costs of providing capacity, such as through fewer macrocells or small cells. Or alternatively it could choose to reduce its costs of spectrum and rely to a greater extent on the other approaches to increasing capacity. However, there are limits to these choices.

4.63 While we consider it is unnecessary to have equal shares of spectrum for national wholesalers to be credible, a national wholesaler with a very small share of spectrum may not provide an effective constraint on rivals. This is for the following reasons:

- While there are a number of substitutes available, spectrum is an important input to capacity. With a small share of spectrum the costs for expanding capacity to serve more consumers or meet increasing expectations of existing customers

³⁹ See also paragraphs 3.49 to 3.56 of Annex 6 of the January 2012 consultation.

⁴⁰ See paragraphs 3.23 to 3.56 of Annex 6 of the January 2012 consultation.

⁴¹ See paragraph 3.22 and 3.67 of Annex 6 of the January 2012 consultation

⁴² Tethering refers to using the mobile service to a smartphone to indirectly provide mobile connectivity to other devices, such as laptops.

may be substantially higher than for their competitors. This could give a national wholesaler less incentive to want to win customers, weakening its impact on competition.⁴³

- As well as the cost, there may also be practical constraints in building large numbers of sites, such as the time it takes to roll out additional new sites beyond the size of existing networks, which also constrain the speed with which capacity can be added.⁴⁴ These constraints are likely to apply much more to macro sites than to small cells.
- While small cells are likely to have an important role to play in providing capacity in the future, they are likely to be most suitable for delivering capacity in relatively small areas of high demand. There is likely to remain a role for macrocells delivering capacity over wide areas to reach locations not in small cells. National wholesalers are therefore likely to want access to a mix of small and macrocells. While a national wholesaler with a small share of spectrum may make greater use of small cells, there may come a point where lack of capacity on the macrocell layer means that national wholesaler is no longer credible.
- There is a limit on the extent to which a national wholesaler can have more constraints on capacity than rivals and still be a credible competitor. A national wholesaler with a small market share may be able to deliver the same average data rates as its rivals, even though it has less capacity. However, to act as an effective constraint on rivals, a national wholesaler must be capable of increasing its market share. A national wholesaler with a very small share of spectrum may not have this capability. It may have less ability or incentive to increase its market share because its marginal costs of increasing capacity are higher.
- Similarly there is a limit to commercial strategies to reduce its capacity requirements. For example, it can avoid providing services to the heaviest data users or adapt its prices to manage the demand it faces. However, these strategies tend to weaken the competitive threat posed by that national wholesaler.

4.64 By way of illustration, if there were four national wholesalers, then if one only held 10% of the spectrum, the other 90% would be distributed between the three other national wholesalers. If they each held 30% this would mean the one with 10% would hold only a third as much as each of its rivals. A holding of less than 10% would result in an even greater disparity in holdings compared to the other three on average. Notwithstanding the use of other possible approaches to the provision of capacity discussed above, we consider there would be a risk that a national wholesaler with a small share of spectrum might not be capable of being credible.

Spectrum relevant to rely on for enabling the credibility of national wholesalers

⁴³ In our January 2012 consultation we drew on our technical modelling results to illustrate this for macro cell deployment. Figure 3.4 of Annex 6 of the January 2012 consultation showed how the required number of sites to provide a specified level of capacity increased with smaller spectrum holdings. Figures A7.41 to A7.43 of Annex 7 of this Statement show the same effect. As we would expect, the basic shape and relationship of the curves are unchanged, and the inferences we drew in paragraphs 3.27 to 3.30 of Annex 6 of the January 2012 consultation are unchanged despite the revisions to the technical analysis.

⁴⁴ See paragraphs 3.33 to 3.36 of Annex 6 to the January 2012 consultation for more explanation of the possible practical constraints.

- 4.65 We also need to consider what spectrum bands are relevant when considering whether a national wholesaler is capable of being credible. To enable a national wholesaler to be credible, the spectrum needs to be capable of serving a reasonable range of user devices. Having spectrum that can only provide capacity to serve simpler devices (like dongles) may be valuable for competing for certain segments of services or customers. But we consider that, if a national wholesaler were not able to provide services to a reasonable range of more sophisticated user devices, such as smartphones and tablets, it is unlikely to be credible.
- 4.66 We also recognise that national wholesalers have some influence over the availability of devices for particular spectrum. This influence is greatest for relatively simple devices. While they also have some influence over what spectrum more sophisticated devices like smartphones and tablets are capable of using, this is more limited.
- 4.67 We consider that the paired 800 MHz, 900 MHz, 1800 MHz, 2.1 GHz and 2.6 GHz bands should all be included when we consider the share of spectrum. These bands are mainstream harmonised mobile bands in Europe and we consider there will be a wide range of devices (either HSPA or LTE) for these bands in the future, including sophisticated user devices such as smartphones and tablets.⁴⁵
- 4.68 While it has the potential to be valuable for providing capacity, we do not consider that we can rely on other spectrum being available and used in a sufficiently large range of user devices, including smartphones and tablets, for enabling the credibility of a national wholesaler. This is because there is greater uncertainty concerning either the availability or usefulness or both of that spectrum compared to the paired spectrum in the bands referred to in the previous paragraph. We discuss the reasons for this more fully from paragraph A2.68 in Annex 2.

Conclusion of minimum share of spectrum

- 4.69 We recognise that the share of spectrum is to some degree an imperfect measure, as it takes no account of lower frequencies being better for adding capacity (especially to indoor locations from macrocells) and of different bands being suitable for different technologies which are different in terms of how spectrally efficient they are.⁴⁶ However, we do not consider these limitations so fundamental that they undermine our view that a national wholesaler's share of spectrum is a relevant factor in assessing its capability to be credible. But the limitations are one reason why we identify a range for the share of spectrum that is the necessary minimum, not a single threshold.
- 4.70 We consider it difficult to identify what the minimum share of spectrum a national wholesaler would need in order to be credible. Our conclusion therefore is framed in terms of the risk of a national wholesaler having or not having a sufficient share of spectrum to be credible rather than a definitive view.
- 4.71 As with our provisional view in the January 2012 consultation, our conclusion is that there is material risk that a national wholesaler would not have enough capacity to be

⁴⁵ Real Wireless, *LTE and HSPA device availability in UK-relevant frequency bands: current availability and future evolution*, May 2012, published alongside this Statement.

⁴⁶ See for example from paragraph A2.59 of Annex 2 for when different bands might be used for LTE. For the extent of the differences in spectral efficiency of the different technologies see paragraphs 3.49 to 3.55 of Annex 6 of the January 2012 consultation.

credible after the Auction if it held less than 10-15% of the total paired spectrum available after the Auction for the provision of mobile services.⁴⁷

- 4.72 We consider the smaller the share of spectrum held (below 10-15%) the greater the risk that a national wholesaler will not have the necessary minimum to be capable of being credible and that the risk reduces the higher that share is above 15%. If a national wholesaler has a much greater share of spectrum than 10-15% this is likely to be an important strength in terms of contributing to sufficient spectrum to be credible.
- 4.73 This is consistent with evidence from other countries, which show that while the shares of spectrum held by operators vary considerably, in general, it is unusual for a national wholesaler to have a share of paired spectrum less than 10%.⁴⁸

Ability to provide good quality coverage

- 4.74 Coverage is an important dimension of the quality of mobile data services available to consumers, and indoor coverage appears to be increasingly important to consumers.⁴⁹ Looking at quality of coverage from the perspective of the consumer experience, we consider various aspects in the round such as, where the consumer can obtain a service, the speed (and other characteristics of service) where it is available, and the consistency of experience as consumers seek to use mobile data services in different locations. We have considered the importance of this dimension to the credibility of a national wholesaler. We focus on what we have called depth of coverage, that is the ability to deliver a service to harder to serve locations,⁵⁰ e.g. within buildings, which we note was a particular focus in responses.
- 4.75 Coverage can be provided by the macrocell network and there are also alternative means, including small cells solutions like Wi-Fi and Femtocells. Wi-Fi currently plays a major role in providing services to mobile devices, especially smartphones and tablets, and especially indoors. We expect Wi-Fi (and small cells in general) to continue to be important in the future. Today small cell solutions like Wi-Fi and Femtocells tend to be supplementary layers to the existing macrocellular layer and managed independently. Increasingly in the timescales we are interested in networks are expected to make use of a range of different cell types and hetnets.
- 4.76 A key issue in responses was whether sub-1 GHz spectrum was necessary for a national wholesaler to be credible. For example, Everything Everywhere and H3G (who currently do not hold licences to use sub-1 GHz spectrum) argued that it was necessary. In particular, they challenged the technical modelling results in our January 2012 consultation. H3G also referred to statements on the value and advantages of sub-1 GHz spectrum by other regulators, mobile operators, academics

⁴⁷ See from paragraph A3.151 in Annex 3 where we discuss relevant responses and why we consider that our analysis and preliminary conclusions in the January 2012 consultation are appropriate.

⁴⁸ See Figure A2.28 of Annex 2 to this Statement and also paragraphs 3.57 to 3.63 of Annex 6 to the January 2012 consultation.

⁴⁹ See, for example, the evidence at paragraphs 3.121 to 3.124 of the January 2012 consultation. There was no strong disagreement in responses on the importance of indoor coverage. See also section 5.3.5 in the Communications Market Report 2012 on internet access on a mobile handset, for example Figure 5.83 (location of internet access using a mobile handset):

http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr12/CMR_UK_2012.pdf

⁵⁰ In the January 2012 consultation, we tended to use the term 'harder to serve' to refer to shallow indoor locations and 'hardest to serve' to refer to deep indoor locations. In this Statement, we do not use the term 'harder to serve' to have such a specific meaning, rather we use it to refer to locations that are more challenging to reach with a macrocell network, including both shallow and deep indoors.

and others. On the other hand, Vodafone and Telefónica (who currently do hold licences to use sub-1 GHz spectrum) argued it was not necessary.⁵¹

4.77 We consider that sub-1 GHz spectrum is likely to give national wholesalers some advantage relative to those that do not have sub-1 GHz spectrum. That sub-1 GHz spectrum is particularly valuable compared to higher frequencies is clear from recent auction results in Europe. But just because sub-1 GHz spectrum is valuable or gives advantages does not necessarily mean holding it is a necessary requirement to be capable of being a credible national wholesaler (i.e. that it is in the inner circle in Figure 4.1 above). For example, it may be valuable partly because it allows lower network costs, rather than because there are necessarily large differences in the value of services provided to consumers.⁵²

4.78 We have considered the scale of the advantage that sub-1 GHz spectrum gives to a national wholesaler in a macrocell network compared to 1800 MHz and 2.1 GHz spectrum and other ways that a national wholesaler can provide good quality coverage such as the use of Wi-Fi. Our key conclusions on this, and the key evidence we have drawn on, are as follows.

4.79 For the coverage gap in a macrocell network:

- As one input, we have undertaken technical modelling, which we have revised following responses to the January 2012 consultation. As we set out in more detail at the beginning of Annex 7, any attempt to derive the performance of a mobile network using a theoretical modelling approach is always going to be inherently uncertain, and this is particularly the case when modelling new technologies such as LTE.
- While recognising this uncertainty, in our technical modelling we have explored the likely size of the coverage gap for indoor services between sub-1 GHz and 1800 MHz spectrum in a macrocell network. We consider the gap is likely to be material.⁵³ Our modelling predicts that the coverage gap in a macrocell network is most pronounced if we are considering basic connectivity, by which we mean the ability to provide low data-rate services such as basic internet connectivity (e.g. email, non-media rich web browsing, etc) and data-rates capable of supporting voice traffic.⁵⁴ For a single user this might require speeds typically in the range 100 to 500kbts/s.⁵⁵
- Our macrocell modelling considers the case where coverage is limited by downlink. We also consider the sensitivity of this analysis to some uplink traffic to manage quality of service. We do not look at the case where there is symmetric uplink and downlink traffic, for example in symmetric video-conferencing.
- If instead we consider macrocell coverage for higher data rate services, then the bandwidth of the carrier becomes important as well as the frequency of the spectrum. This means for higher data rate services, if the higher frequencies are

⁵¹ For a fuller discussion of responses and our views on them see from paragraph A3.102 in Annex 3. See also Annex 10 which discusses the responses on our technical modelling.

⁵² See from paragraph A2.52 in Annex 2 for more details of why sub-1 GHz spectrum may be more valuable and how this affects our competition assessment.

⁵³ See from paragraph A2.14 in Annex 2 for a summary of the technical modelling results for the difference in coverage between frequencies when considered on a like-for-like basis.

⁵⁴ Although release 8 of the 3GPP standards does not standardise LTE voice and voice services are unlikely to be central to early LTE deployments.

⁵⁵ See paragraph A7.47 in Annex 7 for more details of what we mean by basic connectivity.

available in greater bandwidths, it is not necessarily the case that lower frequencies give better coverage. Given that there are larger amounts of higher frequency spectrum available, the advantage of sub-1 GHz spectrum in a macrocell network is likely to be most important for those consumers who place a high value on having coverage with some basic connectivity, even if the data rates are lower than those attainable using higher frequency in locations that are not as hard to serve.⁵⁶

4.80 The other ways for a national wholesaler to provide good quality coverage are as follows:

- Alternative technologies, such as small cells, can be used to deliver services indoor. For example, the use of Wi-Fi in particular is widespread and deployments are growing. Wi-Fi is currently extremely important in terms of delivering data to mobile devices, especially in the home. Such alternative technologies (especially Wi-Fi, but for example also other small cell technologies such as femtocells) are likely to be important for improving coverage in certain locations or scenarios (for example, in one's own home). But they may not remove the coverage gap in all locations or scenarios. We therefore regard alternative technologies as an important way for a national wholesaler to provide good quality coverage with higher frequencies in certain circumstances, but do not consider that they completely remove the advantages of sub-1 GHz spectrum.⁵⁷
- We consider that it may also be possible for a national wholesaler without sub-1 GHz spectrum to partly close the coverage gap by building more macro sites than networks using sub-1 GHz spectrum. This is consistent with some responses to our consultations that implied that building more sites mitigates the coverage disadvantages of higher frequencies.^{58 59}

4.81 National wholesalers can, to a significant extent, make choices between different ways of providing coverage and a different balance between spectrum and network costs. A national wholesaler can invest in the high costs of acquiring or retaining sub-1 GHz spectrum (relative to higher frequency spectrum) which allows it to provide coverage, economising on network costs in terms of fewer sites for macrocells and small cells. A national wholesaler without sub-1 GHz spectrum avoids the associated high spectrum costs but faces more network costs to provide coverage. However, there are limits to these choices.

⁵⁶ See from paragraph A2.31 in Annex 2 for a summary of the technical modelling results that consider coverage for higher data rates and different bandwidths.

⁵⁷ See from paragraph A2.38 in Annex 2 for more details of our views and the evidence we have relied on.

⁵⁸ For example, H3G's response to the January 2012 consultation cites studies by various bodies (including the Global Mobile Suppliers Association, Technical University of Vienna for BNetzA and Jan Markendahl of Sweden's Royal Institute of Technology, Analysys Mason and Motorola) that have found that holding sub-1 GHz spectrum reduces the number of sites (and hence cost) of providing coverage. Everywhere's response refers to it having invested over time in more sites to compensate against the competitive disadvantage of not having sub-1 GHz spectrum (footnote 31 of its response).

⁵⁹ It may also be possible to mitigate the coverage disadvantage by reducing the loading on a carrier, though it is unclear how feasible this is in practice and it anyway may not make that much difference. See paragraphs A7.90 to A7.93 in Annex 7 for a description of the technical modelling results that explore the impact of lighter loading.

- 4.82 Despite there being important alternatives to low frequency spectrum to provide good quality coverage, we consider it likely that there will remain some indoor coverage advantage from holding sub-1 GHz spectrum compared to 1800 MHz or 2.1 GHz spectrum, especially for low data rate services. This advantage is both in terms of the depth of coverage that a national wholesaler can provide and also greater certainty of coverage due to less reliance on such alternative measures.
- 4.83 Nevertheless, given the alternative ways to provide good quality coverage, our judgement is that it is unlikely that the coverage disadvantage to a national wholesaler without sub-1 GHz spectrum is so large that it is necessary to hold sub-1 GHz spectrum to be credible. But we consider that the coverage advantage provided by sub-1 GHz can be an important strength in capability that contributes to a spectrum portfolio being sufficient to enable a national wholesaler to be credible.⁶⁰
- 4.84 The macrocell coverage difference between sub-1 GHz spectrum and 2.6 GHz spectrum is greater than between sub-1 GHz spectrum and 1800 MHz or 2.1 GHz spectrum. We consider the higher the frequency on which the national wholesaler is relying for macrocell coverage the greater the risk that the extent and/or quality of coverage that the national wholesaler could provide would be inadequate for it to be a credible national wholesaler.
- 4.85 For our lesser concern about competition for some services and customers however, we recognise that, even if national wholesalers can provide sufficiently good quality coverage to act as credible national wholesalers, if one or more do not hold sub-1 GHz spectrum there may be weaker competition in particular service or customer segments such as those demanding coverage in the hardest to serve locations.

Ability to provide services with the highest peak data rates

- 4.86 We consider three forms of data rate:
- **The peak data rate** is what a technology can deliver under ideal signal conditions and without contention between users (i.e. a single user occupying all of the resources of one cell and very close to the base station).
 - **The single user throughput** is the maximum data rate that a single user would theoretically be able to receive if it were the only user in the serving cell demanding service at any particular instant of time, but when the user may not be at a location with ideal signal conditions. If the user were very close to the base station, the single user throughput would be the same as the peak data rate.
 - **The average data rate** is the data rate which users actually experience on average under realistic conditions in a network shared with other users.

⁶⁰ We recognise that in other European countries that have already auctioned the 800 MHz spectrum, nearly all national wholesalers hold sub-1 GHz spectrum. However, we do not consider that strong implications can be drawn from this, for the reasons given in paragraph A2.186 in Annex 2. See also paragraphs 3.125 to 3.135 of Annex 6 of the January 2012 consultation and from paragraph A2.181 in Annex 2 for fuller details of the international evidence.

- 4.87 We have already discussed average data rates above when we considered capacity. Here we consider the importance of peak data rates and single user throughputs to the credibility of a national wholesaler.⁶¹
- 4.88 The maximum peak data rate and single user throughput that are possible with early LTE⁶² are achievable with 2x20 MHz of contiguous spectrum. However, 2x15 MHz of contiguous spectrum with LTE will deliver relatively high peak data rates and single user throughputs, and we consider this is likely to allow national wholesalers to avoid a significant competitive disadvantage even for customers that value high peak data rates in the near term. This is consistent with the EC's Decision on the Orange and T-Mobile merger, where it considered that divestment of 2x15 MHz of 1800 MHz was sufficient to alleviate the concerns it had identified.⁶³
- 4.89 Peak data rates and single user throughputs delivered using HSPA are increasing. However, for any particular release standard, they are less than what can be delivered using LTE with a 2x15 MHz or 2x20 MHz carrier. Longer term the specific spectrum bands held by an operator are likely to become a less important determinant of the maximum peak data rates and single user throughputs as standards become more flexible in their ability to aggregate blocks of spectrum in different bands for a single user and the total amount of spectrum becomes more important. However, there is still likely to be a difference in the maximum peak rate which can be offered by an operator of HSPA compared to an operator of LTE.
- 4.90 This may matter because not all the spectrum suitable for mobile services will be equally useful for LTE services at least in the near term. In the longer term there is likely to be much less differentiation between bands. We therefore focus on the position in the first few years after the award.
- 4.91 National wholesalers with particular frequencies of spectrum are likely to be able to offer LTE services more quickly. In particular, we expect it to be possible to offer competitive mobile services using LTE in 800 MHz, 1800 MHz and 2.6 GHz spectrum earlier than in other bands. The evidence suggests that a reasonable selection of user devices for LTE at 900 MHz is not likely to be available until after these frequencies, though how much later is less clear. In part, this is likely to depend on whether LTE gives material advantages to national wholesalers or not. We also recognise that the standards currently are limited to up to 2x10 MHz for 900 MHz spectrum. LTE in the 2.1 GHz band is unlikely to be available until even further into the future.⁶⁴
- 4.92 Our preliminary conclusion in the January 2012 consultation was that it is not clear to what extent consumers will value the highest peak data rates or highest single user throughputs. While there is evidence that average data rates are important to

⁶¹ See paragraphs 3.153 to 3.172 of Annex 6 of the January 2012 consultation for more detail on our views on peak data rates. We show predicted single user throughputs in our technical modelling results in Annex 7.

⁶² By 'early LTE' we mean network and user equipment complying with LTE Release 8 or 9, which is what we expect to be used in the UK initially after the Auction. The initial LTE deployments in Europe and elsewhere are with Release 8 or 9, rather than Release 10. We also recognise that Release 10 (LTE Advanced) may be deployed relatively soon at least in the USA. When Release 10 will be deployed in Europe may depend in part on when there will be user devices capable of using Release 10 for the frequencies used in Europe.

⁶³

http://ec.europa.eu/competition/mergers/cases/decisions/M5650_20100301_20212_247214_EN.pdf

⁶⁴ See from paragraph A2.59 in Annex 2 for more detail on our views on the timing of LTE use in different bands.

consumers, it is less clear that the highest peak data rate or single user throughput are relevant because consumers will rarely experience them in practice. Peak data rates indicate the 'top speed' of technologies, but they are only achieved under ideal conditions. Peak data rates require that the device has excellent channel conditions, and both peak data rates and single user throughputs are only relevant when there is a single consumer's device being served per cell at any particular instant of time.

- 4.93 Consumers are unlikely often to experience these 'ideal' conditions and therefore they are unlikely to experience the highest peak data rates or even the highest single user throughputs very often in practice. They will often be sharing a cell with other consumers. The right conditions for the highest data rates and highest single user throughputs are more likely to occur in small cells than macrocells. In small cells there are likely to be fewer users and the channel conditions are more likely to be close to the levels needed for the peak data rates.
- 4.94 Responses to the January 2012 consultation generally said little about peak data rates, although they did provide some evidence that suggested that peak data rates for LTE using a 2x10 MHz carrier were only slightly higher than those for a comparable HSPA release. Respondents to our separate Notice of proposed variation of Everything Everywhere's 1800 MHz spectrum licences⁶⁵ generally agreed that peak data rates were higher with LTE than HSPA and some suggested that this may result in marketing advantages.⁶⁶ As we noted in the January 2012 consultation, in other countries, consumers on LTE networks are reported to have received significantly higher data rates than on HSPA networks, but these differences are likely to be due in large part to the LTE network being relatively lightly used, rather than to do with peak data rates. We consider that such benefits are taken into account in our consideration of capacity and average data rates as a dimension of capability.
- 4.95 We recognise that being able to deliver the highest peak data rates might potentially give a marketing advantage, by advertising a high 'up to' data rate. However, in order not to be misleading, such advertising may need to make clear that the conditions under which such peak data rates might be achieved are limited. This would reduce the impact of such marketing.⁶⁷
- 4.96 Overall we consider the importance of the capability to deliver the highest peak data rates (and single user throughputs) is unclear, and that it is unlikely to be so important as to be necessary to be a credible national wholesaler (i.e. it is unlikely to be in the inner circle in Figure 4.1 above). While it may provide a capability strength that could contribute to a national wholesaler being credible (i.e. it may be in the

⁶⁵ <http://stakeholders.ofcom.org.uk/consultations/variation-1800mhz-lte-wimax/>

⁶⁶ See from paragraph A3.205 in Annex 3 where we discuss relevant responses and why we still consider that our analysis and preliminary conclusions in the January 2012 consultation are appropriate.

⁶⁷ For fixed broadband, for example, action has been taken to prevent misleading advertising of "up to" speeds. The significant differences between the advertised and actual download speeds of ADSL-based services led the Advertising Standards Authority to initiate a review of the use of "up to" speed claims. This resulted in guidance on the use of speed claims which came into force in April 2012. For more details see: <http://bcap.org.uk/Media-Centre/2012/New-Telecoms-Help-Notes-get-up-to-speed.aspx>

This is in addition to the Voluntary Code of Practice on Broadband Speeds ('the Code'), initiated by Ofcom, which requires internet service providers who are signatories to provide clear and accurate information on the broadband services available to consumers at the point of sale.

<http://stakeholders.ofcom.org.uk/telecoms/codes-of-practice/broadband-speeds-cop-2010/code-of-practice/>

outer circle in Figure 4.1 above), it is unclear how important such an advantage is likely to be.⁶⁸

- 4.97 In relation to our lesser concern about competition for some services and customers, even if it is not necessary to be a credible national wholesaler, there may be weaker competition in some particular service or customer segments if one or more national wholesalers do not hold the spectrum necessary for delivering the highest peak data rates (and single user throughputs).

Other LTE advantages (such as better latency)⁶⁹

- 4.98 We have considered the importance to the credibility of a national wholesaler of being able to provide mobile services specifically using LTE technology or whether another technology, such as HSPA, would be adequate to ensure that a national wholesaler is capable of being credible.⁷⁰ Some of the advantages of LTE relate to the quality dimensions we considered above. For example, LTE gives better cell spectral efficiency which gives greater capacity and average data rates for any fixed amount of spectrum. The larger bandwidth of spectrum that can be used with LTE provides the potential to deliver higher peak data rates than HSPA.
- 4.99 As we have considered capacity and high peak data rates above, here we concentrate on other aspects of performance that are better with LTE than other technologies. Our conclusion is that there are some other advantages of LTE over HSPA, both from the perspective of the operator and the consumer. The key other advantages delivered are lower latency and quality of service guarantees, such as 'guaranteed bit rate'. LTE may also be attractive to early adopters and others influenced by having access to the latest technology.
- 4.100 In the January 2012 consultation we stated that the extent to which consumers are aware of and value latency advantages and better traffic prioritisation is unclear. The attractiveness of LTE is likely to depend on the availability of LTE devices and we said that it was unclear how quickly this will grow. Our provisional conclusion was that it was unclear whether the other advantages of LTE mean that a national wholesaler requires early access to LTE (i.e. in the years immediately after the award) in order to be credible.
- 4.101 Responses to the January 2012 consultation generally said little about the other advantages of LTE. As a result, these responses would not lead us to change from the position set out in the January 2012 consultation.⁷¹

⁶⁸ This is slightly different to our articulation of the importance of this factor in paragraph 3.170 of Annex 6 of the January 2012 consultation. This reflects the updated approach which we are using to assess credibility (i.e. the circles depicted in Figure 4.1), which draws out more clearly the distinction between necessary minimum requirements and contributions to sufficient capability strengths to be credible.

⁶⁹ In the January 2012 consultation, we used the heading 'early route to LTE' as shorthand to capture these other benefits of LTE that were not included in capacity and highest peak data rates. This caused confusion in some responses, so we have changed the way we refer to these advantages to help explanation. We now refer to 'other LTE advantages' to make clearer that this dimension of capability is distinct from and does not overlap with the capabilities assessed under other dimensions.

⁷⁰ See paragraphs 3.173 to 3.221 of Annex 6 of the January 2012 consultation for more explanation of our conclusion on the ability to providing LTE services and its significance for credibility.

⁷¹ See from paragraph A3.225 in Annex 3 where we discuss relevant responses and why we still consider that our analysis and preliminary conclusions in the January 2012 consultation are appropriate.

- 4.102 Respondents to our separate Notice of proposed variation of Everything Everywhere's 1800 MHz spectrum licences advanced a number of arguments about the attractiveness of LTE services. We were provided with confidential forecasts of LTE take-up, in the event that we were to allow Everything Everywhere to use its 1800 MHz spectrum to provide LTE services. In principle, such forecasts may provide some indication of the other LTE advantages and how attractive they are for consumers, though they will also include any advantages from peak data rates or higher average data rates. However, in practice there are a number of limitations to using this data to assess credibility in the context of this competition assessment.^{72 73}
- 4.103 Specifically on latency, we recognise that it is likely to be important for real time applications that are sensitive to delays and require a high degree of responsiveness, including VoIP (Voice over IP), video conferencing and gaming. What the evidence available to us does not make clear is whether the size of the differences in latency between early LTE and what is possible with HSPA is significant enough to make a difference to the credibility of a national wholesaler. On quality of service guarantees, the ability to differentiate on quality and offer a higher quality product could be more important for some customers, such as business customers.
- 4.104 Overall we consider it unclear that it is necessary to have an early route to LTE because of other LTE advantages, such as better latency. Hence, it is unclear that access to 800 MHz, 1800 MHz or 2.6 GHz spectrum is necessary to be credible. Being able to offer LTE services in the near term (rather than HSPA, for example) may provide a capability strength that contributes to a national wholesaler being credible, but its importance for this is also unclear.
- 4.105 Indeed, for a period, there could also be advantages of HSPA over LTE because of a larger range and stock of compatible devices.
- 4.106 In the longer term, as the difference between LTE and HSPA grows, it is more likely to be necessary to provide LTE services to be credible. But in the longer term, 900 MHz spectrum is also likely to provide a route to LTE.⁷⁴
- 4.107 For the reasons we set out later, we do not consider that our policy proposals are sensitive to the importance of other LTE advantages. This is primarily because we consider it relatively unlikely that Telefonica and Vodafone would fail to obtain spectrum suitable for an early route to LTE if they needed such spectrum to be credible. But we consider that H3G or a new entrant would still be at risk of not obtaining the spectrum it would need to be credible in relation to other dimensions.
- 4.108 Also, in relation to our lesser concern about competition for some services and customers, even if providing LTE services is not necessary for acting as a credible national wholesaler, there may be weaker competition in some particular service or customer segments (e.g. video conferencing or gaming) if one or more national wholesalers do not hold the spectrum necessary for providing LTE services.

⁷² For example, the forecasts only relate to a limited time period.

⁷³ For the purposes of the competition assessment in this Statement, we are considering the credibility of a national wholesaler and our timeframe begins after the award and lasts for up to 5-10 years.

⁷⁴ See from paragraph A2.63 in Annex 2 for why we consider 900 MHz spectrum is likely to provide a route to LTE in the longer term.

Summary of our conclusions on importance of each of the dimensions for the credibility of national wholesalers

4.109 Figure 4.2 below sets out a summary of our conclusions on the importance of the different dimensions for the credibility of a national wholesaler, when each is considered in isolation. It breaks down what spectrum we consider is a necessary condition for being a credible national wholesaler and what can contribute to providing sufficient capabilities to be credible.

Figure 4.2: Summary of conclusions on dimensions of capability (each considered in isolation) and spectrum for credibility

Quality dimension	Necessary condition for credibility?	Importance for helping provide sufficient capability for credibility?
Capacity and average data rates	Necessary to have enough capacity to deliver a competitive average data rate. Not necessary to have 25% of paired spectrum, partly because there are other ways of providing capacity. There is a material risk of not achieving the necessary minimum if hold less than 10-15% of paired spectrum after the Auction.	Greater spectrum share than 10-15% increases capability and a much larger holding than this is an important capability strength .
Quality of coverage	Necessary to have enough quality of coverage. Sub-1 GHz spectrum is unlikely to be necessary , given alternative ways of providing good quality coverage. Greater risk of not having the necessary minimum quality of coverage the higher the frequency on which the national wholesaler is relying for coverage.	While unlikely to be necessary, sub-1 GHz spectrum is likely to give some advantage and so is an important capability strength .
Highest peak data rates	Unlikely to be necessary to deliver highest peak data rates for credibility. So unlikely that access to 2x15 MHz or 2x20 MHz contiguous block of 800 MHz, 1800 MHz or 2.6 GHz spectrum is necessary to be credible.	Ability to deliver highest peak data rates may be a source of capability strength, but it is unclear how important this is as a contribution to credibility.

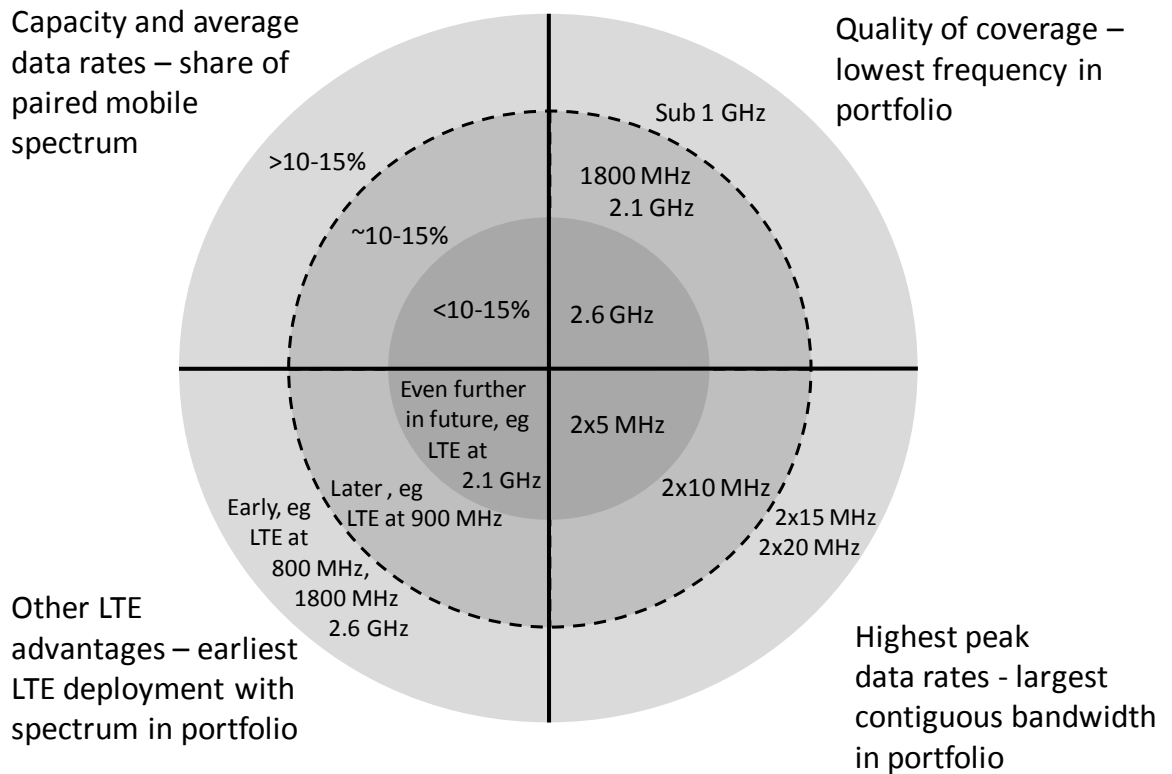
Quality dimension	Necessary condition for credibility?	Importance for helping provide sufficient capability for credibility?
<p>Other LTE advantages (e.g. better latency)</p>	<p>Unclear that it is necessary to deliver services with other LTE advantages, such as better latency, in the near term. So unclear that access to 800 MHz, 1800 MHz or 2.6 GHz spectrum is necessary to be credible.</p> <p>However, providing LTE services is more likely to be necessary longer term to be credible. In the longer term 900 MHz spectrum is likely to provide a route to LTE.</p>	<p>Other LTE advantages may be a source of capability strength, but it is unclear how important as a contribution to credibility.</p> <p>Longer term, the importance of this strength is likely to grow, and 900 MHz spectrum is likely to provide a route to LTE.</p>

4.110 We also illustrate these conclusions below using the format of the inner and outer circles originally shown in Figure 4.1 above. In Figure 4.3 below the darker inner circles, bordered by the dashed line, represent what we consider is likely to be necessary to enable a national wholesaler to be credible. We have divided this into two concentric circles to illustrate that, even within what we consider is necessary for a national wholesaler to be credible, there are gradations and some holdings give greater capability than others. So there is a greater risk that the spectrum in the innermost (darkest shaded) circle is less than the necessary minimum requirements for credibility.

4.111 In each of the four quadrants, the spectrum holdings become stronger as you move from the centre outwards. If a national wholesaler has spectrum of the right type or amount for one of the outer parts of a quadrant, it will also satisfy the requirements of the inner parts of that quadrant. So, for example, if a national wholesaler has sub-1 GHz spectrum, it also has the capability in the inner circles in that quadrant.

4.112 We also stress that the representation in Figure 4.3 is an illustration and makes some simplifications. For example, we have shown the ability to deliver services early with other LTE advantages as being in the outer circle (i.e. not a necessary minimum requirement), but our conclusion is actually that it is unclear whether it is necessary or not in the near term. Figure 4.3 also uses shorthand to refer to our conclusions, which are set out more precisely in Figure 4.2 above. So, for example, for the share of capacity, while we have simply used the label '~10-15%' as the necessary minimum requirement in Figure 4.3, our conclusion is actually that there is uncertainty over what share is needed and that there is a material risk below this range, as set out in Figure 4.2 above.

Figure 4.3: Illustration of our judgements on how dimensions of capability and spectrum affect ability to be credible



- 4.113 In our assessment of spectrum holdings in the round, we consider the necessary minimum requirements, illustrated in the inner circles (bordered by the dashed line); and then the contributions other or further spectrum can make to a national wholesaler having sufficient capability to be credible, illustrated in the outer circle.
- 4.114 In terms of the necessary minimum requirements, the spectrum needed for capacity and coverage has full weight in our assessment, as we consider they are necessary to be credible. However, there is less weight on the spectrum holdings in the quadrant of the inner circles for other LTE advantages because it is unclear that this capability is necessary in the near term, though it is more likely to be necessary in the longer term. There is relatively little weight on highest peak data rates as we consider it is unlikely to be necessary.
- 4.115 In terms of contributions of other or further spectrum to sufficient capability to be credible, the outer circle contributions in the quadrants for capacity and coverage are important, i.e. important contributions to sufficient capability can be achieved through strength in spectrum holdings for either (or both) of these quality dimensions. There is less weight on the outer circle contribution in the quadrant for other LTE advantages as again it is unclear how important this is, although its importance is likely to grow over time. Finally, there is even less weight on the outer circle contribution in the quadrant for highest peak data rates as it is unclear how important this is to help a national wholesaler have sufficient capability to be credible.
- 4.116 As we said earlier, another way of viewing this is in terms of risk. For the inner circles we have identified necessary minimum requirements for capacity and coverage (but for the other two dimensions the necessary minimum capability is either unlikely to be necessary or unclear that it is necessary). There is a difficult judgement to identify exactly what those minimum levels are for capacity and

coverage and accordingly we identify a range as set out in Table 4.2 and illustrated in Figure 4.3. We consider that there is a risk to credibility if a national wholesaler has a portfolio with spectrum towards the weak end of the range in either of these dimensions (e.g. close to 10% share of spectrum for capacity or 2.6 GHz spectrum for coverage).

- 4.117 For the outer circle, not having a strength in capability arising from spectrum especially for both capacity and coverage (the capabilities on which we place most weight) would mean we would have a low level of confidence that a national wholesaler is capable of being credible. This is because it would be dependent on the alternatives to spectrum (such as small cells) to achieve capability strength in both capacity and coverage to close the gap sufficiently against competitors who have stronger spectrum capabilities. The more spectrum a national wholesaler has beyond the necessary minimum in each of these capabilities, the lower the risk that it will not be capable of being credible.
- 4.118 Also, while we have initially considered these dimensions separately, we recognise there can be important interactions between them, and have considered those interactions when we assess particular portfolios.
- 4.119 The assessment in Figure 4.2 and 4.3 above is in terms of the quality dimensions and the credibility of a national wholesaler. But even if there are at least four national wholesalers, some quality dimensions could be important for particular service or customer segments, and weaker competition for such services or customers might be a concern. We consider this lesser concern about competition for some services and customers further below.

Evaluation of the risks faced by national wholesalers

- 4.120 Taking our conclusions on the importance of the different capabilities, we now assess in the round the spectrum holdings of each of the existing national wholesalers and a potential new entrant as to whether each is likely to be capable of being a credible national wholesaler in the future. We consider in turn:
- Everything Everywhere (holding the highest amount of spectrum among current national wholesalers but no sub-1 GHz spectrum);
 - Telefónica (holding sub-1 GHz spectrum but a more modest share of spectrum than Everything Everywhere).
 - Vodafone (holding sub-1 GHz spectrum but a more modest share of spectrum than Everything Everywhere).
 - H3G (holding the least spectrum of the existing national wholesalers and no sub-1 GHz spectrum); and
 - A potential new entrant (holding no existing spectrum).

Figure 4.4: Current spectrum holdings for each of the existing national wholesalers⁷⁵

	900MHz	1800MHz	2100MHz
Everything Everywhere		2 x 45	2 x 20
Telefonica	2 x 17.5	2 x 6	2 x 10
H3G			2 x 15
Vodafone	2 x 17.5	2 x 6	2 x 15
EE divestment*		2 x 15	

* Spectrum that EE agree to release as part of the merger commitments given to the European Commission

Everything Everywhere

4.121 When we consider Everything Everywhere’s existing spectrum holdings, we exclude the 2x15 MHz of 1800 MHz spectrum that Everything Everywhere will divest.⁷⁶ We therefore consider its existing holdings to be:

- 2x45 MHz of 1800 MHz spectrum, and
- 2x20 MHz of 2.1 GHz spectrum.⁷⁷

4.122 The tables below break down these holdings in a different way and assess the portfolio against the four dimensions of quality we have identified.⁷⁸

	A: 2.6 GHz & below	B: 2.1 GHz & below	C: Sub-1 GHz
Spectrum holdings for data services – near term ⁷⁹	2x40 MHz	2x40 MHz	-
Spectrum holdings for data services – longer term	2x65 MHz (after complete refarming) (24%) ⁸⁰	2x65 MHz (after complete refarming) (33%)	(0%)

	Assessment
Capacity and average data rates	With 24% of total paired spectrum available after the Auction, Everything Everywhere is well above what we consider is likely to be the necessary minimum. We consider Everything Everywhere’s large current spectrum holdings to be an important strength which materially contributes to its ability to be credible. ⁸¹

⁷⁵ The figures quoted for the different national wholesalers are rounded to the nearest 2x0.5 MHz.

⁷⁶ Everything Everywhere has committed to divest 2x15 MHz of its current 2x60 MHz of 1800 MHz spectrum. It is required to release 2x10 MHz of this by September 2013 and the remaining 2x5 MHz by September 2015.

⁷⁷ Everything Everywhere also holds 10 MHz of unpaired 2.1 GHz spectrum.

⁷⁸ We have changed the way we present the assessment of credibility from that shown in the January 2012 consultation for the reasons explained at paragraph A2.89 in Annex 2.

⁷⁹ This assumes that Everything Everywhere can refarm 2x20 MHz of its 1800 MHz holdings in the near term.

⁸⁰ This percentage is of the 2x266 MHz of total paired spectrum available after the Auction, assuming the operator wins no additional spectrum in the Auction. The 2x266 MHz consists of 2x30 MHz of 800 MHz, 2x35 MHz of 900 MHz, 2x72 MHz of 1800 MHz, 2x59 MHz of 2.1 GHz and 2x70 MHz of 2600 MHz spectrum. We have excluded unpaired 2.1 GHz and 2.6 GHz spectrum from the calculation of spectrum shares. The percentage in column B (2.1 GHz and below) is for the 2x196 MHz spectrum at 2.1 GHz and below that will be available after the Auction; and in column C (sub-1 GHz) for the 2x65 MHz of 800 MHz and 900 MHz spectrum that will be available after the Auction.

⁸¹ Everything Everywhere’s spectrum is clearly not all currently available for data services, as the 1800 MHz spectrum is currently used for 2G services. If Everything Everywhere choose not to refarm much of its spectrum in the near term, its share of spectrum used for data services could be lower in the near term. This might reduce its strength in terms of a large share of spectrum, at least in terms of

Quality of coverage	With 1800 MHz spectrum we consider that Everything Everywhere has the likely necessary requirements for quality of coverage to be capable of being a credible national wholesaler given the range of ways of providing coverage. However, without sub-1 GHz spectrum it will be more challenging for Everything Everywhere to deliver a service in locations that are harder to serve. This is a disadvantage compared to national wholesalers with sub-1 GHz spectrum.
Highest peak data rates	Everything Everywhere is likely to be able to deploy a 2x20 MHz carrier in the 1800 MHz band relatively quickly which is a strength in capability, but it is unclear how important this is for credibility.
Other LTE advantages (e.g. better latency)	Everything Everywhere has an early route to LTE with 1800 MHz spectrum and so can provide services that offer LTE specific advantages, which is a strength in capability, but it is unclear how important this is for credibility.

4.123 We consider that Everything Everywhere’s holdings have all the necessary components for it to be credible. It has at least 10-15% of paired spectrum and spectrum at 2.1 GHz or below. And, while we consider it unlikely or unclear whether they are necessary, it has the ability to offer the highest peak data rates and to offer services with other LTE advantages in the near term. We have therefore considered whether its existing spectrum holdings are also sufficient to be credible.

4.124 As we said in the consultation, Everything Everywhere’s existing spectrum portfolio has important strengths and weaknesses. It has no sub 1GHz spectrum, but has strengths in terms of its share of spectrum and an early route to LTE with a 2x20 MHz LTE carrier. It is unclear how important it is to offer LTE services in the near term and to offer the highest peak data rates. But Everything Everywhere’s large share of spectrum is an important strength – at 24% it is substantially greater than our likely range for the necessary minimum share of 10-15%. Moreover, taking account of the interaction between coverage and capacity, as all its spectrum is at 1800 MHz and 2.1 GHz, it will be able to deliver capacity to more locations than if some of the spectrum were at 2.6 GHz.

4.125 On balance we consider its existing holdings are likely to be sufficient to enable it to be capable of being a credible national wholesaler in the future even if it wins no additional spectrum in the Auction.

4.126 We recognise that in the unlikely event that Everything Everywhere were not to win anything in the Auction, it would be possible for there to be four national wholesalers each with around 25% of total paired spectrum. Everything Everywhere may then be relatively weaker than the other national wholesalers (as it would have roughly the same share of spectrum but no sub-1 GHz spectrum). We do not consider that this relative disadvantage is so significant that it would not be able to be credible (given that we consider sub-1 GHz is unlikely to be necessary for sufficient quality of coverage to be credible). We do not consider that competitors need to be equal in terms of the extent of their strengths, provided the disadvantages between them are not too large.

Telefónica

4.127 Telefónica currently holds:

providing data services. However, given our view on the ability of Everything Everywhere to refarm its 1800 MHz spectrum (and on other national wholesalers to refarm their existing spectrum from 2G), we consider that its share of spectrum used for data services is likely to be materially above 10-15% even in the near term. See also the section on refarming from paragraph A3.135 in Annex 3.

- 2x17.4 MHz of 900 MHz spectrum;
- 2x5.8 MHz of 1800 MHz spectrum; and
- 2x10 MHz of 2.1 GHz spectrum.⁸²

4.128 The tables below show this and assess the portfolio against the four dimensions of quality we have identified.

	A: 2.6 GHz & below	B: 2.1 GHz & below	C: Sub-1 GHz
Spectrum holdings for data services – near term	2x15-20 MHz ⁸³	2x15-20 MHz	2x5-10 MHz
Spectrum holdings for data services – longer term	2x33 MHz (after complete refarming) (12%)	2x33 MHz (after complete refarming) (17%)	2x17.4 MHz (after complete refarming) (27%)

	Assessment
Capacity and average data rates	Telefónica has a relatively limited share of spectrum even in the longer term, with 12% ⁸⁴ of total paired spectrum after the Auction, though it benefits from having a higher share of the lower frequency spectrum which can deliver more capacity. But while Telefónica uses its spectrum for HSPA it will add less capacity than spectrum used for LTE. Although it may meet the likely necessary minimum requirement, we consider there is a risk that it is insufficient to enable Telefónica to be credible in the longer term.
Quality of coverage	In our view Telefónica clearly has the necessary spectrum for quality of coverage, with 2x17.4 MHz of 900 MHz spectrum. This represents an advantage of Telefónica's existing spectrum portfolio. We consider it is therefore well placed to deliver consistency of coverage even in the hardest to serve locations.
Highest peak data rates	With 900 MHz and 2.1 GHz spectrum and only 2x5 MHz of 1800 MHz spectrum, Telefónica will not be able to deliver the highest peak data rates with early LTE. Even if 900 MHz spectrum is used for LTE, the standards currently do not allow 2x15 MHz contiguous blocks to be deployed with LTE at 900 MHz, reducing the peak data rates that could be achieved with 900 MHz. It is possible that the standards could be changed (or that this may become less relevant with carrier aggregation), but we accept that there is some risk that the standards may not allow high peak speeds to be delivered with 900 MHz spectrum in the future. It is unclear how important high peak data rates are for ensuring a national wholesaler is credible, but we consider it unlikely to be necessary.
Other LTE advantages (e.g. better latency)	The 900 MHz and 2.1 GHz spectrum that Telefónica holds does not provide an early route to LTE. While Telefónica has 2x5 MHz of 1800 MHz, which could provide an early route to LTE, such a network would have limited LTE capacity. It is unclear how important it is in the near term to offer LTE services for ensuring a national wholesaler is credible. Any disadvantage would last until Telefónica could deploy LTE at 900 MHz. We consider that the timing is, to some extent, likely to depend on the importance of differences between LTE and HSPA: the better LTE is, the more quickly we might expect 900MHz to move to LTE. But we recognise that this may depend on international demand for LTE900 rather than just demand in the UK.

4.129 An important strength of Telefónica's existing spectrum portfolio is its 900 MHz spectrum, which represents over 25% of sub-1 GHz spectrum post Auction. We

⁸² Telefónica also holds 5 MHz of unpaired 2.1 GHz spectrum.

⁸³ Telefónica has already refarmed 2x5 MHz of the 900 MHz spectrum for HSPA and is likely to be able to refarm at least a further 2x5 MHz from 2G to HSPA by around 2016 (see from paragraph A3.135 in Annex 3.

⁸⁴ Not all of this spectrum is likely to be used for data services in the near term, but longer term we consider Telefónica has the option of using the spectrum for data services.

consider it is therefore well placed to deliver consistency of coverage for voice and data services even in the hardest to serve locations. We also consider that the rapidly growing stock of UMTS900 devices may give those with 900 MHz spectrum an advantage until there is a reasonable selection of LTE devices, and a reasonable stock of such devices in use. Longer term, we consider that Telefónica is likely to be able to refarm 900 MHz for LTE.

- 4.130 But Telefónica’s existing spectrum holdings also have weaknesses in terms of not being able to offer the highest peak data rates or take advantage of other LTE advantages in the near term. We consider it unclear how important these weaknesses are. Also, with 12% of overall paired spectrum, its share is not high especially taking into account the lower spectral efficiency of HSPA and the later timing when Telefónica’s existing spectrum may be used for LTE.
- 4.131 Given these weaknesses and despite its holdings of 900 MHz spectrum, we consider it unclear whether Telefónica’s existing holdings are sufficient for it to be credible.
- 4.132 If Telefónica needed spectrum to be credible, then what it would need would depend on why it was not credible with its existing spectrum. If it needed a larger share of spectrum or the ability to offer services that had LTE specific advantages even in the near term, such as better latency, then it is likely to be sufficient to obtain at least 2x10 MHz of either 800 MHz or 2.6 GHz spectrum, or the 2x15 MHz of 1800 MHz spectrum. An extra 2x10 MHz would give Telefónica 16% of total paired spectrum after the Auction. With this additional spectrum, we consider that Telefónica is likely to have sufficient spectrum to be credible, especially given its share of sub-1 GHz spectrum. We consider it unlikely that Telefónica would also need to be able to provide the highest peak data rates with early LTE to be credible, but if so we consider that bandwidth of 2x15 MHz in any auctioned band including 2.6 GHz would be sufficient.

Vodafone

- 4.133 Vodafone’s spectrum holdings are the same as Telefónica’s except that it holds rights to use 2x5 MHz more 2.1 GHz spectrum.⁸⁵ Compared to Telefónica, its overall spectrum share is 14% rather than 12%.
- 4.134 Despite a larger amount of 2.1 GHz spectrum, we consider that the assessment for Telefónica above is also broadly applicable for Vodafone. The strengths and weaknesses of Vodafone’s spectrum are largely the same as for Telefónica. Our conclusion, therefore, is also the same.

H3G

- 4.135 H3G currently holds 2x15 MHz of 2.1 GHz spectrum.⁸⁶ H3G is in our view not likely to be credible on the basis of this holding. The tables below show this and our assessment against the four dimensions of quality we have identified.

	2.6 GHz & below	B: 2.1 GHz & below	C: Sub-1 GHz
Spectrum holdings for data services – near term	2x15 MHz	2x15 MHz	-
Spectrum holdings for data services – longer term	2x15 MHz (6%)	2x15 MHz (8%)	- (0%)

⁸⁵ Also, unlike Telefónica, Vodafone does not have 5 MHz of unpaired 2.1 GHz spectrum.

⁸⁶ H3G also holds 5 MHz of unpaired 2.1 GHz spectrum.

	Assessment
Capacity and average data rates	With only 6% of spectrum overall, there is a material risk that H3G would not be credible with its existing spectrum holdings. This weakness is reinforced by H3G's 2.1 GHz spectrum being likely to be used for HSPA for some time, as HSPA has lower spectral cell efficiency than LTE. We consider the limited spectrum amount to be an important weakness of H3G's current holdings.
Quality of coverage	With 2x15 MHz of 2.1 GHz, H3G has the likely necessary requirements for quality of coverage. However, without sub-1 GHz spectrum it will be more challenging for H3G to deliver a service in locations that are harder to serve. We consider this a disadvantage (compared to national wholesalers with sub-1 GHz).
Highest peak data rates	With 2.1 GHz spectrum, H3G will not be able to deliver the highest peak data rates with early LTE. The importance of high peak speeds is unclear, though we consider it unlikely to be necessary to be credible.
Other LTE advantages (e.g. better latency)	With 2.1 GHz spectrum, H3G does not have an early route to LTE and the use of LTE at 2.1 GHz is likely to be later than at 900 MHz. It is unclear how important it is for credibility to offer LTE services in the near term. In the longer term it is more likely to be necessary.

4.136 With just 2x15 MHz of 2.1 GHz spectrum:

- There is a material risk that H3G would not be credible due to its low share of spectrum.
- It cannot deliver the highest peak speeds or LTE services in the near term, though the importance of these to credibility is unlikely or unclear. But in the longer term it is more likely to be necessary to deliver LTE services to be credible and we consider that the use of LTE with 2.1 GHz spectrum is likely to occur later than for 900 MHz spectrum. This means that with H3G's existing holding it may not be able to offer services with the highest peak data rates or other LTE advantages for some considerable time.⁸⁷
- It also has no particular strengths, i.e. nothing in the outer circle in any of the quadrants in Figure 4.3 above. While their importance is unclear, with its existing holding H3G cannot deliver the highest peak data rates or other LTE advantages in the near term. More importantly, it has a low share of spectrum and no sub-1 GHz spectrum.

4.137 We therefore consider that H3G is unlikely to be credible without additional spectrum in the Auction. Our conclusion that H3G is unlikely to be credible without more spectrum was not seriously questioned in responses to the January 2012 consultation.

4.138 The more challenging judgement we must make is what additional spectrum H3G would need to be capable of being credible. Below we set out our judgement on what different spectrum holdings are likely to enable H3G to be credible. However, we stress that it does not follow automatically from this that we need to reserve one of these portfolios for H3G or a new entrant. As set out earlier, the next step in our approach includes considering how likely is it that H3G would not obtain one of these portfolios without measures in the Auction.

⁸⁷ See from paragraph A2.59 in Annex 2 for our evidence and conclusions on when different bands are likely to be used for LTE, and the factors that affect this.

- 4.139 To reach a view on what spectrum H3G might need to be credible, we start by considering 2x15 MHz of 1800 MHz spectrum or 2x10 of 800 MHz spectrum. We consider there is still a low level of confidence that H3G would be credible with either of these portfolios. See from paragraph A2.90 in Annex 2 for our full assessment of these portfolios.
- 4.140 2x10 MHz of 800 MHz would only give H3G 9% of total paired spectrum after the Auction, which may be insufficient to enable H3G to be credible, even though it would have a reasonable amount of sub-1 GHz spectrum. As noted in paragraph 4.116 above, there is a risk to credibility if a national wholesaler's spectrum is towards the weak end of our range for the necessary minimum requirement for capacity.
- 4.141 2x15 MHz of 1800 MHz would give H3G a slightly larger share of spectrum at 11%, but no sub-1 GHz spectrum and it would still be a relatively weak portfolio when considered in the round.
- 4.142 We have therefore considered slightly larger portfolios. Our conclusion is that it is likely that any one of the bottom four portfolios shown in the table below in bold is likely to be sufficient to enable H3G to be credible. See from paragraph A2.85 in Annex 2 for our full assessment of the portfolios H3G might need to be capable of being credible.

Figure 4.5: Alternative portfolios considered that could enable H3G to be credible

	Additional spectrum			Existing spectrum	Summary of assessment
	800 MHz	1800 MHz	2.6 GHz	2.1 GHz	
	-	-	-	2 x 15 MHz	Unlikely to be credible
	2 x 10 MHz	-	-	2 x 15 MHz	Low level of confidence that H3G would be credible
	-	2 x 15 MHz	-	2 x 15 MHz	
	-	2 x 15 MHz	2 x 10 MHz	2 x 15 MHz	
Portfolio 1	2 x 15 MHz	-	-	2 x 15 MHz	Likely to be sufficient spectrum for credibility
Portfolio 2	2 x 10 MHz	-	2 x 10 MHz	2 x 15 MHz	
Portfolio 3	2 x 5 MHz	2 x 15 MHz	-	2 x 15 MHz	
Portfolio 4	-	2 x 15 MHz	2 x 20 MHz	2 x 15 MHz	

- 4.143 It is because of the advantage of having a reasonably large share of sub-1 GHz spectrum that we regard Portfolio 1 as being sufficient to make H3G credible. Portfolio 2 gives the advantages of sub-1 GHz as well as a larger share of spectrum.
- 4.144 We consider the case for Portfolio 3 is more finely balanced. In the January 2012 consultation we considered there may be concerns about this portfolio in terms of coverage (especially at higher speeds) and capacity. In its response, H3G has argued that it would be sufficient for it to be credible if it had 2x5 MHz of 800 MHz spectrum combined with 2x15 MHz of 1800 MHz and 2x5 MHz of 2.6 GHz spectrum. We have therefore reviewed the value of 2x5 MHz of 800 MHz spectrum.
- 4.145 We consider that while 2x5 MHz of 800 MHz cannot provide much capacity, it would allow some basic connectivity in a wide range of locations. 800 MHz spectrum may also give an advantage in the sense that it would allow an operator to obtain national coverage with a relatively small number of sites. This could give a timing advantage in terms of being able to offer a national LTE service more quickly.

- 4.146 When combined with 2x15 MHz of 1800 MHz spectrum, we now consider that 2x5 MHz of 800 MHz spectrum would be likely to be sufficient to make H3G credible.
- 4.147 In the January 2012 consultation we suggested that 2x15 MHz of 1800 MHz and 2x10 MHz of 2.6 GHz would be sufficient to enable H3G to be credible. One criticism of this portfolio in responses was that it suffered from the disadvantage of not having sub-1 GHz spectrum, and did not have any particular strengths. We have reviewed this portfolio and on balance we now consider there is a low level of confidence that it has sufficient strengths to allow H3G to be credible.
- 4.148 To mitigate this risk, we have therefore considered a portfolio with 2x20 MHz of 2.6 GHz spectrum, combined with 2x 15 MHz of 1800 MHz spectrum. We consider this larger portfolio, providing H3G with a share of spectrum in excess of 10-15%, would be likely to be sufficient to enable H3G to be credible.

New entrant

- 4.149 A new entrant obviously needs to obtain spectrum in the Auction to be credible. In terms of the type and amount of spectrum likely to be necessary, we consider that it may need to obtain more than the groups of portfolios we have considered above for H3G. This is because we considered those portfolios would be sufficient to enable a national wholesaler to be credible in the longer term when combined with 2x15 MHz of 2.1GHz spectrum.
- 4.150 However, if a new entrant obtained only the spectrum portfolios we considered for H3G, it is likely to be possible for it to roll out an LTE network that would allow it to be credible initially. In the longer term, however, there is a material risk that its share of spectrum may not be sufficient for it to be credible on its own.
- 4.151 We also recognise that sub-1 GHz spectrum might be particularly valuable to a new entrant to assist it to roll out a network more quickly, because it would allow it to obtain national coverage with a much smaller number of sites than higher frequencies, albeit that such a network would have little capacity, which would need to be increased subsequently. A new entrant may also be able to roll out a national service quickly with higher frequencies if it can negotiate access to an existing network. We recognise that, without sub-1 GHz spectrum, it may take a new entrant more time to become a credible national wholesaler, but we consider that it is likely to be capable of doing so.

Step 1: conclusions on larger competition concern and identification of lesser competition concerns

- 4.152 As we have noted above, there is significant uncertainty regarding which Auction outcomes (in which existing national wholesalers or a new entrant do not acquire the spectrum they need to be credible) could be detrimental to competition. Nevertheless, we believe it is necessary to make some judgements on this in order to assess the types of measures that could be adopted to promote competition. We conclude on the following:
- Everything Everywhere's existing holdings are likely to be sufficient for it to be a credible national wholesaler in the future even if it wins no additional spectrum in the Auction.
 - Telefónica and Vodafone's existing holdings may be sufficient for them to be credible, although this is unclear. With a further 2x10 MHz of either of 800 MHz or

2.6 GHz spectrum or the 2x15 of 1800 MHz spectrum we consider that Telefónica and Vodafone would be likely to have sufficient spectrum to be credible.

- H3G is unlikely to be credible without additional spectrum. We consider that H3G is likely to be capable of being credible with any one of the following set of portfolios (in combination with its existing 2.1 GHz spectrum):

	800 MHz	1800 MHz	2.6 GHz
Portfolio 1	2 x 15 MHz	-	-
Portfolio 2	2 x 10 MHz	-	2 x 10 MHz
Portfolio 3	2 x 5 MHz	2 x 15 MHz	-
Portfolio 4	-	2 x 15 MHz	2 x 20 MHz

- A new entrant obviously needs to obtain spectrum in the Auction to be credible. A new entrant may need to obtain more spectrum than H3G to be credible in the longer term. Also, unless a new entrant were able to negotiate access to an existing network, sub-1 GHz spectrum might be particularly valuable to a new entrant to assist it to roll out a network quickly.

4.153 Even if a national wholesaler is credible, it may not be well placed to deliver certain dimensions of service, or for serving some particular service or customer segments. This is our lesser competition concern we identified above. We have identified five ways in which competition could be weaker for certain segments of customers or services.⁸⁸ The first four are if one or more credible national wholesalers does not have:

- sub-1 GHz spectrum, which is spectrum that is not currently held by Everything Everywhere, H3G or a new entrant;
- 2x15 MHz in a contiguous block for LTE, which is spectrum that is not currently held by Telefónica, Vodafone, H3G or a new entrant;
- other LTE advantages (e.g. better latency) - spectrum providing an early route to LTE is not currently held by Telefónica, Vodafone, H3G or a new entrant; or
- enough spectrum for capacity and average data rates for service and customer segments with especially high demand for this quality dimension, which is a risk with the current spectrum holdings of H3G or a new entrant and also Telefónica and Vodafone to a lesser extent.

4.154 The fifth source of weaker competition is if one competitor has a very large share of spectrum.

Step 2: How likely is it that Auction outcomes that could give rise to competition concerns will occur?

4.155 Under the previous step we identified that there are some potential Auction outcomes in which different national wholesalers do not acquire the spectrum that we consider they are likely to need (i) to be capable of being credible national wholesalers, and/or (ii) to avoid being at a specific competitive disadvantage in relation to being able to provide particular services or serve particular customer segments. If the outcomes

⁸⁸ See paragraphs 4.94 to 4.101 of Annex 6 of the January 2012 consultation for more details on these competition concerns.

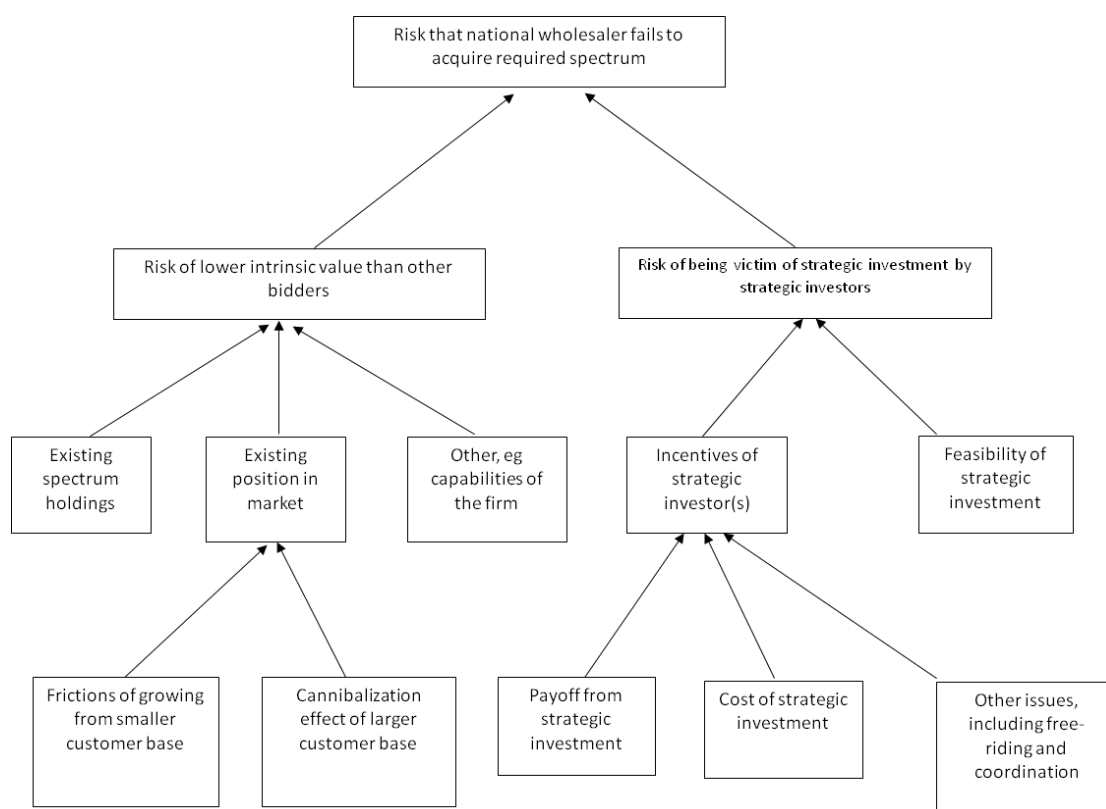
under (i) were to materialise, our aim of promoting competition by seeking to ensure there are at least four national wholesalers who are capable of being credible would not be met.

- 4.156 In this step we consider how likely those outcomes are to come about, if there were no measures to promote competition in the Auction, focussing on the risk of outcomes under (i). By this we mean: whether a national wholesaler that needs additional spectrum of a particular type and quantity in order to be credible will fail to acquire such spectrum in the Auction.
- 4.157 Before discussing the likelihood of these particular Auction outcomes we explain our framework for considering the likely determinants of Auction outcomes.

Likely determinants of auction outcomes

- 4.158 The allocation of spectrum in the Auction is determined by the relative bids that participants make. This in turn is likely to be determined by their expected difference in profits from supplying wholesale and retail services with and without the spectrum.
- 4.159 We distinguish between two sources of value (i.e. profits) in bidding for spectrum:
- a) **Intrinsic value.** The present value of additional profits a bidder expects to earn when holding the spectrum compared to not holding it, in the absence of any strategic considerations to obtain spectrum to reduce competition in mobile services from the existing level.
 - b) **Strategic investment value.** The present value of additional expected profits earned from bids aimed at affecting the future structure of competition in mobile services by depriving one or more competitors of spectrum.
- 4.160 In the second source of value we are reflecting the fact that spectrum is a strategic asset for national wholesalers and access to spectrum is likely to have a major impact on a national wholesaler's competitive strength in the market. Moreover, spectrum is a scarce resource and the forthcoming Auction for the 800 MHz and 2.6 GHz spectrum is likely to be a vital opportunity to access additional spectrum resources within the timescale we are considering. This suggests that the outcome of the Auction is likely to shape the future competitiveness of the mobile sector for at least the next decade. Recognising this potential lasting impact, some national wholesalers might have an incentive to buy more spectrum than would otherwise be the case with the aim of weakening rivals and thereby reducing the competitive constraint that they will face.
- 4.161 In considering strategic investment in this way, we are not supposing that bidders, individually or collectively, will act in a prohibited manner in the Auction. Our concern is to consider whether strategic investment by one or more bidders, in pursuit of rational commercial goals, might result in an outcome that made the market less competitive, such that it posed a risk to our policy objective to promote competition through the Auction.
- 4.162 The framework we have used to analyse whether a particular national wholesaler will acquire spectrum in the Auction is illustrated in Figure 4.6. Our January 2012 consultation (Annex 6) sets out detailed comments on the assessment of intrinsic value (paragraphs 5.11 to 5.38) and strategic investment (paragraphs 5.39 to 5.73).

Figure 4.6: Illustration of the analytical framework for acquisition of spectrum in the Auction



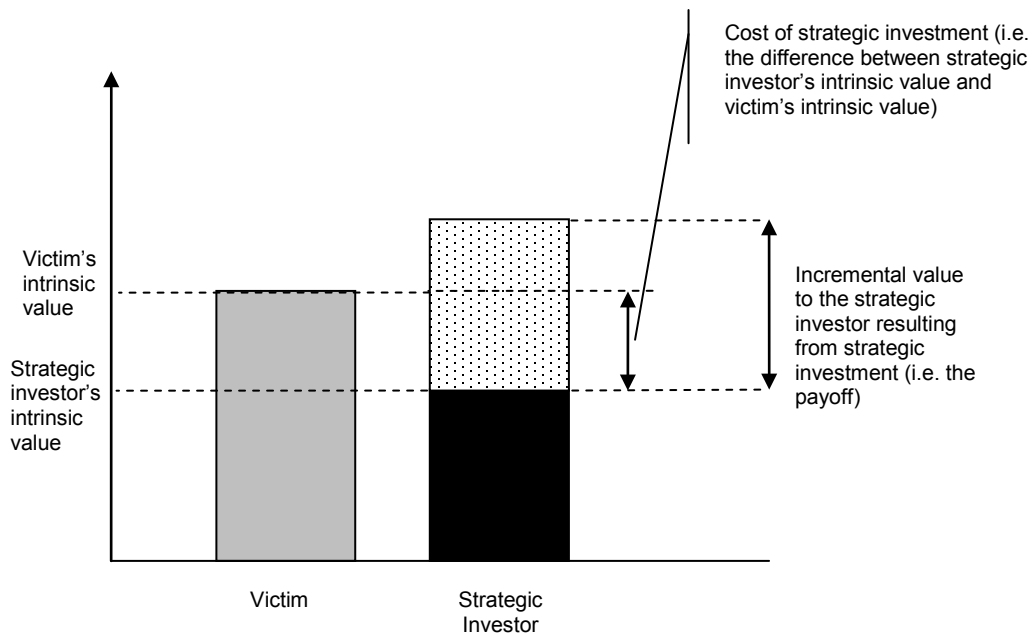
4.163 Individual national wholesalers may fail to acquire the spectrum they need due to their having a lower intrinsic value of the spectrum than other bidders, or to strategic investment by competitors, aimed at denying the victim access to the required spectrum:

- *Lower intrinsic value:* the value placed by a bidder on a given frequency and amount of spectrum is affected by a number of factors, including the bidder's existing holdings of spectrum, the bidder's existing position in the market, the bidder's technical and organisational capabilities, and the bidder's expectations about the profits it can generate from the spectrum. Frictions in consumer switching may make it more difficult or slower for a bidder with a smaller customer base, than one with a larger customer base, to monetise investment in spectrum to deliver new services. On the other hand, a bidder with a large customer base may fear that by introducing new services it will largely cause its own customers to upgrade from existing services, rather than expanding the firm's market share (the cannibalization effect). A small difference in intrinsic value may be enough for a firm to fail to acquire spectrum.
- *Strategic investment:* even if the national wholesaler has a higher intrinsic value than other bidders for specified spectrum, it may fail to acquire it in the Auction if it is the victim of strategic investment. The likelihood of strategic investment depends on two distinct elements: feasibility, i.e. whether there are Auction outcomes that would allow strategic investment to occur, and incentives, i.e. the profitability of the strategy for the strategic investors. As regards feasibility, there are a number of Auction outcomes which could lead to certain national wholesalers failing to acquire spectrum they need, and we consider these below. Incentives for strategic investment are affected by (i) the payoff, i.e. the

incremental profits arising from the exclusion of the victim; and (ii) the costs, i.e. the additional price that strategic investors have to pay to achieve the exclusion. If strategic investment by more than one firm is needed for success, this will be more likely to occur if there is a clear ‘focal point’ that can assist individual strategic investors to coordinate. By focal point we mean a particular outcome of spectrum acquisition in which the victim is denied the spectrum it needs to be credible.

- 4.164 If a potential victim of strategic investment has a lower intrinsic value for a block of spectrum than its rivals, it can be prevented from winning without any strategic investment. If the potential victim has a *higher* intrinsic value for the spectrum, this will increase the cost of strategic investment against it. This case is illustrated in the diagram below.

Figure 4.7: Illustration of cost of strategic investment and expected payoff



- 4.165 The grey area represents the victim’s intrinsic value while the black area identifies the lower intrinsic value of the strategic investor. The dotted area above the black one represents the payoff from strategic investment – i.e. the increase in profits the strategic investor enjoys if a rival is excluded.
- 4.166 The difference between the victim’s and strategic investor’s intrinsic value represents the costs of strategic investment – the strategic investor will have to pay more than the victim’s intrinsic value to prevent the victim obtaining the spectrum, and the price the strategic investor will have to pay for the spectrum will then be set by the victim’s intrinsic value.^{89 90} If more than one firm needs to invest strategically

⁸⁹ Note that the price premium paid by the strategic investor(s) does not depend on whether it knows the victim’s intrinsic value. Indeed, even if the strategic investor bid higher than the victim’s intrinsic value (because, for example, it overestimates the value) it would nonetheless pay a price at auction set at the victim’s intrinsic value (where the strategic investor is bidding against the victim and not other bidders). That is because the winning price in the Auction is set according to a second-price rule.

to foreclose a victim, then each one will face the cost illustrated in Figure 4.7 above, although the actual cost will differ as firms will generally have different intrinsic values of the spectrum.⁹¹ If, for example, effective strategic investment requires the participation of three players, then it will only be effective if it has a positive payoff for all three (including the one with the lowest intrinsic value of the three).

4.167 Before considering the case of particular national wholesalers, we can make some general comments about the likelihood that Auction outcomes will give rise to competition concerns:

- a) *Intrinsic value:* Vodafone has argued that a firm which requires spectrum to be credible will have a very high intrinsic value for that spectrum, such that strategic investment against it would be prohibitively expensive. We recognise that a firm may bid more for spectrum if it needs that spectrum to be a credible national wholesaler, but we do not agree that this means that any firm which needs spectrum to be credible faces no risk of being the victim of strategic investment.
- b) *Strategic investment:* We have considered multiple strategic investment outcomes, and it is not necessarily the case that strategic investment will be based on a clear view of rivals' intrinsic values, or who the victim will be:
 - i) In particular, the spectrum available in the award includes 2x30MHz of 800 MHz spectrum, and 2x70 MHz of 2.6 GHz spectrum. If a bidder took the view that one (or more) of its rivals needed some 800 MHz spectrum to be credible, it could invest strategically⁹² in 2x10 MHz of 800 MHz spectrum, in the belief that this would support an outcome in which a rival did not acquire any 800 MHz spectrum, or acquired less than it needed.⁹³
 - ii) Similarly, if a bidder took the view that one or more of its rivals needed more than 2x10 MHz of 2.6 GHz spectrum, it could invest strategically in 2x20 MHz of 2.6 GHz. With 2x70 MHz of this spectrum available, at most three firms can acquire 2x20 MHz, and if one firm which does not acquire it needs this spectrum (or 2x15 MHz) to be credible, then this outcome will have a strategic value to its rivals. From the perspective of an individual bidder, strategic investment in 2x20 MHz of 2.6 GHz spectrum could help to support such an outcome.
- c) *Payoff from strategic investment:* Firms would benefit from foreclosing a rival in two respects. Firstly, the likely reduction in competition from removing a credible competitive force from the market would allow them to offer higher prices and lower quality, with less risk that customers would respond by switching (as customers would have fewer alternatives than before). Secondly, the customers of the foreclosed rival would have an increased incentive to switch to those

⁹⁰ It is possible that the intended victim will also bid above its intrinsic value for reasons of strategic investment. However it remains the case that the firm with the lowest intrinsic value will be most at risk from strategic investment.

⁹¹ The intrinsic value of additional spectrum to a bidder may diminish as it acquires more spectrum. One implication of this is that, other things being equal, the more spectrum a bidder has to acquire to achieve strategic advantage, the more likely it is to have a relatively low intrinsic value for the last lot of spectrum it needs to achieve this purpose, and therefore the more costly strategic investment in this lot will be.

⁹² i.e. bid more than its own intrinsic value for the spectrum, and up to its expected strategic value of foreclosing its 'weakest' rival – the one most likely to be a victim of strategic investment.

⁹³ This outcome could arise because two of the other firms strategically invested in 2x10 MHz of 800 MHz spectrum, or because they had a higher intrinsic value for this spectrum than the victim.

providers who were still credible competitors. This second benefit could be greater if a larger rival were foreclosed than a smaller rival.

- 4.168 Using this framework we now consider the risk that particular national wholesalers would fail to acquire the spectrum they might need to compete in the future.

Likelihood that a fourth national wholesaler does not acquire the spectrum it needs to continue to be or to become a credible national wholesaler

- 4.169 We have considered whether there is a risk that a fourth national wholesaler, i.e. H3G or a new entrant, does not acquire the spectrum it needs to continue to be or to become a credible national wholesaler absent measures in the Auction.

- 4.170 As noted above, we consider that H3G is likely to need one of the following portfolios to enable it to be a credible national wholesaler:⁹⁴

	800 MHz	1800 MHz	2.6 GHz
Portfolio 1	2 x 15 MHz	-	-
Portfolio 2	2 x 10 MHz	-	2 x 10 MHz
Portfolio 3	2 x 5 MHz	2 x 15 MHz	-
Portfolio 4	-	2 x 15 MHz	2 x 20 MHz

Intrinsic value

- 4.171 Differences in intrinsic value may arise from differences in spectrum holdings, market position, or other factors such as firm capabilities. We refer in the analysis below to some of the responses to our January 2012 consultation on intrinsic value but see Annex 3, from paragraph 3.287 for a more comprehensive discussion.

- 4.172 Vodafone argued that if additional 4G spectrum were critical for H3G then the intrinsic value of such spectrum would be up to the total net present value of its future UK cash flows. Vodafone approximated this by estimating H3G's enterprise value.

- 4.173 We agree with Vodafone that if a fourth national wholesaler such as H3G requires a particular block of spectrum in order to be a credible national wholesaler then this is likely to increase its intrinsic value of that spectrum. However, Vodafone's argument implicitly assumes that H3G has no value without the spectrum in question. We do not consider that this is a reasonable assumption, even as an approximation. Whilst we recognise that its profits are likely to be diminished if it is no longer a credible national wholesaler, there would still be options for it to continue to be a commercially viable business, such as continuing to operate at the retail level or serving specific service or customer segments, or it could realise the value of some of its assets. Therefore, we consider that Vodafone's claim that H3G might bid up to its enterprise value for the spectrum that it needs to be credible is unlikely to be realistic.⁹⁵

- 4.174 Annex 6 of our January 2012 consultation, paragraphs 5.84-5.114, set out our analysis of H3G's likely intrinsic value of the spectrum that is available in this award relative to other national wholesalers. This included data on H3G's share of various mobile services, as summarised below. H3G is by far the smallest national wholesaler in terms of overall mobile subscriptions and revenues. It is closer to its rivals in share of 3G subscriptions, but H3G's share of 3G subscriptions has declined

⁹⁴ A fourth national wholesaler which did not have H3G's existing spectrum holdings would be likely to need a larger portfolio than shown here to be credible in the longer term.

⁹⁵ See also from paragraph A3.294 in Annex 3.

(from around 75% in 2005) as the number of 3G subscribers has grown. Its strong performance in data services, and relatively low share of smartphone users, may reflect that H3G has pursued a strategy focusing on aggressive pricing of data services, while the other three national wholesalers have been successful in selling 3G services with smartphones e.g. in Telefónica's case initially through an exclusive agreement to supply the iPhone.⁹⁶

Figure 4.8: H3G's share of subscriptions and revenues

H3G's share* of:	
Mobile subscriptions	7%
Mobile revenues	9%
3G subscriptions	17%
Smartphone users	9%
Data volumes	44%
Datacard/dongle subscribers	52%

**2010 figures: based on January 2012 Consultation, Figures 5.4, 5.5, 5.6 and 5.7.*

- 4.175 Vodafone has argued that 2G customers were unlikely to be early adopters of 4G services, suggesting that the intrinsic value of new spectrum was likely to depend more on 3G customers, in which H3G did not have a significant disadvantage.
- 4.176 We consider that, given the clear trend towards moving from 2G services to high speed services, national wholesalers with a large base of 2G customers may be able to obtain value from the spectrum in the Auction more rapidly.⁹⁷ H3G's experience of 3G is an example of an initial advantage being lost to rivals with larger customer bases (although other factors may have played a part). In our view, having a large customer base is important because of the time taken to acquire new customers, and doing so tends to be more expensive compared to retention and upgrading of existing customers.⁹⁸ H3G has a significantly smaller customer base than the other current national wholesalers and so may face frictions that slow down how quickly it can generate sales from the new spectrum. H3G's lack of 2G customers is likely to reduce its ability to monetise new spectrum relative to rivals, even if its market share disadvantage among 3G subscribers is smaller. While Vodafone's comment related to early adopters, we note that, given the relatively long timeframe of our analysis, our competition assessment also needs to take account of later adopters of 4G services. These considerations also apply to a new entrant (unless it has an existing customer base in another market that it can easily exploit).
- 4.177 Vodafone, Telefónica and Everything Everywhere have each suggested that acquiring 800MHz spectrum could be important to them (albeit for differing reasons) and have indicated a desire to win 800 MHz spectrum.⁹⁹ If a fourth national wholesaler had a lower intrinsic value for 800 MHz spectrum it might not be able to achieve any of Portfolios 1 to 3 above which include spectrum in this band. This

⁹⁶ January 2012 consultation, Annex 6, paragraph 5.98.

⁹⁷ January 2012 consultation, Annex 6, paragraph 5.88.

⁹⁸ January 2012 consultation, Annex 6 paragraph 5.30.

⁹⁹ January 2012 consultation, Annex 6, paragraph 5.83. In response to this consultation, Everything Everywhere (page 23) said that all operators needed sub-1 GHz spectrum; Vodafone (paragraph 77) commented that 900 MHz spectrum was not a good substitute for 800 MHz spectrum at least in the medium term, but also said (page 3) that the divested spectrum in the 1800 MHz band is an adequate substitute for sub-1 GHz spectrum for any potential purchaser; while Telefónica (paragraph 135) also said that 1800 MHz spectrum is a near substitute for 800 MHz.

would mean it needed to acquire the 1800 MHz spectrum and 2x20 MHz of 2.6 GHz spectrum (i.e. Portfolio 4) to remain credible.

- 4.178 We expect that Vodafone and Telefónica will also have an intrinsic value for 1800 MHz and/or 2.6 GHz spectrum, such as to achieve a higher share of spectrum for capacity (or to offer services with LTE-specific advantages in the near term, if they do not acquire 800 MHz). Also Everything Everywhere might want 2.6 GHz spectrum to achieve a higher share of spectrum.
- 4.179 In our January 2012 consultation (Annex 6, paragraph 5.117) we said that, while it was difficult to conclude what the most likely outcome was based on intrinsic value, the evidence suggested that there was a material risk that a fourth national wholesaler had a lower intrinsic value for the spectrum it required to be credible.
- 4.180 We recognise that, other things equal, a firm is likely to have a higher intrinsic value of spectrum which it needs to be credible. However, on balance we conclude that there remains a risk that a fourth national wholesaler may have a lower intrinsic value for the award spectrum than the other national wholesalers, and this could prevent it acquiring spectrum it needs to be credible.

Strategic investment

- 4.181 We also consider there to be a material risk that, even if a fourth national wholesaler has a higher intrinsic value, it might not acquire the spectrum it needs in the Auction due to strategic investment by its competitors. There may also be a mixed case in which the fourth national wholesaler is excluded due to having lower intrinsic value than some rivals, and strategic investment by others.
- 4.182 As set out above, we consider that a fourth national wholesaler is likely to need to acquire some combination of the following amounts of spectrum in each of the three bands (depending on what spectrum it acquires in the other two bands) in order to be credible:
- a) 15 MHz, 10 MHz, or 5 MHz of paired spectrum in the 800 MHz band;
 - b) 15 MHz of paired spectrum in the 1800 MHz band;
 - c) 20 MHz or 10 MHz of paired spectrum in the 2.6 GHz band.
- 4.183 We consider the risk of strategic investment in each of these bands in turn. Based on this analysis, we consider the overall risk that a fourth national wholesaler would fail to acquire any of the portfolios it needs to be credible.
- 4.184 The risk of strategic investment depends on its feasibility, the potential payoff from successful strategic investment, and its cost.
- 4.185 As regards the potential payoff, we set out in our January 2012 consultation our concerns¹⁰⁰ in relation to the potential detrimental effect for consumers if fewer than four national wholesalers were credible after the Auction. A reduction in competition, due to a reduction in the number of national wholesalers, could allow the remaining national wholesalers to set higher prices, offer poorer quality, and reduce investment. In view of this we expect that the payoff to national wholesalers of successful

¹⁰⁰ In Section 2, Annex 6 of the January 2012 consultation.

strategic investment which prevented a fourth national wholesaler from acquiring sufficient spectrum to be credible, could be considerable.¹⁰¹

- 4.186 We consider the feasibility and cost of strategic investment against a fourth national wholesaler in relation to each band of spectrum.
- a) *15 MHz, 10 MHz, or 5 MHz of paired spectrum in the 800 MHz band;*
- 4.187 *Feasibility:* The feasibility of strategic investment against a fourth national wholesaler requires there to be at least one Auction outcome in which it does not acquire 800 MHz spectrum. If Vodafone, Telefónica and Everything Everywhere each acquired 2x10 MHz of 800 MHz, a fourth national wholesaler would be excluded from this band. If two of the three acquired 2x10 MHz and the third acquired 2x5 MHz, the fourth national wholesaler would be prevented from acquiring 2x10 MHz (but could acquire 2x5 MHz), while if two of the three acquired 2x10 MHz and the third acquired none, the fourth national wholesaler would be prevented from acquiring 2x15 MHz.
- 4.188 *Cost:* The costs of strategic investment are driven by the difference between the victim's and the strategic investors' intrinsic value. We have discussed the sources of differences in value of 800 MHz spectrum in our January 2012 consultation (Annex 6, paragraphs 5.125 to 5.131) and in paragraphs 4.171 to 4.180 above. Given the plausibly high intrinsic value of this spectrum to the other three, their cost of strategic investment may not be high relative to the payoff. Indeed as suggested above they (or some of them) might outbid a fourth national wholesaler simply by bidding their respective intrinsic values, i.e. without strategic investment.
- 4.189 *Other issues:* As discussed in our January 2012 consultation (Annex 6, paragraphs 5.146 to 5.148) the coordination required between the other three operators may not be complex, as each acquiring 2x10 MHz may be an easily identifiable focal point for coordination. While coordination may be more difficult if the parties have differing intrinsic values, this need not reduce the likelihood of strategic investment. For example, a fourth national wholesaler could be excluded by two players with lower intrinsic value (than the third and fourth) investing strategically, and by the third player outbidding the fourth because it has a higher intrinsic value.
- 4.190 We note the outcome of five out of six European auctions held so far for 800 MHz involving at least four national wholesalers has been that all of the available spectrum was won by the largest three incumbent companies.¹⁰² In four of these auctions, the three largest incumbents each won 2x10 MHz.
- b) *15 MHz of paired spectrum in the 1800 MHz band;*
- 4.191 *Feasibility:* One of Vodafone or Telefónica could acquire the single block of 2x15 MHz of 1800 MHz, either before or in the Auction to exclude a fourth national wholesaler from this band.
- 4.192 *Cost:* To the extent that Vodafone and Telefónica face constraints in deploying LTE in the near term or need more spectrum capacity, these considerations will tend to

¹⁰¹ Paragraph 5.124 in Annex 6 of the January 2012 consultation.

¹⁰² The exception was Sweden, in which two incumbents (Tele2 and Telenor – a joint venture known as Net4Mobility) bid jointly for 2x10 MHz, so the fourth wholesaler (Hi3G) won 2x10 MHz. This is of limited relevance to the UK since our auction rules prevent any of the incumbent operators from bidding jointly. The auctions referred to here exclude Portugal and Switzerland which only have three national wholesalers.

increase their intrinsic value of spectrum in the Auction including 1800 MHz, and hence potentially reduce the cost to them of strategic investment in 1800 MHz.

4.193 *Other issues:* Vodafone suggested that strategic investment by either party in this block of spectrum could be inhibited by a free rider effect – i.e. Vodafone (for example) might prefer to allow Telefónica to incur the costs of strategic investment against H3G rather than itself incurring those costs. If both Telefónica and Vodafone were to engage in such free-riding behaviour, strategic investment might be unsuccessful or even not attempted (i.e. if both were to bid no higher than their intrinsic values). On the other hand, it could still be more profitable for each to decide to strategically invest (at least up to some level), even at the risk of increasing the cost of strategic investment by bidding against each other. This is more likely, the larger the payoff from successful strategic investment.

4.194 Furthermore, as we discuss in Annex 3, paragraph 3.353, there may be a focal point to assist in coordination between Vodafone and Telefónica, e.g. it may be that they will understand which of the two of them is likely to have the higher intrinsic value of the spectrum.

c) 20 MHz or 10 MHz of paired spectrum in the 2.6 GHz band.

4.195 *Feasibility:* If each of Everything Everywhere, Vodafone and Telefónica strategically invested in 2x20 MHz of 2.6 GHz spectrum, then a fourth national wholesaler would not be able to acquire 2x20 MHz.

4.196 Strategic investment to prevent a fourth national wholesaler from acquiring 2x10 MHz of 2.6 GHz spectrum would require one of the other operators to acquire *more than* 2x20 MHz of 2.6 GHz spectrum (or for low power sharers to acquire 2.6 GHz spectrum).

4.197 *Cost and other issues:* As noted above, Everything Everywhere, Vodafone and Telefónica each has reasons to acquire 2.6 GHz spectrum. We consider that there is a plausible focal point of each of the three largest operators acquiring 2x20 MHz of 2.6 GHz spectrum. Other European auctions of 2.6 GHz spectrum have led to a range of different outcomes (see Annex 3, paragraphs A3.384 to A3.391). However, in several of these (Austria, Denmark, Germany, Spain and Sweden) three bidders have each acquired 2x20 MHz of paired 2.6 GHz spectrum, usually with a fourth bidder acquiring the remaining 2x10 MHz. Among these examples, the three bidders winning 2x20 MHz were typically the three largest operators (with the exception of Austria, where Hi3G, the fourth largest operator, acquired 2x20 MHz).

4.198 The case in which a fourth national wholesaler requires only 2x10 MHz of 2.6 GHz spectrum does not provide as clear a focal point for strategic investment as a scenario where it requires 2x20 MHz of 2.6 GHz spectrum. There is one example (Finland) in which three national wholesalers acquired all 2x70 MHz of the available 2.6 GHz spectrum, with two of those operators each acquiring 2x25 MHz and the third acquiring 2x20 MHz. However in this case there was no fourth national wholesaler. Similarly in Switzerland, with only three national wholesalers, one of the three operators obtained 2x25 MHz and the other two obtained 2x20 MHz each, while the remaining spectrum was unsold.

Analysis across portfolios

4.199 The above discussion indicates that there is a risk that strategic investment could prevent a fourth national wholesaler from acquiring sufficient spectrum in the

800 MHz, 1800 MHz or 2.6 GHz bands. As a result, a fourth national wholesaler could potentially be prevented from acquiring any of the portfolios set out in paragraph 4.170.

4.200 Such successful strategic investment could be achieved by the following (non exhaustive) examples involving plausible focal points to assist in coordination between the strategic investors:

a) Everything Everywhere, Vodafone and Telefónica each acquiring 2x10 MHz of 800 MHz, plus one of Vodafone or Telefónica acquiring 2x15 MHz of 1800 MHz; or

b) Everything Everywhere, Vodafone and Telefónica each acquiring 2x10 MHz of 800 MHz and 2x20 MHz of 2.6 GHz.¹⁰³

4.201 Many considerations can affect the payoffs and cost of strategic investment. While the costs can be significant, they can be more than offset by the potentially large payoff from a reduction in the number of credible national wholesalers. Whilst this may not be the case in all possible scenarios, we consider that the risk of strategic investment against a fourth national wholesaler is realistic.

Conclusion

4.202 Our conclusion is that, absent measures in the Auction, there is a material risk that a fourth national wholesaler would not acquire the spectrum it needs to enable it to be a credible national wholesaler.¹⁰⁴

Likelihood that other national wholesalers do not win the spectrum they may need to be credible

Everything Everywhere

4.203 We summarised at paragraphs 4.78 and 4.81 above the reasons why we consider it is unlikely to be necessary for a national wholesaler to hold sub-1 GHz spectrum to be credible. But even if technical and market conditions were such that sub-1 GHz spectrum were more important than we have judged, we consider it is less likely that Everything Everywhere would need it to be credible compared to a fourth national wholesaler. This is because of Everything Everywhere's large holdings of 1800 MHz spectrum.

4.204 Furthermore, even if it were the case that Everything Everywhere needed sub-1 GHz spectrum to be credible, we consider that 2x5 MHz of 800 MHz spectrum would be

¹⁰³ If the 1800 MHz spectrum is acquired before the Auction, whether by a fourth national wholesaler or by one of Vodafone or Telefónica, this could make even clearer the strategic investment needed in the award to foreclose a fourth national wholesaler.

¹⁰⁴ In our January 2012 consultation (Annex 6, paragraphs 5.169 to 5.176) we considered the risk (relative to the risk of strategic investment which prevented a fourth national wholesaler from being credible) that, even if a fourth national wholesaler were credible, it might fail to acquire spectrum it needed to avoid being at a disadvantage in competing for particular service or customer segments. We argued that overall the relative incentives of rivals to strategically invest to bring about such an outcome were ambiguous, because the payoff from strategic investment would likely be lower but the costs could also be lower, depending on whether or not the potential strategic investor needed some spectrum of the relevant type.

sufficient.¹⁰⁵ In this case, there would be some risk that Everything Everywhere would not acquire the spectrum it needs to be credible in the Auction. Everything Everywhere could be a victim of strategic investment. However, it is likely to be at a lower risk of failing to acquire sub-1 GHz spectrum in the Auction than a fourth national wholesaler, if both need 800 MHz to be credible. This is because the size of a national wholesaler's existing customer base tends to affect what it is prepared to pay for the spectrum, as we discuss above, and Everything Everywhere has a larger existing customer base than any fourth national wholesaler.¹⁰⁶

Vodafone and Telefónica

4.205 If either Vodafone or Telefónica needed a larger share of spectrum, or the ability to offer services that had LTE specific advantages in the near term, then we consider 2x10 MHz of either 800 MHz or 2.6 GHz is likely to be sufficient for this, or the 2x15 MHz of 1800 MHz spectrum.

Intrinsic value

4.206 For similar reasons as for Everything Everywhere, we do not consider it likely that Vodafone or Telefónica will fail to acquire the spectrum they may require in the Auction due to having a lower intrinsic value than other bidders, since they are both established national wholesalers with large customer bases.

Strategic investment

4.207 In this case, either party could obtain the spectrum it needs by acquiring at least 2x10 MHz of any spectrum in the Auction. We consider it relatively unlikely that strategic investment would prevent this outcome. For example, effective strategic investment against Telefónica would require:

- i) Everything Everywhere, Vodafone and a fourth national wholesaler collectively to acquire at least 2x25 MHz of 800 MHz spectrum; and
- ii) Vodafone or a fourth national wholesaler to acquire 1800 MHz spectrum; and
- iii) Everything Everywhere, Vodafone and a fourth national wholesaler (and low power sharers) collectively to acquire at least 2x65 MHz of 2.6 GHz spectrum.

4.208 The probability of successful strategic investment against Telefónica is the probability of all three of these conditions holding simultaneously. While there are various outcomes that could lead to condition (i) holding, the most likely may be either:

- Everything Everywhere acquiring at least 2x15 MHz and Vodafone acquiring 2x10 MHz of 800 MHz (or vice versa); or

¹⁰⁵ We have set out why we consider H3G would be capable of being credible with a portfolio of 2x5 MHz of 800 MHz and 2x15 MHz of 1800 MHz spectrum from paragraph A2.117 in Annex 2. We consider that the same arguments apply to Everything Everywhere but that it is much more certain that Everything Everywhere would be capable of being credible, given it has significantly more 1800 MHz spectrum.

¹⁰⁶ In our January 2012 consultation (Annex 6, paragraphs 5.200 to 5.201) we considered the risk that, even if Everything Everywhere were credible, it might fail to acquire spectrum it needed to avoid being at a disadvantage in competing for particular service or customer segments. We noted that compared to the case where Everything Everywhere needed sub-1 GHz spectrum to be credible, both the costs and payoff of strategic investment against Everything Everywhere could be lower in this case. We said that overall strategic investment could be less likely, although this was not clear.

- Everything Everywhere and Vodafone acquiring 2x10 MHz each and a fourth national wholesaler acquiring at least 2x5 MHz.
- 4.209 As we have noted, the outcome of other European auctions of 800 MHz spectrum (see paragraph 4.190 above) has typically been for the three largest incumbents to win 2x10 MHz each of 800 MHz spectrum. In the context of spectrum that Telefónica needed to be credible, while it is possible for an operator to win more than 2x10 MHz or for the fourth national wholesaler to win some 800 MHz spectrum, these outcomes seem less likely.
- 4.210 As to condition (ii), there would be a risk of Vodafone or a fourth national wholesaler acquiring 1800 MHz spectrum and Telefónica failing to do so, either because of higher intrinsic value or strategic investment.
- 4.211 In the absence of new entrants or low power sharers acquiring spectrum, condition (iii) would require either that:
- Each of the other three national wholesaler acquires at least 2x20 MHz, and one of them acquires 2x25 MHz of 2.6 GHz spectrum; or that
 - One of the other three national wholesalers acquires more than 2x25 MHz of 2.6 GHz spectrum.
- 4.212 Taking the second of these first, we consider it unlikely that any operator will acquire *more than 2x25 MHz* of 2.6 GHz spectrum that prevents Telefonica or Vodafone from acquiring 2x10 MHz when it needs such spectrum to be credible, given the likely cost of such strategic investment. We note that acquisition of more than 2x25 MHz by one bidder has not occurred in any other European auction to date (although we recognise that in some countries this was prevented by spectrum caps). The first alternative may be more likely, but may still be relatively unlikely as there may be no obvious focal point for strategic investment (in particular to determine which of the three would acquire 2x25 MHz), and as discussed in paragraph 4.198 above, the only auctions in which any operators have won 2x25 MHz of 2.6 GHz spectrum were those with only three national wholesalers (Finland and Switzerland).
- 4.213 While there is some risk of each of these conditions holding, effective strategic investment against Vodafone or Telefónica would require all three conditions to hold at the same time.¹⁰⁷ In addition, the focal point across all of the bands is not entirely straightforward. On balance we consider it relatively unlikely that all three conditions would hold leading to this outcome (or a similar outcome with Vodafone being the victim of strategic investment).
- 4.214 We conclude that, in the absence of any measures to promote competition, the risk of strategic investment against either Vodafone or Telefónica is substantially less than the risk to a fourth national wholesaler.¹⁰⁸ In particular:

¹⁰⁷ If Vodafone or H3G were to acquire the 2x15 MHz of 1800 MHz spectrum prior to the award, this would reduce the number of options available to Telefónica for acquiring spectrum it might need to be credible. However it would still be able to bid for spectrum in the 800 MHz or 2.6 GHz bands.

¹⁰⁸ As discussed in paragraphs 5.229 and 5.230, Annex 6 of our January 2012 consultation, strategic investment to prevent Vodafone or Telefónica from acquiring spectrum they need to avoid a disadvantage in competing for particular service and customer segments (even if they are credible) could be less costly, but also have a lower payoff, than if they did need the spectrum to be credible. Overall the effect on the risk of strategic investment was unclear.

- a) There is a much lower risk that Vodafone or Telefónica will need additional spectrum to be credible compared to a fourth national wholesaler.
- b) If either needs more spectrum to be credible, we consider it unlikely that they would need more than 2x10 MHz of spectrum. This is less than the minimum we consider would be needed by a fourth national wholesaler.
- c) If either needed 2x10 MHz to be credible, they could acquire this spectrum in any band. In contrast, while a fourth national wholesaler could be credible with 2x15 MHz of 800 MHz spectrum, if it were excluded from acquiring this much 800 MHz spectrum it would be likely to need to acquire spectrum across two bands in order to be credible.
- d) If there were spectrum that both a fourth national wholesaler and Telefónica or Vodafone needed to be credible, they would be likely to have a higher intrinsic value for the spectrum than a fourth national wholesaler because of their larger customer base.

Step 3: Summary of potential competition concerns if there were no measures in the Auction to promote national wholesale competition

- 4.215 Having considered the potential Auction outcomes that might give rise to our competition concerns and the likelihood of the outcomes arising in the Auction absent any regulatory measures to prevent them, we are able to identify the competition concerns that we believe we should be concerned about. Effectiveness in addressing these concerns provides a key part of our assessment of potential measures to promote competition in the next step in the analysis, before we consider the costs and disadvantages of the particular measure.
- 4.216 As discussed above we have two types of competition concern affecting the future competitiveness of markets for the provision of mobile services:
- i) our larger concern that there could be fewer than four credible national wholesalers after the Auction; and
 - ii) our lesser concern that even if there are at least four credible national wholesalers, one or more of them is at a disadvantage in competing for some services and customers.

Fewer than four credible national wholesalers

- 4.217 This is our larger concern because it would have a greater magnitude of effect were it to arise, since we believe there is likely to be a significant reduction in consumer benefits if there were fewer than four credible national wholesalers as a result of the Auction. In the light of our analysis of the potential Auction outcomes that could give rise to this concern we have concluded that the highest source of risk relates to the failure of a fourth national wholesaler to win the spectrum it would need to continue to be, or become, a credible national wholesaler in the future after the Auction.
- 4.218 We recognise that there is some risk that this concern could arise through the failure of one of Everything Everywhere, Vodafone or Telefónica to have sufficient spectrum to be credible after the Auction but we consider that this risk is much lower. This is for a combination of reasons: first, since it is less clear that additional spectrum is needed for them to be credible, and second, even if it is, it is less clear that these national wholesalers would be unable to acquire sufficient spectrum in the Auction to

mitigate the risk. The balance between these two factors differs for these national wholesalers but we consider the overall effect is similar.

4.219 Figure 4.9 set out our conclusions in more detail. The final column of Figure 4.9 shows the importance of each competition concern. By importance in this table we mean the combined effect of three factors: the likely magnitude of the competition concern from a specified Auction outcome and the possible size of associated consumer detriment; the likelihood of technical and market conditions being such that the detriment arises with that Auction outcome; and the likelihood of national wholesalers failing to acquire the required spectrum to avoid that Auction outcome.

Figure 4.9: Summary of assessment of first type of competition concern: fewer than four credible national wholesalers after the Auction

Competition concern	Comment	Importance of concern
1. Fourth national wholesaler not credible because insufficient share of spectrum & no sub-1 GHz spectrum, & no highest peak data rates with early LTE nor other LTE advantages in near term and perhaps longer term	This is our single largest concern. The potential magnitude of this concern is high, as there would be a risk of significant consumer harm with fewer credible national wholesalers. We consider there is a material risk in relation to this concern. This is because a fourth national wholesaler is likely to need more spectrum of the right type & amount to be credible, and it may not obtain it without measures in the Auction, due either to lower intrinsic value or strategic investment by other bidders.	High
2. Everything Everywhere not credible because no sub-1 GHz spectrum	While the potential magnitude of this concern is high (as with concern 1), we consider the likelihood is low. This is because of Everything Everywhere's large current holdings of 1800MHz and 2.1 GHz spectrum, which we consider mean it is likely to be credible even without spectrum in the Auction.	Low to Medium
3. Telefónica/Vodafone not credible because no highest peak data rates with early LTE, no other LTE advantages in near term or insufficient share of spectrum	While the potential magnitude of this concern is high (as with concern 1), we consider the likelihood is low. It is unclear whether Vodafone & Telefónica would be credible without spectrum in the Auction, but if they do need spectrum to be credible we consider it is substantially less likely that they would fail to obtain what they need than the risk to a fourth national wholesaler.	Low to Medium

One or more national wholesalers is at a disadvantage in competing for some services and customers

4.220 In relation to our lesser type of concern, by definition the magnitude of this concern is lower as it only relates to some particular customer or service segments (which are not of such over-riding importance to consumers that a national wholesaler's credibility is undermined). However, weaker competition in such segments could still materially reduce consumer benefits. Our analysis has identified a number of ways in which competition might be weaker: a lack of access to sub-1GHz spectrum, a large contiguous bandwidth for LTE, spectrum that provides other LTE advantages in the near term, sufficient spectrum capacity, and because one competitor has a very large share of spectrum. These are summarised in Figure 4.10.

Figure 4.10 Summary assessment of lesser competition concerns: one or more national wholesalers are at a disadvantage in competing for some services and customers even if there are at least four credible national wholesalers

Competition concern	Comment	Importance of concern
4. Weaker competition because one or more competitors does not have sub-1 GHz spectrum	Although there could be material consumer detriment, we consider that this is a lesser concern than having fewer than four credible national wholesalers because it would not affect all customers and the degree of consumer impact would be lower if there are four credible national wholesalers. In addition, national wholesalers may be able to acquire this spectrum in the Auction (although there is a risk they may fail to do so).	Low
5. Weaker competition because one or more competitors does not have 2x15 MHz or 2x20 MHz contiguous block for LTE	This is a lower concern for the same reasons as concern 4. We are also not certain how much high peak data rates matter to consumers (as opposed to average data rates), though it is possible that they may be more relevant to small cells where there is more likely to be a single user. (Divestment of 2x15 MHz of 1800 MHz spectrum also clearly helps this concern and the following concern. This divestment is happening anyway and is independent of the Auction).	Low
6. Weaker competition because one or more competitors does not have early route to LTE and so cannot provide other LTE advantages (e.g. better latency)	This is a lower concern for the same reasons as concern 4. It is also a lower concern because it is temporary. In the longer term 900 MHz and even 2.1 GHz spectrum will be suitable for LTE. We are also not certain that LTE will offer other significant competitive advantages over evolving HSPA standards.	Low
7. Weaker competition because one or more competitors does not have enough spectrum for capacity and average data rates	This is a lower concern for the same reasons as concern 4.	Low
8. Weaker competition because one competitor has a very large share of spectrum	This is a lower concern for the similar reasons as concern 4.	Low

4.221 In addition to the smaller magnitude of detriment to consumers arising from these concerns, they would also be mitigated to some extent by the spectrum acquired by national wholesalers in most Auction outcomes. Accordingly we do not believe that this set of lesser concerns provides a strong basis for taking very interventionist measures in the Auction to promote competition but that if there are measures that are lower cost then it might nevertheless be proportionate to adopt them.

Step 4: Measures to promote national wholesale competition

4.222 The final step in our analysis is to consider in the round what measures would be effective in addressing the competition concerns we have identified, and whether it would be appropriate and proportionate to adopt them.

4.223 Below we summarise our policy option assessment, and then explain why we consider the particular measures we have chosen are both effective in addressing our concerns, and appropriate and proportionate.

Option assessment and decision

4.224 In the January 2012 consultation we assessed a range of options for addressing the competition concerns:¹⁰⁹

- Option 1: No measures in the Auction to promote national wholesale competition;
- Option 2: Safeguard caps only;
- Option 3: Tight caps to promote at least four national wholesalers;
- Option 4: Competition constraint and safeguard caps¹¹⁰;
- Option 5: Reservations of spectrum to ensure at least four national wholesalers when sub 1GHz spectrum essential, and safeguard caps;
- Option 6: Reservations of spectrum to ensure at least four national wholesalers when an early route to LTE is essential, and safeguard caps; and
- Option 7: Reservations of spectrum to mitigate all risks to national wholesaler competition, and overall cap.

4.225 We provisionally concluded that Option 4 was capable of effectively addressing our larger competition concern, and the most appropriate and proportionate option to do so.

4.226 Some responses to the January 2012 consultation questioned the rigour and logic of our assessment, and also suggested new options or variations of options. In particular, Everything Everywhere and Telefonica considered that we had understated the advantages of Option 3 (tight caps) compared to Option 4. Everything Everywhere said we should have considered a different set of tight caps, and made alternative suggestions for what the tight caps might be. Vodafone suggested the use of bidder credits. We have considered these responses, including these new options. However, for the reasons set out below and in Annex 3 our view remains that Option 4 is more appropriate and proportionate than other options suggested by consultation respondents.¹¹¹ In reaching our decision we have considered which option (both from those we originally considered and those proposed in responses) is the most effective and proportionate to address our overall aim of promoting competition. We make this assessment on the basis of:

- which options are effective at addressing our policy aim, and especially our larger competition concern that the Auction might result in fewer than four credible national wholesalers because of the material risk for a fourth national wholesaler. Recognising that some options are more effective than others, but also that some options are more onerous than others, as part of our assessment here, we have

¹⁰⁹ See paragraphs 4.184 to 4.224 of the January 2012 consultation for our original policy assessment, together with section 8 of Annex 6 of that consultation.

¹¹⁰ We referred to Option 4 as 'reservation for a fourth national wholesaler and safeguard caps' in the January 2012 consultation, but here we refer to it as the 'competition constraint and safeguard caps'. While Option 4 is a type of reservation, we want to distinguish it from a simpler 'set aside' type of reservation that would involve the reservation of a single portfolio. In contrast to this, Option 4 involves the reservation of one portfolio from a group of alternative portfolios with bids made in the Auction determining which particular portfolio is reserved for a fourth national wholesaler.

¹¹¹ Our assessment of the advantages and disadvantages of the options proposed in responses compared to Option 4 is set out from paragraph A3.431 in Annex 3.

taken into account which option addresses our competition concerns in a proportionate way;

- for those options that are effective at addressing our policy aim, we consider which is the least onerous one required to achieve our policy aim; and
- whether the least onerous option produces adverse effects arising which are disproportionate to the aim pursued.

4.227 In comparing the options, we note that we are comparing them in the presence of considerable uncertainty. We consider that uncertainty is an inevitable aspect of our competition assessment, given its forward-looking nature and the potential for rapid and unexpected developments in technology, mobile services and consumer demand. These uncertainties mean that making decisions on the relative importance of the different competition concerns involves a measure of judgement, but one informed by the analysis we have undertaken.

Effectiveness of policy options to achieve the policy aim identified

4.228 We continue to consider that Option 1 (no measures) and Option 2 (safeguard caps only) are unlikely to be effective at addressing the competition concerns.

4.229 We further still consider that Options 3 to 7 all appear to be reasonably effective at addressing our larger competition concern, with some addressing our other competition concerns better than others.¹¹² We consider that one set of tight caps proposed by Everything Everywhere would be effective at addressing our larger competition concern.¹¹³ As regards Vodafone's suggestion of bidder credits, we consider these may be less effective than the other options at addressing our larger competition concern, because of the significant scope for error in setting an appropriate bidder credit such as the risk that the amount of the bidder credit was insufficient to ensure a fourth national wholesaler could acquire spectrum to be credible.

4.230 As a further step in assessing the effectiveness of these options, recognising that some options are more effective than others, but also that some options are more onerous than others, in order to reach our overall conclusion, we have considered which options should be discounted on the basis that they do not address the competition concerns in a proportionate way. In considering this, we consider it relevant to take into account the considerable uncertainty around each option.

4.231 This uncertainty could in our view lead to two rather different types of response:

- attempt to mitigate as many competition concerns as possible; or
- favour approaches that address the key competition concerns but involve making fewer and more limited regulatory judgements.

¹¹² As explained in paragraph A3.412 in Annex 3, we have modified our scoring on three of the options compared to our January 2012 consultation.

¹¹³ One of Everything Everywhere's proposed set of caps involved a 2x20 MHz cap on sub-1 GHz spectrum and a 2x15 MHz cap on 800 MHz spectrum. If only two parties obtained sub-1 GHz spectrum, this would ensure that the fourth national wholesaler would obtain 2x15 MHz of 800 MHz spectrum. We consider the other set of caps proposed by Everything Everywhere would not ensure the fourth national wholesaler was able to obtain the spectrum we consider is likely to be necessary for it to be credible. See from paragraphs A3.463 in Annex 3 for more explanation of this.

- 4.232 These different responses have fundamentally different implications.
- 4.233 The first response implies a highly interventionist approach in which regulation determines major aspects of the allocation of the spectrum to be awarded. This approach would tend to favour Option 3 (tight caps) and Option 7 (mitigate all risks) that addressed all the more important competition concerns about ensuring at least four credible national wholesalers well, and also some of the lesser competition concerns reasonably well.
- 4.234 However, this comes at the cost of being highly restrictive in terms of potential outcomes from the Auction. This increases the risk of an inefficient spectrum outcome. As a result, we consider that these options are relatively less effective ways of achieving our policy aim than others, particularly in light of our statutory duties to secure the optimal use of the spectrum.
- 4.235 The second response implies a much less interventionist approach allowing competition in the Auction to determine the acquisition of spectrum to a large extent, constrained only by targeted measures such as to focus on the competition concern of greatest significance.
- 4.236 On balance, we favour the second response. This is because we are concerned that attempting to mitigate as many risks as possible will lead to a high degree of intervention, which may not only risk that we fail to secure our statutory duties, but may also result in significant costs when a less onerous option (Option 4) is available and achieves our policy aim. Therefore, having regard to proportionality, we do not consider that it would be an effective way of achieving our policy aim to put in place restrictions in the Auction which would attempt to mitigate more or as many risks as possible.

Assessment of the least onerous option

- 4.237 This does not mean however that there should be no measures in the Auction to promote national wholesale competition where the competition concern is sufficiently important. In our analysis, despite the uncertainty, the evidence supports the view that the competition concern that there may be fewer than four credible national wholesalers after the Auction falls into this category. In addition, taking into account existing spectrum holdings, we consider it is clear that the risk of failing to be a credible national wholesaler is significantly greater for a fourth national wholesaler (H3G or a new entrant) than for the three largest current national wholesalers. These considerations point towards Option 4 (competition constraint) as being the most appropriate and proportionate option on the basis that we consider that this is the least onerous option of those that are effective in achieving our policy aim. We consider that two of the new options we have considered in Annex 2 (bidder credits and set aside reservation) are also consistent with the second response, but that these are less effective or more onerous than the competition constraint.
- 4.238 We also do not believe we should disregard the other potential competition concerns completely and have decided to impose safeguard caps on both sub-1 GHz and overall spectrum as a way to mitigate some of them. We consider that the costs and risks associated with these caps are likely to be low as they do not tightly prescribe what bidders may win.¹¹⁴ As such, we consider them to be proportionate.

¹¹⁴ See also paragraphs 8.11 to 8.26 in Annex 6 of the January 2012 consultation.

- 4.239 We therefore consider it is most appropriate to impose the competition constraint (which reserves a portfolio of spectrum for a fourth national wholesaler from a group of alternative portfolios) together with safeguard caps. Having reached this conclusion, we go on to consider the proportionality of the form of competition constraint imposed by assessing which of the possible alternative formulations of the option is the least onerous.
- 4.240 We have considered a number of different ways in which we might specify the details of what spectrum we should reserve. In doing so we have to balance two conflicting considerations: on the one hand the risk the reservation is insufficient to ensure enough spectrum of the right type to facilitate a credible fourth national wholesaler, and on the other hand that we go too far and weaken competition or create inefficiency in using spectrum reservation. The risk of weakening competition could arise, for example, from limiting the amount of spectrum that would be available to other national wholesalers which could facilitate strategic investment in spectrum in the Auction such that one or more of these other national wholesalers were weakened. The risk of inefficiency could arise if it turned out that a fourth national wholesaler was not the most efficient user of the reserved spectrum.
- 4.241 To decide which groups of portfolios to reserve in the competition constraint we have considered:
- (i) the portfolios that, if acquired by a fourth national wholesaler, are likely to enable it to be credible; and
 - (ii) the portfolios we should reserve, having regard to proportionality, in light of the answers to question (i).
- 4.242 On the question of the spectrum a fourth national wholesaler needs to enable it to be credible, in the January 2012 consultation, we considered three alternative groups of portfolios for this option relating to the different spectrum which could be reserved for the fourth national wholesaler, namely a smaller group of portfolios, a medium group of portfolios and a larger group of portfolios.¹¹⁵ We have now decided on a group of portfolios most similar to the medium group in the January 2012 consultation, but we have modified some of the portfolios to align with our final assessment of what portfolios would be likely to enable a fourth national wholesaler to be credible. We consider this modified medium group of portfolios compared to a smaller group and a larger group.
- 4.243 In terms of (i) above, we remain of the view that it is likely that the modified medium group of portfolios are sufficient to ensure the fourth national wholesaler obtains sufficient spectrum to be capable of being credible. We consider that the smaller group of portfolios (i.e. 2x10 MHz of 800 MHz spectrum or 2x15 MHz of 1800 MHz spectrum) would give a low level of confidence that the fourth national wholesaler would be credible. Larger portfolios would further increase the likelihood that they would be sufficient for the fourth national wholesaler to be credible.
- 4.244 Turning to (ii) above, we have considered whether it would be proportionate to reserve either the larger or smaller portfolios rather than the modified medium group.
- 4.245 We do not consider that it would be proportionate to reserve larger portfolios than the modified medium group. While reservation of larger portfolios would increase the confidence of reserving sufficient spectrum for a fourth national wholesaler, it would

¹¹⁵ See Figure 4.11 of the January 2012 consultation.

be at the cost of a more interventionist approach and a greater risk of adverse effects. In particular, if the modified medium group of portfolios were insufficient and the fourth national wholesaler needed a larger set of portfolios to be credible, it may be more likely that Telefonica and Vodafone would also need additional spectrum to be credible. Reserving a larger group of portfolios would increase the risk of the adverse effect of Telefonica and Vodafone not obtaining the spectrum they need to be credible.

- 4.246 To assess whether it would be proportionate only to reserve the smaller set of portfolios (i.e. 2x10 MHz of 800 MHz spectrum or 2x15 MHz of 1800 MHz spectrum), we have considered whether such reservation would still enable the fourth national wholesaler to obtain sufficient spectrum to be credible. In other words, whether the fourth national wholesaler could still obtain one of the modified medium portfolios by purchasing appropriate unreserved spectrum in the Auction to add to one of the smaller reserved portfolios. Specifically, if only the smaller set of portfolios were reserved, the fourth national wholesaler would need to win unreserved spectrum in the Auction in either the 800 MHz or 2.6 GHz bands to achieve any one of Portfolios 1 to 4 (see the table in our conclusions on Step 1 above for the composition of these Portfolios).
- 4.247 Our analysis above (from paragraph 4.169) indicates that a fourth national wholesaler is at risk of strategic investment in each of these spectrum bands, which could prevent it acquiring the additional unreserved spectrum. We illustrate this with an example. If the other three national wholesalers were each to acquire 2x10 MHz of 800 MHz spectrum, then the fourth national wholesaler would win the reserved portfolio of 2x15 MHz of 1800 MHz spectrum (rather than the other smaller reserved portfolio of 2x10 MHz of 800 MHz). This would mean that the fourth national wholesaler would fail to achieve either Portfolio 1 or Portfolio 2. Since in this example the other three national wholesalers would acquire all 2x30 MHz of 800 MHz between them, the fourth national wholesaler would also fail to achieve Portfolio 3 – it would not acquire the additional unreserved 2x5 MHz of 800 MHz it would need to add to the reserved 2x15 MHz of 1800 MHz. Furthermore, if the other three national wholesalers were also each to acquire 2x20 MHz of 2.6 GHz spectrum, then the fourth national wholesaler would fail to achieve Portfolio 4 as well, because it would not acquire the additional unreserved 2x20 MHz of 2.6 GHz that it would need to do so. We note that this example involves a clear focal point for the other three national wholesalers, i.e. that each acquires 2x10 MHz of 800 MHz and 2x20 MHz of 2.6 GHz.
- 4.248 Given the risk of the fourth national wholesaler failing to acquire the required additional unreserved spectrum, we consider that, if only the smaller set of portfolios were reserved (i.e. 2x10 MHz of 800 MHz spectrum or 2x15 MHz of 1800 MHz spectrum), we would not have a high level of confidence that it would be capable of being credible.
- 4.249 We also consider below the risk that our measures would have adverse effects, in particular of increasing the risk of Everything Everywhere, Vodafone or Telefonica failing to acquire spectrum they might need to be credible. Such an outcome could lead to a reduction of competition. However, based on our analysis below, we consider that the risk of effective strategic investment against either Vodafone or Telefónica with our measures to promote competition is still materially less than the risk of effective strategic investment against a fourth national wholesaler in the absence of these measures.

4.250 We therefore consider that it is appropriate to reserve all of Portfolios 1 to 4 (as shown in Figure 4.11 below) in order to enable the fourth national wholesaler to acquire the spectrum it needs to enable it to be credible.¹¹⁶ We consider this is the least onerous way of achieving our policy aim of promoting national wholesale competition, given the uncertainties we have about the efficacy of the smaller portfolios in addressing our main concerns.

4.251 Overall we consider that our measures are an appropriate and proportionate way of achieving our policy aim of promoting national wholesale competition.

Specification of the portfolios included in the competition constraint

4.252 If the 2x15 MHz of 1800 MHz to be divested by Everything Everywhere as a result of its merger commitments to the European Commission is not sold prior to the Auction and so is to be awarded through the Auction, following on from our conclusions above, then we will reserve one of the following portfolios for a fourth national wholesaler.

Figure 4.11: Alternative portfolios reserved for fourth national wholesaler

	800 MHz	1800 MHz	2.6 GHz
Portfolio 1	2 x 15 MHz	-	-
Portfolio 2	2 x 10 MHz	-	2 x 10 MHz
Portfolio 3	2 x 5 MHz	2 x 15 MHz	-
Portfolio 4	-	2 x 15 MHz	2 x 20 MHz

4.253 Within this group of portfolios, bidding in the Auction would determine which particular portfolio a fourth national wholesaler obtained (and also which bidder obtained it), but a fourth national wholesaler would be guaranteed one of the portfolios (as long as it was willing to pay the reserve price). Subject to that caveat, we consider that this arrangement ensures that a fourth national wholesaler can obtain sufficient spectrum to be capable of being credible in a way that minimises the risk of distorting the Auction outcome. All bidders can to some extent influence which portfolio will be obtained by a fourth national wholesaler. This reduces the risk of inefficient spectrum allocation by allowing bidding in the Auction to have a greater

¹¹⁶ We have also considered possibilities in between the smaller portfolios and Portfolios 1 to 4. First, we considered the possibility of reserving only Portfolios 3 and 4 (and omitting Portfolios 1 and 2). However, this would run counter to the approach of the competition constraint, which for reasons of spectrum efficiency includes as reserved portfolios all of the minimum portfolios that would enable the fourth national wholesaler to be credible and then allows the choice of portfolio to be determined by bidding in the Auction. Second, given that the risk that a fourth national wholesaler is the victim of strategic investment and fails to acquire 2x10 MHz of 2.6 GHz is lower (compared with the risk for 2x20 MHz of 2.6 GHz), we considered the possibility of reserving Portfolios 3 and 4 plus a cut-down version of Portfolio 2, i.e. including as a reserved portfolio 2x10 MHz of 800 MHz but omitting the other component of Portfolio 2 of 2x10 MHz of 2.6 GHz, which would then also be a cut-down version of Portfolio 1 (albeit that was not the basis for the option). However, there would remain a risk that the opted-in bidder would win the portfolio that is a cut-down version of Portfolios 1 and 2, but would fail to acquire the additional unreserved spectrum it would need to increase its acquisition in the Auction up to the full version of either Portfolio. For example, one source of such risk is that the opted-in bidder would fail to obtain 2x5 MHz of 800 MHz of unreserved spectrum to achieve the full version of Portfolio 1, because of strategic investment in the 800 MHz band. This could put at risk our objective of promoting national wholesale competition. It could also reduce spectrum efficiency because the choice of winning reserved portfolio would be affected through some of the bids including strategic investment value not only the intrinsic value of the bidders. There is also a risk of strategic investment denying the opted-in bidder 2x10 MHz of 2.6 GHz to achieve the full version of Portfolio 2, although this risk is lower.

influence over the outcome than if we were simply to reserve specific spectrum for a fourth national wholesaler.

4.254 The portfolios are not intended to give precisely the same capability but rather to provide a national wholesaler with sufficient spectrum to be capable of being a credible national wholesaler.

4.255 We have also decided to impose the following safeguard caps:

- sub 1GHz safeguard cap of 2x27.5 MHz; and
- overall spectrum cap of 2x105 MHz.

4.256 We consider these particular caps to be the minimum necessary to avoid very asymmetric distributions of spectrum.

Treatment of a new entrant

4.257 As proposed in the January 2012 consultation, we have decided to have the same reservation for H3G or a new entrant.¹¹⁷ In particular, for the reasons set out from paragraph A2.133 of Annex 2, we consider that it is more appropriate and proportionate to reserve the same portfolios for H3G and a new entrant. Further, we consider that this does not preclude a new entrant obtaining sufficient spectrum in the Auction to be capable of being credible even in the longer term, but we recognise it may need to obtain more than the reserved spectrum (either in the Auction or subsequently). As a result, on balance we consider it is likely to be sufficient for promoting at least four national wholesalers to set the same portfolios for H3G and a new entrant.

4.258 Portfolio 4 does not contain sub-1 GHz spectrum, which might be particularly valuable to a new entrant to assist it to roll out a network more quickly. However, the relevant question for inclusion in the set of reserved spectrum portfolios is whether Portfolio 4 would enable a new entrant to be credible. We consider that Portfolio 4 is likely to do so, even if we recognise that it may take a new entrant more time to become credible without sub-1 GHz spectrum (see paragraph 4.151 above). To the extent that a new entrant has a preference for other of the reserved portfolios which include sub-1 GHz spectrum, it can reflect this in the bids it makes in the Auction

Alternative portfolios reserved for fourth national wholesaler if the 2x15 MHz of 1800 MHz divestment is sold before the Auction

4.259 If Everything Everywhere sells the 2x15 MHz of 1800 MHz spectrum that it is required to divest as part of its merger commitments before the Auction, the reserved portfolios will change depending on who acquires that spectrum. We set out an analysis of the options for the reserved portfolios from paragraph A2.158 of Annex 2.

4.260 In summary, if the 2x15 MHz of 1800 MHz spectrum is bought by Vodafone or Telefónica, then the group of portfolios that would be reserved for a fourth national wholesaler reduces to those shown in the table below.

¹¹⁷ See from paragraph A3.561 in Annex 3 for our discussion of responses on this point, and from paragraph A2.133 in Annex 2 for the full analysis of the issue.

Figure 4.12: Alternative portfolios reserved for fourth national wholesaler when 2x15 MHz of 1800 MHz spectrum is acquired by Vodafone or Telefónica before the Auction

	800 MHz	1800 MHz	2.6 GHz
Portfolio 1	2 x 15 MHz	-	-
Portfolio 2	2 x 10 MHz	-	2 x 10 MHz

- 4.261 Alternatively, if the divested 2x15 MHz of 1800MHz were obtained by H3G or a potential new entrant, then the portfolios would differ for those two parties, for the reasons set out in Annex 2.¹¹⁸
- 4.262 If the acquirer of the 2x15 MHz of 1800MHz spectrum opts in (so as to bid for the reserved spectrum), then to satisfy the competition constraint it would need to acquire the other part of Portfolios 3 and 4, the two reserved portfolios containing 1800 MHz spectrum that we have decided on (given that they would already hold 2x15 MHz of 1800 MHz spectrum):

Figure 4.13: Alternative portfolios for the party that had already acquired the 1800 MHz divestment spectrum (if they entered the Auction and opted-in)

	800 MHz	1800 MHz	2.6 GHz
Portfolio 3a	2 x 5 MHz	-	-
Portfolio 4a	-	-	2 x 20 MHz

- 4.263 The portfolios that would be available to other opted-in bidders in this case would be Portfolios 1 and 2, the two reserved portfolios that do not contain 1800 MHz spectrum (given that the portfolios involving 2x15 MHz of 1800 MHz spectrum would no longer be available):

Figure 4.14: Alternative portfolios for other opted-in bidders

	800 MHz	1800 MHz	2.6 GHz
Portfolio 1	2 x 15 MHz	-	-
Portfolio 2	2 x 10 MHz	-	2 x 10 MHz

Possibility of producing adverse effects which are disproportionate to the aim pursued

- 4.264 Finally, we have also considered more generally whether our measures produce adverse effects which are disproportionate to the aims we are pursuing.

Risk of regulatory failure

- 4.265 We consider that the main risks of potential regulatory failure with measures in the Auction designed to achieve the desired objective of promoting competition by promoting at least four credible national wholesalers in the future are the risks of (i) unintentionally weakening competition or (ii) causing spectrum inefficiency.
- 4.266 We do not consider the effects of our measures are disproportionate to our aims. There are two scenarios to consider: first where a fourth national wholesaler would have obtained the spectrum reserved for it in any case even in the absence of the measures; and second where it obtains the spectrum as a result of the reservation. In

¹¹⁸ We received several mixed views from respondents about the appropriate reserved portfolios if the 1800 MHz spectrum is sold pre-Auction to a party other than Telefonica or Vodafone, and these are set out from paragraph A3.569.

the first scenario the cost of the measure is clearly low.¹¹⁹ In the second scenario there may be costs of spectrum inefficiency associated with the fourth national wholesaler acquiring the spectrum when it had a lower intrinsic value. However, we consider it likely that the benefits to consumers from seeking to ensure at least four credible national wholesalers outweigh such costs.

4.267 Finally, the risk of regulatory failure associated with promoting at least four national wholesalers in the Auction is mitigated since, if the market evolves in a way that means it would in fact have been in consumers' interests to have fewer national wholesalers, this can, at least in part, be addressed later through, for example, market consolidation. This could be subject to scrutiny under merger control or a competition assessment of the trade at that time as appropriate. By contrast if measures are not put in place in the Auction to promote four credible national wholesalers such that only three national wholesalers emerge and this is shown not to be in consumers' interest, then it would be much more difficult to change this position to increase the number of national wholesalers in the future.

Reserve prices and consideration of a roll out obligation

4.268 The way we are proposing to set reserve prices helps to mitigate the risk that we reserve spectrum for a fourth national wholesaler when the opposite would have been in consumers' interests. It might be against consumers' interests to reserve spectrum for a fourth national wholesaler if that fourth national wholesaler had a much lower intrinsic value than the parties that would otherwise have obtained the spectrum and if the competition benefits from having a least four national wholesalers were not sufficiently large. We have considered this risk when setting reserve prices. The reserve prices we have proposed to set for the spectrum in the reserved portfolios are considerably higher than if they were set at a low but not trivial level. This helps to mitigate this risk that we reserve the spectrum when it is not in consumers' interest.¹²⁰

4.269 H3G argued in its response that a roll-out obligation should be imposed on the winner of the reserved spectrum to minimise the risk of speculative entry, when a party acquiring the spectrum has no real plans to roll out a network and compete effectively with the established operators. We have considered imposing such an obligation, in addition to the way we have set reserve prices, as a way of mitigating reserving spectrum when it is inefficient to do so. While we see some merit in the argument H3G made, we have decided not to impose such an obligation. This is because we consider the risk is small of a party obtaining the reserved spectrum and not rolling out a network to be a national wholesaler and because we consider there are risks of unintended consequences from the introduction of such an obligation, including the risk of deterring a new entrant.¹²¹

Strategic investment, with our measures to promote competition

4.270 As part of our consideration of whether our measures produce adverse effects which are disproportionate to the aim pursued, we have also considered whether these measures would increase the risk of Everything Everywhere, Vodafone or Telefónica failing to acquire additional spectrum which they might need to be capable of being credible.

¹¹⁹ See paragraphs 7.31-7.34 in Annex 6 of the January 2012 consultation.

¹²⁰ See Section 8 for more explanation on how we determined our proposals for reserve prices.

¹²¹ See from paragraph A3.597 in Annex 3 for a more detailed explanation of why we have not imposed a roll-out obligation.

- 4.271 As described above, we consider it unlikely that Everything Everywhere needs spectrum to be credible. But if it were the case that Everything Everywhere needed sub-1 GHz spectrum to be credible, we consider that 2x5 MHz of 800 MHz spectrum is likely to be sufficient. We consider that our package of measures may make it more likely that Everything Everywhere would be able to obtain this, compared to if there were no measures in the Auction. This is because of the sub-1 GHz spectrum caps which prevent Vodafone and Telefónica from acquiring all of the 800 MHz spectrum and because the alternative spectrum portfolios that are reserved include a portfolio that does not include sub-1 GHz spectrum.¹²²
- 4.272 If Vodafone or Telefónica needed at least 2x10 MHz of any spectrum, then taking the example of Telefónica, effective strategic investment against Telefónica would require all of the following to apply simultaneously:
- i) Everything Everywhere, Vodafone and a fourth national wholesaler collectively to acquire 2x25 MHz of 800 MHz spectrum; and
 - ii) Vodafone or a fourth national wholesaler to acquire 1800 MHz spectrum; and
 - iii) Everything Everywhere, Vodafone and a fourth national wholesaler (and low power sharers) collectively to acquire 2x65 MHz of 2.6 GHz spectrum.
- 4.273 Our sub 1 GHz spectrum cap rules out some outcomes which could lead to Telefónica being prevented from acquiring 2x10 MHz of 800 MHz spectrum, such as, for example, Everything Everywhere and Vodafone each acquiring 2x15 MHz (as this would put Vodafone's holdings of sub-1 GHz spectrum above the cap).
- 4.274 On the other hand, our reservation measures mean that a fourth national wholesaler will acquire some spectrum in one or two of the three bands (800 MHz, 1800 MHz, and 2.6 GHz). This means that the reservation could increase the possibility of any two of the three conditions above holding.
- 4.275 None of the portfolios leads to a reservation for a fourth national wholesaler in all three bands. If a fourth national wholesaler won 800 MHz and 1800 MHz spectrum in Portfolio 3, this would not, in itself, prevent Telefónica from acquiring 2.6 GHz spectrum, or if a fourth national wholesaler won Portfolio 4, our measures would not stop Telefónica acquiring 800 MHz spectrum. Having said that, reservation of spectrum for a fourth national wholesaler could in principle increase the overall risk of strategic investment against Telefónica (or Vodafone).
- 4.276 Telefónica has argued that if the 1800 MHz spectrum were acquired by Vodafone then it would be at risk of strategic investment.¹²³ If the fourth national wholesaler were prevented from acquiring 1800 MHz spectrum, and therefore of achieving Portfolios 3 and 4, this would mean that it would be reserved either Portfolio 1 (2x15 MHz of 800 MHz) or Portfolio 2 (2x10 MHz of 800 MHz and 2x10 MHz of 2.6 GHz). In the case of Portfolio 1, Telefónica could be prevented from obtaining 2x10 MHz of 800 MHz spectrum if either Everything Everywhere or Vodafone acquired 2x10 MHz of this spectrum. In the case of Portfolio 2, both Everything Everywhere and Vodafone may need to acquire 800 MHz spectrum (e.g. 2x10 MHz each) for successful strategic investment against Telefónica.

¹²² See paragraphs A3.414 to A3.415 in Annex 3 for more explanation.

¹²³ Telefónica response to our January 2012 consultation, paragraph 133.

- 4.277 However, such an outcome would leave either 2x70 MHz (if the fourth national wholesaler acquired Portfolio 1) or 2x60 MHz (Portfolio 2) of 2.6 GHz spectrum. If Everything Everywhere and Vodafone each acquired 2x20 MHz of this spectrum, that would leave 2x30 MHz or 2x20 MHz of 2.6 GHz spectrum available. The fourth national wholesaler could potentially also acquire 2x20 MHz of 2.6 GHz spectrum, but in this case the fourth national wholesaler would be acquiring more than it needed to be credible, as a strategic investment against a national wholesaler with a larger customer base (which needed such spectrum to enable it to be credible). We consider this to be relatively unlikely.
- 4.278 Furthermore, even if Everything Everywhere, Vodafone and the fourth national wholesaler each acquired 2x20 MHz of 2.6 GHz spectrum, there would still be potentially 2x10 MHz left which Telefónica could acquire (if the fourth national wholesaler obtained Portfolio 1). So successful strategic investment in that case would require (along with the other conditions outlined above) either that Telefónica needed more than 2x10 MHz of additional spectrum, or that one of the other operators acquired more than 2x20 MHz of 2.6 GHz spectrum (or acquisition of spectrum by low power bidders).
- 4.279 In conclusion, reservation for a fourth national wholesaler could have some impact in increasing the risk of strategic investment against Vodafone or Telefónica. However, we consider that the risk of effective strategic investment against either Vodafone or Telefónica with our measures to promote competition is materially less than the risk of effective strategic investment against a fourth national wholesaler would be in the absence of these measures.

Conclusion

- 4.280 In light of the analysis above, we do not consider that the measures we have decided to take produce adverse effects which are disproportionate to the aim pursued. Accordingly, we therefore consider that it is appropriate and proportionate to take the measures set out above in the Auction to address our single largest competition concern relevant to achieving our policy aim of promoting competition to the benefit of consumers, i.e. that a fourth national wholesaler may not emerge from the Auction with sufficient spectrum to enable it to be a credible national wholesaler.

Competition Assessment: future retail competition

- 4.281 As explained above, our policy aim in the context of this competition assessment is the promotion of competition in markets for the provision of mobile services. In addition to those measures proposed at the wholesale level, we have considered whether competition should be further promoted at the retail level.
- 4.282 Compared to retail-only competitors such as MVNOs, entry or expansion by sub-national RAN operators, based on shared use of 2.6 GHz spectrum at low power, could promote competition over more of the value chain and facilitate innovative business models, including through the deployment of 'inside-out' networks.
- 4.283 One way to facilitate such an outcome would be by aggregating the bids of low power users, so that a block of spectrum would be awarded to low power users if the sum of bids from such users exceeded the highest bid for standard power use for that block. We have consulted on the view that it is appropriate to aggregate the bids of low power bidders for 2.6 GHz spectrum. By avoiding the need for users to negotiate a

joint bid, aggregation would go some way to dealing with any coordination failure.¹²⁴ In response, stakeholders have not provided evidence that changes our view. We conclude that it is appropriate and proportionate to aggregate bids from low power use, from up to ten bidders, for either 2x10 MHz or 2x20 MHz of 2.6 GHz spectrum.¹²⁵

- 4.284 We have also considered whether we should go further to reserve spectrum, in particular 2x10 MHz of 2.6 GHz spectrum, for low power use.
- 4.285 In our January 2012 consultation (Annex 6, paragraph 9.67) we said that, given the potential benefits to consumers of low power entry, and the risk that it would not occur without reservation, we were minded to favour reservation of 2x10 MHz of 2.6 GHz spectrum. However we recognised this was a difficult judgement, and said that we would welcome more evidence on the costs and benefits of such a measure.
- 4.286 A decision to reserve spectrum for low power use would need to be based on an expectation that:
- a) market entry by sub-national RAN operators using 2.6 GHz spectrum is a better outcome for consumers than such spectrum being used by others (such as standard power use by a national wholesaler) – i.e. the benefits of such entry are likely to exceed the opportunity cost; and
 - b) if so, that there is a significant risk that such entry would not occur in the absence of reservation.
- 4.287 As we set out below, we consider that there is significant uncertainty as to the scale of the benefits that would be delivered by reserving spectrum for low power use, and therefore a risk that reservation would lead to an inefficient use of the spectrum. There is an opposite risk that such entry would be the best use of the spectrum (from a consumer perspective) but would not occur absent reservation. However, on balance we have concluded for the reasons set out below that we should not reserve spectrum for low power use.

Benefits and costs of reservation for low power use

Benefits

- 4.288 Market entry by sub-national RAN operators could potentially deliver significant benefits to consumers (over and above, i.e. incremental to, benefits that consumers would otherwise obtain¹²⁶). By adding mobile services to a fixed high speed broadband network, sub-national RAN operators could offer improved indoor coverage, high data rates, and LTE services. There is also the possibility that these operators could introduce paradigm-shifting business models, for example from being able to integrate fixed and mobile delivery of TV, broadband and telephony services on multiple devices.

¹²⁴ March 2011 Consultation, Annex 6, paragraph 8.27.

¹²⁵ We have considered aggregating bids in addition for 2x15 MHz, however our view is that this will add significantly to implementation complexity for the Auction.

¹²⁶ For example, from standard power use (in spectrum excluding the 2x10 MHz of 2.6 GHz spectrum under consideration for reservation) or through deployment of low power networks in alternative bands. The benchmark of the benefits that consumers would otherwise obtain excludes the benefits from standard power use of the 2x10 MHz of 2.6 GHz spectrum under consideration for reservation, because that is taken into account below when considering the opportunity costs of reservation.

- 4.289 Entry by sub-national RAN operators could also lead to a more competitive outcome. For example, if competition between national wholesalers were to become less intense in the future, the presence of sub-national RAN operators could help to sustain competition, including by acting as a competitive fringe to undermine any coordinated outcome between national wholesalers. Sub-national operators might also introduce innovative services or business models which could act as a disruptive competitive force.¹²⁷
- 4.290 However, prospective entry based on low power use of 2.6 GHz spectrum is subject to considerable uncertainty. In particular we note that:
- a) There remain some issues to be resolved for the business models and technical implementation of low power entry. Everything Everywhere¹²⁸ argued that the technical viability of concurrent low power licences was unclear, and described the business model as unproven. Similarly Arqiva, while arguing that entry based on lower power use was likely to deliver significant benefits, noted that “industry is still working through the technical and business implications”.¹²⁹
 - b) There is a risk that market entry will not occur on a substantial scale, or that it will not be successful. In response to our January 2012 consultation, only two firms have expressed (ongoing) interest in entering the market using low power licences. It is possible that entry by one or two firms could have a significant positive impact on competition and consumer outcomes, and that other interested parties would emerge. We also recognise that the firms who have expressed interest have a significant presence in related services. However, the lack of broad interest in entering the market raises the risk that, if the firms currently supporting reservation do not persist in their plans, or if the business models they intend to adopt do not succeed, reservation will not lead to positive consumer outcomes or large benefits. One party which had previously expressed an interest in entering has since told us that it has abandoned its plans in this area.
 - c) If successful market entry does occur, it remains to be seen whether it will lead to greatly improved consumer outcomes, as this will depend on the new services which are offered, and the extent to which they are an improvement on, or addition to, services which are currently available (or will anyway be available from standard power networks).
 - d) Similarly, the competitive impact of successful market entry depends on a range of factors, including whether or not entrants have plans for aggressive growth (e.g. through low pricing), whether customers see the new services as substitutes or complements, and whether these services offer only marginal improvements on existing services, or are significant innovations potentially leading to disruptive competition.
- 4.291 In summary, while we consider that there is an opportunity for market entry through low power use of spectrum, there remains considerable uncertainty about the extent of such entry and the size of incremental benefits to consumers and competition.

¹²⁷ January 2012 consultation, Annex 6, paragraphs 9.21 and 9.22.

¹²⁸ Everything Everywhere’s response to our January 2012 consultation, sections 7.4 and 7.3.

¹²⁹ Arqiva response to our January 2012 consultation, page 3.

Costs

- 4.292 If the spectrum were not acquired by such operators but by national wholesalers, this would create value by allowing increased capacity and higher average data rates, or even the deployment of LTE networks for those without other spectrum that is suitable for early deployment of LTE. Denying this value is the opportunity cost of the use of this spectrum by sub-national RAN operators.
- 4.293 Results from other European auctions suggest that the value to standard power users of 2x10 MHz of 2.6 GHz spectrum could be around £30-150 million in the UK. The lower bound of this range reflects our proposed reserve price for paired 2.6 GHz spectrum. The upper bound reflects the top end of the range of international benchmarks for this spectrum. See Section 8 for further details. This indicates that the opportunity cost of reserving this spectrum for low power use would be significant.
- 4.294 It seems relatively clear that there will be significant costs associated with reservation for low power and preventing national wholesalers from obtaining some 2.6 GHz spectrum, even though we have a wide range in our estimate of the level. By contrast the size of the benefits from new entry and innovation by low power users is relatively less certain.
- 4.295 In summary, it is not clear whether market entry by sub-national RAN operators using 2.6 GHz spectrum is a better outcome for consumers than such spectrum being used by others (such as standard power use by a national wholesaler).

Risk that net-beneficial entry would not occur in the absence of reservation

- 4.296 We have considered the risk that low power shared users would not acquire spectrum in the Auction even if it would be better for consumers if they did so. There are three potential reasons why this might be the case. Bidders for shared low power use may not acquire the spectrum because:
- co-ordination issues amongst themselves reduce their bids (below their intrinsic value);
 - these bidders have a lower intrinsic value (in aggregate) compared to national wholesalers, even if low power entry would lead to better consumer outcomes; or
 - these bidders (even if they have a higher intrinsic value in aggregate) are victims of strategic investment by national wholesalers.
- 4.297 As in the January 2012 consultation (Annex 6, paragraphs 9.30 to -9.35 and 9.61), our view is that there is a low risk that, with aggregation of bids, low power bidders will fail to coordinate, leading to bids below their respective intrinsic values.
- 4.298 On the second reason, we assessed potential differences in intrinsic value in our January 2012 consultation, Annex 6, paragraphs 9.36 to 9.45. As we noted there, arguments can be made in both directions as to the relative intrinsic value of low power bidders (in aggregate) and national wholesalers and our consideration of responses has not led us change that view.¹³⁰

¹³⁰ See also from paragraph A3.610 in Annex 3.

- 4.299 On the third reason, we assessed the risk of strategic investment in our January 2012 consultation, Annex 6, paragraphs 9.46 to 9.52. We concluded that whilst there was not clear evidence, we did not consider that we could rule out the possibility of strategic investment by national wholesalers. We note that our reservation of spectrum for a fourth national wholesaler may increase the likelihood of a fourth national wholesaler acquiring 2x20 MHz of 2.6 GHz spectrum in the Auction. If this were to occur, the other three wholesalers could prevent low power entry by acquiring the remaining 2x50 MHz (or potentially by acquiring 2x45 MHz).
- 4.300 Such an outcome is feasible, as two national wholesalers could acquire 2x15 MHz with the third acquiring 2x20 MHz, or two could acquire 2x20 MHz with the third acquiring 2x10 MHz. It is not obvious which of the three remaining operators would acquire a different amount of spectrum than the other two. However it may be that the three operators could find a suitable focal point. In light of this, we consider that there is a possibility of strategic investment by national wholesalers preventing 2.6 GHz spectrum being won for low power use.
- 4.301 Overall, whilst there is the opportunity for low power users to win 2.6 GHz spectrum in the Auction, we recognise that there is a risk that beneficial entry of sub-national RAN operators would not occur in the absence of reservation.

Link between benefits, costs and risk that beneficial entry will not occur

- 4.302 We further note that there is a link between the benefits of sub-national RAN entry and the risk that entry will not occur in the absence of reservation.
- 4.303 To the extent that low power bidders have a fairly accurate assessment of their prospects of successful market entry it seems reasonable to expect that if sub-national RAN entry will have a larger consumer benefit, then low power bidders will have a higher intrinsic value for the spectrum, and will bid on that basis. Whilst there is still a risk of beneficial entry not occurring, it is likely to be reduced, e.g. strategic investment is still possible but is more costly the higher the (aggregated) intrinsic value of low power bidders. Therefore, the stronger the prospects of successful market entry, the more likely it is that low power bidders will win spectrum and their entry will occur even in the absence of reservation.

Conclusion

- 4.304 Responses to our January 2012 consultation did not provide substantial new evidence on the benefits from low power entry. We have reappraised our view in the light of the evidence set out in our January 2012 consultation, and the limited new evidence we have received since the consultation.
- 4.305 In conclusion we continue to believe that arguments regarding the merits of reserving spectrum for low power use are finely balanced. Nonetheless, whereas we are more certain that there will be a relatively significant cost associated with a low power reservation, there is less certainty about the magnitude of the benefits such a reservation would confer. We recognise there is a risk that low power bidders might fail to acquire 2.6 GHz when it was desirable for consumers. However, based on the available evidence we are not sufficiently confident that low power use is necessarily more beneficial for consumers than standard power use for the more interventionist approach of reservation for low power to be proportionate.
- 4.306 In our January 2012 consultation (Annex 6, paragraphs 9.53 to 9.59), we considered whether our concerns could be mitigated through the level at which we would set a

reserve price for spectrum reserved for low power bidders. However, we consider that there is no clear basis for setting a reserve price and there is a substantial risk of a regulatory failure, because if the reserve price were too low or too high, it would not provide the intended test of whether or not the spectrum should be reserved for low power.¹³¹

4.307 We have therefore decided not to reserve 2.6 GHz spectrum for low power use.

4.308 We have decided to enable aggregated bids in the Auction between up to ten low power bidders for 2x10 MHz and 2x20 MHz of 2.6 GHz to allow the choice between low power and standard power use of this spectrum to be determined by competition in the Auction.

Overall conclusions

4.309 In this section we have set out our decisions on measures that we consider are likely to be the most appropriate and proportionate to address those concerns.

4.310 In summary we have decided:

- to reserve spectrum for a fourth national wholesaler;
- to impose safeguard spectrum caps on holdings of sub-1 GHz spectrum and overall spectrum; and
- to allow aggregated bids from potential low power shares for 2x10 MHz and 2x20 MHz of 2.6 GHz spectrum, but not to reserve any 2.6 GHz spectrum for shared low power use.¹³²

4.311 In particular we have decided to reserve one of the following portfolios for a fourth national wholesaler:¹³³

	800 MHz	1800 MHz	2.6 GHz
Portfolio 1	2 x 15 MHz	-	-
Portfolio 2	2 x 10 MHz	-	2 x 10 MHz
Portfolio 3	2 x 5 MHz	2 x 15 MHz	-
Portfolio 4	-	2 x 15 MHz	2 x 20 MHz

4.312 Exactly which of these portfolios will be reserved for a fourth national wholesaler will be determined by the Auction.

¹³¹ Respondents to our January 2012 consultation did not comment on the question of using a reserve price to mitigate the risk of an inefficient allocation of spectrum.

¹³² This differs from our proposals in the January 2012 consultation where we were minded to favour reservation of 2x10 MHz of 2.6 GHz spectrum for low power use by operators of sub-national RANs. This change, to not reserve spectrum for such use but rather put in place specific rules in the Auction to allow for this competition to take place through aggregating the bids made by low power bidders, is in light of the responses to the January 2012 consultation and our further analysis, which is discussed further from paragraph 4.281 above.

¹³³ Having considered the responses to the January 2012 consultation and undertaken further analysis, we decided to make two changes to the portfolios we previously set out. In Portfolio 5 from the January 2012 consultation (now Portfolio 3 in the table above), we have reduced the quantity of 800 MHz spectrum to 2x5 MHz (from 2x10 MHz). In Portfolio 6 from the January 2012 consultation (now Portfolio 4 above), we have increased the amount of 2.6 GHz spectrum from 2x10 MHz to 2x20 MHz. The reasons for these changes are discussed from paragraph 4.142 above.

4.313 We have also decided to impose the following safeguard caps:

- sub-1 GHz safeguard cap of 2x27.5 MHz; and
- overall spectrum cap of 2x105 MHz.

4.314 We consider that these decisions are consistent with our principal duty to further the interests of citizens and consumers, where appropriate by promoting competition.

4.315 In particular, we have taken account of our duty to secure optimal use of the spectrum, and consider that our decisions are likely to secure an outcome in which scarce mobile spectrum is likely to be used in a manner which best exploits its potential, by ensuring a level of competition at the wholesale level which incentivises competitors to use the spectrum in the most efficient manner to the benefit of consumers.

4.316 We have considered the likely impact of our decisions on investment and innovation and the availability and use of high speed data transfer services through the United Kingdom. We note that the spectrum in the combined award is highly suited to providing high speed data transfer services, and we have sought to put together measures which are most likely to promote competition and thereby investment, innovation and wide availability of such services in the future. In our view, our measures also draw an appropriate balance between existing investments by current competitors which have led to relatively competitive markets to date, and possible future investment and innovation by both existing competitors and also possible new entrants, on either a national or sub-national basis.

4.317 We have also kept in mind our duty to have regard to the interests of consumers in respect of choice, price, quality of service and value for money. We consider that by imposing measures in the Auction intended to promote a vibrant national wholesale market, the retail market should be capable of providing consumers with a wide range of services at competitive prices.

4.318 Finally, we consider that the measures we have decided to impose provide equality of opportunity for competitors to be able to compete in future mobile markets, without discriminating unduly in favour of, or against, any individual or class of competitors. We have in particular taken care to take account of existing spectrum holdings, in order to seek to ensure that the Auction should not result in overall spectrum holdings which distort competition. In setting out our decisions, we have considered whether these are the least onerous necessary to achieve our intended aims, and as such constitute proportionate and appropriate measures to put in place to further the interests of consumers by promoting competition.

Section 5

Mobile coverage and related issues

5.1 In section 5 of the January 2012 consultation we explained the further consideration we had given to the potential role of the Auction in promoting future mobile coverage in the light of responses to our proposals in the March 2011 consultation. We put forward a revised proposal for a more extensive coverage obligation than we had previously proposed. In this section we review responses to our revised proposal and explain the decisions we have reached on including coverage obligations in 800 MHz licences.

Policy objective in setting coverage-related obligations

5.2 The auctioning of 800 MHz provides a rare opportunity, through the release of new spectrum, to promote the development of next generation mobile broadband services for the benefit of consumers and citizens. One of the core policy objectives informing our work on the Auction is to ensure that the benefits of these services become available to the vast majority of consumers and citizens in a timely manner.

5.3 We have designed the Auction to promote a competitive market in the supply of mobile broadband services and we believe that competition will play a significant role in promoting the timely and efficient delivery of these services. However, competition on its own may not necessarily lead to rapid roll-out: notwithstanding the existence of a competitive market, none of the 2G mobile operators started to provide 3G services until late 2004¹³⁴ – almost four years after the award of 3G licences in 2000. Although there may be greater challenges to rolling out a mobile data service at 2.1 GHz (rather than at 800 MHz), it was nevertheless ten years after the award before 3G service coverage had reached 87% of the UK population¹³⁵. This suggests that market forces alone may not be sufficient to ensure that next generation mobile broadband services are delivered to the vast majority of the UK population in a timely manner and that it may be appropriate for us to impose coverage-related obligations to achieve our objective. We consulted on proposals for a coverage obligation in both the March 2011 and January 2012 consultations.

Proposals in the January 2012 consultation

5.4 In the January 2012 consultation:

- We proposed to include an obligation in one of the 800 MHz licences to provide a mobile broadband service for indoor reception to significantly more than 95% of the UK population. We asked for views on this and on the proposed extent of a coverage obligation.
- We invited views on how we might define an indoor coverage obligation.
- We set out two approaches to specifying the coverage obligation and invited comments on which of the two would be preferable:

¹³⁴ http://stakeholders.ofcom.org.uk/binaries/research/cmr/comms_mkt_report05.pdf

¹³⁵ http://stakeholders.ofcom.org.uk/binaries/research/cmr/753567/CMR_2010_FINAL.pdf

- Approach A, which would require the licensee to provide a 4G mobile data service to an area within which at least 98% of the UK population lives.
- Approach B, which would require the licensee to provide the specified mobile data service with coverage comparable to the combined mobile voice coverage of today's 2G networks and in addition to provide the same service with coverage comparable to that of the additional mobile voice coverage achieved through the Government's Mobile Infrastructure Project (MIP)¹³⁶, in those areas where MIP infrastructure would be capable of supporting a 4G mobile data service.
- We invited views on the suggestion that, if an additional coverage obligation below the UK level were considered desirable, the appropriate level might be 95% of the population of each nation.
- We invited comments on our assessment that it was unlikely to be proportionate to impose the coverage obligation on more than one licensee.
- We invited views on the costs and benefits of a wholesale access obligation on the licensee with the coverage obligation in respect of those areas beyond existing 2G mobile voice coverage.
- We invited views on the value of monitoring compliance with the coverage obligation by complementing technical criteria by some testing of actual experience.
- We invited comments on the possibility that we might consider granting concurrent licences in certain limited circumstances.

5.5 We summarise below the responses we received on each of these points. We then set out the position we have taken on each of them and our decisions, under the following headings:

- An obligation to provide indoor coverage to 98% of the UK;
 - Approach A versus Approach B
 - Measuring indoor coverage
 - An "outside-in" obligation and use of customer premises equipment (CPE)
 - Use of alternative spectrum bands and technologies
 - Proportionality of the obligation
- An obligation to provide indoor coverage to at least 95% of homes in each nation
- An obligation on a single licensee with no wholesale access obligation
- The licence condition and compliance monitoring

¹³⁶http://www.culture.gov.uk/what_we_do/telecommunications_and_online/8757.aspx

- Enforcement
- Granting concurrent licences

Responses received

An obligation for the UK as a whole

- 5.6 The coverage obligation we proposed in the January 2012 consultation had a number of aspects. These included the extent of the obligation, whether it should specify both indoor and outdoor coverage, and how it should be defined – by reference to a certain proportion of the population or to some other coverage measure.
- 5.7 In the March 2011 consultation we had proposed to include in one 800 MHz licence an obligation to provide a mobile broadband service to an area within which 95% of the UK population lives. We reviewed our proposal in light of responses to that consultation, our further analysis of the costs of extending coverage in rural areas and the Government's decision to invest £150m in the MIP to improve mobile coverage in rural areas. In the January 2012 consultation we proposed to include a more extensive coverage obligation and asked for comments on the proposed extent of the obligation.
- 5.8 19 responses explicitly supported an enhanced coverage obligation beyond the 95% of UK population proposed in our March 2011 consultation. Four were not in favour, including BT and Intel. Some responses suggested there was a lack of clarity or insufficient analysis in our proposals, which prevented them from giving a definitive response on some aspects of the proposals – these included Everything Everywhere (Everything Everywhere), BT, Intellect, Vodafone and the Department of Enterprise, Trade and Investment (DETI)¹³⁷.
- 5.9 Responses objecting to a proposed extended obligation made the following main points:
- The cost of a 98% coverage obligation, or an obligation benchmarked to 2G voice coverage, represents very large costs for high speed mobile data provision to replicate an equivalent service available on fixed networks indoors and is therefore not proportionate (BT).
 - A coverage obligation could be onerous and disadvantage the relevant licensee. If the objective is to deliver broadband to rural areas that should be the metric. Coverage obligations should be balanced with a realistic business case and a least restrictive regulatory regime. (Intel).
- 5.10 Points made on the need for more clarity or further analysis were:
- The proposal lacks the detail needed to discuss meaningfully the extent of the coverage obligation. A critical aspect is the network loading to be assumed for measuring compliance. Other important factors are the assumed SINR and building penetration loss (Everything Everywhere).
 - It is unclear what the obligation to provide a 4G mobile data service means. A specific data rate available at a given percentage of locations where

¹³⁷ DETI is the main government department in Northern Ireland dealing with economic development.

population lives or geographic areas, measured at locations outdoors, would be a much clearer and more predictable and verifiable metric (BT).

- It is unclear whether we intend to require new technology to be deployed everywhere (to deliver 4G) or just to the extent needed to extend and improve existing 3G data services (BT).
- Neither option is very clear and both will be hard to verify (Intellect).
- We have not considered whether it would be proportionate to extend the obligation to 98% (Vodafone).
- We have not considered whether the extended obligation would favour any particular operator (Vodafone).
- We have not considered what it would mean for the reserve price of the lot with the obligation (Vodafone).
- Concern that the options had not been adequately considered or supporting evidence for the conclusions was sound (DETI).

Indoor coverage

5.11 Our proposal in the March 2011 consultation was for the licensee with the coverage obligation to provide a mobile broadband service with a 90% probability of indoor reception. Because indoor reception of mobile broadband is highly dependent on the building in which reception is desired and where the user is located in the building, in the January 2012 consultation we invited views on how we might define an indoor coverage obligation.

5.12 Five responses recognised the importance of providing mobile data coverage indoors. BT and Intellect queried whether setting an indoor coverage obligation was the right objective, either because it was inappropriate or difficult to verify (or both). Specific comments were:

- An obligation focused on extending indoor mobile broadband coverage to areas where equivalent indoor mobile broadband is delivered by fixed networks (commercially funded in some cases, subsidised in others) is a distortion of competition and a waste of public funds (BT and Intellect).
- The obligation will reduce the bid price and so represent a government subsidy and, as indoor coverage is already provided by fixed networks, this would be contrary to EU State Aid rules (BT).
- Assuming Approach A relates to indoor coverage of 2Mbps downlink, it is unclear where inside the buildings located where 98% of population lives this data rate must be available, with what probability and what type of devices. The obligation should not prescribe indoor signal levels but should focus on coverage of locations where a certain percentage of population is located (BT).
- An indoor coverage obligation, effectively subsidised by government, favours one means of broadband delivery over another and may distort competition and investment in other networks. Any obligation is better specified in terms

of outdoor coverage. WiFi and femtocells offer alternatives for indoor coverage. Indoor coverage cannot be verified (Intellect).

- To provide assured indoor coverage at any given location the minimum signal level should be set at around -83dBm calibrated using agreed radio planning tools (H3G).
- Providing indoor coverage through window-ledge consumer premises equipment (CPE) would not be a mobile service. We need to be clear whether our objective is to deliver mobile broadband or fixed broadband, which is addressed by Broadband Delivery UK (BDUK)¹³⁸. A mobile network coverage obligation should not rely on using CPEs (Everything Everywhere).

Options for an extended coverage obligation

5.13 As noted above, we set out two potential approaches to specifying an extended obligation – Approach A, based on 98% coverage, and Approach B, defined with reference to 2G voice coverage including the additional voice coverage delivered by MIP. There was no clear preference for either of our two proposed approaches to specifying the coverage obligation. Some responses were opposed to both or agnostic between them and made the following comments:

- More important than which of these two specifications is chosen is that there is an extensive coverage obligation to ensure that rural consumers receive the coverage that they deserve. The best approach would be to ensure that an obligation lies on the provider of the Mobile Infrastructure Project (MIP) infrastructure to ensure that it has to carry services provided by the 800 MHz licensees. Among other things, this guarantees to the 800 MHz licensees that they are able to meet their coverage obligation in a cost effective way (Arqiva).
- One respondent (Vodafone) was unable to judge the merits of the two options because of lack of clarity in defining Approach B.
- One respondent (Everything Everywhere) said it was difficult to discuss the geographical extent of the obligation in the abstract as coverage depends on precise technical specifications of what is being measured. Subject to appropriate technical specifications, it suggested the obligation might be to cover an area in which 98% of UK population lives according to the latest census results, including the provision of services from MIP sites where feasible.
- Neither approach can be supported without caveats – they are both unclear and would be hard to verify (Intellect).

Approach A: provide a service to an area in which 98% of UK population lives

5.14 Seven responses supported Approach A, although three of those wanted 100% coverage. Three of the four responses opposing this approach saw the risk of no

¹³⁸ BDUK is a team within DCMS set up to deliver the Government's broadband strategy - see http://webarchive.nationalarchives.gov.uk/+/http://www.culture.gov.uk/what_we_do/telecom_munications_and_online/7781.aspx

coverage for remote areas. Specific comments from some of those that did not support this approach or were ambivalent are summarised below:

- Do not favour Approach A as it would allow the operator to choose where to cover to achieve 98%, which is likely to be in those areas that are most economical for the operator (Communications Consumer Panel).
- Approach A will simply encourage focussed investment in limited areas (Buckinghamshire Thames Valley and Hertfordshire Local Enterprise Partnership).
- If any coverage obligation is necessary, then of the two proposals, we think that a variation of Approach A may be preferable. However, the obligation should focus on coverage of locations where a certain percentage of population is located. The percentage should be carefully considered to ensure that it is proportionate, taking into account other solutions, including existing and planned fixed line and satellite solutions (BT).
- Neither approach can be supported without caveats but if an obligation is needed, one based on Approach A measured against an outdoor target that can be verified, might be the simplest solution (Intellect).

Approach B: provide a service with coverage comparable to today's combined 2G coverage plus additional voice coverage achieved through MIP

5.15 Nine responses supported Approach B, three did not favour it and seven had reservations about it – mainly because of uncertainty about MIP. Specific comments made by respondents in relation to Approach B include the following:

- Geographical coverage needs to be much more clearly defined than 'current 2G coverage (combined)' in order to avoid costly uncertainty. Strongly opposed to Approach B (Everything Everywhere).
- While not against a link between 4G coverage obligation and improved 2G coverage as a result of the MIP, without further detail of the programme and its impact on 2G mobile coverage for consumers in Scotland there is an inherent risk in linking this to the 800 MHz licence coverage requirement. An informed decision on whether to link a licence requirement to the 2G coverage levels can only be taken once firm details of the MIP are established (Consumer Focus Scotland).
- Concerned that Approach B might lead to a considerably lower coverage for Scotland, Wales and Northern Ireland than the suggested 95% for each nation in Approach A. For MIP to be effective a more detailed study is required to determine the location of these not-spots, which will also determine how the £150m allocated could be effectively utilised (Ofcom Advisory Committee for Scotland).
- Linking coverage to the MIP offers opportunity to direct investment to at-risk or not-spots areas. However, insufficient information on the MIP has been made available as part of this consultation to draw any informed decisions on the option (DETI).
- We do not believe that Ofcom should include a MIP commitment in the coverage obligation. It is far from clear how the MIP process will work and, in

our view, an open-ended commitment could lead to considerable valuation uncertainty for bidders. Further, MIP may need to seek state aid clearance and we would not wish that process to delay the Auction (Telefónica).

- It is quite difficult to comment on the relative merits of the two possible obligations because Ofcom is not explicit about what is 'coverage comparable to the combined mobile voice coverage of today's 2G networks' and how an operator would know whether it had met this obligation. We also see a risk that the location and nature of the MIP infrastructure is not known at the time of the Auction. If bidders cannot accurately assess the cost of meeting the coverage obligation this may introduce some inefficiencies into the Auction (Vodafone).
- If Ofcom does decide to link the Auction licence conditions to the MIP it would make sense to wait until the MIP requirements are decided. At this point the location of the mobile "not spot" areas and the MIP sites are unknown, it is also unclear whether the mobile operators will commit to use these for data services. If they do commit to equip the sites with 3G it is unclear to BT why an obligation to use them for 4G is needed (BT).

Coverage in the nations and regions

- 5.16 In the January 2012 consultation we said that both Approaches A and B would address coverage issues in the nations and rural areas. However, we considered whether the coverage obligation might be extended with a target set for each constituent nation of the UK. We invited views on the suggestion that, if such an additional coverage obligation were considered desirable, the appropriate level might be coverage of areas within which 95% of the population of each nation lives.
- 5.17 There was considerable support from respondents for an additional obligation for the nations (and some wanted more granular obligations or ones covering roads and rail routes), mainly favouring 95% for each nation and some suggesting the figure should be 98%. The 18 respondents that supported an additional obligation represented various national and regional interests, including advisory committees, government organisations and Welsh Assembly members.
- 5.18 Some responses commented on our statement in the January 2012 consultation that a 98% UK obligation was likely to result in a high level of coverage in each of the nations.
- DETI had particularly strong views on this point. It was not convinced that either approach would provide improved coverage to the most pressing locations. It called on us to undertake more detailed and specific analysis of this issue.
 - Ofcom Advisory Committee for Scotland's (OACS) own analysis showed a 98% population coverage for the UK as a whole could result in only a 90% population coverage in Scotland. It said this was because the operators with coverage obligations will cover the densest areas first; Scotland would be disadvantaged because of its high proportion of rural areas. In support of this

argument it cited 2G market data where, for 96.7% UK-wide coverage level, Scotland only had 85% of its population covered.¹³⁹

Number of licences with obligations and the need for a wholesale access obligation

- 5.19 In the January 2012 consultation we considered whether more than one 800 MHz licence should contain the extended coverage obligation. We invited comments on our assessment that it was unlikely to be proportionate to impose the obligation on more than one licensee.
- 5.20 Seven responses agreed with our assessment that it would be disproportionate to impose the extended obligation on more than one licensee (including Arqiva, BT, Everything Everywhere, H3G, Intel and Vodafone). Eleven responses, from representatives of national and regional interests, wanted the obligation placed on two or more licensees in order to ensure consumer choice and competition in rural areas.
- 5.21 In addition to considering the case for imposing an extended coverage obligation on more than one licensee, the January 2012 consultation also considered whether to require the licensee with the coverage obligation to provide other operators with wholesale access to its network in those areas beyond existing 2G coverage that it was obliged to serve. We provisionally concluded this would not be proportionate, but we said we remained open to imposing a wholesale access obligation if we received evidence from stakeholders that the benefits would outweigh the costs.
- 5.22 Ten responses wanted a roaming or sharing obligation, some said this was particularly important if only one licence had the coverage obligation. These responses came from the three Ofcom national advisory committees that responded (for Northern Ireland, Scotland and Wales), the Scottish and Welsh Governments, and consumer representatives. Seven responses opposed a wholesale access obligation (including three mobile network operators, BT, Arqiva and Intel).
- 5.23 The proponents of an access obligation suggested that, for a coverage obligation on one licensee to work, it must be accompanied by roaming in geographically difficult areas – to allow consumers the benefits of choice and competition, reduce the number of base stations needed, protect consumers against unfair termination charges and help consumers who travel in and out of those areas.
- 5.24 Those responses that opposed an access obligation identified practical difficulties, in particular the challenges of managing roaming at the boundaries of the wholesale agreement and defining the specific areas. They thought an obligation would increase regulatory costs of dealing with disputes and defining access terms. They also suggested that operators without the obligation would have a significantly reduced incentive to extend roll-out of their own networks.

Monitoring compliance

- 5.25 In the January 2012 consultation we suggested we might monitor compliance with the coverage obligation in a way consistent with how we propose to measure

¹³⁹ The OACS figures are taken from Ofcom's Communications Market Report 2011 (http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr11/CMR_2011_Scotland.pdf). Our 2012 report (http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr12/CMR_UK_2012.pdf) shows 3G availability as 99.1% of the UK population and 97.0% of Scotland's population, but the data for the two years are not directly comparable.

compliance with the 3G coverage obligation. We also suggested technical assessment of compliance might be complemented by some testing of actual experience and invited views on the value of such an approach.

5.26 Six responses commented on compliance monitoring. The main points they made were as follows:

- Everything Everywhere stressed the need to start without delay the work on how compliance with the coverage obligation will be measured. This needs to be presented in the Information Memorandum at the very latest, as it is an important factor for bidders' assessment of the value of a block with a coverage obligation attached. Experience shows that this can be time consuming to work through.
- The Scottish Government said it would be useful to have a truly representative measure of 'practical user performance' and encouraged Ofcom to conduct independent measurements in the Scottish context.
- BT and Intellect were unclear how we would verify whether either of the preferred possible coverage obligations (once clarified) had been met.
- DETI called for us to publish details of how we would monitor compliance with coverage obligations and the specific steps we would take where there is evidence of default.

Granting concurrent licences

5.27 In the January 2012 consultation we considered the options for addressing, during the proposed initial 20-year period of the licences, a situation where a licensee is not interested in providing services to meet a Government broadband objective or prepared to make the spectrum available to others for this purpose. We said it would be open to us, in certain circumstances, to consider granting additional (concurrent) licences to use the spectrum that we are auctioning. We invited views on this possibility.

5.28 Five responses supported the idea of our issuing concurrent licences. Some others had reservations on the details:

- Arqiva said if such licences were to be issued at all it should only be done in specific and constrained circumstances. Whatever Ofcom concluded on this it should not automatically be seen as a precedent for other spectrum licences, in particular previously auctioned licences. This was an area where Ofcom needed to carry out more analysis and consultation ahead of determining whether this would be a proportionate way to proceed. In particular Ofcom would have to consider issues for other spectrum licences and the uncertainty that was created for current and prospective licensees.
- BT supported this measure but said a five-year period before taking effect was incompatible with Government aims and MIP. Its alternative suggestion was for us to issue concurrent licences where a licensee does not commit to using spectrum on MIP sites. We should issue concurrent licences for areas in which the licensee had declared it did not need the spectrum. We should then charge AIP where spectrum was unused in an area and the licensee had not declared it did not need the spectrum in that area.

- Everything Everywhere said assuming that the delivery of a given policy objective would lead to a financial loss (if not, it would expect the market to deliver the given service), Ofcom should clarify that the licensee would receive financial compensation for a later request to deliver a specific broadband policy goal. Subject to this clarification, it did not think it would become necessary to grant concurrent licences and this should be avoided.
- OACS suggested reassessing the need for concurrent licences in two to three years.
- Vodafone suggested reimbursing licensees the cost of coordination.

Our decisions on the coverage obligation

An obligation to provide indoor coverage to 98% of the UK population

- 5.29 In the light of the responses to the March 2011 and January 2012 consultations and our own further analysis, we have decided to impose a coverage obligation such that users in an area within which 98% of the UK population lives should be able to receive a 2Mbps mobile broadband service both outdoors *and* at some indoor locations within the vast majority of premises, provided that there are few other users using the service simultaneously in the vicinity.¹⁴⁰
- 5.30 Assessing and verifying indoor coverage is complex, and depends significantly on the structure of buildings, which is variable and uncertain. For example, buildings with particularly thick walls suffer considerably greater penetration losses than buildings with thinner walls, and indoor coverage is therefore less reliable in such buildings. Therefore, our formulation of the coverage obligation specifies an *outdoor* service quality to an area where 98% of the population lives. This specification will be sufficient to ensure that there are (at least some) *indoor* locations in the vast majority of residential buildings where a user will be able to receive a 2Mbps mobile broadband service.
- 5.31 In practice, this means that in many premises a good service will be available in all, or a wide range of interior locations, although reception is likely to be best at locations closest to the exterior of the building. In some cases, where the style of construction of the building is more challenging, the service may only be available in a limited range of indoor locations, for example close to windows. We recognise, however, that in a few cases where buildings both are in difficult-to-serve locations and have challenging construction types, it may be impossible to receive a 2Mbps indoor mobile broadband service.
- 5.32 The obligation will apply to a 2x10 MHz lot within the 800 MHz band, but we intend it to be both frequency and technology neutral. Although we anticipate that the obligation holder will predominantly – and potentially entirely – meet the obligation by deploying LTE within the 800 MHz band, we recognise that in some cases it may be more cost-effective and spectrally efficient to use alternative technologies and/or spectrum bands. However, our focus is on a high quality *mobile* broadband service which is available to users across a wide area. As such, the obligation holder will be required to deploy an “outside-in” network rather than meet the obligation through deployment of CPEs within consumers’ homes.

¹⁴⁰ The precise service level that a single user receives will depend on, for example, the user’s location within a cell, the usage of other nearby users and on the location of those users within the cell and surrounding cells.

- 5.33 We consider this obligation to be stretching but objectively justified. Not only will it deliver a mobile broadband service to some indoor locations in the vast majority of premises, it will also provide excellent outdoor coverage in the populated areas of the UK. We estimate that a network conforming to this requirement would provide outdoor coverage sufficient to enable a 2Mbps service in an area where approximately 99.7% of the UK population lives.

Approach A versus Approach B

- 5.34 In deciding how to define the coverage obligation, we have been mindful of two key requirements: first, the need to give potential licensees clarity about what the obligation entails; and second the need to be able to verify compliance with the obligation.
- 5.35 As discussed above, a number of responses argued that it was difficult to define Approach B with sufficient clarity because of the inherent uncertainty in establishing, with reasonable precision, the current combined 2G coverage of all operators and the coverage that would be provided by MIP sites. We recognise the strength of these points and the desirability of avoiding these difficulties. We have therefore decided not to follow Approach B, and instead define the coverage obligation with reference to an area in which a clearly specified percentage of the population lives, as per Approach A. Under this approach the licensee with the coverage obligation may use suitable MIP infrastructure to meet the obligation but will not be obliged to do so.¹⁴¹ Some responses expressed concern that Approach A could result in the operator with the obligation limiting coverage by investing in those areas that would be most economical. Although the operator will be able to choose where to roll out its network we consider the obligation to cover 98% of the UK population and 95% of the population of each nation (as discussed below) will ensure coverage extends to the vast majority of people and households, and does so in the most cost efficient manner.

Measuring indoor coverage

- 5.36 As set out in our January 2012 consultation, current mobile broadband use is predominantly indoors and indoor use has been predicted to increase. One estimate is that at least 80% of today's mobile data traffic comes from indoor locations and some expect 95% of data traffic will come from indoor locations in a few years' time¹⁴².
- 5.37 There are substantial practical challenges associated with testing an indoor coverage obligation in a way that takes account of the wide variety of building types, and, in the event that we undertake field testing, it would be difficult to test indoors. We have therefore decided that the licence condition underpinning the coverage obligation will be tested at outdoor locations but taking account of a specified building penetration loss to indoor locations.

An "outside-in" obligation and use of CPE

- 5.38 Our formulation of the coverage obligation is specifically focused on a requirement to deliver a mobile broadband service. Indoor coverage is an important part of the

¹⁴¹ We will however monitor the deployment of 4G services from MIP sites as part of our infrastructure reporting duty.

¹⁴² <http://www.senzafiliconsulting.com/Blog/tabid/64/articleType/ArticleView/articleId/59/Mobile-data-move-indoors.aspx>

obligation, but so is outdoor coverage. As explained above, we expect that 98% indoor coverage (as defined above) will translate into considerably greater outdoor coverage. In setting the obligation up in this way, we have also considered the role – if any – of CPE.

- 5.39 CPE can provide a relatively low cost means to provide indoor coverage in hard-to-reach locations. Typical consumer prices for current generation femtocells, for example, are of the order of £50¹⁴³. We recognise – and support – CPE as a means of improving the quality of consumer experience in particular circumstances. However, we do not consider that CPE would be a suitable means for the obligation holder to meet our policy objectives for the coverage obligation because it would not contribute materially to the mobile and outdoor aspects of the service. Our proposed formulation of the coverage obligation specifically rules out indoor CPE as a means of satisfying the obligation. Nonetheless, operators may well seek to use CPE for households in the remaining 2% of the UK, or where consumers want to improve the quality or depth of in-building coverage.

Use of alternative spectrum bands and technologies

- 5.40 The coverage obligation will be attached to a 2x10 MHz lot within the 800 MHz band. Specifically, this will be for 811 to 821 MHz paired with 852 to 862 MHz. However, the licensee holding these frequencies will be able to meet the obligation with any frequencies it is permitted to use. It may also use other mobile broadband technologies in addition to, or instead of, LTE. Although we have specified a compliance verification methodology for current generation LTE technology¹⁴⁴, it will be open to the licensee with the obligation to meet the obligation with alternative mobile broadband technologies: we are simply concerned to ensure that a service as specified above is provided, regardless of the technology that the licensee decides to use to do so. Should the licensee decide to use a technology other than LTE to provide the service – or if the LTE specification changes – we will consider the need to revise our approach or define an alternative methodology, always ensuring that the approach is consistent with the service characteristics encapsulated in the current methodology. We may need to undertake field testing as part of this exercise.

Proportionality of the obligation

- 5.41 As set out above, one of our core policy aims is to ensure that the benefits of next generation mobile services become available to the vast majority of consumers and citizens in a timely manner reflecting our obligation to have regard to the desirability of encouraging the availability and use of high speed data transfer services throughout the UK when performing our duties. In light of our policy aim, when setting the level of the coverage obligation, we have to strike an appropriate balance between the consumer and wider social benefits that it will confer and the costs it will impose on the obligation holder.
- 5.42 The coverage obligation will confer significant benefits on consumers and citizens, reflecting the broader social value associated with mobile coverage. Not only will it ensure that the overwhelming majority of the population has a next generation mobile broadband service at locations within their and other people's homes by the end of

¹⁴³ This is the current retail price for Vodafone's "Sure Signal" product. Although this price may include an element of subsidy, and today's costs of 4G femtocells are likely to be higher, we nonetheless consider that current retail prices provide a reasonable indication of the likely price points for 4G CPE in the future.

¹⁴⁴ See paragraph 1.4 in 4G Coverage Obligation Verification Methodology: LTE

2017, but it should ensure that virtually the entire population has outdoor mobile broadband coverage in the area where they live within the same timeframe. Experience with 3G roll-out (cited above) suggests that the coverage level required by the obligation is likely to be significantly in excess of the coverage level that would be delivered commercially within these timescales, absent this intervention.

- 5.43 Having identified the potential consumer benefits of a 98% coverage obligation, we have gone on to consider the costs to a licensee of meeting it, in order to assess whether the obligation is proportionate. We have based our assessment on the experience of roll-out of 2G services, on our own technical analysis and on the views expressed to us by operators in their consultation responses and thereafter.
- 5.44 For the obligation to be proportionate, we believe it should be specified in such a way that it should be possible for at least one operator to be able to meet it predominantly by upgrading existing sites. MIP aside, current site portfolios reflect the extent of roll-out that operators consider to be economic for their existing networks. If we assume the economic case for 4G roll-out is broadly similar to that for existing networks, an obligation that does not require extensive expansion of existing site portfolios will tend to accelerate investment rather than increase its absolute level. Although there are of course costs associated with bringing forward investment, we consider them to be less material than the costs of more extensive roll-out (which we discuss below). We recognise that it would be more challenging for a new entrant to meet the obligation, unless it had access to existing sites. However, our decision to attach the obligation to one spectrum lot in the Auction means that a new entrant will have the option of bidding for other lots that do not have the obligation.
- 5.45 Our technical analysis is described in more detail in Annex 9. Although the results vary according to the detailed specifications of what it means for an area to be served, the analysis shows that as the number of premises served from each additional site (within an existing portfolio) falls, the cost of additional coverage rises sharply. We would expect that at this level of coverage it might be more economic for operators to construct some additional sites if they are to deliver further improvements in coverage – although it may also be possible for operators to use some MIP sites as a means of helping to meet the coverage obligation.
- 5.46 At a more detailed level, the analysis suggests that the incremental costs of additional coverage rise very sharply above the point at which the cost per additional premises served reaches £2,000 to £3,000¹⁴⁵. Beyond this level each additional site only reaches a very few premises and operators would potentially need to construct a large number of additional sites. We do not consider that such costs would be proportionate relative to the additional benefits they would deliver.
- 5.47 We have also reviewed the statements made by the existing national wholesalers. They have either directly stated that they believe that an appropriately specified 98% indoor coverage would be proportionate, or indicated that they would be able to meet such an obligation predominantly by upgrading existing network infrastructure rather than constructing a material number of new sites. For example:

¹⁴⁵ The theoretical analysis underpinning these figures is based on a somewhat lower level of assumed building penetration loss than that in our formulation of the coverage obligation. At higher levels of building penetration loss, the modelling suggests a cost curve of a similar shape, but lower overall levels of population coverage for a given cost per premises. Recognising the inherent limitations of our (high level) modelling methodology, we have compared our results with our understanding of the position of the existing national wholesalers (set out in paragraph 1.47) and we therefore believe that the cost estimates of £2,000 to £3,000 per additional premises broadly correlate to 98% coverage with the characteristics specified in the relevant licence condition.

- ✂
- In oral evidence to the House of Commons Culture, Media and Sports (CMS) Committee H3G estimated that with the site infrastructure that it shared with Everything Everywhere, if it had 2x10MHz at 800 MHz, it would be able to provide indoor coverage with speeds of over 2Mbps to 97% of the UK population, and to go from 97% to 98% would “probably incrementally cost about £100 million in terms of sites.”¹⁴⁶
- Everything Everywhere in its consultation response stated that “under certain conditions (meaning the detailed parameters defining the compliance), a 98% indoor data coverage obligation could be met without excessive cost to the public purse, [redacted] to deliver the 2Mbps mobile broadband service level [redacted].”¹⁴⁷ We consider our technical specification of the obligation is broadly consistent with what Everything Everywhere had in mind. Also, in oral evidence to the CMS Committee Everything Everywhere concurred with the H3G’s estimates set out in the previous bullet point.
- Vodafone expressed concern in its consultation response that we had not examined the proportionality of a 98% obligation. However, Vodafone and Telefónica have since announced their intention to strengthen their existing network partnership. Should they progress with their plans, and subject to the outcome of the Auction, the companies have stated that they intend to offer indoor 4G coverage targeting 98% of the UK population at speeds of at least 2Mbps by 2015¹⁴⁸. Neither Telefónica nor Vodafone has confirmed whether it could meet a 98% indoor coverage obligation if their proposed network partnership does not go ahead, however we note that their existing agreement through Cornerstone would allow them access to a combined portfolio of sites covering a larger population than their individual portfolios.

5.48 We therefore believe that a coverage obligation set at 98% strikes an appropriate balance between consumer benefits conferred and costs imposed.

An obligation to provide indoor coverage to at least 95% of homes in each nation

5.49 Having considered consultation responses and conducted our own further analysis, we have decided that, in addition to including a requirement in relation to UK-wide coverage, the coverage obligation should include specific provisions in relation to the nations. Specifically, it will require the same provision as for the whole UK but for an area within which 95% of the population of each nation lives.

5.50 Our rationale is that we wish to ensure that citizens and consumers in each of the nations benefit from timely and widespread availability of next generation mobile services alongside the rest of the UK. Such an approach mitigates the risk that an

¹⁴⁶ <http://www.publications.parliament.uk/pa/cm201012/cmselect/cmcomeds/1258/1258.pdf>.

See oral evidence given on 21 June 2011, in particular replies to questions 85 to 87 (Ev12).

¹⁴⁷ See Section 8 of http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/responses/Everything_Everywhere.pdf.

¹⁴⁸ <http://news.o2.co.uk/Press-Releases/Telef%C3%B3nica-UK-and-Vodafone-UK-to-strengthen-their-network-collaboration-385.aspx> and <http://www.vodafone.co.uk/consumer/groups/public/documents/webcontent/vftst162773.pdf>

operator might satisfy the UK-wide element of the coverage obligation but still leave markedly lower levels of coverage in some of the nations, to the detriment of citizens and consumers. By way of example, although (outdoor) UK-wide 3G coverage is now 99.1%, more than ten years after the award of licences, 3G coverage in Northern Ireland is only 88.3%¹⁴⁹.

- 5.51 Table 5.1 draws on our technical analysis and sets out the levels of coverage that may be technically feasible to achieve in each of the nations within the relevant timeframes using a set of existing sites.

Table 5.1: Estimated LTE 800 coverage achieved from a set of existing sites¹⁵⁰

Max Coverage by Nation	Indoor	Outdoor
England	98.4%	99.97%
Scotland	95.1%	99.0%
Wales	95.1%	99.7%
Northern Ireland	86.0%	97.5%
UK	97.6%	99.8%

- 5.52 Table 5.1 shows that an operator achieving (in this case) fractionally less than 98% coverage in the UK as a whole may be able to achieve more than 95% coverage in England, Scotland and Wales. The implication is that although some additional sites would be needed to meet the UK-wide target, an obligation of 98% UK-wide would lead to coverage above 95% in both Scotland and Wales. We therefore consider that a 95% obligation for Scotland and Wales would also be proportionate. As the table shows, provision of an indoor service at this level would at the same time provide a very high level of outdoor population coverage.
- 5.53 We also consider that notwithstanding the current coverage in Northern Ireland, a 95% obligation would be appropriate, on (i) grounds of fairness – the number of sites required in Northern Ireland is small relative to the other nations and MIP sites may also contribute some additional coverage; and (ii) because the coverage picture there is changing rapidly. Specifically, we understand that as a result of the planned expansion of MBNL’s network¹⁵¹, there is likely to be a material improvement to 2G and 3G coverage in Northern Ireland over the next one to two years. This suggests that for some operators at least the costs of meeting a 95% obligation will be materially less than those that might be implied by our technical analysis, which is based on current network deployment.
- 5.54 Hence, in view of the results in Table 5.1 and the information we have about planned network expansion in Northern Ireland, we believe it would be feasible for the obligation holder to achieve the 95% coverage obligation in each of the nations within the relevant timeframe.

¹⁴⁹ Ofcom Communications Market Report 2012 (http://stakeholders.ofcom.org.uk/binaries/research/cmr/cmr12/CMR_UK_2012.pdf). These figures relate to areas in which there is coverage from at least one operator.

¹⁵⁰ The results of our technical analysis relate to coverage of premises; population coverage would effectively be at the same levels. Figures assume BPL of 10.5dB with standard deviation of 6.8dB (as explained further in Annex 9).

¹⁵¹ <http://www.telegeography.com/products/commsupdate/articles/2012/02/15/mbnl-to-spend-gbp25-million-boosting-3g-coverage-in-northern-ireland/>

- 5.55 We have also considered whether it would be proportionate to go beyond 95% in each nation. Our conclusion is that it would not be. The cost of increasing coverage to greater than 95% in the nations is likely to be considerable as it is likely that a significant number of new sites would be required in order to achieve this. Our analysis described in Annex 9 shows that for one site portfolio that achieves 98% UK indoor coverage (albeit with somewhat more limited indoor coverage¹⁵²) the cost of coverage above 95% in Scotland and Wales increases very significantly. We estimate that at 95% coverage, the incremental cost per additional premises in both nations is approximately £1,500 to £3,000. Increasing coverage beyond 96% could raise the incremental cost per additional premises to over £10,000. A more cost-effective way of providing an indoor service to those outside the 95% coverage area might be via CPE such as femtocells, WiFi or similar devices.
- 5.56 A small number of responses suggested a national coverage obligation could be complemented by obligations specified at a local authority level and obligations to provide coverage on A roads and rail routes. Such obligations are likely to involve costs additional to those needed to meet the primary obligation for UK and nations coverage. They would also be more difficult to formulate and enforce. We consider they are unnecessary to meet our primary objective of guaranteeing that virtually all consumers and citizens of the UK will have some access to next generation mobile broadband services, in a relatively quick timeframe.

An obligation on a single licensee with no wholesale access obligation

- 5.57 We have decided that the coverage obligation should only apply to one licence and that no wholesale access obligations will be attached to that licence.
- 5.58 We believe the benefits associated with including a coverage obligation in more than one licence or imposing a wholesale access obligation on the coverage obligation holder would be limited. There are a number of reasons for this:
- 5.58.1 We consider that competition will encourage operators without the obligation to accelerate their roll-out as well. Competition between operators remains a powerful driver of coverage. As we have explained above, the focus of our obligation is on bringing forward investment in coverage rather than (materially) increasing it beyond what would be delivered commercially. Unconstrained by any coverage obligation, we would expect all licensees aiming to provide 4G services to the vast majority of consumers throughout the UK to roll out their networks to similar extents, within similar timescales, and that ultimately their coverage would broadly match existing 2G coverage. Hence, if the effect of the coverage obligation is to accelerate the roll-out of one operator, we would expect competition to drive other operators to accelerate their roll-out as well.
- 5.58.2 Even if the obligation holder were the only operator in some regions for a period of time, we would not expect it to be in a position to charge higher prices to consumers in those regions. Operators currently charge uniform prices across the UK. Although some price discrimination between consumers is of course possible, today's prevailing pricing practices suggest to us that there is not a significant risk that consumers in areas where only the coverage obligation holder offers a service would have to pay higher prices than consumers in other parts of the country.

¹⁵² See footnote 146 above.

5.58.3 Many of today's concerns about coverage relate to a lack of clarity about which operator offers coverage in a particular area. Consumers may be in areas with good coverage, but not from their own operators. By contrast, the obligation holder will offer an excellent level of coverage to the vast majority of premises. Consumers that value coverage will be able to sign up to services from the obligation holder with confidence that they will receive good coverage in most areas of the UK. Hence the problem of coverage uncertainty should – to a large extent – be mitigated, and we would expect the obligation holder to market any coverage advantage accordingly (although as explained above, we would expect other operators to compete away much of the advantage).

5.59 For these reasons, we do not believe that it is either necessary or desirable to impose the coverage obligation on more than one operator. We also do not believe a wholesale access obligation would be appropriate:

- Most importantly, we consider that it could be challenging to construct an obligation in a way which would not undermine the very important commercial incentive described in 5.58.1 above, as rival operators would no longer need to compete with the obligation holder for coverage, but could instead rely on the obligation holder to provide coverage.
- It would also be difficult to specify the details of such an obligation. In particular, we anticipate that we would need to define in the licence the relevant areas within which an access obligation would apply, and it is not clear what basis we would have for determining those areas. The alternative of leaving this until after the Auction would simply postpone the challenge of identifying the areas and create uncertainty for bidders.
- Finally, there is a risk that the consumer experience in roaming areas would be poor, for example from calls dropping as a consumer roams onto another network, or from delays or disruptions to the quality of service during the transition. There are technical solutions to many of these consumer experience problems, but they are not perfect and our discussions with operators suggest that they would be likely to be costly to implement.

5.60 We have also considered the question of State aid that BT raised in its response to the January 2012 consultation. BT argued that:

- the reduced bid price that would result from the coverage obligation is a grant of state aid to the bidder;
- this is a subsidy financed from State resources that should be notified to the European Commission for approval;
- the coverage obligation would overlap with services already provided in buildings by fixed networks and as such would distort competition;
- there would be little additional consumer benefit generated by the huge additional costs of the operator subject to the coverage obligation if it has to deliver mobile broadband inside buildings in areas where competing services are already available;
- it would make better sense and is a legal requirement to procure subsidised in-building broadband coverage in a technology neutral manner and only in

areas where no operator, irrespective of technology, will invest its own money in delivering affordable broadband services.

- 5.61 We do not agree with BT that the coverage obligation we have decided to impose would constitute a grant of State aid. The reduced valuation of the licence (if any) reflects a public service obligation imposed on the successful bidder, and any competitive advantage to the bidder will be as a result of the bidder's own investment in meeting the obligation. The coverage obligation is also one being imposed pursuant to the regulatory scheme under the European framework and the relevant domestic law. We have taken account of our statutory duties under that framework in deciding whether, and then how to specify the obligation.
- 5.62 We also disagree with BT's more general description of the service that we anticipate will be provided pursuant to the obligation. BT argues that the broadband service concerned is already being provided by fixed networks in buildings. Whilst that may effectively be the case in one's own home (or possibly even a friend's home) where mobile devices can switch to a WiFi enabled fixed broadband service and then move around that location, the purpose behind this obligation is to enable the user to use their device across the vast majority of the country, both outdoors and at some indoor locations. It is therefore a more extensive mobile service than is provided by a fixed broadband network extended by WiFi. Further, whilst it is our intention that users should receive an indoor service at some locations within the vast majority of homes, we have specified the obligation as an outdoor obligation adjusted for a standardised building penetration loss so as to enable us to measure compliance. Given the variance in building types and the effect that this can have on coverage and service level, we recognise that in some indoor locations a user will not receive the minimum service specified.

The licence condition and compliance monitoring

- 5.63 We outline above in paragraphs 1.29 to 1.33 our policy approach to the coverage obligation. We set out in the licence the exact formulation of the obligation¹⁵³. In Annex 9 we provide detail on the specification and testing of the obligation. We have ensured, where appropriate, that the verification methodology is consistent with the 3G coverage obligation verification methodology, which we developed in consultation with the relevant national wholesalers¹⁵⁴. The verification methodology calculates achieved service based on predictions of coverage and interference from the relevant licensee's site portfolio, which we believe is a practical way of verifying compliance.

Enforcement

- 5.64 The coverage obligation that we have specified forms an important part of our overall policy decisions for the Auction. As such, we will take compliance with the obligation extremely seriously.
- 5.65 We intend to monitor the licensee's progress to achieving compliance so that we have a good understanding of whether or not the obligation is likely to be met in the required timeframe.

¹⁵³ The draft schedule for the 800 MHz licence with the coverage obligation is in annex 2B of the auction information memorandum, which is being published alongside this statement.

¹⁵⁴ http://stakeholders.ofcom.org.uk/binaries/consultations/2100-MHz-Third-Generation-Mobile/annexes/methodology.pdf?utm_source=updates&utm_medium=email&utm_campaign=2100MHz-methodology

- 5.66 Should we receive any indication that the obligation will not be, or has not been met, we will consider carefully the range of enforcement measures available to us, including our power to vary or revoke licences in the event of a contravention of a term of a licence.

Granting concurrent licences

- 5.67 In the January 2012 consultation we noted that, in common with all existing mobile spectrum licences, the licences to be awarded will not guarantee exclusive use of the spectrum to the licensee. This means it would be open to us to consider granting additional (concurrent) licences to use the spectrum that will be the subject of the Auction. We have discretion to authorise use of these or any other frequencies, for any purpose, in line with our statutory duties, whether through licensing or licence exemption.
- 5.68 We would not expect to consider granting any concurrent licences for the auctioned spectrum within the first five years of the licence term. This is on the basis that a licensee winning rights to use the spectrum in the Auction might require some years to roll out a network covering a high proportion of the UK, particularly rural areas. We consider five years to be a period beyond which it would be reasonable to judge whether a licensee intended to use the spectrum to provide services to deliver a specific Government broadband policy (where such a policy has been articulated by Government).
- 5.69 BT made the point that this period is incompatible with Government aims and MIP and suggested we issue concurrent licences where a licensee did not commit to using spectrum on MIP sites. The Government's primary aim in establishing MIP is to eliminate mobile voice not-spots. The spectrum to be auctioned is likely to be used for next generation mobile broadband services and we do not consider that it will be suitable to support the Government's primary aim for MIP.
- 5.70 We would assess the need to issue concurrent licences in the circumstances prevailing at any given time (though not until five years had elapsed for the grant of the auctioned licences). Our current view is that we would only consider issuing concurrent licences in the following circumstances:
- Government had articulated a specific broadband policy that was not being delivered in certain geographic areas (e.g. certain rural areas);
 - the relevant licensee was unwilling or unable to provide services to deliver that Government policy and was unwilling to trade the spectrum to allow another to do so; and
 - we had received a request from a third party to use the spectrum in question in a specified area to deliver that Government broadband policy.
- 5.71 Everything Everywhere sought clarification that the licensee would receive financial compensation for a request to deliver a specific broadband policy goal. It would be a matter for licensees to decide whether they wished and were able to use the spectrum to provide services to deliver the Government broadband policy. In doing so they would no doubt consider the financial aspects of doing so, which could include any support that might be provided within the terms of the relevant policy scheme.

- 5.72 Vodafone suggested reimbursing licensees the cost of coordination. Any concurrent licence granted would run alongside licences awarded through the Auction and all the licensees would have to comply with a co-ordination procedure. This would ensure that each licensee's system did not interfere with the operation of another. It would be for the mutual benefit of the licensees and they would bear the costs of co-ordination.

Section 6

Spectrum packaging

- 6.1 Following the March 2011 and January 2012 consultations, stakeholders were in broad agreement with our proposed approach and responses to the January 2012 consultation focused on very specific aspects. In this section, we summarise our most recent proposals from January 2012, the responses we received to that consultation and we set out our decision for spectrum packaging in the Auction. We cover the following topics:
- a) the general principles that guide our decision on how to package the available spectrum; and
 - b) the specific provisions for the packaging of lots we are putting in place for the relevant categories of spectrum:
 - o the 800 MHz band,
 - o the 2.6 GHz band, and
 - o the 1800 MHz spectrum that Everything Everywhere needs to divest, if included in the Auction.

General principles for spectrum packaging

- 6.2 Respondents to the January 2012 consultation made few comments on our proposed general principles for spectrum packaging. They focussed on how we applied those principles when deriving specific proposals in respect of each spectrum band. This followed broad support for the principles we had proposed in March 2011.
- 6.3 Therefore, the general principles we use to develop the specific spectrum packaging measures we adopt in this Statement are the same as those we put forward in the January 2012 consultation.
- 6.4 These general principles relate to the following aspects.
- a) Available categories – no relinquishment into the Auction
 - b) Band plans – supporting economies of scale in equipment manufacture
 - c) Lot size in each category – minimum useful block size for combinatorial bidding
 - d) Number of categories of lots – as few categories as possible given the technical characteristics
 - e) Contiguity of lots – licensees will benefit from contiguous assignments in each band
 - f) Geographical reach of lots – UK-wide lots

Available categories – no relinquishment into the Auction

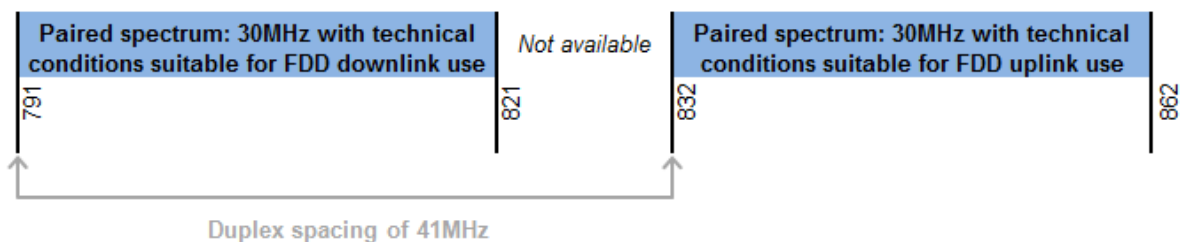
- 6.5 In addition to the spectrum that will be available in the Auction, at 800 MHz and 2.6 GHz, and that may be available in the Auction, at 1800 MHz, there is spectrum suitable for national wholesale mobile services currently licensed at 900 MHz, 1800 MHz and 2.1 GHz. In principle, holders of corresponding licences could relinquish spectrum ahead of the Auction, for example to be capable of bidding for more of the 800 MHz, 2.6 GHz and, if available, the 1800 MHz divestment spectrum than they would otherwise be, given the spectrum caps in the Auction.
- 6.6 In the case of the 900 MHz band, any additional spectrum in the 1800 MHz band (over and above the possibility of having the 1800 MHz spectrum divestment in the Auction) and the 2.1 GHz band, we have not identified any reason to require relinquishment into the Auction.
- 6.7 In addition, no holders of rights to those spectrum bands have requested relinquishment of spectrum into the Auction in response to the January 2012 consultation, which proposed the same sub-1 GHz and overall caps that we will be using for the Auction.
- 6.8 We have therefore decided that it is not necessary to make provision for including lots from these bands in the Auction and we will not be allowing relinquishment into the Auction.

Band plans – supporting economies of scale in equipment manufacture and providing flexibility where appropriate

- 6.9 We believe that, in the circumstances, using fixed band plans consistent with the European spectrum decisions referred to in section 3 and international equipment standards for both the 800 MHz and the 2.6 GHz bands is the appropriate approach. By fixed band plan, we mean, in a given band:
- a) a fixed amount of paired spectrum, with a fixed amount of spectrum suitable for uplink use and a fixed amount suitable for downlink use, at specified frequencies; and
 - b) a fixed amount of unpaired spectrum suitable for both uplink and downlink use, at specified frequencies.
- 6.10 If the 1800 MHz spectrum that Everything Everywhere needs to divest were available in the Auction, it would also follow a fixed band plan consistent with the EC merger decision COMP/M.5650 in that the Commission identified specific frequencies at 1800 MHz for Everything Everywhere to divest.
- 6.11 There will therefore be no flexibility in the amounts of paired and unpaired spectrum in any of the spectrum bands available in the Auction.
- 6.12 Our main principles in selecting band plans are to ensure that:
- a) they are consistent with relevant international obligations;
 - b) they are consistent with the requirements for likely use and the technical characteristics of suitable equipment, so that spectrum users can benefit from economies of scale in equipment manufacturing; and

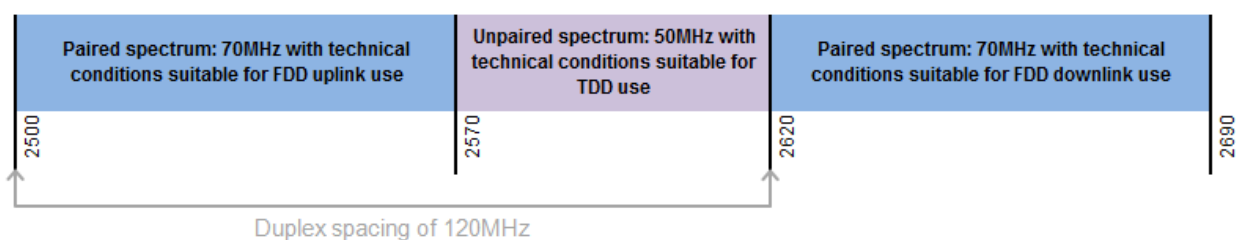
- c) we have regard for potentially competing demands for use of a band in a measured, pragmatic way, taking account of the degree of complexity that accommodating different uses might create.
- 6.13 In the case of the 800 MHz band, the relevant EC decision and international standards incorporate the same fixed band plan and we are not aware of competing demands that would require band plan flexibility.
- 6.14 In the case of the 2.6 GHz band, the relevant EC decision and international standards are consistent with a fixed band plan, but also envisage some potential band plan flexibility. During the consultation process (and unlike in the period from 2005 to 2009 approximately), we have not identified any evidence of demand for potentially different band plans at 2.6 GHz. There are therefore no clear benefits to implementing band plan flexibility in this case. In addition, there would be costs, in terms of auction complexity, both for the design of the auction rules and their implementation into a robust piece of software, as well as for bidders. We are therefore not using flexible band plan arrangements at 2.6 GHz.
- 6.15 In addition, the EC merger decision COMP/M.5650 identifies specific frequencies at 1800 MHz for Everything Everywhere to divest, which may be available in the Auction if Everything Everywhere does not trade the rights privately ahead of the Auction and ahead of the relevant deadline in the merger undertakings.
- 6.16 For the available spectrum, the fixed band plans are as follows.
- a) 800 MHz
- Paired spectrum suitable for downlink: 791-821 MHz.
 - Paired spectrum suitable for uplink: 832-862 MHz.
 - Duplex spacing of 41 MHz.
 - Unpaired spectrum: not applicable. We will be considering options for use of the duplex gap at 821-832 MHz separately and at a later date.

Figure 6.1: Band plan for the 800 MHz band



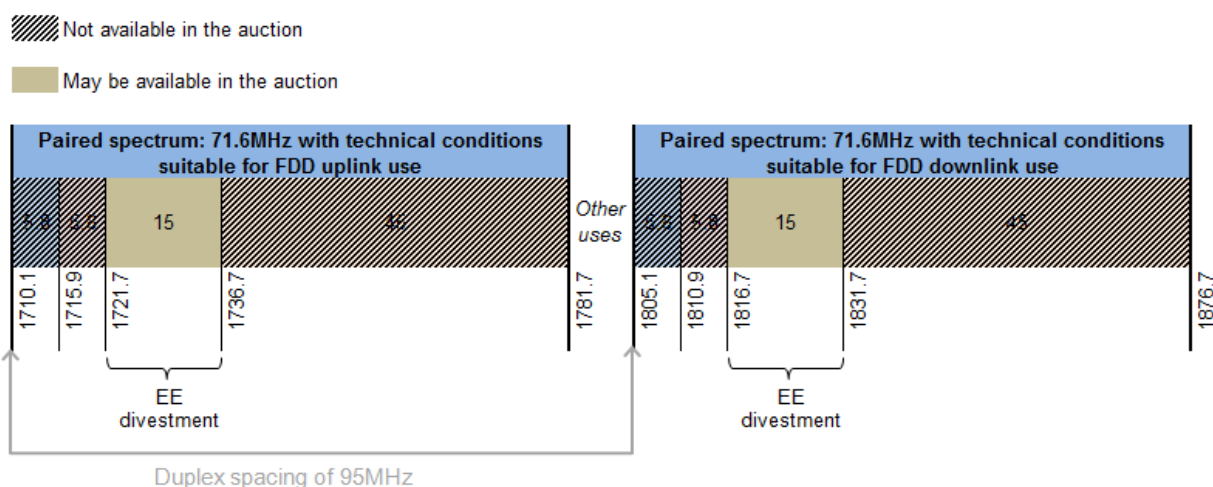
- b) 2.6 GHz
- Paired spectrum suitable for uplink: 2500-2570 MHz.
 - Paired spectrum suitable for downlink: 2620-2690 MHz.
 - Duplex spacing of 120 MHz.
 - Unpaired spectrum suitable for both uplink and downlink: 2570-2620 MHz.

Figure 6.2: Band plan for the 2.6 GHz band



- c) 1800 MHz divestment (if available in the Auction)
 - o Paired spectrum suitable for uplink: 1721.7-1731.7 MHz (first tranche of the divestment for relinquishment by 30 September 2013) and 1731.7-1736.7 MHz (second tranche of the divestment for relinquishment by 30 September 2015)
 - o Paired spectrum suitable for downlink: 1816.7-1826.7 MHz (first tranche of the divestment for relinquishment by 30 September 2013) and 1826.7-1831.7 MHz (second tranche of the divestment for relinquishment by 30 September 2015)
 - o Duplex spacing of 95 MHz
 - o Unpaired spectrum: not applicable

Figure 6.3: Band plan for the 1800 MHz band



Lot size in each category – minimum useful block size for combinatorial bidding

- 6.17 We are setting lot size for each category of spectrum in the Auction by balancing two factors:
- a) providing a large degree of choice to bidders so that they would be able to express their true preferences in the Auction, which suggests making spectrum available in small blocks that bidders can aggregate as they wish; and
 - b) managing complexity in the Auction and focusing on allowing those combinations of package sizes that are consistent with likely productive uses and known market demand, which suggests not actively trying to support block sizes that are not aligned with prospects for future use.

- 6.18 We discuss this balance and, where relevant, stakeholder concerns regarding risks to the scope for aggregating lots efficiently in respect of the 800 MHz and 2.6 GHz bands below.
- 6.19 We have no discretion over the lot size for the 1800 MHz divestment (if available in the Auction), as EC merger decision COMP/M.5650 requires that it be sold as a single lot of 2x15 MHz to a single approved acquirer.

Number of categories of lots – as few categories as possible given the technical characteristics

- 6.20 Our approach to the number of categories of lots is consistent with our proposals in the January 2012 consultation. We are using multiple categories of lots for the available spectrum, in order to reflect material differences between specific frequencies.
- a) There are structurally different types of uses and rights in this Auction.
 - o First there is paired and unpaired use, with each involving distinct technology choices, leading to different categories within a given band, i.e. at 2.6 GHz.
 - o Second there is individual use of paired spectrum at standard powers and concurrent use of paired spectrum at low powers, with each involving licence rights that are different in nature, leading to different categories of paired spectrum at 2.6 GHz.
 - b) The available bands – 800 MHz, 2.6 GHz and potentially 1800 MHz – have sufficiently different propagation characteristics (and, to an extent, different timings for their availability) which is the reason for using different lot categories.
 - c) Within the 800 MHz and 2.6 GHz band, there will be distinct types of lots, with the number of categories depending on:
 - o the likely costs of the coverage obligation;
 - o any difference across blocks in the implications of adjacent uses on the available frequencies; and
 - o any difference across the available blocks in technical restrictions under the licences.
 - d) If the 1800 MHz divestment is available in the Auction, it will be as a single lot given the requirement for a single winner of the 2x15 MHz.
 - e) In principle, differences in the timing of availability of certain parts of each band might justify differentiating between lots on that basis.
- 6.21 In relation to 6.20c) above, we noted concerns from two respondents regarding the scope for DTT use adjacent to the 800 MHz band to have an impact that could justify different categories of lots. Our approach to DTT co-existence does not differ by frequency lot (see Section 11 and Annex 6) and therefore we have decided that differentiation of lots for this reason is not required. More generally the technical licence conditions we have decided to adopt do not warrant different categories either at 800 MHz or at 2.6 GHz. We do consider that given our decision to impose a

coverage obligation the lots associated with this obligation should be treated as a separate category. Our approach to this is explained below (see paragraph 6.43).

- 6.22 In relation to 6.20e) above, we do not believe that there are differences in timing of availability that would justify using different lot categories for that reason. The timing for the use of the spectrum is set out in the Information Memorandum that accompanies this Statement.
- 6.23 In reflecting material differences between frequencies, we also believe that having as few categories of lots as possible is beneficial. The benefits take the form of reduced auction complexity, ease of choice for bidders in each of the bidding rounds and a more efficient demand and price revelation process (from reduced switching of demand between categories of lots that are substitutes, in response to round price changes). Having few categories of lots works particularly well in the context of the combinatorial clock auction design which we will be using, even if it is not a necessary condition for this type of auction format. The format is specifically designed to resolve first how much spectrum each bidder wins in each generic category of substitute spectrum blocks (Principal Stage) and to resolve in a second stage which specific frequencies each winner will receive (Assignment Stage). Therefore, the Assignment Stage serves to address any differences between specific frequency blocks in the same lot category from the bidders' perspective, subject to those differences being second order (see section 7 and Annex 5 for an explanation of the auction design and rules). This approach is consistent with the broad support we received from respondents to our consultations, subject to detailed points in relation to specific bands and lots categories.
- 6.24 Later in this section, we set out how we are applying these principles in respect of each band relevant to the Auction.

Contiguity of lots – licensees will benefit from contiguous assignments in each lot category

We will ensure contiguity for each bidder in each lot category

- 6.25 Respondents did not raise any concern regarding our proposal to ensure contiguity of lots for a bidder assignment in each lot category. We continue to believe that this will support consumer benefits through higher service performance and efficient use of the spectrum, including minimising the number of adjacencies between licensees in each lot category.
- 6.26 At 2.6 GHz, this will not mean ensuring contiguity between the three available lot categories for each bidder (i.e. standard power paired, low power paired, and unpaired). First, it would not be possible to do so for all winners if there were many of them. Second, the winners in each category may not be the same entities, such that contiguity across winners and categories would be irrelevant. Third, stakeholders have not requested measures other than the ability to express preferences in the Assignment Stage for specific frequencies to seek to achieve contiguity across lot categories in the band. Indeed, the three categories of lots at 2.6 GHz are sufficiently different (and their respective technical rights provide a sufficiently robust basis for managing interference risks) that it is unlikely that contiguity across those categories would generate material benefits. To the extent that there may be benefits from contiguity across categories for a bidder, we would expect those to be of a second order. It is therefore appropriate to leave the possibility for bidders to express preferences in this respect to the Assignment Stage (through their bids for specific frequencies at contiguous edges of lot categories).

- 6.27 Issues that some respondents raised previously regarding the ability in practice to ensure contiguity of lots in a band, and in particular at 800 MHz, if there are many categories of lots do not apply given our choice for the number of categories in each band. We discuss this further in relation to each band.

Contiguity of lots across multiple bidders considered as part of the auction design proposals

- 6.28 We consider the issue of contiguity of lots across multiple bidders in section 7 on auction design, in relation to the Assignment Stage of the Auction.

Geographical reach of lots – UK-wide lots

- 6.29 Respondents to the January 2012 consultation did not comment on our proposals to use UK-wide lots. We remain of the view that, in the circumstances of this Auction, there are clear arguments for using national lots rather than regional lots. In particular, the arguments against using regional lots include the lack of evidence of demand for regional lots and the complexity associated with identifying and then implementing regional lots.
- 6.30 We are also mindful that, following an auction of UK-wide lots, regional use of spectrum available in the Auction would be possible through trading between UK licensees as well as between UK licensees and prospective users for sub-parts of the country (except for the specific case of shared low power spectrum discussed below).
- 6.31 All lots in the Auction are therefore UK-wide.
- 6.32 Consistent with our January 2012 proposals, we believe that the specific circumstances of the concurrent low power category at 2.6 GHz justify preventing regional trades. This is unlike other categories of lots, which are for individual use, for which all types of trades will be possible. The reason for not allowing regional trades for the concurrent low power category is that if a single concurrent licensee traded regional rights, it would likely impose costs on the other concurrent licensee (in the form of coordination costs with a new licensee). This creates risks to participation from prospective low power licensees and risks to the efficiency of their use post-auction were they to win rights to spectrum. Geographical trading would cause uncertainty regarding coordination costs and would risk undermining the scope for concurrent use. As explained in section 9, regional trades for concurrent low power licences at 2.6 GHz will not be possible.
- 6.33 The only type of trade allowed for concurrent low power licences is the outright total trade, under which all the rights and obligations under a licence are transferred to a third party. Sub-national leasing might be an option, subject to further consideration of the issues in due course.

Packaging for the 800 MHz band

- 6.34 Respondents commented on three areas of packaging for the 800 MHz band:
- a) lot sizes for the band;
 - b) whether and to what extent we can treat lots as generic; and
 - c) the coverage lot.

- 6.35 We consider the points they raised in deciding how to apply the general principles described above.

Whether and to what extent we can treat lots as generic

- 6.36 H3G was concerned about the risk that the bottom 2x10 MHz of the 800 MHz band might be at greater risk of interference from neighbouring uses. This might make those bottom frequencies unfavourable and might impact the prospects of their winner in the Auction. Everything Everywhere supported the approach to have as few categories of lots in the band as possible, but reserved the right to comment further on the use of two categories in light of final decisions on DTT co-existence. Intellect supported Ofcom's proposal for the 800 MHz band, noting the DTT co-existence proposals and likely limited differences between frequency blocks. BT noted that Ofcom's proposals on DTT co-existence meant that option 1 for the packaging of the band (with generic lots save for the coverage obligation) was suitable. However, David Hall Systems supported Option 2 (with more categories of lots) in the consultation as more appropriate.
- 6.37 As noted above, our approach to DTT co-existence and more generally the technical licence conditions that will be included in licences for the 800 MHz spectrum do not provide a reason for distinguishing between lots.
- 6.38 We consider the coverage lot below and, subject to this issue, all other 800 MHz lots will be in a single generic category.
- 6.39 In light of their generic properties, all lots at 800 MHz are suitable to count towards satisfying the competition constraint and towards the sub-1 GHz spectrum cap.

Generic lots – category A1

- 6.40 Following earlier broad support for 2x5 MHz lots, there was a limited number of further comments in response to the January 2012 consultation. A confidential respondent supported lots of 2x5 MHz (subject to any coverage obligation). It noted that if coverage obligations were associated with all lots, then we should ensure it is still possible to bid for a block of 2x15 MHz. BT also supported 2x5 MHz lots for lots other than the coverage lot and a 2x10 MHz lot associated with the coverage obligation.
- 6.41 There is overall support for lots of 2x5 MHz for lots other than that with the coverage obligation and we will be using this lot size for generic lots in the band.

The coverage lot – category A2

- 6.42 A confidential respondent argued that it was important to clarify that the 2x10 MHz lot at 800 MHz with the coverage obligation would not count toward satisfying the competition constraint. It believed that, if the lot did count towards it, then H3G would be advantaged over any new entrant in respect of any Minimum Portfolio Package (MPP)¹⁵⁵ including 2x10 MHz of 800 MHz, because of the greater challenge that entrants would face to meet the coverage obligation.

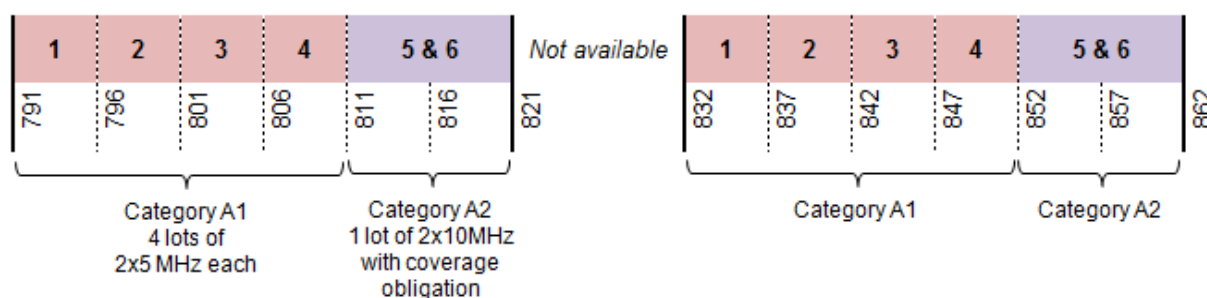
¹⁵⁵ For a specific bidder that opts in to benefit from the competition constraint, an MPP is a package of lots that, if won by the bidder, would be sufficient for the bidder to count towards satisfying the competition constraint. Section 4 sets out the MPPs.

- 6.43 Vodafone favoured lots that are as generic as possible and questioned whether a category was necessary for the lot with a coverage obligation. It proposed to address the allocation of that lot through the Assignment Stage. We consider that there could be material differences in the value of the spectrum in the 800 MHz band that is subject to the coverage obligation and the spectrum which is not. The reserve prices we set out in section 8 reflect this. Accordingly, we consider that to leave the allocation of the lot with the coverage obligation to the Assignment Stage would not be consistent with our objective of promoting an efficient allocation of the spectrum. In particular, there would be a risk that different bidders taking different views of their likelihood of winning the coverage lot could result in an outcome that is not consistent with underlying valuations and therefore less efficient than was possible. Therefore, we have decided to have a separate category for the lot with coverage obligation and, as explained below, to fix its location in the band.
- 6.44 Telefonica supported a fixed position at the top of the band for the coverage lot.
- 6.45 We believe that there are benefits to fixing the position of the coverage lot. The key reason is that it simplifies the Auction, in particular the Assignment Stage by reducing the number of potential sets of assignments in the band. By contrast, fixing its position does not result in any significant costs for bidders or consumers, given that the 800 MHz in A1 and A2 categories are good substitutes for each other.
- 6.46 The coverage lot will therefore be fixed at the top of the band.
- 6.47 We have also taken account of the confidential respondent's concern regarding potential differences in position between bidders eligible to benefit from the competition constraint. It is possible, or even likely, that a new entrant would find it more challenging than H3G to meet the coverage obligation, as H3G already has a wide-ranging pool of network sites and assets. It might be so challenging for a new entrant as to make it unattractive to bid for the coverage lot and to face the prospect of winning it. Of course, we want to ensure that there are no undue deterrents for new entrants to benefit from the competition constraint. Opting-in to benefit from the competition constraint requires eligible bidders to bid on a pre-defined set of packages, the MPPs, at reserve prices. The concern regarding the ability of a new entrant to meet the coverage obligation means that we should not and will not require bidders eligible to opt-in to bid on packages that include the coverage lot.
- 6.48 Effectively, we will provide bidders eligible to opt-in with three choices for the Opt-in Round: not to opt-in; to opt-in by making a bid for the MPPs that do not include the coverage lot (category A2); or to opt-in by making a bid for all MPPs including those that the coverage lot is part of. These provisions and associated rules on permissible packages appear in the auction rules in Annex 5. This means that each bidder will be free to decide whether to bid on the coverage lot and that competition in the Auction will determine which bidder wins that lot.
- 6.49 We do not consider that it is appropriate or necessary to require that any 800 MHz spectrum that an opted-in bidder may win would have to be or to include the coverage lot. This would be inconsistent with the recognition above of the challenges facing new entrants. We are also allowing bidders that are not eligible to opt in to compete for the coverage lot, even under scenarios where the 1800 MHz divestment is not available in the Auction. It would seem undesirable systematically to restrict the scope for all such bidders to win the coverage lot; one or more of them may want to bid for that lot and might be its most efficient user. Any opted-in bidder that selects a set of MPPs that includes the A2 lot may therefore face competition for the A2 lot from bidders that are not eligible to opt in.

Packaging for the 800 MHz band

- 6.50 Figure 6.4 sets out the resulting packaging provisions for the 800 MHz band. It involves:
- Four generic lots of 2x5 MHz each in category A1, for the frequencies 791-811 MHz paired with 832-852 MHz;
 - One specific lot with the coverage obligation in category A2, for the frequencies 811-821 MHz paired with 852-862 MHz.
- 6.51 All lots in category A1 and A2 count towards the sub-1GHz cap and towards the satisfaction of the competition constraint in the Auction provided that the relevant opted-in bidder has bid for the MPPs that include lot A2 in the opt-in round.
- 6.52 Lot A2, the coverage lot, is not part of the packages that bidders eligible to do so need to bid on at reserve prices, but they may do so if they wish.

Figure 6.4: Band plan for the 800 MHz band



- 6.53 This means that there are no issues with ensuring contiguity in the band, as bids for 800 MHz lots will be for one or more A1 lots, or the A2 lot, or one or more A1 lots and the A2 lot. Any A1 lots included in a package bid that also includes the A2 lot will be adjacent to the A2 lot and all lots in that package will be contiguous.

Packaging proposals for the 2.6 GHz band

- 6.54 Respondents supported our proposed approach to the band plan (as discussed above). There was also broad support for treating lots generically in each category in the band, as neither respondents nor we identified reasons for uses in adjacent bands or technical conditions in each lot category to justify further differences.
- 6.55 Comments on our January 2012 proposals related to two main categories of issues for the packaging of this band:
- the size of lots in each of the three categories; and
 - other provisions for any concurrent low power lots, in particular their position in the band.
- 6.56 We consider these issues, as well as how each category counts towards the competition constraint and spectrum caps, covering each lot category in turn.

Paired lots for individual use at standard powers – category C

- 6.57 H3G supported the use of 2x5 MHz lots, which provide more flexibility than 2x10 MHz lots. A confidential respondent also supported the use of 2x5 MHz lots, noting that some bidders in European auctions won packages of 2x5 MHz and 2x15 MHz in the band. BT, David Hall Systems and Intellect were also in favour of 2x5 MHz lots, with Intellect noting the importance of supporting the aggregation of lots to achieve wide bandwidths. Vodafone supported our proposals, arguing they would lead to a more efficient allocation of spectrum.
- 6.58 In light of the demand for the ability to bid on multiples of 2x5 MHz lots and the ability under the auction rules to aggregate lots and to bid for packages that can only be won in their entirety, we have decided to use lots of 2x5 MHz for individual use at standard powers.
- 6.59 There will be 14 category C lots available. The number of category C lots in the outcome of the Auction will depend on competition between category C lots and category D lots as explained below. There are three possible outcomes, subject to unsold lots: there could be either 10, 12 or 14 category C lots.
- 6.60 All paired lots for individual use are suitable to count towards the competition constraint and to be part of MPPs in the Auction. They also count towards the overall spectrum cap (but not the sub-1GHz spectrum cap).

Paired lots for concurrent use at low powers – category D

- 6.61 A confidential respondent noted that it was important to have a single block of low power spectrum, to avoid increasing the costs of sharing and limiting how useable the spectrum would be. Another confidential respondent argued that the number of concurrent licences associated with a 2x20 MHz block could be 10, but that it should be lower if the block was smaller. It considered that the low power lot should not be at the top of the band, because of interference risks that standard power users were better placed to manage.
- 6.62 There will be two types of lots available for concurrent low power use: lots of 2x10 MHz and lots of 2x20 MHz. D1 lots of 2x10 MHz will relate to a single block of 2x10 MHz; D2 lots of 2x20 MHz will relate to the same 2x10 MHz block as D1 lots for the first 2x10 MHz and to a contiguous 2x10 MHz block for the second 2x10 MHz. There will not be a reservation for concurrent low power use, and categories D1 and D2 will be in competition with category C. Section 7 on auction design and the auction rules at Annex 5 set out how this competition will work. As a result, in total, there may only be up to 10 concurrent low power lots, so the following three conditions need to be met at the same time. There may be:
- a) up to 10 D1 lots;
 - b) up to 10 D2 lots; and
 - c) up to 10 lots across categories D1 and D2.
- 6.63 Category D1 and D2 lots, given their concurrent rights shared amongst up to 10 licensees with respect to the same blocks of frequencies and their restricted power levels, are not suitable to count towards satisfying the competition constraint. For the same reason, they do not count towards the spectrum caps.

- 6.64 In addition, we recognise how risks of interference affect users of low power spectrum in a specific way. This is because the equipment that meets the low power limits is not capable of dealing with certain interference risks from adjacent uses without features such as large filters. Those features are not compatible with the sort of form factors that would be appropriate for likely uses (e.g. in homes) or that would support economies of scale in production. We have therefore included specific measures in the Assignment Stage (see section 7) to ensure, as far as possible, that any category D lots are not within 10 MHz of the edges of the band.

Unpaired lots for individual use – category E

- 6.65 H3G considered that Ofcom should require larger lot sizes because of the risk of fragmentation and the need for restricted blocks between distinct right holders, which reduce the amount of spectrum available for use at standard powers. H3G was in favour of lots of at least 25 MHz each, i.e. two lots at most. By contrast, Everything Everywhere supported our proposals of 5 MHz lots, with the lowest lot of each allocation of unpaired spectrum being a lot with restricted technical conditions. A confidential respondent also supported lots of 5 MHz to allow bidders to express their preferences, and referred to recent European auctions in which bidders bought rights to blocks of less than 50 MHz in the unpaired band. BT, David Hall Systems and Intellect agreed with the proposal for lots of 5 MHz. Vodafone supported our proposals, arguing it would lead to a more efficient allocation of spectrum.
- 6.66 In light of the Auction format and rules that we describe in section 7, bidders will not face aggregation risks. Therefore, the number of assignments within the unpaired range will reflect bids and will be a result of the competition between bidders. We do not consider that, in itself, a higher number of restricted blocks would necessarily mean lower spectrum efficiency or a reduced value for consumers. Indeed, more unpaired licensees offer the prospect of greater competition in the use of unpaired technology. We have therefore decided to use a lot size of 5 MHz.
- 6.67 In Section 10 and Annex 11, we explain why each assignment of unpaired lots requires a restricted block as its lowest lot, to manage the risk of interference between users of unpaired spectrum as well as between users of unpaired spectrum and users of paired spectrum. For this reason, a restricted block needs to be in place at the upper boundary between unpaired use and paired use (block 10 at 2615-2620 MHz).
- 6.68 In the competition assessment, we recognise that the prospects for use of unpaired spectrum at 2.6 GHz are somewhat uncertain at present. As a result, they are not suitable to count towards satisfying the competition constraint. However, they count towards the overall cap given its role as a safeguard. With the caps being expressed as paired spectrum, the way in which unpaired 2.6 GHz lots count towards the overall cap is as follows. Each lot of 5 MHz with standard power levels counts as $5 = 2 \times 2.5$ MHz towards the overall cap. Therefore, a bid for a total of n unpaired lots, which includes one restricted lot, counts as $(n-1) \times 2 \times 2.5$ MHz towards the overall cap of 2x105 MHz.

Packaging for the 1800 MHz divestment spectrum (if in the Auction)

- 6.69 The 1800 MHz divestment spectrum if available in the Auction will be a single lot of 2x15 MHz (category B), as illustrated in Figure 6.3 above.
- 6.70 This lot will count towards satisfying the competition constraint and towards the overall spectrum cap.

- 6.71 Any purchaser of the 1800 MHz divestment spectrum in the Auction has to be approved by the European Commission as fulfilling the criteria set out in the commitments given to the European Commission by Everything Everywhere's parent companies as part of the merger clearance for the T-Mobile/Orange joint venture. Further details are set out in the Information Memorandum which is being published alongside this Statement. Any party interested in bidding for the 1800 MHz spectrum, should it be available in the Auction, should refer carefully to the approval criteria set out in paragraph 18 of those commitments.

Overview of spectrum packaging in the Auction

- 6.72 Table 6.1 below provides a summary of the spectrum packaging provisions that will apply in the Auction.

Table 6.1: Overview of spectrum packaging

Band	Lot categories	Counts towards			No. of lots	Lot size (MHz)	Eligibility per MHz (**)	Eligibility per lot
		Competition constraint	Sub-1GHz cap	Overall cap				
800 MHz	Two categories of lots: A1 (4 lots of 2x5 MHz each) and A2 (1 lot of 2x10 MHz).							
	A1 lots relate to generic frequencies for the bottom four 2x5MHz blocks.	Yes	Yes	Yes	4	2x5	225	2250
	The A2 lot relates to the 2 blocks of 2x5 MHz at the top of the band and has the coverage obligation.	Yes	Yes	Yes	1	2x10	225	4500
1800 MHz (*)	Category B: single lot for specific frequencies as per the EC decision on the Everything Everywhere merger	Yes	No	Yes	1	2x15	75	2250
2.6 GHz paired	Category C: paired lots for individual use at standard powers 14 generic lots available	Yes	No	Yes	14	2x5	15	150
	Categories D1 and D2: paired lots for concurrent low power use Whether there are any D1 and/or D2 lots in the Auction outcome depends on competition between demand for these lots and for C lots.	No	No	No	10 across D1 and D2	2x10 (D1) 2x20 (D2)	1.5	30 (D1) 60 (D2)
2.6 GHz unpaired	Category E: unpaired lots for individual use covering lots at standard powers and any necessary lot at restricted powers Each bid is for n lots and includes n-1 lots at standard powers and one lot at restricted powers (located at the bottom of the group of lots). There is a requirement for n to be equal to or greater than 2.	No	No	Yes, n lots count as (n-1)x2x2.5 MHz	9 (***)	5	0.2 (excluding restricted lots)	(n-1) points for n lots

(*) if available in the Auction

(**) see Section 7, paragraphs 1.55-1.61 for more detail

(***) Unpaired block 10 (2615-2620 MHz) is not available in the Principal Stage and is granted to the winner of block 9 (2610-2615 MHz) in the Assignment Stage.

Section 7

Auction design: final decision

- 7.1 In this section we set out our final decisions on the design of the Auction. The final design follows closely the design proposed in the January 2012 consultation. The main changes are some general simplifications to the rules and changes aimed at encouraging truthful bidding in the Supplementary Bids Round. The final design takes into account further advice by Dotecon and Professor Peter Cramton.
- 7.2 Annex 5 contains a detailed description of the Auction rules. Annex 4 contains a summary of the responses we received to the January 2012 consultation and presents our views on the points raised.

Auction format: Combinatorial Clock Auction

- 7.3 The format we have decided on is a Combinatorial Clock Auction (CCA) involving a Principal Stage and an Assignment Stage. This format was proposed in our March 2011 and our January 2012 consultations and received broad support from stakeholders.
- 7.4 The structure of the Auction is as follows
- a) The Principal Stage consists of three parts that take place in sequence:
 - o an opt-in round during which those bidders that are eligible to opt in decide whether to make bids at the reserve price for a set of Minimum Portfolio Packages (“MPPs”);
 - o a series of Primary Bid Rounds during which Ofcom, the Auctioneer, sets round prices in light of excess demand for each lot category and bidders respond to the changes in prices with revised bids until there is no longer excess demand for any of the lot categories; and
 - o a Supplementary Bids Round, i.e. a single further round of bidding during which bidders can, if they wish, update the amounts of their bids on packages they bid on in the Primary Bid Rounds and bid on different packages. The amount of each supplementary bid is subject to constraints resulting from the preferences bidders expressed in the Primary Bid Rounds (a ‘relative cap’).
 - b) Our measures to promote competition involve requiring that the outcome of the Principal Stage includes, subject to demand, at least one winner of an MPP that is not Everything Everywhere, Telefónica or Vodafone. We refer to this requirement as the Competition Constraint.
 - c) Each package bid made in the Auction stands in its entirety. Winner determination for the Principal Stage therefore involves exploring all the combinations of bids (from the Opt-in Round, Primary Bid Rounds and Supplementary Bids Round) that: involve at most one bid from each bidder, award no more lots in each category than are available, are consistent with restrictions on bids (e.g. spectrum caps) and satisfy the Competition Constraint. The winning combination is the combination for which the sum of bid amounts plus the reserve price in respect of any unsold spectrum is highest. We identify the price that each winner pays according to a ‘second-price’ rule, specifically the

price in the minimum revenue core that is closest to Vickrey prices. Winner determination includes provision for tie-breaking.

- d) The Assignment Stage is a single round of bidding in which Principal Stage winners can, if they wish, bid on preferred frequencies in each category of lots that they have won (where there are different options for where their lots could fall in a given band).

- 7.5 This design supports the three general principles that we set out in the January 2012 consultation: to make price and demand revelation as clear as possible, subject to controlling the risks of collusive strategies; to make sure bidders have the incentives to make bids that reflect their true preferences; and a manageable level of complexity for both bidders and the Auctioneer.¹⁵⁶

Changes to the design proposed in the January 2012 consultation

- 7.6 We have decided to make a number of changes to the design proposed in the January 2012 consultation. In order to prevent bidders from being able to make bids in the Supplementary Bids Round that cannot win but that can raise prices that other bidders pay, we have decided not to implement the Final Price Cap. Other changes are aimed at simplifying the Auction design, in particular changes to the activity rule during the Primary Bid Rounds and the information reported during the Primary Bid Rounds.

Encouraging truthful bidding in the Supplementary Bids Round (removal of Final Price Cap)

- 7.7 Our proposals in the January 2012 consultation incorporated a number of rules to ensure that bidding in the Supplementary Bids Round is consistent with bids made in the Primary Bid Rounds. This provides strong incentives to bid truthfully in the Primary Bid Rounds (i.e. bid on the most profitable package in each round at prevailing clock prices). Specifically we proposed all bids made in the Supplementary Bids Round must meet both the Relative Cap and the Final Price Cap. The Relative Cap ensures supplementary bids are consistent with choices made in those rounds where a bidder dropped eligibility. The Final Price Cap ensures supplementary bids are consistent with those made in the final Primary Bid Round.
- 7.8 The Final Price Cap in particular ensures that bidders can guarantee they win the package they bid on in the final Primary Bid Round (their Final Primary Package). This provides a powerful incentive to bid on the most profitable packages during the Primary Bid Rounds. It also provides greater certainty that the outcome in the final Primary Bid Round will resemble the final outcome of the Auction, something we acknowledged was desirable.¹⁵⁷
- 7.9 However, following a confidential response from a stakeholder we acknowledge that the Final Price Cap can have unintended consequences. Specifically, it allows bidders to place bids in the Supplementary Bids Round that they know cannot win but that might raise the prices other bidders pay for spectrum.¹⁵⁸ In our January 2012

¹⁵⁶ See paragraph 7.10 to 7.13 of the January 2012 consultation.

¹⁵⁷ See in particular paragraphs 7.68 to 7.75 and Annex 11 of the January 2012 consultation.

¹⁵⁸ In particular, if there are no unsold lots at the end of the Primary Bid Round, Final Primary Packages are guaranteed regardless of the Supplementary Bids that are made. A bidder can then place Supplementary Bids on a whole range of packages that will subsequently form part of the calculation of prices other bidders pay.

consultation we accepted the undesirability of an Auction design that allows bids that cannot win and we introduced sets of Permissible Packages to prevent bidders from bidding on packages that are known from the start to be unwinnable.¹⁵⁹ We now accept that the Final Price Cap can have a similar effect in that, during the Supplementary Bids Round, bids can be made that cannot win but that can influence the final prices other bidders pay.

- 7.10 As a result, we have decided to remove the Final Price Cap from the Auction design. Supplementary Bids will now only be subject to Relative Caps (as well as spectrum caps and restrictions on Permissible Packages). We believe the Relative Price Cap should still create sufficiently powerful incentives for truthful bidding in the Primary Bid Rounds, without creating the certainty that allows cost-raising bids¹⁶⁰. Although bidders will now face less certainty about winning their Final Primary Package, we believe the change is nonetheless overall in the interests of Auction efficiency.
- 7.11 In deciding how best to address the issue of riskless cost-raising supplementary bids we considered and rejected a proposal suggested by the confidential respondent under which the Supplementary Bids Round would be dropped in cases where the Primary Bid Rounds ended with demand matching supply in all lot categories. With unsold lots, the respondent suggested running a further round in which only bids on unsold lots are considered and where any winning bids would be added to Final Primary Packages. The difficulty with this solution is that unsold lots may only have value to bidders as part of a larger package and it may therefore be necessary to reallocate the lots contained in Final Primary Packages in order to obtain the value maximising outcome. By guaranteeing Final Primary Packages, the proposal risks an inefficient allocation of unsold lots.

General simplifications

- 7.12 Our proposals in the January 2012 consultation contained a number of changes to the previous design proposed in the March 2011 consultation aimed at improving the information reported to opted-in bidders and ensuring the existence of the competition constraint is reflected in the calculation of excess demand during the Primary Bid Rounds. We maintain the objectives of these changes, but have decided to make a number of simplifying changes.

Removal of the ability to make Capped Primary Bids in Primary Bid Rounds

- 7.13 With the removal of the Final Price Cap, bidders no longer face the risk that if they do not make a Capped Primary Bid (i.e. a bid that exceeds eligibility in the current round) during the final Primary Bid Round they will not be able to make it in the Supplementary Bids Round. The activity rules in the Primary Bid Rounds can therefore be simplified significantly by removing the option to make Capped Primary Bids; bidders will only be able to bid on packages that are within their eligibility in a given round. Bidders will still be able to make any bid that they would have been able to make as a Capped Primary Bid in the Supplementary Bids Round; this change will

¹⁵⁹ See paragraphs 7.28 to 7.35 of the January 2012 consultation. In the present context, the risk is that the prices bidders pay are driven up to the clock prices that prevail in the final round. This would effectively turn the Auction into a first price (and linear price) Auction and introduce incentives for demand withdrawal (i.e. bidder would reduce demand in an attempt to stop the clocks at a lower price).

¹⁶⁰ The confidential respondent argued that the Relative Cap can also, in some circumstances, guarantee Final Primary Packages and allow cost raising bidding. However, since bidders do not know the Relative Caps that apply to other bidders they will always face the risk of winning any bids that are intended to raise prices for others.

therefore not affect the bids a bidder is ultimately permitted to make, only the time when they can be placed.

- 7.14 This change means that Chain Bids (i.e. additional bids that are placed to ensure Capped Primary Bids remain consistent with earlier bids) are also unnecessary and have been removed.
- 7.15 This change may have a small effect on price discovery in the Primary Bid Rounds since reported excess demand and clock prices will no longer reflect demand from Capped Primary Bids. However, since Capped Primary Bids are entirely optional for bidders in the absence of a Final Price Cap it is likely that many bidders would have refrained from using them anyway.

A stopping rule for the Primary Bid Rounds that is simpler but also reflects the Competition Constraint

- 7.16 In the January 2012 consultation we introduced a new stopping rule for the Primary Bid Rounds and method of calculating excess demand in order to ensure that the existence of the Competition Constraint would be reflected even when all opted-in bidders were no longer bidding.¹⁶¹
- 7.17 The stopping rule proposed in the January 2012 consultation ran a Provisional Winner Determination in each round based on all bids received in the Auction up to the current round and including the need to allocate spectrum to satisfy the Competition Constraint. This ensures that the existence of the Competition Constraint is reflected in clock prices and the stopping decision.
- 7.18 However, the proposed stopping rule involved a significant amount of complexity since a full winner determination would have been run in each round. We have consequently decided on a simpler method of incorporating the existence of the Competition Constraint into calculations of excess demand. Under the new rule, if one or more opted-in bidders are bidding on a package compatible with the Competition Constraint ('MPP-compatible package') demand will simply be measured by the sum of bids made in a given round in each Lot Category. If no opted-in bidder is bidding on an MPP-compatible package¹⁶² the rules will identify the MPP-compatible bid from earlier rounds that is closest in value to its cost at current round prices (with an appropriate tie breaking rule). This MPP-compatible bid will then be added to the total demand (and if the bid comes from a bidder that is still active it will replace their current bid for the purposes of calculating demand). The stopping rule then requires that there is no excess demand in any Lot Category.
- 7.19 The new stopping rule means that, apart from bids necessary to satisfy the Competition Constraint, bids from earlier rounds do not play a role in determining excess demand and the ending of the Primary Bid Rounds.

Information provided to all bidders during the Primary Bid Rounds (new method for reporting demand)

- 7.20 We previously proposed to report to all bidders after each Round the total demand in each lot category resulting from a Provisional Winner Determination calculation. The

¹⁶¹ See paragraphs 7.49 to 7.53 and Annex 11 of the January 2012 consultation.

¹⁶² This will only be possible if there are two or more opted-in bidders, since the set of Permissible Packages requires that a solitary opted-in bidder must bid on an MPP-compatible package at all times.

calculation considered all bids made up to and including the current Round and also the need to meet the Competition Constraint. As a simplification we have decided to report only the sum of the bids made in each Lot Category in the previous Round.

- 7.21 This change also has the benefit that, unlike our previous proposals, reported demand represents only bids made at prevailing clock prices. This reveals more clearly the demand at current clock prices and allows bidders to get a better sense of what others are willing to pay. This helps price discovery.
- 7.22 The new method for reporting demand means that allocations required to meet the Competition Constraint will only be reported if an opted-in bidder is still bidding on an MPP-compatible package. However, the stopping rule described above ensures that, even when no opted-in bidder is bidding on an MPP-compatible package, allocations necessary to meet the Competition Constraint do still play a role in determining excess demand and therefore clock prices throughout the Primary Bid Rounds.
- 7.23 We discuss below a change that also results in new information being provided to all bidders at the start of each Primary Bid Round.

Information provided to opted-in bidders during the Primary Bid Rounds

- 7.24 In the January 2012 consultation we introduced a Competition Credit for opted-in bidders that would provide them with information during the Primary Bid Rounds about the level of competition from other opted-in bidders¹⁶³. Specifically, the Credit showed at each stage of the Primary Bid Rounds the highest possible opportunity cost for an MPP-compatible package given the bids other opted-in bidders would be permitted according to their eligibility levels and the constraining packages from previous rounds.
- 7.25 The introduction of the Competition Credit recognised the fact that the demand information reported to all bidders at the end of each round would be of less use to an opted-in bidder in gauging the level of competition they face. Since the credit was deducted from the value at clock prices of bids made, it also allowed the opted-in bidder to continue bidding even when clock prices were higher than their valuation.
- 7.26 Further analysis, however, suggests that the Competition Credit is not as useful for opted-in bidders as was originally envisaged. The size of the Credit in each round was restricted to ensure that the price of a MPP net of the Credit cannot fall from one round to the next. Our analysis suggests this constraint binds often and that as a result the Credit reveals little information (e.g. it appears very possible that the Credit will remain at zero throughout the Primary Bid Rounds even when there is a single opted-in bidder).
- 7.27 The Competition Credit also received criticism from Telefónica and a confidential respondent who argued that it gave opted-in bidders an informational advantage that they could exploit. In particular, an opted-in bidder would have a better idea by the end of the Primary Bid Rounds of the final price it would have to pay and the specific package it would be likely to secure.
- 7.28 We continue to think it is appropriate to provide some information that allows opted-in bidders to gauge the level of competition they face during the Primary Bid Rounds, but have decided to reject the Competition Credit proposed in the January 2012 consultation. We have instead chosen a simpler approach in which we reveal to all

¹⁶³ See paragraphs 7.44 to 7.48 in the January 2012 consultation.

bidders at the start of each round whether there is more than one opted-in bidder with sufficient eligibility to bid on an MPP-compatible package.

Other decisions

- 7.29 There are a number of further decisions and clarifications that do not constitute significant changes to the design proposed in the January 2012 consultation. These are generally technical issues that we do not anticipate will have any significant effects on the performance of the Auction.

Vickrey-nearest pricing

- 7.30 We previously considered two pricing rules: Vickrey-nearest pricing and linear reference pricing.¹⁶⁴ Both rules ensure that winners pay both their individual and collective opportunity costs of the lots they are allocated. However, where collective opportunity costs exceed the sum of individual opportunity costs they may differ in the final prices they select for bidders (though not the total sum of payments across bidders). Both rules can create theoretical incentives to deviate from truthful bidding, though in practice we believe these are small.¹⁶⁵
- 7.31 On balance, we have decided to use Vickrey-nearest pricing. This is because further analysis we have conducted has highlighted that the prices selected by linear reference pricing can be very sensitive to the reserve prices that are selected. We regard this as an undesirable feature of a pricing rule.

Pricing rule for opted-in bidders

- 7.32 A confidential respondent argued that if opted-in bidders win a package of spectrum that is larger than (and encompasses) one of the MPPs they should pay a price that reflects a broader opportunity cost that does not require the Competition Constraint to hold. In other words, the opportunity cost would be the next highest value allocation of spectrum regardless of whether this meets the requirement of the Competition Constraint.
- 7.33 This approach would create a powerful disincentive for an opted-in bidder to bid for additional spectrum and risks creating an inefficient allocation. Additional spectrum beyond the MPP should be awarded if the opted-in bidder is willing to pay an incremental amount that exceeds the opportunity cost of the additional spectrum. The alternative rule would demand that in addition they pay the 'shadow value' of the Competition Constraint itself. Such a rule would go against our objective of promoting competition.
- 7.34 Consequently we will calculate prices for opted-in bidders in a way that ensures they pay an opportunity cost that reflects the need for the Competition Constraint to hold. We set out below further information on how this opportunity cost is calculated.

Implementing reserve prices by lot instead of by package

- 7.35 In previous proposals we planned to implement reserve prices by requiring that the price of a winning bid was at least as large as the sum of the reserve prices on its constituent lots. This has the effect that once a bid on a package is large enough, additional lots can be added to the package without having to adjust the bid made on

¹⁶⁴ Annex 12 of the January 2012 consultation discusses these two rules in technical terms.

¹⁶⁵ See the discussion in paragraphs 7.143 to 7.147 of the January 2012 consultation.

it. In other words, the reserve prices do not necessarily affect the marginal cost of adding spectrum to packages. This tends to favour bidders on larger packages over bidders on smaller packages. For example, bidders who are bidding on larger, more valuable packages with price far above reserve prices could potentially add incremental spectrum to their bid without cost.

- 7.36 We have now decided to apply reserve prices to individual lots instead of packages. In practical terms this means that unsold spectrum is valued at reserve prices when calculating the total value of any combination of bids, both for the purposes of winner determination and pricing. This ensures that all bidders pay at least the reserve price for incremental spectrum added to packages. We have taken this into account in determining our proposed reserve prices in section 8.

Implementation of competition between category C and category D at 2.6 GHz

- 7.37 As discussed in section 4, we have decided that individual use at standard powers and concurrent low power use will compete for access to spectrum at 2.6 GHz. We recognise that we cannot be certain of the optimal size of any concurrent low power allocation, and there will therefore be two categories of low power lots: category D1, with up to 10 lots relating to 2x10 MHz and category D2 with up to 10 lots relating to 2x20 MHz and with up to 10 lots in total across D1 and D2.
- 7.38 We will do so by aggregating bids for category D lots such that:
- a) during the Primary Bid Rounds, leaving aside the effect of the competition constraint, prices at 2.6 GHz will increase unless it is possible to accommodate all bids made in a given Round for category C, D1 and D2 lots in the available supply;
 - b) when computing who the winners are, the optimisation will aggregate the value of bids for low power spectrum. Therefore, bids for categories D1 and D2 will add up as part of feasible combinations of bids and, for each combination, there will be
 - up to 12 category C lots, if the combination includes bids for D1 but not D2 lots;
 - up to 10 category C lots if the combination includes bids for D2 but not D1 lots or for both D2 lots and D1 lots.
- 7.39 The Auction rules at Annex 5 set out in detail the way in which the assessment of excess demand at the end of each Primary Bid Round, the selection of the high-value combination of bids and the identification of prices for each winning bidder will operate.

The Assignment Stage and Joint Bidding

- 7.40 In January 2012, we invited comments on options relevant to joint bidding in the Auction. This related to potential provisions regarding “passive shareholders”, joint bidding in the Principal Stage and facilitating spectrum sharing in the Assignment Stage. We also set out a working hypothesis that any low power lots would be at the top of the paired range in the 2.6 GHz band.

No facilitation of joint bidding or choice of neighbour

- 7.41 No stakeholder expressed support for the relaxation of provisions on overlaps between bidders' corporate groups in respect of "passive shareholders". We are therefore not including any provisions in this respect in the Auction rules.
- 7.42 We identified clear potential concerns regarding competition in the Auction and competition law in respect of any joint bidding in the Principal Stage. We explained that dealing with such concerns through an orderly process would likely take time in the case where parties to a joint-bidding agreement were competitors in the provision of mobile services. Depending on when the corresponding vehicle was formed and on when relevant competition authorities were informed, due consideration of any competition law implication might not be possible without delaying the award. This risked causing consumer harm through delays in the grant of licences and, consequently, the availability of mobile services using the available spectrum.
- 7.43 Our view remains that it would not be appropriate to facilitate joint bidding in the Principal Stage of the Auction. We have considered the position where two or more competitors set up a joint venture for the purpose of bidding in the Auction, and in particular whether we should include (as part of the criteria that we would take into account when deciding whether to qualify applicants) some form of competition assessment of such arrangements. We have decided not to do so, on the basis that it would not be possible to carry out a thorough competition assessment as part of the qualification process, and a light-touch competition assessment would risk reaching unsound and/or disproportionate conclusions. We note in this regard that (a) it is for potential bidders to satisfy themselves that their arrangements are consistent with all applicable laws, and (b) any competent competition authority would have powers to impose appropriate remedies, including potentially as to the need to divest or surrender spectrum licences, should any joint arrangements be found to infringe competition law and/or constitute mergers that are found not to be permitted.
- 7.44 In the January 2012 consultation we set out three options to facilitate spectrum sharing in the Assignment Stage. These were to allow negotiations between Principal Stage winners; to allow joint bidding for the purpose of the Assignment Stage; or to allow bids contingent on the identity of neighbour(s) in the Assignment Stage. We identified significant downsides with each option such that we did not favour any of them. Respondents did not express any support for these options and they did not advocate developing alternative provisions to facilitate joint bidding or to allow a Principal Stage winner to influence the identity of its spectrum neighbours. Rather, one respondent expressed concerns regarding the issues such measures might raise for network sharing.
- 7.45 We have therefore decided not to implement any measures for joint bidding or contingent bidding in the Assignment Stage.

Position of low power lots in the 2.6 GHz paired range

- 7.46 Respondents who had an interest in concurrent low power use at 2.6 GHz raised concerns regarding the illustrative position of any low power lots set out in the January 2012 consultation. They were concerned that coexistence with uses adjacent to the 2.6 GHz band would raise challenges for the practicality and cost of manufacturing base stations (e.g. femto-cells) for concurrent low power use. By contrast, respondents with an interest in individual use at standard powers at 2.6 GHz did not raise similar concerns (in addition they do not face the same challenges

for high power base stations and they have the option of also bidding for concurrent low power spectrum).

- 7.47 We see some merit in the arguments regarding coexistence between concurrent low power use and uses adjacent to the 2.6 GHz paired range (in particular radars above 2690 MHz and unpaired 2.6 GHz use below 2620 MHz). It would be undesirable to limit the scope for any concurrent low power use to emerge from the award because of such coexistence reasons, when it is possible to design rules regarding the location of any concurrent low power lot that address the issues relatively simply.
- 7.48 We have therefore decided to require that any concurrent low power spectrum be at least 10 MHz away from the edges of the band, subject to there being a sufficient number of winners of paired spectrum for individual use at standard powers to allow this. For further details, see Annex 5.

Specification of the Assignment Stage

- 7.49 The rules we have decided on for the Assignment Stage therefore allow each bidder to bid on the Assignment Stage options available to it independently of any other bidder. For each lot category excluding category D in respect of which there are several winners, there will be a separate Auction, in which winners may bid on specific locations for their assignment within the available frequency range for that lot category.
- 7.50 For the 800 MHz band, only winners of category A1 lots may bid for specific assignments.
- a) Any unsold lots will form a contiguous range at the bottom of the band (i.e. including block 1 at 791-796 MHz paired with 832-837 MHz), except that if the A2 lot is unsold that will remain at the top of the band.
 - b) There will be no Assignment Stage option available to the winner of the A2 lot (if any), as it is a specific lot, and any category A1 lots it wins will be contiguous to the A2 lot.
 - c) The Assignment Stage options available to winners of A1 lots will therefore be the locations that their assignment can take in the available range without overlapping with other assignments, subject to any unsold lots.
- 7.51 For the 1800 MHz lot, there are no Assignment Stage options and no bidding is required as it is a single specific lot.
- 7.52 For the 2.6 GHz paired lots, only winners of category C lots may bid for specific assignments.
- a) Any unsold lots will form a contiguous range at the top of the paired range (i.e. including block 14 at 2565-2570 MHz paired with 2685-2690 MHz).
 - b) Each winner of category C lot will receive a contiguous assignment in that category. The Assignment Stage options available to category C lot winners will be the locations that their assignment can take in the available range without overlapping with other assignments, subject to any unsold lots.
 - c) The location of any concurrent low power assignment will be determined by the number of category C winners, the sizes of their winning bids, and category C

winners' bids on their Assignment Stage options. Specifically, the location of category D lots will be:

- ○ If there is only one winner of category C lots that winner will be assigned lots at the bottom of the band and the category D winners will be assigned the 2x10 MHz and/or 2x20 MHz immediately above this;
- If there are two winners of category C lots, one of whom has won only one lot, and there is at most 2x5 MHz of 2.6 GHz paired spectrum unsold, then the winner of the larger number of category C lots will be assigned lots at the bottom of the band, the category D winners will be assigned the 2x10 MHz and/or 2x20 MHz immediately above this, and the winner of the one category C lot the 2x5 MHz immediately above this.
- Otherwise, winners of category C lots will have the option of bidding on assignment options compatible with each of them being assigned a contiguous block of frequencies that matches the number of lots in their winning principal stage bid, with any unsold lots at the top of the band, and it being possible for the winners of category D lots to be assigned a contiguous block of 2x10 MHz and/or 2x20 MHz (as the case may be) that is at least 10 MHz away from both the top and bottom of the band. In this case the winners of category D lots will be assigned whichever 2x10 MHz and/or 2x20 MHz (as the case may be), that is at least 10 MHz away from both the top of bottom and the band, that is not assigned to winners of category C lots in the winning combination of assignment stage bids.
- In all cases, if there are winners of both category D1 lots and category D2 lots, the winners of category D1 lots will be licensed to use the lowest 2x10 MHz of the block of 2x20 MHz assigned to the category D2 winners.

7.53 For the 2.6 GHz unpaired lots, each winner will have the option to bid on any of the locations that its assignment can take in the available range without overlapping with other assignments, subject to any unsold lots.

- a) Any unsold lots will be at the bottom of the range (i.e. including block 1 at 2570-2575 MHz).
- b) Each winner of category D lots will receive a contiguous assignment in that category.

7.54 Winner and price determination will follow the same principles as for the Principal Stage, as described in Annex 5.

Eligibility Points

7.55 Eligibility points serve to constrain the choices that bidders can make in each Primary Bid Round of the Auction in order to facilitate efficient price discovery. In particular, under the design we have developed, there are two key provisions that relate to eligibility. First, bidders can only bid on packages that are of the same size (measured in eligibility points) as, or smaller than, their bid in the previous round (or their initial eligibility in the case of the first Primary Bid Round). Second, each reduction in eligibility during the Primary Bid Rounds results in a cap on the bid amount that a bidder can make during the Supplementary Bids Round in relation to those packages that are larger (have greater associated eligibility) than the package bid on in the round.

- 7.56 When developing our consultation proposals, we set out two main guiding principles for identifying specific values related to these properties. The first principle is to provide a reasonable reflection of likely relative prices of the different categories of available spectrum. The second principle is to facilitate bids that reflect genuine preferences in light of round prices; this involves supporting switches of demand between lot categories that are sufficiently similar, if price changes for the relevant categories warrant it.
- 7.57 In our January 2012 consultation, we included proposals for a relaxation to the rule requiring bidders either to maintain or to reduce eligibility from one primary bid round to the next (i.e. Capped Primary Bids). This would have reduced the extent of the constraints from eligibility points on bidders' ability to reflect their preferences. As explained above, we are not including this relaxation in the rules for the Auction. Our choice of eligibility point values therefore has greater significance than it might have done. The choice of specific eligibility point values for the different lot categories needs to take account of the constraints that flow from them. At the same time, we recognise that setting specific values involves judgment and that there is not a single "perfect answer" for eligibility points. Our key concern is to make sure that the eligibility points we select are consistent with our objectives for the Auction and in particular in supporting an efficient process.
- 7.58 Our January 2012 proposals included a description of the broad relativities in value between lot categories and type of switching which we proposed facilitating, as well as an illustration of eligibility points that could reflect these considerations. Some respondents expressed concerns regarding the consideration of relative values between 800 MHz lots and the 1800 MHz lot in particular and regarding the associated illustrative eligibility points (the proposals included the same number of eligibility points for 2x10 MHz of 800 MHz and 2x15 MHz of 1800 MHz). The respondents referred to recent Auction results as a guide for a lower relative value for the 1800 MHz lot.
- 7.59 We have considered the responses carefully alongside information from recent European Auctions. Our decision is based on the available information and relevant considerations as follows:
- a) Lot categories at 800 MHz – A1 and A2 (with coverage obligation)
 - Despite the likely difference in values as a consequence of the coverage obligation in A2, we consider it important to facilitate switching between lot categories at 800 MHz on a 1 MHz to 1 MHz basis. Therefore the A2 lot (2x10 MHz) will have the same eligibility as two A1 lots (two lots of 2x5 MHz each).
 - b) Lot category at 1800 MHz – B
 - Evidence suggests that our January 2012 proposals tended to over-state the value of the 1800 MHz lot relative to 800 MHz lots. However, we remain of the view that facilitating the option to switch between the 1800 MHz lot and 800 MHz spectrum is desirable, particularly in the UK context, even if this might not directly reflect market information on relative values in some other countries.
 - Given the lot size at 800 MHz, we have therefore decided to associate the same number of eligibility points to one A1 lot (2x5 MHz) and the B lot (2x15 MHz).

- c) Lot categories at 2.6 GHz – C (paired), D (concurrent low power), E (unpaired)
- Information from recent European Auctions suggests that spectrum at 2.6 GHz has a much lower value than spectrum at 800 MHz. There are also uncertainties regarding the prospects for use of the unpaired 2.6 GHz spectrum (category E) as well as 2.6 GHz concurrent low power spectrum (category D).
 - In relation to 2.6 GHz lots, the eligibility points we selected reflect our assessment of likely relative values for all available lots as discussed in section 8. We note that these values mitigate the risk of bidders parking demand on lower value spectrum.

7.60 Table 7.1 sets out the eligibility point values that result from these considerations. Their relativities are consistent with the proposed reserve prices set out in section 8 (apart from the relative reserve prices of A1 and A2).

Table 7.1: Eligibility points for each lot category

Lot category	Lot size (MHz)	Eligibility points per lot	Eligibility point per MHz
800 MHz – A1	2x5	2250	225
800 MHz – A2 (coverage)	2x10	4500	225
1800 MHz – B	2x15	2250	75
2.6 GHz – C (paired)	2x5	150	15
2.6 GHz – D (concurrent low power)			
D1	2x10	30	1.5
D2	2x20	60	1.5
2.6 GHz – E (unpaired)	1x5	(n-1) points for n lots	0.2 (excluding restricted lots)

7.61 These values are reflected in the draft Auction regulations published alongside this Statement.

Opt-in bids for 800 MHz spectrum

7.62 In the January 2012 consultation we proposed that bidders who opt-in be required to place bids on all Minimum Portfolio Packages at reserve prices. Since 800 MHz spectrum will be included in some of these packages and since one lot category for 800 MHz spectrum includes a coverage obligation (the A2 category), we clarify here that the mandatory opt-in bids will be on 800 MHz spectrum without the coverage obligation (the A1 category). In section 6 packaging, we explain our decision not to require eligible bidders to bid on packages that include the A2 lot as part of the Opt-in Round, but to give them the option to do so. If a bidder opts in but does not select the set of opt-in bids that include the A2 lot, they will be able to bid for packages that include the A2 lot, but these will not count towards fulfilment of the competition constraint and so the bidder will only win such a package if they outbid all other bidders and not just other opted-in bidders. This is to prevent the ‘leveraging’ of the

Competition Constraint and to ensure that bidders face the full opportunity cost for incremental spectrum that they may acquire in addition to an MPP.

Section 8

Reserve prices

Introduction

8.1 This section outlines the framework we have used in determining our proposals on reserve prices as set out in the draft auction regulations. We will make a final decision on reserve prices when we make the auction regulations, subject to any representations received on them from stakeholders by the date given in the notice which accompanies those draft regulations.¹⁶⁶

8.2 The section has the following structure:

- First, it sets out a summary of our policy rationale for setting reserve prices in this Auction.
- Second, it sets out the different risks which we consider are of particular relevance to setting reserve prices for this Auction.
- Third, it briefly presents a study we commissioned from DotEcon and Aetha to inform our judgement on reserve prices. In particular, we describe the methodology and the main results of the study, including the views expressed by a panel of financial experts.
- Fourth, it sets out our proposed reserve prices for each spectrum category (summarised in the table below) and discusses how these proposals (i) strike a balance between different risks and (ii) relate to DotEcon and Aetha's recommendations and other evidence available.

8.3 Table 8.1 below summarises our proposals.

Table 8.1: Summary of Ofcom's proposal for reserve prices

Lot Category	A(i)	A(ii)	B	C	D(i)	D(ii)	E
	800 MHz 2x5 MHz	800 MHz 2x10 MHz (with coverage obligation)	1800 MHz 2x15 MHz (Divestment)	2.6 GHz 2x5 MHz (standard power)	2.6 GHz 2x10 MHz (shared low power)	2.6 GHz 2x20 MHz (shared low power)	2.6 GHz 5 MHz (unpaired)
Ofcom's proposal	£225m	£250m	£225m	£15m	£3m per bidder, £30m threshold	£6m per bidder, £60m threshold	£0.1m

Policy rationale for setting reserve prices

8.4 The reserve price is the price below which the auctioneer (in this case, Ofcom) will not sell the item being awarded. In the past, we have often set reserve prices for

¹⁶⁶ Notice of Ofcom's proposal to make regulations in connection with the Award of 800 MHz and 2.6 GHz Spectrum

spectrum at a low but not trivial level (such as £100,000 for a 20 year licence covering 2x5 MHz of spectrum) mainly in order to discourage frivolous bidding.

- 8.5 In paragraphs 8.106 – 8.110 of the March 2011 consultation, however, we considered that in the case of this Auction there are reasons to depart from such an approach. We set out two additional options which we consider better suited to an award which also includes a competition constraint:
- 8.5.1 We considered (paragraph 8.114) that there is some merit in using reserve prices that would be likely to cover at least spectrum clearance costs, but unlikely to be close to the full value of the spectrum: these may help to mitigate the risk of strategic bidding, encourage better regulatory engagement and reduce the time the Auction takes to reach market clearing prices. We also explained our view that such prices would only create small risks of inefficiency in the auction process and in the use of the spectrum afterwards.
- 8.5.2 We also considered at paragraph 8.113 (b) the option of determining reserve prices at a level reflecting likely market value estimated in a conservative way. We also considered that higher reserve prices create risk and these effects are likely to be more pronounced as reserve prices get higher and closer to the likely value of the spectrum (paragraph 8.112).
- 8.6 We also raised the possibility of applying different reserve prices to different categories of spectrum (paragraphs 8.116 – 8.118). Specifically we set out the possibility that spectrum that was going to be the subject to potentially lower competition as a result of competition measures could attract a level of reserve price different from that for other spectrum in the Auction.
- 8.7 In the January 2012 consultation at paragraph 6.99 we considered further the implementation of differentiated reserve prices and concluded that it would be particularly complex to implement such an approach.¹⁶⁷ We also said that the reasons for using a level of reserve price that is close to market value are relevant to all the spectrum in the Auction, irrespective of whether it is reserved under the competition constraint.
- 8.8 In the competition assessment we recognised that setting a reserve price for each spectrum category by reference to estimated market value but with a discount (a further option to those considered in the March 2011 Consultation) strikes a balance between two important effects of reserve prices that pull in opposite directions.¹⁶⁸ On the one hand, there are likely efficiency benefits from higher reserve prices, in that such reserve prices reduce any potential pay-off from strategic bidding (such as strategic demand reduction) and ensure that competition measures do not mean that the spectrum is obtained by a party that places a very low value on it (and might be unlikely to bring the competition benefits that are the objective of our intervention). On the other hand, there is a risk of deterring potential bidders from participating which could mean that fewer than four credible national wholesalers emerge from the Auction. There is also a risk that spectrum may remain unsold if reserve prices are too high.

¹⁶⁷ We note that one respondent (See Telefónica non-confidential response at paragraph 274) welcomed our clarification that we did not propose to set differential reserve prices for spectrum reserved for Opted-in Bidders, from other spectrum in the same band.

¹⁶⁸ See paragraph 7.17 of Annex 6 of the January 2012 consultation.

Factors we take into consideration in setting reserve prices

- 8.9 Ofcom has powers under the Authorisation Directive and the Wireless Telegraphy Act 2006 to impose fees for the rights of use of radio frequencies which reflect the need to ensure the optimal use of frequencies. In setting such fees, Ofcom must ensure that they are objectively justified, transparent, non-discriminatory and proportionate, and that they take account of the objectives in Article 8 of the Framework Directive, which (among other things) requires Member States to promote competition by ensuring there is no distortion or restriction of competition in the electronic communications sector, and encouraging efficient use and effective management of spectrum.
- 8.10 The Authorisation Directive provides that sums payable as a result of bids in an auction are covered by the above provisions. Ofcom therefore needs to ensure that any reserve prices it sets (which may be the sums payable as a result of the Auction, if no-one bids above the reserve price for any given block of spectrum) are set consistent with the above principles.
- 8.11 In assessing the appropriate level of reserve prices for this Auction, we have considered the following risks.
- 8.11.1 An important consideration given the competition constraint to reserve spectrum is the risk that a potential fourth national wholesaler (or opted-in bidder)¹⁶⁹ is unable to obtain the reserved spectrum in the Auction because of an excessive reserve price, when it would be in consumers' interest to have the fourth national wholesaler obtain the spectrum. This risk can be mitigated by setting lower reserve prices (below the intrinsic value of a fourth national wholesaler).
- 8.11.2 The risk, conversely to the previous one, that an opted-in bidder obtains the spectrum when it would have been in consumers' interests that the opted-in bidder did not win the spectrum, because it has a much lower intrinsic value than the parties that would otherwise have obtained the spectrum. In the January 2012 consultation, we considered that in the presence of competition constraint there is a case for setting reserve prices by reference to the expected market value but with a discount. This is to strike a trade-off between the potential static efficiency cost of reserving spectrum for a fourth national wholesaler with lower intrinsic value and the dynamic benefits to competition and consumers if it acquires the spectrum.¹⁷⁰ This risk can be mitigated by setting higher reserve prices.
- 8.11.3 The risk of setting reserve prices too high, above the willingness to pay of the marginal bidder for the last lot in any spectrum category, which could result in spectrum that is inefficiently unsold. This risk can be mitigated by setting lower reserve prices.
- 8.11.4 The risk of strategic demand reduction which involves bidders reducing their demand at the margin, to pay less on infra-marginal units won: this may result in an inefficient allocation of the spectrum. While our auction design is intended to reduce the incentive for such strategic bidding, setting

¹⁶⁹ To be clear, our priority is to ensure the participation of a fourth national wholesaler when in the interest of consumers, but we are neutral as to whether this is an existing national wholesaler (i.e. H3G) or a new entrant.

¹⁷⁰ See Annex 6 in the January 2012 consultation, paragraphs 6.31 and 7.17.

the level of reserve prices towards the market value of the spectrum can assist in reducing the risk that bidders will engage in such a strategy. In Annex 12, we discuss the role that higher reserve prices can play in mitigating the risk of demand reduction by holders of 900 MHz and 1800 MHz spectrum as a consequence of the potential for auction prices to affect revised Annual Licence Fees (ALFs) for such spectrum.

- 8.11.5 The risk of tacit collusion to reduce bids in the Auction to lower prices when this results in some spectrum not being acquired by the party that values it most. For example, there may be potential focal points over which bidders could tacitly coordinate: setting “high” reserve prices (for example, close to market value) reduces the ability to engage in such tacitly coordinated bidding strategies. Similarly to the case of strategic demand reduction, while auction design may reduce the incentives to collude, setting higher reserve prices towards the market value of the spectrum can reduce the risk of bidders engaging in such undesirable bidding.
- 8.11.6 The risk that efficient demand for different bands of spectrum is distorted by a set of reserve prices that does not reflect the relative values of different bands. This may distort the choice of the package for the reserved spectrum and may also reduce spectrum efficiency: when bidders are budget constrained, the level of reserve prices could shift the preference of bidders towards the less expensive packages. This risk is mitigated by setting band-specific reserve prices (and within the same band, category-specific reserve prices)¹⁷¹ rather than a uniform reserve price.
- 8.12 As noted above, some of these risks can be mitigated by setting higher reserve prices, closer to estimated market value. Conversely, other risks (e.g. the risk that a fourth national wholesaler fails to acquire the reserved spectrum) can be mitigated by setting lower reserve prices. We have sought to strike a balance between these contrasting risks when setting reserve prices. As we discuss below in the detailed analysis by band, some of the risks are relatively more important for certain spectrum categories than others.
- 8.13 This balancing of risks is especially important for the combined award (compared to past auctions), because the high value of the spectrum accentuates many of the risks to spectrum inefficiency, and the first two risks are specific to the competition constraint being used in this Auction.

DotEcon and Aetha study

- 8.14 We commissioned a study by DotEcon and Aetha (also referred to as the Consultants in the following) on the likely valuation of the spectrum to be auctioned on the part of existing national wholesalers and a hypothetical new entrant, so as to assist us in considering reserve prices.¹⁷² The Consultants evaluated the likely market value of 800 MHz, 1800 MHz and 2.6 GHz spectrum, and also considered the likely willingness to pay (excluding strategic considerations) of different bidders.
- 8.15 Their methodology included a combination of international benchmarking, business modelling and expert advice. We briefly consider the approach to each of these

¹⁷¹ For example, we distinguish between 800 MHz spectrum with and without a coverage obligation.

¹⁷² DotEcon and Aetha, *Spectrum value of 800 MHz, 1800 MHz and 2.6 GHz – A DotEcon and Aetha Report for Ofcom*, July 2012 (also referred to as the ‘DotEcon and Aetha Report’).

elements. The non-confidential version of the report is published alongside the Statement.

Benchmarking from international awards

- 8.16 The international comparison looked at the demonstrated willingness to pay of bidders for comparable frequencies in similar situations. It should therefore in principle produce a reasonable lower bound estimate for the willingness to pay of bidders, expressed as inflation adjusted licence prices (including any annual fees), on a per MHz per capita basis for a normalised licence duration of 20 years.
- 8.17 The main results from the international benchmarking are summarised in Table 8.2 below, and we discuss each frequency band in more detail below. The ranges shown here formed the basis for the recommendations in the study.

Table 8.2: Benchmark valuations of relevant spectrum (*)

	2x5MHz of 800 MHz	2x15MHz of 1800 MHz	2x5MHz of 2.6 GHz	5MHz of unpaired 2.6 GHz
Small bidder (fourth player)	£159m-£273m	£276m-£414m	£50.4m-£76.2m	£3.5m-£18.6m
Large bidders (top three incumbents)	£290m-£450m	£276m-£414m	£54.8m-£76.2m	£3.5m-£18.6m

(*) Calculated from results expressed in terms of £ per MHz per capita, assuming UK population of 63 million. Source: DotEcon and Aetha 's report

Business case modelling of existing UK players

- 8.18 The Consultants also sought to model the business cases for existing UK national wholesalers. This piece of work aimed to establish the maximum amount that bidders could pay for certain portfolios of spectrum whilst maintaining a positive business case under different scenarios. To do so, the study assessed the impact of alternative spectrum configurations for existing national wholesalers taking into account their current spectrum holdings, estimating differences in traffic and revenues with and without specified packages of spectrum in the Auction, on the assumption that all buyers would be credible national wholesalers. (The business modelling was not designed to explore what spectrum holdings are required to be a credible national wholesaler.)
- 8.19 The business modelling only considered the technical value (that is, the capex and opex cost savings that can arise from access to spectrum for additional capacity and/or coverage purposes) and the commercial value (that is, the revenue gains that would arise from having access to particular spectrum, such as higher numbers of customers, higher spend per user and greater customer retention), but it did not include potential strategic investment value from obtaining the spectrum.
- 8.20 Modelling such complex businesses in an environment of uncertainty inherently requires a degree of pragmatism and simplification. The Consultants therefore focused only on the major drivers that affect the value of the spectrum.
- 8.21 They did so under a range of different scenarios (for example, the Consultants modelled several auction outcomes, low / medium / high demand growth for mobile services, different evolution of market shares over time) and carried out sensitivity analysis to changing assumptions (for example, using higher or lower discount rates to reflect the uncertainty that remains about future market developments).

- 8.22 However, the consultants explain the results are at best indicative and do not give precise valuations of a spectrum package to different players or the value of different packages to a specific player. Given this, the business case modelling plays a relatively minor role in informing the recommendations of the study, and serves more as a consistency check of the benchmarking results.¹⁷³

Expert Panel's views

- 8.23 The Consultants also assembled a panel of financial experts ('Expert Panel' in the following) with experience in the mobile industry. The Expert Panel commented in respect of the likely response of financial markets to the valuations produced by the above analysis. The views of the Expert Panel play a role in the recommendations in the study in influencing where in relation to the benchmark range the recommended reserve price should lie. We refer in more detail to the Expert Panel views where relevant during the discussion for each spectrum category set out below.

Summary of Ofcom's proposed reserve prices for paired spectrum

- 8.24 In reaching our proposed reserve prices we have reflected on the recommendations that DotEcon and Aetha made and also on the underlying benchmarking and other data they provided. In the next section we explain for each band, and where relevant each category of lot within that band, our proposed reserve prices. We explain specifically why, in some cases, we have taken a different view from the recommendations of DotEcon and Aetha.¹⁷⁴
- 8.25 We also took into account the comments received from respondents to our January 2012 consultation, and we address these more specifically where relevant in the following sections.
- 8.26 In determining reserve prices, a degree of discretion and judgement is inevitable, given the range of relevant considerations and the nature of the available evidence. We consider that our proposed reserve prices strike a sensible balance between conflicting risks under reasonable scenarios and are consistent with our statutory duties.
- 8.27 Since the reserved spectrum portfolios for a fourth national wholesaler include each of the categories of paired spectrum, this table and our proposals focus on the benchmarking range for small bidders. This reflects in particular the mitigation of the risks set out above relating to a fourth national wholesaler.

¹⁷³ We have excluded the results of the business modelling analysis from the published non-confidential version of the DotEcon and Aetha Report. We note that we do not rely on the business case modelling for our proposed reserve prices. Indeed, we consider that it would be inappropriate for this section of the report to be published, as it contains various estimates based on potential individual bidders' positions, and as such could in our view adversely affect the efficiency of the Auction and/or the position of individual bidders in the Auction, should they decide to participate.

¹⁷⁴ Furthermore, we note that the DotEcon and Aetha study assumed that we would apply reserve prices by package (that is, we derive a reserve price figure for each lot category but the application of reserve prices is to set a minimum price for each package of spectrum). However, since the study was conducted our position has changed and we have now decided to apply reserve prices by lot (that is, a winning bidder pays at least the lot reserve price for each element of its winning package), as explained in Section 7 above. Although the advantages exceed the disadvantages, the latter approach carries a higher risk of unsold spectrum at the margin. We have taken this into account in our proposals.

8.28 Our proposed reserve prices are set out in the draft auction regulations which we are publishing alongside the Statement, and in relation to which stakeholders are invited to make any representations they wish by the date given in the notice which accompanies those draft regulations.

Summary of Ofcom proposals

8.29 Table 8.3 below summarises DotEcon and Aetha’s recommendations and our proposed set of reserve prices for the various categories of paired spectrum.

Table 8.3 – Reserve prices for specific lots of paired spectrum (£m)

	Lot cat. A(i) 2x5 MHz of 800 MHz	Lot cat. A(ii) 2x10 MHz of 800 MHz with coverage obl.	Lot cat. B 2x15 MHz of 1800 MHz	Lot cat. C 2x5 MHz of 2.6 GHz
Report ranges of small bidder valuation from benchmarking	£159m - £273m	£180m - £500m	£276m- £414m (*)	£50.4m -£76.2m
Report recommended reserve prices	£217m	£180m	£276m	£50.4m
Ofcom’s proposals	£225m	£250m	£225m	£15m

(*) For 1800 MHz it was not possible to distinguish between small and large bidders.

8.30 We explain below our proposed reserve price for each frequency band.

Detailed analysis by band

Lot category A(i) – 800 MHz (without coverage obligation)

Benchmark results

8.31 Relatively good benchmark information is available for this frequency band, as strong competition in some auctions has revealed a relatively large amount of information about small and large bidders’ valuations (especially when compared with other frequency bands). For example, the Consultants estimated the marginal value of a first 2x5 MHz block to be £0.658 per MHz per capita (average of Italy’s £0.644 and Germany’s £0.671), and a third block to be around £0.210 per MHz per capita (from German bidding data). Assuming a simple straight line decrease, the average value of 800 MHz spectrum is £0.434 per MHz per capita, which is the upper bound of the benchmark range.

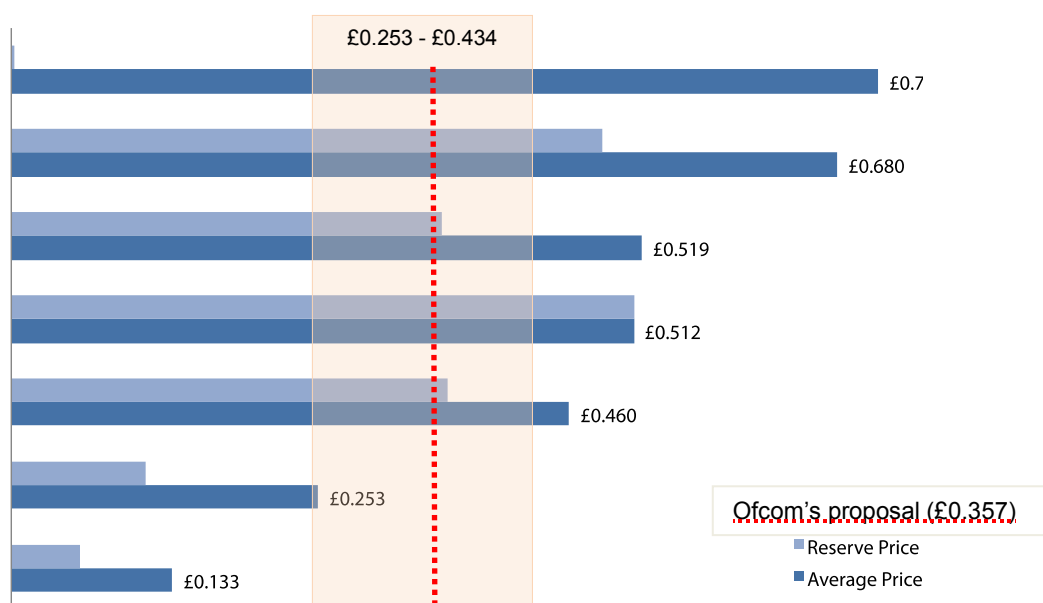
8.32 The final auction price in Sweden, where two incumbents decided to bid jointly thereby weakening competition, is by contrast likely to provide a lower bound for the benchmark range. First of all, the Consultants note that H3G Sweden paid an average price of £0.159 per MHz per capita in this auction for 2x10 MHz of 800 MHz spectrum, which could provide an indication of the lower bound of the willingness to

pay of a fourth player into the market.¹⁷⁵ However, they also consider that bidding information from other benchmark auctions suggests that a fourth national wholesaler's true willingness to pay could be higher: for example the Consultants note that in France Free Mobile decided to bid at reserve prices of £0.236 per MHz per capita for 2x10 MHz and £0.354 per MHz per capita for 2x5 MHz, which are well above the price paid by H3G in Sweden. Further, assuming a first block marginal value of £0.658 per MHz per capita (average of marginal values from Germany and Italy) suggests that the average value of 2x10 MHz to the fourth player must be at least £0.329 per MHz per capita (as the value of the second block cannot be negative). Secondly, the Consultants note that the final auction price of £0.253 per MHz per capita is likely to provide some indication of the maximum willingness to pay of a new entrant, since the marginal bidder was likely to be a new entrant. The Consultants conclude that the entrant valuation in Sweden (£0.253 per MHz per capita) represents a significant mark down (approximately 50%) of the fourth player's valuation and use it to estimate the lower bound of the benchmark range for a small bidder.

- 8.33 Some auctions however were a less useful source of information because of weaker competition. For example, the Consultants considered that there was little competition in Spain (due to Yoigo's decision not to participate) and Portugal (where there were only three incumbent bidders for three 2x10 MHz blocks sold at reserve prices).
- 8.34 Figure 8.1 below summarises the benchmark information from comparable European auctions for this spectrum band. The shaded area represents the range of results from the benchmark analysis and the dotted red line represents our proposal.

¹⁷⁵ The Consultants note at paragraph 70 that the spectrum blocks at the edge of the band, such as those bought by H3G, are likely to be less valuable because of the "cheaper-block-edge" effect arising from the auction format (that is, blocks at the edge of the band sell at a lower price than blocks in the centre as they provide bidders with less flexibility to create contiguous blocks of spectrum). Furthermore, the Consultants also note at paragraph 72 that the two bottom blocks are subject to stricter usage restrictions related to DTT coexistence. For example, the Consultants note (paragraph 73) that the lowest block sold for almost two thirds less than the rest of the band.

Figure 8.1: Average prices for paired spectrum in the 800 MHz band and DotEcon and Aetha 's suggested range of reserve prices (£ per MHz per capita)



Note: Inflation adjusted licence prices (including annual fees), in GBP (as of May 2012), on a per MHz per capita basis, for a normalised licence duration of 20 years.

Source: DotEcon and Aetha 's report

Consultants' recommendations

8.35 The Consultants considered that:

“For 800MHz spectrum, while a price at the upper end of the benchmark range for small bidders might be appropriate in isolation, this would create a risk of discouraging bids for smaller packages by some of the established players. In order to mitigate this risk, considering the business modelling valuations for these packages, the price for 800MHz spectrum could to be set around the middle of the small bidder benchmark range. The middle value of the benchmark range of £0.344 per MHz per capita would suggest a reserve price of £217m for a 2x5MHz lot in the 800MHz band without coverage obligations.”¹⁷⁶

Ofcom's proposal

8.36 We consider that the potential for costly spectrum inefficiency (e.g. arising from the competition constraint or the risks of strategic demand reduction or tacit collusion – the second, fourth and fifth risks in paragraph 8.11) is concentrated in this frequency band, given the higher financial value of 800 MHz spectrum compared to other frequency bands in the Auction. One way to mitigate these risks is for the reserve price to be higher, such as at the upper boundary of the benchmark range.

8.37 However, we are also mindful that in the presence of decreasing marginal valuations demand for larger blocks of spectrum (for example 2x15 MHz) might be inefficiently deterred if we were to set the reserve price too high. While this risk could also be

¹⁷⁶ DotEcon and Aetha Report, paragraph 263.

mitigated by setting non-linear reserve prices that reflect the incremental value of different blocks within possible spectrum packages, we consider that such an approach would be disproportionately complex to implement.

8.38 We acknowledge that the intrinsic value of 800 MHz spectrum may be affected by usage limitations and obligations imposed on the spectrum. Potential mitigation costs are one of the factors that we have taken into account when determining the reserve price for 800 MHz spectrum. For example:

8.38.1 On the one hand, in Denmark and Sweden those 800 MHz lots subject to strict technical and operational restrictions for DTT coexistence sold for almost two thirds less than the rest of the band, at a value below the benchmark range. The arrangements we are putting in place for DTT coexistence have been structured in such a way that creates greater cost certainty for bidders.¹⁷⁷ These arrangements should therefore have a smaller effect on the value of the spectrum than those in Sweden and Denmark, for example.

8.38.2 On the other hand, the circumstances of the German and Italian auctions suggest that the cost of DTT coexistence mitigation measures was likely to be more limited than in the UK.

8.39 The benchmark figures from auctions in other countries are also likely to reflect the mitigation arrangements that have been put in place in those countries, but we do not have a sound basis for determining precisely to what extent mitigation costs would be higher or lower in other countries. However, there is a risk that the upper bound of the benchmark range overestimates the value of 800 MHz spectrum in the UK.

8.40 DotEcon and Aetha note that prices from auctions in Italy, Germany, France and Spain may factor in the cost of coverage obligations or usage restrictions which were imposed on some blocks of spectrum, but that it is impossible to make adjustments due to a lack of precise information. We hence consider that the benchmark results already represent a cautious estimate of the value of 800 MHz spectrum without coverage obligations for a fourth national wholesaler. This consideration suggests that there is a relatively small risk that such a reserve price would deter an efficient prospective opted-in bidder.¹⁷⁸ However, that risk is greater the higher the reserve price within the range, especially for reserve prices close to the upper end of the benchmark range (because of the concern in the previous paragraph about DTT coexistence costs).

8.41 The benchmark range for large bidders is above the top end of the range for small bidders (see Table 8.2), which also suggests that the risk of unsold 800 MHz spectrum for such bidders is relatively low at such a reserve price.

8.42 The Consultants noted that:

“The Expert Panel felt that it should be possible to justify a price for 800MHz at the high-end of the proposed benchmark range for a small bidder. This would be in line with the expectation of the financial markets since this is lower than the prices paid by the

¹⁷⁷ See Annex 6 for further details.

¹⁷⁸ Given the impact of existing spectrum holdings on the intrinsic value of spectrum in the Auction, further support for this view is the absence of sub-1 GHz in the existing holdings of a fourth national wholesaler in the UK (whether this is a new entrant or H3G) in the UK, which was generally not the case for small bidders in the auctions considered in the benchmarking analysis.

parent companies of the likely bidders in other European auctions.”¹⁷⁹

- 8.43 We note that Telefónica expressed concerns regarding the impact that a discount on market prices for 800 MHz could have on the flexibility for opted-in bidders to acquire more spectrum at 2.6 GHz in addition to reserved spectrum in a profitable way.¹⁸⁰ We consider that this risk is mitigated by the application of reserve prices by lot and the role that the bids of both opted-in and non-opted bidders play in the choice of the specific portfolio that is reserved for the winning opted-in bidder.
- 8.44 In light of the above evidence our proposal is to set the reserve price at £225m for a 2x5 MHz block without a coverage obligation. This value is in the top half of the benchmark range for smaller bidders but not at the upper end to account for the potential effect of DTT co-existence mitigation cost on bidder’s valuation. We consider that this level of the lot reserve price balances the risks of spectrum inefficiency with the risks of deterring a bidder from opting in or leading to unsold spectrum.
- 8.45 We note that our proposal differs slightly from the Consultants’ recommendation. DotEcon and Aetha suggested that we might choose a mid-point in the benchmark range in order to mitigate the risk of spectrum going unsold due to the low valuation of certain smaller packages. But especially given the change in application of reserve prices set out in footnote 175, we consider that a better mitigation to this risk is through the reserve price of 2.6 GHz spectrum as discussed below.

Lot category A(ii) – 800 MHz with coverage obligation

Benchmarking results

- 8.46 DotEcon and Aetha considered that it was not possible to assess the extent to which benchmarking information already incorporates the anticipated costs of the coverage obligation.

Consultants’ recommendations

- 8.47 Notwithstanding the difficulties of assessing whether or not the international benchmarks included costs of coverage obligations, the Consultants set out their views on the potential costs of the coverage obligation for the UK. Citing commentaries from different parties about the potential costs of reaching coverage targets, they stated that “*a reasonable estimate of the cost of a 98% population [indoor] coverage obligation should range from £100m to £400m*”.¹⁸¹ However, it is difficult to know from the evidence available if this is only the incremental cost of the obligation, or whether it is net or gross of additional revenues from the obligation.¹⁸²

- 8.48 The Consultants recommended that:

“[A]s a conservative approach, the coverage obligation should be imposed on a 2x10MHz lot to ensure that this lot is not inefficiently

¹⁷⁹ DotEcon and Aetha Report, paragraph 261.

¹⁸⁰ Telefónica non-confidential consultation response, paragraph 190.

¹⁸¹ DotEcon and Aetha Report, paragraph 268.

¹⁸² It is difficult for a third party to assess the counterfactual, that is to assess what level of costs would have been incurred and what level of revenues would have been achieved in the absence of a coverage obligation.

unsold. The reserve price should not be set higher than suggested by the bottom end of the large bidder benchmark. At a benchmark value of £0.460 per MHz per capita, and a cost of £400 million, this would suggest a reserve price of £180m for 2x10MHz with a coverage obligation in the 800MHz band.”¹⁸³

Ofcom’s proposal

- 8.49 There were mixed views among respondents as to whether we should set a specific reserve price for a 800 MHz spectrum lot with a coverage obligation. Vodafone considered that the reserve price should be set at a lower initial level to reflect a reasonable initial estimate of the cost of meeting the obligation.¹⁸⁴ By contrast, Telefónica proposed common reserve prices for all lots in the 800 MHz band, irrespective of the coverage obligation.¹⁸⁵
- 8.50 We consider that spectrum with a coverage obligation attached is likely to be a close substitute for spectrum of the same type without such an obligation for at least some bidders. However, we would expect the former to have a lower intrinsic value than the latter, reflecting the incremental costs that bidders are likely to incur as a result of the obligation (net of incremental revenues from the additional coverage). For this reason, we identify a separate spectrum category (and hence set a separate reserve price) for the 800 MHz block subject to a coverage obligation.
- 8.51 We explained above that each bidder is likely to have a lower intrinsic value of spectrum with a coverage obligation, and that this is likely to be reflected in auction prices. Hence we consider that we should also make a corresponding adjustment to the reserve prices for the 800 MHz spectrum lot that is subject to a coverage obligation, so as to mitigate the risk of it not being sold.
- 8.52 We agree with the Consultants that there is a risk that the benchmarking information does not correctly reflect the cost of a coverage obligation, and we consider that it would be appropriate to offset this from our proposed reserve price for 800 MHz spectrum. In addition, we do not have the information to assess the incremental effect on spectrum valuations of different coverage obligations (compared to the UK requirements) and we have not assessed the effects of different geographic conditions on the cost of a coverage obligation.
- 8.53 In practice, however, it is very difficult with our technical modelling to estimate such incremental net cost for each player. Therefore, we considered the estimates of cost that different players brought forward, although we recognise that there was a degree of uncertainty about the precise formulation of the coverage obligation reflected in those estimates.¹⁸⁶
- 8.54 To assist in the efficient allocation of the 800 MHz spectrum, it is desirable that there is at least one player interested in acquiring the spectrum subject to a coverage obligation. We do not need to use the top of the range of estimated cost to be reasonably confident that at least one bidder will compete for this spectrum lot. We note that H3G and Everything Everywhere suggested that if they had 2x10 MHz of

¹⁸³ DotEcon and Aetha Report, paragraph 274

¹⁸⁴ Vodafone non-confidential response, page. 42, response to Question 6.1

¹⁸⁵ Telefónica non-confidential consultation response, paragraph 278, letter c.

¹⁸⁶ We also note that the focus of the coverage obligation is on accelerating the network roll-out to commercial levels (that is, bringing forward investment) rather than prompting large amounts of new investment.

800 MHz spectrum it would cost them around £100m to reach 98% indoor coverage from their existing shared network.¹⁸⁷ Our judgement is that – based on our specification of the coverage obligation (and including a substantial uplift on a cautious basis) – the difference in intrinsic value for at least one operator is likely to be no more than £200m, using the available evidence referred to above.

- 8.55 Contrary to the Consultants' methodology, we consider that it is more appropriate to use the reserve price for the 800 MHz spectrum without a coverage obligation as a starting point (which is based on the benchmark for small bidders and is hence lower than the report's starting point based on the benchmark for large bidders): this is in order to mitigate the risk that the relative value of different categories of 800 MHz spectrum is distorted.
- 8.56 In light of the above considerations, our proposal is to set the reserve price for 2x10 MHz of 800 MHz with a coverage obligation at £250m.

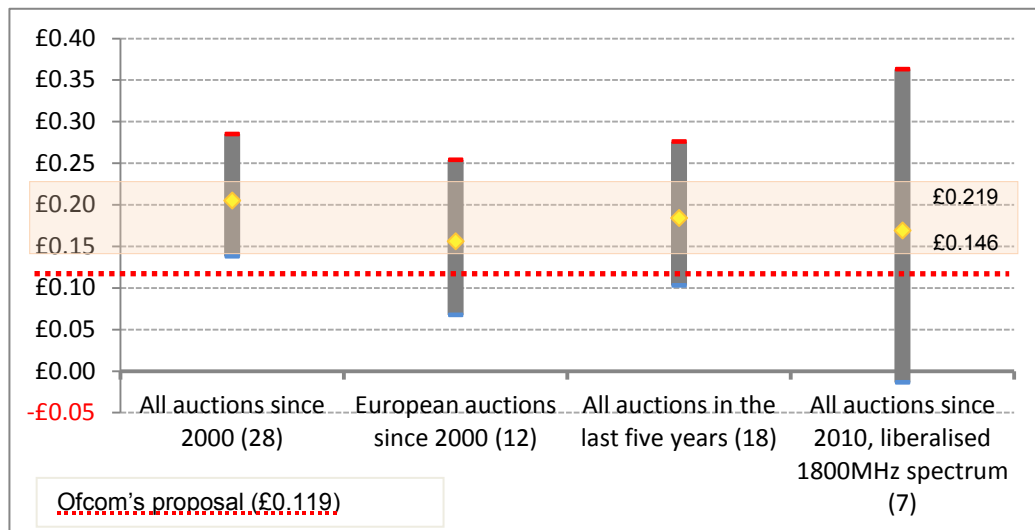
Lot category B – 1800 MHz

Benchmarking results

- 8.57 There is only a limited amount of comparable benchmark information for 1800 MHz spectrum liberalised for LTE use in Europe in recent years, and no case of an operator winning 2x15 MHz of liberalised 1800 MHz spectrum in an auction.
- 8.58 DotEcon and Aetha hence looked at a wider sample of 1800 MHz auctions worldwide, the majority of which were for non-liberalised spectrum and characterised by very different degrees of competition. As a result the prices paid in these auctions may be a poor guide to the value of liberalised spectrum in the UK. Furthermore, given the nature of this benchmarking exercise, it is not possible to differentiate between the valuation of small bidders and large bidders.
- 8.59 The study also considered a number of sub-samples, looking at average prices paid for liberalised spectrum, prices paid over a longer time period and prices paid within Europe. Figure 8.2 below shows the 95% confidence interval and mean for these sub-samples, with the shaded area representing the results of the benchmark analysis. DotEcon and Aetha's benchmark range is £0.146 to £0.219 per MHz per capita, based on the bidding in recent auctions in the EU (Sweden and Italy respectively for the lower and upper bound to the range).

¹⁸⁷ Response to Q.85 by H3G's Kevin Russell and response to Q.87 by Everything Everywhere's Richard Moat. House of Commons, Culture, Media and Sport Committee, Spectrum, Eight Report of Session 2010-12, 25 October 2011, Ev 12, 21 June 2011, available at: <http://www.publications.parliament.uk/pa/cm201012/cmselect/cmcomeds/1258/1258.pdf>

Figure 8.2: 1800 MHz auction average prices (and 95% confidence intervals) and DotEcon and Aetha 's suggested range of reserve prices (£ per MHz per capita)



Note: Inflation adjusted licence prices (including annual fees), in GBP (as of May 2012), on a per MHz per capita basis, for a normalised licence duration of 20 years. The numbers in brackets indicate the number of observations in the sample.

Source: DotEcon and Aetha 's report

Consultants' recommendations

8.60 DotEcon and Aetha recommended that:

“For the 1800 MHz spectrum, the reserve price might be set in the region of the lower end of the benchmark range (and potentially below that level). The lower end benchmark of £0.146 per MHz per capita would suggest a reserve price of £276m for a lot of 2x15MHz in the 1800MHz band.”¹⁸⁸

Ofcom's proposal

8.61 We note that for this frequency band it was not possible to distinguish between small and large bidders, hence the range may overestimate a small bidder's valuation.

8.62 According to the Consultants' report:

“The Expert Panel were concerned that even the bottom end of the range for the 1800MHz band would be regarded by many financial analysts as high in the event that H3G acquired this spectrum as a “consolation prize” for not obtaining 800MHz spectrum. The Expert Panel felt that given the considerable uncertainty about the benchmarking value of spectrum in this band and in light of the low prices paid in other major auctions (e.g. Germany), it might be appropriate to consider a reserve price lower than the bottom end of the benchmark range.”¹⁸⁹

8.63 In light of the above uncertainty, and in balancing the risks of spectrum inefficiency with the risks of deterring a fourth national wholesaler from opting in and of unsold

¹⁸⁸ DotEcon and Aetha Report, paragraph 263

¹⁸⁹ DotEcon and Aetha Report, paragraph 262

spectrum, our proposal is to set the reserve price at £225m for 2x15 MHz, below DotEcon and Aetha's range as the Expert Panel suggests. For simplicity, in selecting a specific figure we have aligned it with the reserve price for 2x5 MHz of 800 MHz.

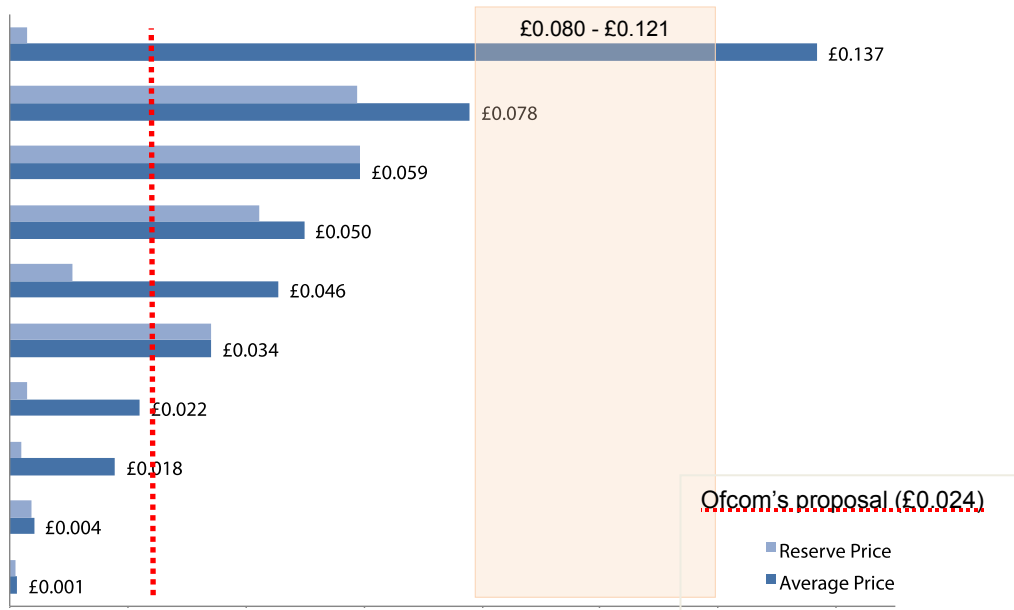
Lot categories C, D(i) and D(ii) – Paired 2.6 GHz

Benchmarking results

- 8.64 Relatively little information about the value of 2.6 GHz spectrum for a small bidder was disclosed during the European auctions. DotEcon and Aetha note that *“for the 2.6 GHz band reserve prices were mostly set at a LBNT [low but not trivial] level. Auction results thus vary greatly in line with the level of competitiveness.”*¹⁹⁰
- 8.65 DotEcon and Aetha also consider that in several cases there was little competition for this band - for example, they considered that this may be due to:
- tight spectrum caps which limited the potential demand for the spectrum (Netherlands and Portugal);
 - “parking strategies” whereby bids are placed on relatively cheap lots merely to maintain eligibility and hence flexibility to bid on high-value lots later during the auction (Germany);
 - the non-participation by the fourth national wholesaler (Spain);
 - the decision not to submit a bid by a qualified bidder (Belgium); or
 - other features of the auction design (Finland and Norway).
- 8.66 In other instances, DotEcon and Aetha considered that the timing of the auction was such that it is unlikely to prove a useful predictor of the value of the spectrum to national wholesalers in the UK. For example, the unusually high prices in Sweden may be due to the fact that the auction was held in 2008, before the EC's recommendation to release the digital dividend and before the financial crisis.
- 8.67 DotEcon and Aetha derive the lower boundary of their benchmark range based on the willingness to pay of a new entrant for 2x20 MHz in the French auction, and consider that this may underestimate the value of the spectrum due to aggregation risk (that is, separate auctions for each band meant that bidders could not be sure what they would win at 800 MHz at the time of bidding for 2.6 GHz spectrum). The benchmark range is higher than the average price paid in any EU auctions except Sweden (which the Consultants suggested may overstate bidders' current valuation because of the earlier timing of the auction).
- 8.68 Figure 8.3 below summarises the benchmark information from comparable European auctions for this spectrum band. The shaded area represents the range of results from the benchmark analysis and the dotted red line represents our proposal.

¹⁹⁰ DotEcon and Aetha Report, paragraph 106

Figure 8.3: Average prices for paired spectrum in the 2.6 GHz band and DotEcon and Aetha 's suggested range of reserve prices (£ per MHz per capita)



Note: Inflation adjusted licence prices (including annual fees), in GBP(as of May 2012), on a per MHz per capita basis, for a normalised licence duration of 20 years.
Source: DotEcon and Aetha 's report

Consultants' recommendations

8.69 The Consultants recommended that:

“For the paired 2.6GHz spectrum, the reserve price might be set in the region of the lower end of the benchmark range for small bidders. Assuming a UK population of 63 million, the lower end benchmark of £0.080 per MHz per capita would suggest a reserve price of £50.4m for a lot of 2x5MHz in the 2.6GHz band.”¹⁹¹

Ofcom's proposal

8.70 DotEcon and Aetha rely on a single observation to estimate the lower bound of the range. However the outcomes of the Italian auction (where final average prices are below the proposed range) and the Belgian auction (where one of the qualified bidders did not submit any bid even at a reserve price lower than the proposed range) may indicate that the estimated valuation of the spectrum may be too high. We are concerned that there is a risk that DotEcon and Aetha's recommended reserve price may deter efficient demand from a fourth national wholesaler or more generally result in unsold spectrum.

8.71 Given the lower value of paired 2.6 GHz spectrum compared to other bands, strategic demand reduction or tacit collusion may be less likely to occur and the potential for spectrum inefficiency is generally more limited than for 800 MHz or 1800 MHz. As such, we place particular weight for this band on the risk of choking off efficient demand and leaving spectrum unsold. Because of the limited evidence

¹⁹¹ DotEcon and Aetha Report, paragraph 263

available on the marginal valuation of 2.6 GHz lots for small and large bidders, we propose to take a cautious approach to mitigate the risk of unsold spectrum.

- 8.72 Our proposal is to set reserve prices substantially below the benchmark range, at £15m for a 2x5 MHz block.

Reserve price for aggregated bids for low power use

- 8.73 We have decided that it will be possible for up to ten bidders to aggregate bids for shared low power use of 2x10 MHz or 2x20 MHz of 2.6 GHz spectrum.
- 8.74 We note that, in its response to our consultation, the Federation of Communication Services (FCS) did not support a high reserve price for 2.6 GHz low power lots. It was concerned that this would create a further barrier to entry and would be disproportionate given the licence conditions.¹⁹²
- 8.75 We propose setting the reserve prices for the shared low power spectrum at £3m for each shared low power user in 2x10 MHz (or £6m for 2x20 MHz). This is based on the reserve price for 2x10 MHz for standard power use, that is £30m, divided by the maximum number of low power lots. For consistency with the reserve price for standard power bidders, we also propose to impose a minimum reserve price threshold for the sum of aggregated low-power bids of £30m for 2x10 MHz and £60m for 2x20 MHz (equivalent to the reserve price for respectively a 2x10 MHz and 2x20 MHz package of standard power paired 2.6 GHz spectrum).

Relativities

- 8.76 In reaching the proposals discussed above we have taken into consideration the desirability of reserve prices allowing the relative value of frequency bands to emerge in the Auction. One respondent supported this view: Vodafone considered that reserve prices, like eligibility points, should reflect (roughly) the relative values of the different spectrum categories.¹⁹³ Another respondent commented on specific levels of relative reserve prices: H3G considered that the ratios of reserve prices between different lot categories proposed in March 2011 are appropriate in light of information from recent European auctions. H3G was concerned about the potential to apply ratios for reserve prices similar to the ratios for eligibility points in the January 2012 consultation, in particular if Ofcom were to use the ratio of 1.5 for the 800 MHz and 1800 MHz reserve prices, there would be a real risk of overvaluing the 1800 MHz spectrum.¹⁹⁴
- 8.77 There are wide variations in the relative value of frequency bands in other European auctions and in the recommendations we received. Table 8.4 below summarises the relative values of different frequency bands¹⁹⁵, as emerged from the average prices paid in some EU auctions and as implied in DotEcon and Aetha's recommendations, comparing this with Ofcom's proposal.

¹⁹² FCS non-confidential response, page 2.

¹⁹³ Vodafone non-confidential response, page 43, response to Question 7.1

¹⁹⁴ H3G non-confidential response, page 142

¹⁹⁵ This relative value is expressed as the ratio between the price for the specific frequency band and the price for 2.6 GHz spectrum.

Table 8.4: Relative value of frequencies in different auctions / proposals, expressed as a multiple of the value of 2.6 GHz spectrum

	800 MHz	1800 MHz	2.6 GHz paired
Germany	32.5 (*)	n.a.	1.0
Italy	13.6 (*)	4.4	1.0
France	6.7 (*)	n.a.	1.0
Sweden	1.8	1.1	1.0
Report recommendations	4.3	1.8	1.0
Expert Panel, engineering perspective	4.0	2.0	1.0
Expert Panel, financial market perspective	10.0	1.0	1.0
Eligibility points (per MHz)	15.0	5.0	1.0
Ofcom's proposal	15.0	5.0	1.0

(*) The benchmark figures used may include some off-setting of coverage obligations, but it is impossible to quantify the effect.

- 8.78 Results in the benchmark auctions vary especially between 800 MHz and 2.6 GHz: for example, the relative value was around 33:1 in Germany, 14:1 in Italy, 6:1 in France and only 1.8:1 in Sweden. We have limited information about the ratio between the value of 1800 MHz and 2.6 GHz in other auctions, especially for spectrum liberalised for LTE use.
- 8.79 DotEcon and Aetha's benchmark values imply low relativity ratios, generally less than 4:1 for 800 MHz to 2.6 GHz and 2:1 for 1800 MHz to 2.6 GHz spectrum (in short, 4:2:1 ratio). Taking different value points within DotEcon and Aetha's recommended ranges produces limited variation in the relativity ratios between 800 MHz and 2.6 GHz.¹⁹⁶ Their recommended reserve prices yield a 4.3:1.8:1 ratio.
- 8.80 The Consultants considered that:
- “The Expert Panel noted that whilst the engineering analysis supported a ratio of 2:1 between the 1800MHz and 800MHz band and a similar ratio between the 2.6GHz and 1800MHz band, many financial analysts would not take account of this in their assessments. In particular such analysts would typically consider higher frequency spectrum (including 1800MHz) to be worth a tenth of the price of 800MHz spectrum. (...)The financial markets' perception of the relative value of different spectrum bands might affect bidders' willingness to pay, in order to meet shareholders' demands”¹⁹⁷
- 8.81 Our proposal implies relativities at 15:5:1. This ratio is higher than the ratio implied in DotEcon and Aetha's proposal for two reasons:

¹⁹⁶ At most the relativities ratio can be stretched to 5.5:1.8:1 by taking the upper bound of 800 MHz and 1800 MHz and the lower bound for 2.6 GHz.

¹⁹⁷ DotEcon and Aetha Report, paragraph 240-241

- 8.81.1 We propose to set the reserve price for 800 MHz spectrum slightly above the middle of the recommended range: this is the band where we consider potential for spectrum inefficiency is concentrated, due to the high value of the spectrum.
- 8.81.2 We propose to set the reserve price for 2.6 GHz spectrum much lower than recommended by DotEcon and Aetha. This is because we have placed more weight on the risk of unsold spectrum.

Ofcom’s proposal on the reserve price for lot category E, 2.6 GHz unpaired spectrum

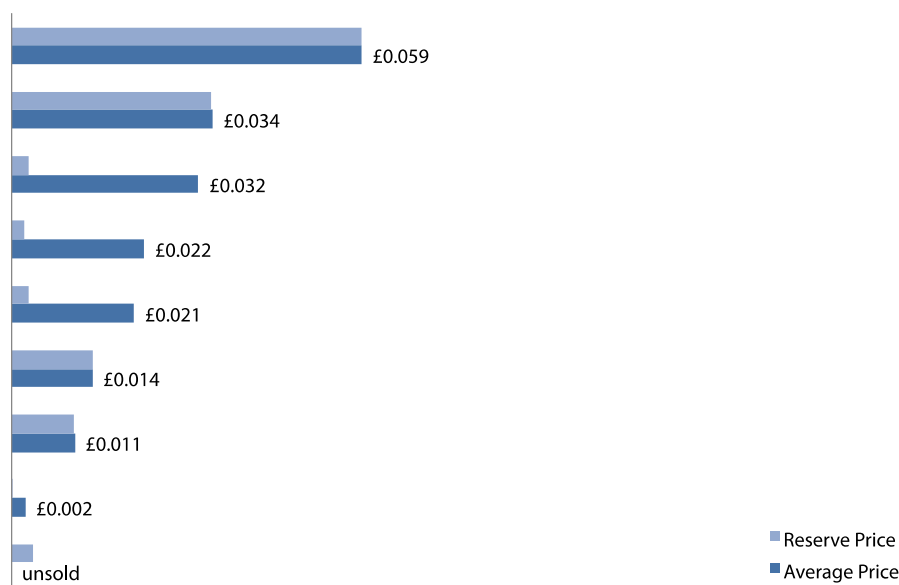
Benchmarking results

8.82 The Consultants consider that “*in the case of unpaired 2.6 GHz spectrum, there is very limited benchmark information available.*”¹⁹⁸ More specifically:

“The observed prices range from £0.011 to £0.059 per MHz per capita. The top of the range is set by the reserve price in the non-competitive Belgian auction, where a new entrant bought the unpaired spectrum. The lower end of the range consists of non-competitive awards, where prices are determined by the reserve price and the need for parking strategies.”¹⁹⁹

8.83 They also considered that “[o]nly in Italy and Sweden was there competition for unpaired spectrum”, with the average price respectively £0.034 and £0.032 per MHz per capita.²⁰⁰ Figure 8.4 below summarises the benchmarking results.

Figure 8.4: Average prices for unpaired spectrum in the 2.6 GHz band (£ per MHz per capita)



¹⁹⁸ DotEcon and Aetha Report, paragraph 252

¹⁹⁹ DotEcon and Aetha Report, paragraph 147

²⁰⁰ DotEcon and Aetha Report, paragraph 148

Note: Inflation adjusted licence prices (including annual fees), in GBP (as of May 2012), on a per MHz per capita basis, for a normalised licence duration of 20 years.

Source: DotEcon and Aetha 's report

Consultants' recommendations

8.84 DotEcon and Aetha stated that “a *LBNT [low but non trivial] reserve price might best be used for this band. The Expert Panel agreed with this view.*”²⁰¹

Ofcom's proposal

8.85 We consider that there is a low risk of spectrum inefficiency in this band and low risk of negative effects on competition, with the key concern being the risk of unsold spectrum. Hence we propose a £100,000 reserve price per unpaired 5MHz block.

²⁰¹ DotEcon and Aetha Report, paragraph 252

Section 9

Non-technical licence conditions

- 9.1 In section 7 of the March 2011 consultation we set out the non-technical licence conditions that we proposed to include in the 800 MHz and 2.6 GHz licences. In particular we outlined our proposals on
- licence commencement and duration;
 - revocation rights during the initial term;
 - the territorial extent of licences;
 - making the licences tradable in secondary markets;
 - non-technical restrictions;
 - service obligations; and
 - the provision of information to promote efficient use of spectrum.
- 9.2 In the light of responses to the March 2011 consultation, we gave further consideration in section 5 of the January 2012 consultation to our proposal on revocation rights.
- 9.3 This section summarises the responses we received to these proposals and outlines our final decisions in respect of non-technical licence conditions.

Licence commencement and duration

- 9.4 In the March 2011 consultation we proposed offering licences with an indefinite duration, which would include an initial term lasting from the date of grant until 20 years from the 1 January 2013. During the initial term the grounds for revocation would be limited. The purpose of this initial 20 year term was to give prospective licensees a reasonable degree of certainty that they would be able to offer services for a length of time that will give them a reasonable prospect of earning a commercial return on their investments. The proposal that the 20 year period would not begin to run until 1 January 2013 reflected the fact that the use of both the 800 MHz and 2.6 GHz bands would be restricted in some parts of the UK for a period after issuing the licences.
- 9.5 Once the initial term had expired, licensees would be liable to pay annual licence fees, and we would have the power to revoke the licence on spectrum management grounds on five years' notice.
- 9.6 There were 15 responses to these proposals. Everything Everywhere (EE), BT, Vodafone, Intellect, David Hall Systems Ltd and DETI agreed with the initial term of 20 years. H3G noted that this term should not be any shorter. Skype disagreed with our proposals and argued that the duration of the licences should be restricted to 15 or 20 years as indefinite licences risked entrenching particular industry models and market structures, particularly given the potential benefits arising from new developing technologies.

- 9.7 Everything Everywhere said that as the 800 MHz spectrum will not be clear for full use until October 2013, the 800 MHz licences should start 1 January 2013 (or when available) with the initial 20 year period ending 31 October 2033 rather than 31 December 2032. Another respondent thought that there should be a start date before 1 January 2013 for the licence for the top 2 x 10 MHz of the 800 MHz band.
- 9.8 In light of these responses we have reviewed our proposals. We still consider that licences should have an indefinite duration with an initial term lasting 20 years. The security of tenure which this initial term will provide will be conducive to licensees making the investments necessary to exploit the spectrum efficiently. We consider that a shorter initial term would not offer adequate certainty.
- 9.9 However, we consider that the commencement date for the initial term should be modified to reflect the revised timescale for the auction. We are now working towards holding the auction in the first quarter of 2013 and so our proposal for the initial term to be measured from 1 January 2013 is no longer appropriate. Rather, we consider the initial term should run from the date of grant of the licences. We recognise that some restrictions on the use of the 800 MHz and 2.6 GHz bands will apply at this point. However, following the revised timescales for the auction and for addressing the re-location of existing users of the 800 MHz band and the mitigation to radars operating in the 2.7 – 3.1 GHz band, we now foresee that the new licensees will be able to make productive use of the spectrum in parts of the UK from the grant of the licences.
- 9.10 As regards the 1800 MHz spectrum (should it be in the auction), stakeholders should also be aware that the commitments given to the European Commission by Everything Everywhere require it to clear this spectrum, and surrender its licences to Ofcom by no later than 30 September 2013 (in relation to the frequencies 1721.7-1731.7 MHz and 1816.7-1826.7 MHz) and 30 September 2015 (in relation to the frequencies 1731.7-1736.7 MHz and 1826.7-1831.7 MHz). As a result, any licence awarded by Ofcom in this band will only permit use of the relevant frequencies from after these dates.

Revocation rights during the initial term and variation

- 9.11 In our March 2011 consultation, we proposed not to include ‘use it or lose it’ or ‘use it or sell it’ obligations in licences. We considered that an alternative would be to include a licence condition that would allow us, during the initial term, to revoke use of some of the licensed frequencies in particular areas if their use was needed to deliver a specific policy goal.
- 9.12 There were a number of consultation responses on this issue. Four respondents said such licence conditions were unnecessary or impracticable. Most others were concerned about spectrum remaining unused and supported either ‘use it or sell it’ conditions or additional revocation powers during the initial term.
- 9.13 In light of the responses we gave the matter further consideration in our January 2012 consultation. We examined the options for addressing a situation where a licensee is not interested in providing services to meet a Government broadband objective or not prepared to make the spectrum available to others for this purpose. We concluded that partial revocation would not be practical or effective, in particular when taking into account the need for clarity in the licence conditions, and the need for potential bidders to be able to assess the risk of partial revocation of their

spectrum rights. Therefore we proposed not to include a licence condition that would give us the power to revoke a licensee's spectrum rights during the initial period of the licence in order to make those rights available to another person for the delivery of a broadband service.

- 9.14 Some respondents to the January 2012 consultation thought that additional rights of revocation relating to coverage should be included in the initial term. The underlying concern in responses was about licensees hoarding spectrum and licensees preventing others from using the spectrum to provide mobile broadband in particular areas.
- 9.15 Our conclusion is that we should not include additional revocation rights, such as 'use it or lose it' conditions in the licences. We still consider that introducing additional revocation rights would not be practical and that we are likely to be able to achieve optimal use of the spectrum through other means. In this context we note that in certain circumstances, such as the scenario where a licensee was not willing to provide services to meet a Government broadband objective, it would be possible for us to grant additional (concurrent) licences to use spectrum in specific areas, subject to such a grant being compatible with our statutory duties. We address this as part of our discussion of mobile coverage policy in section 5 of this document.
- 9.16 We have decided not to include any limitation in the licences on our power to vary the licences, either during the initial term or thereafter. Our powers to vary wireless telegraphy licences are subject, in particular, to Article 14 of the Authorisation Directive and section 10 and Schedule 1 of the Wireless Telegraphy Act 2006.

Territorial extent of licences

- 9.17 In our March 2011 consultation, we proposed that the licences would permit use only within the United Kingdom of Great Britain and Northern Ireland. They would not permit use in the Channel Islands and the Isle of Man. We did not receive any responses in relation to this licence condition and have therefore decided to proceed on that basis.

Spectrum trading

- 9.18 In the March 2011 consultation we proposed to allow the licences to be tradable, with all legal forms of trading to be permitted subject to our consent. However, we proposed to restrict the type of transfer to be allowed in relation to the rights and obligations arising under low-power 2.6 GHz licences, with only outright total transfers of these rights and obligations being permitted.
- 9.19 We also proposed that our consent would be required for a transfer, and that we would reserve the right to conduct an *ex ante* competition check before giving consent.
- 9.20 We received 14 responses in relation to these proposals. Skype, H3G, BT and Cable & Wireless supported a competition check being undertaken. Vodafone requested clarity on the process of the competition assessment e.g. the legal standard of review and procedural framework. Everything Everywhere said that a competition check was not necessary and mobile spectrum should not be dealt with differently to other spectrum.
- 9.21 On 2 February 2011 we published a Notice proposing to make tradable the licences for 900, 1800 MHz and 2.1 GHz spectrum and to allow us to undertake an *ex ante*

competition check before determining whether to consent to a trade. We set out in the Notice (paragraphs 2.9ff) our assessment of the case for an *ex ante* competition check on mobile spectrum trades. We considered mobile spectrum different from spectrum in general, in part because there was a *material risk* that concentration of mobile spectrum holdings could affect downstream competition. We concluded that this justified the provision in the trading regulations for an *ex ante* competition check.

- 9.22 On 20 June 2011, we published a statement of our decision on the proposals to make the licences for 900, 1800 MHz and 2.1 GHz spectrum tradable²⁰² (the June 2011 Statement). In this we addressed comments that had been made in responses to the February 2011 Notice about the need for clarity on the competition assessment process. Annex 1 of the statement set out guidance on the procedures we will follow in considering whether competition is likely to be distorted as a result of a transfer of the rights and obligations in licences for use of mobile spectrum.
- 9.23 We consider that the same considerations apply to licences for the 800 MHz and 2.6 GHz spectrum since that spectrum will be used to provide the same or similar services to those provided using the 900 MHz, 1800 MHz and 2.1 GHz band; and that it would therefore be appropriate to also make these licences tradable and to follow the competition assessment procedures set out in Annex 1 of our June 2011 statement.
- 9.24 Three responses did not support the proposal to restrict the type of transfer to be allowed for low-power 2.6 GHz licences. FCS thought that any restriction that limited the leasing and trading of low power licences would fail to encourage competition and to maximise use of the spectrum.
- 9.25 Any bidder who wins a low-power 2.6 GHz licences will hold a distinct licence but with identical rights and obligations for the concurrent use of identical frequencies nationally. In order to manage their shared access to the spectrum, the licensees will be required to use their best endeavours to agree a code of practice on engineering coordination and to adhere to it. Our purpose in restricting the number of low-power lots to is to keep to a manageable number the parties with whom all the other licensees would have to coordinate and hence to control their engineering coordination costs.
- 9.26 Some types of transfer would result in an increase in the number of low-power licensees. These are.
- concurrent total transfers, i.e. transfers of all of the rights and obligations arising under a licence, to a third party which result in a concurrent holding of those rights and obligations by the transferor and the transferee(s);
 - outright partial transfers, i.e. outright transfers of some of the rights and obligations arising under a licence to a third party; and
 - concurrent partial transfers, i.e. transfers of some of the rights and obligations arising under a licence to a third party that results in a concurrent holding of those partial rights and obligations by the transferor and the transferee(s).
- 9.27 The concern with these three types of transfer is that they would allow one licensee unilaterally to increase the number of licensees and so the number of parties with

²⁰² <http://stakeholders.ofcom.org.uk/binaries/consultations/trading-900-1800-2100/statement/900-1800-2100-statement.pdf>

whom all the other licensees would have to coordinate. We consider that it is desirable to limit the number of low-power 2.6 GHz licences and only allow those types of trades that do not increase the number of licensees in the band. In practice this will mean we will allow only the total outright transfer of licences, i.e. the transfer to a third party of all the rights and obligations under a licence, with the transferor retaining none of those rights and obligations.

- 9.28 We will be consulting on and making the necessary statutory instrument to implement our decisions on spectrum trading in advance of the holding the auction.

Non-technical restrictions on use

- 9.29 We proposed the licences should not restrict the service to be offered or the technology or type of equipment to be used (other than the minimum technical restrictions necessary to control harmful interference). We did not receive any responses in relation to this licence condition and have therefore decided to proceed on this basis.

Provision of information to facilitate optimal spectrum use.

- 9.30 We proposed to include a condition in the licences to require licensees to provide us with information regarding their equipment and use of frequencies, or roll out of their network. We proposed that we might publish periodically information on spectrum use in areas throughout the UK, which could help interested parties to identify areas where they might provide additional services. It would then be open to them to gain access to spectrum in those areas by trading with licensees.
- 9.31 There were 17 responses commenting on this proposal. Vodafone and Everything Everywhere disagreed with it. Everything Everywhere considered that we had not provided any evidence in support of our proposal, and said that the Digital Economy Act 2010 (as incorporated into sections 134A and 135 of the Communications Act 2003) provided Ofcom with the necessary powers anyway. It also highlighted concerns about the disclosure of the information provided. Vodafone said that there was no clear benefit, as interested parties would be able to approach the relevant operator anyway, without Ofcom needing to facilitate this. H3G said that information a mobile operator considers as commercially sensitive should not be made available in the public domain.
- 9.32 Four respondents noted potential issues that should be considered when using the information. David Hall Systems Ltd thought that the information may provide an incorrect view of spectrum use due to the timescales required for rolling-out LTE networks. FCS and Intel noted that security needed to be considered when managing this information.
- 9.33 Twelve respondents supported our proposal, with some respondents wanted the provision of more information. South of Scotland Alliance wanted mapping data on planned and actual 4G networks. DETI said they would be interested in the capacity, backhaul and utilisation figures of base stations and the details of annual investment in the regions/nations. Cotswold Wireless wanted good quality coverage maps.
- 9.34 We note that we have powers under both the Communications Act 2003 (section 135 to 146) and the Wireless Telegraphy Act 2006 (sections 32 to 34) to require third parties to provide us with information in certain circumstances. However, we consider that there remains a benefit in requiring licensees to compile and maintain basic details relating to the radio equipment that they are using pursuant to the licence so

that it is readily available in the event that it is needed, for example, in cases of alleged interference. We have therefore decided to include in the licences an obligation on licensees to compile and maintain such basic information. In particular in the case of the standard power licences for 2.6 GHz and the licences for 800 MHz we have specified that records of the location of the radio equipment which must be kept include a national grid reference to at least 1m resolution. This is a more exact location requirement than in some existing wireless telegraphy licences but we believe this is appropriate because of the particular risks of interference to use in adjacent bands that apply in the case of these licences. We have modified the recording keeping obligation so it is less onerous in the case of deployment of femtocells or smart repeaters under these licences and in the case of the low power licence for 2.6 GHz to reflect the practical difficulties of keeping records of the location of such radio equipment.

Coexistence with DTT

- 9.35 A set of additional licence conditions will apply in the 800 MHz licences in relation to the coexistence of new mobile services in the 800 MHz band with existing DTT services. We set these out in Annex 6 of this document.

Section 10

Technical licence conditions

Introduction

- 10.1 The framework for the technical licence conditions for each of the bands comes from two Commission Decisions:
- Commission Decision 2010/267/EU²⁰³ of 6 May 2010 on harmonised technical conditions of use in the 790-862 MHz frequency band for terrestrial systems capable of providing electronic communications services in the European Union; and
 - Commission Decision 2008/477/EC²⁰⁴ of 13 June 2008 on the harmonisation of the 2500-2690 MHz frequency band for terrestrial systems capable of providing electronic communications services in the Community
- 10.2 In June 2011 Ofcom published a consultation²⁰⁵ on technical licence conditions, in which we set out the technical parameters from these Commission Decisions and also consulted on proposals for further parameters. This section provides an explanation of the technical licence conditions being used in the auction of 800 MHz and 2.6 GHz spectrum. Annex 11 also sets out a summary of the technical licence conditions, responses to the June 2011 and January 2012 consultations, and the decisions made by Ofcom on the matters under consultation. The licences and accompanying notices containing the relevant technical licence conditions are published alongside this statement as annexes to the Information Memorandum.²⁰⁶

Technical licence conditions for the 800 MHz band

Base station power

- 10.3 The licences for the 800 MHz band permit a maximum mean in-block power for base stations of 61dBm/(5 MHz) EIRP.

Block edge mask

- 10.4 Commission Decision 2010/267/EU defines a block edge mask for emissions from 800 MHz base stations. Separately it has three options for emissions into spectrum below 790 MHz.
- 10.5 The permissible out-of-block emissions in the licences have been set to align with the block edge mask in the Commission Decision. For unwanted emissions below 790 MHz, we have used the set of limits denoted “Case A”. These limits are national restrictions and do not take account of any specific additional technical restrictions that may be needed for achieving the co-existence of new services in the 800 MHz band with adjacent DTT use.

²⁰³ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:117:0095:0101:en:PDF>

²⁰⁴ <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:163:0037:0041:EN:PDF>

²⁰⁵ <http://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/>

²⁰⁶ <http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/statement/IM.pdf>

Requirements for protection of DTT use of Channel 61 and 62

- 10.6 During the period between the auction of 800 MHz licences and the completion of the relocation of DTT services to other frequencies outside the 800 MHz band, there will be areas of the country where DTT channel 61 or 62 is still in use. It is therefore necessary to put in place transitional measures for protection of this DTT use.
- 10.7 Ofcom will issue a *Notice of Transitional Restrictions on Mobile Networks in the 800 MHz band for protection of DTT in channels 61 and 62*²⁰⁷, which sets out the procedures that 800 MHz licensees will have to comply with to protect channel 61 and 62 DTT usage. This places limits on the cumulative interfering field strength at test points on the edge of the protected service area of a DTT station. Prior to rollout, 800 MHz licensees must satisfy themselves that the DTT protection requirements specified will not be exceeded by their planned mobile networks. This requirement also applies on an ongoing basis to any changes in mobile network configurations until DTT is cleared from channels 61 and 62.

International cross-border coordination

- 10.8 The licences require compliance with cross-border coordination and sharing procedures notified to the licensees by Ofcom. The following coordination procedures are currently in place:
- *Memorandum of Understanding on frequency coordination between the Republic of Ireland and the United Kingdom in the frequency band 790-862 MHz*
- 10.9 The values in this Memorandum of Understanding are consistent with those in ECC Recommendation (11)04²⁰⁸: *Frequency planning and frequency coordination for terrestrial systems for Mobile/Fixed Communication Networks (MFCN) capable of providing electronic communications services in the frequency band 790-862 MHz*.
- 10.10 We do not currently have any procedure in place for coordination with the 800 MHz usage in France. France wishes to consolidate the separate documents addressing each frequency band used for public mobile communication (900 MHz, 1800 MHz, 2.1 GHz and 2.6 GHz) into a single Memorandum of Understanding and add the relevant provisions for 800 MHz based on the values in ECC Recommendation (11)04. We are minded to accept the proposals from France. If we enter into a Memorandum of Understanding, any relevant obligations will be notified to the licensees.

800 MHz terminals

- 10.11 We will make regulations for the exemption of terminals from the requirement for individual licensing, provided that they comply with certain technical parameters. The power limit on terminals for compliance with the exemption regulations will be 23dBm, specified as EIRP for fixed or installed terminal stations and as total radiated power (TRP) for mobile or nomadic terminal stations. Allowances for tolerance and measurement uncertainty would be consistent with the ETSI harmonised standard EN 301 908.

²⁰⁷ *Notice of Transitional Restrictions on Mobile Networks in the 800 MHz band for protection of DTT in channels 61 and 62* set out in Annex 6 of the Information Memorandum

<http://stakeholders.ofcom.org.uk/binaries/consultations/award-800mhz/statement/IM.pdf>

²⁰⁸ <http://www.erodocdb.dk/Docs/doc98/official/Word/REC1104.DOC>

10.12 We expect to consult on draft regulations on exemption of 800 MHz and 2.6 GHz terminals in autumn 2012. The regulations should then be effective by the end of 2012.

Technical licence conditions for the 2.6 GHz band

Paired spectrum (standard power)

Base station power

10.13 The licences for standard power base stations using paired frequencies in the 2.6 GHz band permit a maximum mean in-block power of 61dBm/(5 MHz) EIRP, in line with the value specified in Commission Decision 2008/477/EC.

Block edge mask

10.14 Commission Decision 2008/477/EC defines a block edge mask for emissions from 2.6 GHz base stations. The extent of the technical conditions in the Commission Decision is from 2500 to 2695 MHz. The permissible out-of-block emissions in the licences have been set to align with the block edge mask for unrestricted blocks in the Commission Decision within the range 2500 to 2695 MHz. We have also included emission limits up to 3100 MHz for the protection of radars operating in the 2.7-3.1 GHz band.

Unpaired spectrum

Base station power

10.15 The licences for base stations using unpaired frequencies in the 2.6 GHz band permit the following maximum mean in-block powers, in line with the values specified in Commission Decision 2008/477/EC:

- Unrestricted frequencies: 61dBm/(5 MHz) EIRP
- Restricted frequencies: 25dBm/(5 MHz) EIRP

Block edge mask

10.16 Commission Decision 2008/477/EC defines a block edge mask for emissions from 2.6 GHz base stations. The extent of the technical conditions in the Commission Decision is from 2500 to 2695 MHz. The permissible out-of-block emissions in the licences have been set to align with the block edge mask for unrestricted blocks in the Commission Decision within the range 2500 to 2695 MHz. We have also included emission limits up to 3100 MHz for the protection of radar radars operating in the 2.7-3.1 GHz band.

Restricted frequencies: alternative out-of-block limits for base stations with additional restrictions on antenna placement

10.17 In cases where base station antennas are placed indoors or where the antenna height is below 12m, the alternative out-of-block emission limits in the Commission Decision may be used. The in-block power limit for restricted frequencies remains valid in these circumstances.

Low power concurrent spectrum access

- 10.18 As explained in sections 4, 6 and 7, it is possible that the outcome of the auction may include either a 2 x 10 MHz or 2 x 20 MHz block of 2.6 GHz spectrum that will be shared by up to 10 licensees for concurrent low power use. Each licensee will have concurrent access to the spectrum. If Ofcom does issue such licences the low power technical licence conditions will be as follows.

Base station power

- 10.19 The licences for low power base stations using paired frequencies in the 2.6 GHz band permit a maximum mean in-block power of 30dBm/(5 MHz) EIRP.

Block edge mask

- 10.20 The permissible out-of-block emissions in the low power licences have been set to align with the block edge mask in Commission Decision 2008/477/EC within the range 2500 to 2695 MHz. We have also included emission limits up to 3100 MHz for the protection of radars operating in the 2.7-3.1 GHz band.

Antenna siting restrictions

- 10.21 Outdoor antennas for low power 2.6 GHz base stations must not be placed at heights exceeding 12m above ground level. There is no height limit for indoor antennas.

Code of practice

- 10.22 Management of the shared access to the 2.6 GHz spectrum will require the development of a code of practice on engineering coordination between licensees. Licensees will be required to use their best endeavours to agree such a code of practice within six months. Licensees will then be required to use their best endeavours to adhere to the agreed code of practice.
- 10.23 Ofcom retains the power to impose a code of practice if licensees have not agreed their own code of practice within six months or where the objectives for such a code as set out by Ofcom in the licences are not being secured. Failure to comply with any code of practice imposed by Ofcom would constitute a breach of the licence.

Requirements for protection of radar use in spectrum above 2.7 GHz

- 10.24 There is a nationwide limit of -45dBm/MHz on unwanted emissions from 2.6 GHz base stations into the 2700 to 3100 MHz spectrum. In addition, there will be a need for coordination with radar usage. Radars operating in the 2700 to 3100 GHz spectrum are sensitive to signals transmitted in the 2.6 GHz band and will be subject to remediation work to make them less susceptible.
- 10.25 Ofcom will issue a *Notice of Co-ordination Procedure required for the deployment of mobile electronic communication networks under the spectrum access licences covering the 2.6 GHz band*²⁰⁹, which includes the radar protection thresholds and coordination procedures to protect radar usage. Details of the radars to be protected are specified in this Notice.

²⁰⁹ *Notice of Co-ordination Procedure required for the deployment of mobile electronic communication networks under the spectrum access licences covering the 2.6 GHz band* set out in Annex 3 of the Information Memorandum.

- 10.26 The protection thresholds are the levels that are required to be met in any circumstance to provide protection to the radar, and the coordination procedures state that radar protection thresholds can only be breached in specific circumstances, with the express agreement of the relevant radar licensee. Co-ordination procedures are applicable to all 2.6 GHz licensed equipment, including low power shared access equipment (e.g. femto cells). Separate protection thresholds are provided for radars before, and after, they are remediated.
- 10.27 Prior to deployment, 2.6 GHz licensees must satisfy themselves that the protection thresholds specified in the notice will not be exceeded by their planned base station deployment unless they have the written consent of any affected radar licence holders. The Notice specifies the ITU-R propagation models to be used in carrying out this assessment. The 2.6 GHz licensees must continue to meet the protection thresholds on an ongoing basis at all times even after a change in base station deployment.
- 10.28 The radar list will be updated as necessary to show changes to the list of radars to be protected. Three types of change are envisaged:
- Radars will be remediated to give them greater protection from interference from signals in the 2.6 GHz band.
 - Some radars may be required by the CAA to change frequency.
 - New radars will be added to the list and radars that cease to be licensed will be removed from the list.
- 10.29 When a new radar is deployed, it will need to take account of existing deployment in the 2.6 GHz band. 2.6 GHz licensees will not be required to adjust the technical parameters of base stations that have already been deployed to take account of new radar deployment. However, where a radar operator does wish to deploy a new radar and there is a 2.6 GHz licensee with an existing base station that may interfere with that new radar, it would be open to the parties to seek to resolve between themselves any coordination issues that would arise as a result of the intended radar deployment.
- 10.30 Some military radars require that all 2.6 GHz base stations are excluded within a range of 1km, instead of using the defined protection threshold procedure described in paragraphs 10.25 to 10.27. Details of the military radars requiring an exclusion zone are given in the notice referred to in paragraph 1.25 above.

Coordination with licensees adjacent to restricted frequencies

- 10.31 Commission Decision 2008/477/EC provides an alternative block edge mask that can be used for base stations with restrictions on antenna placement, i.e. antennas placed indoors or below a certain height. Studies for Ofcom have indicated the potential for interference from base stations using the alternative mask into base stations on adjacent frequencies that are located within particular separation distances.
- 10.32 Ofcom will issue a *Notice of coordination procedure for the licences covering the 2.6 GHz band: Deployment of mobile electronic communication networks in unpaired*

*restricted blocks and in spectrum adjacent to unpaired restricted blocks*²¹⁰, which contains procedures for coordination between the licensee holding restricted frequencies and the licensee in the frequency block adjacent to the restricted frequencies. The procedures apply where an operator wishes to use the alternative mask, enabling that operator to obtain details of neighbouring base stations that lie within the specified separation distances, and then coordinate placement as required. An operator that holds frequencies adjacent to a restricted block will have information about its neighbour's restricted block alternative mask deployments and can decide whether to deploy base stations within the specified separation distances at its own risk.

International cross-border coordination

10.33 The licences require compliance with cross-border coordination and sharing procedures notified to the licensees by Ofcom. The following coordination procedures are currently in place:

- *Memorandum of Understanding on frequency co-ordination between France and the United Kingdom in the frequency bands 2500 - 2690 MHz*
- *Memorandum of Understanding on frequency co-ordination between the Republic of Ireland and the United Kingdom in the frequency bands 2500 - 2690 MHz*

10.34 We have been approached by France on the possibility of modifying our Memorandum of Understanding. The principal change that France has proposed would bring the coordination thresholds into line with those in ECC Recommendation (11)05²¹¹ *Frequency planning and frequency coordination for terrestrial systems for Mobile/Fixed Communication Networks (MFCN) capable of providing electronic communications services in the frequency band 2500-2690 MHz*. In addition, France wishes to consolidate the separate documents addressing each frequency band used for public mobile communication (800 MHz, 900 MHz, 1800 MHz, 2.1 GHz and 2.6 GHz) into a single Memorandum of Understanding. We are minded to accept the proposals from France. If we enter into a Memorandum of Understanding, any relevant obligations will be notified to the licensees.

2.6 GHz terminals

10.35 As set out above, we will make regulations for the exemption of terminals from the requirement for individual licensing, provided that they comply with certain technical parameters.

10.36 The power limit on terminals for compliance with the exemption regulations will be 23dBm in 2500 to 2570 MHz and 26dB in 2570 to 2620 MHz, specified as EIRP for fixed or installed terminal stations and as TRP for mobile or nomadic terminal stations. Allowances for tolerance and measurement uncertainty would be consistent with the ETSI harmonised standards EN 301 908 and EN 302 544.

10.37 We expect to consult on draft regulations on exemption of 800 MHz and 2.6 GHz terminals in autumn 2012. The regulations should then be effective by the end of 2012.

²¹⁰ to Notice of coordination procedure for the licences covering the 2.6 GHz band: Deployment of mobile electronic communication networks in unpaired restricted blocks and in spectrum adjacent to unpaired restricted blocks set out in Annex 4 of the Information Memorandum.

²¹¹ <http://www.erodocdb.dk/Docs/doc98/official/Word/REC1105.DOC>

10.38 The following terminals that do not fall within the scope of the exemption regulations are included within the scope of the standard power paired and unpaired licences:

- mobile or nomadic terminals operating at power levels up to 31dBm/(5 MHz) total radiated power; and
- fixed or installed terminals operating at power levels up to 35dBm/(5 MHz) EIRP.

Section 11

DTT Coexistence

- 11.1 New mobile services in the 800 MHz band have the potential to interfere with the reception of existing DTT services. Such interference will need to be mitigated by the new licensees in the 800 MHz band.
- 11.2 Our technical analysis shows that without action to mitigate interference, up to 2.3m households might lose the ability to access DTT services, either partially or completely. Approximately 40% of households in the UK use DTT as their only means of accessing TV, meaning that around 900,000 DTT-only households could lose some or all of their TV channels.
- 11.3 On 21 February 2012, Government published a number of high-level decisions relating to DTT coexistence, including that:
- A single implementation body (referred to here as 'MitCo') should be set up to manage the delivery of support and mitigation to consumers of DTT services. This body would be owned and operated by the new 800 MHz licensees;
 - The new 800 MHz licensees should be required to provide MitCo with funding of £180m;
 - MitCo should provide support to (primary-set) DTT consumers in the form of information and DTT receiver filters. Where interference is not resolved by the use of a filter, consumers would be provided with access to an alternative TV platform. Where an alternative platform is not immediately available, MitCo would need to spend up to £10,000 per affected household to help these households to continue to receive TV services;
 - An Oversight Board²¹² should be established to monitor MitCo's performance;
 - Additional support, including help to install filters, should be provided to vulnerable consumers.
- 11.4 On 10 July 2012, Government made further supplementary decisions on coexistence²¹³. It decided that:
- Up to £12m of the £180m funding for managing coexistence should be used by MitCo to provide installation support in the form of vouchers (to a value of £50 + VAT per household) to primary DTT households affected by interference whose TV installation comprises a mast-head amplifier;
 - Any underspend of the £180m funding should be returned in full to the 800 MHz licensees²¹⁴;
 - MitCo should remain in existence until one year after the date for reaching the coverage obligation or network roll out completes²¹⁵, whichever is earlier.

²¹² Previously referred to as the Supervisory Board.

²¹³ <http://www.culture.gov.uk/images/publications/letter-dcms-ofcom-10072012.pdf>

²¹⁴ This updates and replaces the February 2012 decision in which underspend was to be shared equally between licensees and Government.

Policy decisions on coexistence of new services in the 800 MHz band with digital terrestrial television

- 11.5 In our February 2012 consultation, we set out proposals for how Government decisions on coexistence should be implemented. Since then, we have carefully reviewed responses and discussed the issues in detail with stakeholders and Government.
- 11.6 We have now made decisions on the framework that will be used for implementing the Government decisions and summarise these decisions below.

Objectives for coexistence

- 11.7 Some respondents to our consultation suggested that arrangements for managing coexistence should be underpinned by a clear set of objectives or principles. In Annex 6, we articulate six objectives for managing coexistence which are based on our statutory duties and which have guided us in designing and finalising the policy decisions on coexistence summarised here and set out in full in Annex 6. We expect that these objectives will underpin the further preparatory work on coexistence leading up to the licence award.

Setting up MitCo

- 11.8 Government has indicated it will appoint a person or persons to carry out preparatory work in advance of the Auction. This work will not establish MitCo as a legal entity but will produce a package of documents (such as draft governance documentation) which will be put at 800 MHz licensees' disposal to use if they wish.
- 11.9 Licensees will be free collectively to agree their own approach and rules to establishing MitCo, but will need to do so within six weeks of the date of 800 MHz licences being granted (except where licensees unanimously request an extension and Ofcom agrees this).. If they cannot agree within that time period, licensees will be required to use the approach and rules prepared by the Government appointed person(s).
- 11.10 Separately, Government has committed to setting up an Oversight Board (OB) which will monitor MitCo's performance.
- 11.11 Licensees will be required to fund MitCo and the work of the OB directly and separately from any monies used in bidding in the Auction. If the total outturn cost of running MitCo and the OB exceeds £180m, the new licensees will not be responsible for providing additional funding, except where the reason the cost exceeds £180m is because licensees have chosen to provide help not required or approved by Government..

Managing MitCo's performance

- 11.12 The 800 MHz licensees will be required to mitigate harmful interference suffered by DTT users. They will be required to operate MitCo in a manner which gives effect to the Government decisions, and consistent with the objectives defined in Annex 6.

²¹⁵ This updates and replaces the February 2012 decision in which the backstop date for closure was 2017.

- 11.13 The licensees will be required to provide support to consumers in line with standards set out in a set of six key performance indicators (KPIs) which are described in detail in paragraphs A6.145 to A6.218 of Annex 6 of this Statement. Failure to comply with these standards will result in the automatic application of operational conditions to licensees, which form part of the KPIs and will, for example require licensees to take steps to prevent interference from occurring whilst they remedy the problems that have arisen. These operational conditions will apply equally to all licensees until MitCo's operation complies with the standards in the KPIs.
- 11.14 Licensees will be required to report to the OB on their performance against the KPIs. They will also be required to establish and enter into a Memorandum of Understanding (MoU) with the OB in advance of commencing operation. The MoU will formalise the interactions and define the information flows between the two bodies.
- 11.15 In addition, licensees will be required to prepare a Code of Service for MitCo (the Code) and consult on the content of this document with the OB. The aim of the Code will be to establish a reasonable expectation of the level of service MitCo will deliver to consumers. The licensees will also be required to openly publish this Code. Suggested elements for inclusion in this Code are set out in paragraphs A6.242 to A6.248 of Annex 6.
- 11.16 Licensees will be required to agree both the MoU and the Code within 6 weeks of licence award (or within an extended period if unanimously requested by licensees and agreed with Ofcom) failing which they will be required to adopt a MoU and/or Code notified to them by Ofcom.

Other conditions

- 11.17 In addition to complying with conditions relating to managing MitCo's performance as outlined above, licensees will be required to undertake a range of other activities that include but are not limited to:
- interference modelling to underpin provision of consumer support and measurement of certain KPIs, with a requirement to consult with the OB on the model and agree the model with Ofcom;
 - defining and implementing a consumer complaint-handling process, with a requirement to consult on this process with the OB.
 - specification and procurement of receiver filters (and any other equipment which might be provided to consumers), with a suggestion that licensees provide an opportunity for the OB to comment on these matters.
- 11.18 Full details of our policy decisions in relation to coexistence are set out in Annex 6 of this Statement.

Section 12

Annual licence fees: further discussion

- 12.1 The Direction requires Ofcom to revise Annual Licence Fees (ALF) for 900 MHz and 1800 MHz spectrum after completion of the Auction so that they reflect the full market value of the spectrum, and in revising them to have particular regard to the sums bid for licences in the Auction.
- 12.2 In Section 8 and Annex 13 of our January 2012 consultation, we set out further discussion on how we anticipated doing this, building on what we said in the March 2011 consultation and responses to it. Here we set out our further thoughts taking account of responses to the January 2012 consultation.
- 12.3 We note that we have taken no decisions at this stage, and are here setting out only our provisional thinking to date on how we will set ALF. We will consult specifically on the revision of ALF for 900 MHz and 1800 MHz spectrum after the Auction.

January 2012 consultation and Additional Spectrum Methodology

- 12.4 Some respondents to the March 2011 consultation read our proposals as suggesting that there should be a mechanistic link between prices in the Auction and ALF. They were concerned that such a link could result in incentives that would reduce Auction efficiency, including a risk that those bidders that would have to pay ALF might shade their bids in the Auction to manage the impact that their own bids would have on the ALF.
- 12.5 We explained in the January 2012 consultation that we had never intended that there should be a mechanistic link between prices in the Auction and ALF. We nevertheless considered in detail the concerns stakeholders had expressed about the incentives for bidders to shade bids. We considered that there were mitigating factors that materially reduce the likelihood of this risk crystallising. However, we agreed that the underlying concern might in principle affect the efficiency of the Auction in certain circumstances and that it was appropriate to consider how we might further mitigate this potential risk.
- 12.6 In light of the Direction, we considered what other information on the full market value of spectrum we might extract from bids in the Auction (if it is sufficiently competitive), without creating the potential risk of the bid-shading incentive described above. We developed another methodology for estimating full market value on the basis of bids in the Auction, which we referred to as the Additional Spectrum Methodology. This methodology excludes any bid that the ALF payer concerned may have made, in order to prevent its bids from influencing the estimate of full market value that results. We recognised that as well as having some advantages, this approach also had weaknesses. For example, the estimates from this methodology for Telefónica and Vodafone might differ even though they currently hold the same amount of 900 MHz spectrum.
- 12.7 We have summarised responses to our January 2012 consultation and our view of those responses in Annex 12. Having considered those responses, we remain of the view expressed in the January 2012 consultation that it is likely to be appropriate to draw on evidence from the following three methodologies to estimate full market value:

- a) the linear reference price methodology described in the March 2011 consultation, using all bids made in the UK Auction;
 - b) the Additional Spectrum Methodology described in paragraphs A13.66 to A13.75 of the January 2012 consultation; and
 - c) values from Auctions for comparable spectrum in other countries that we consider to be sufficiently competitive, adapted to reflect UK circumstances. This is likely to include considering the relativities of different frequencies in Auctions where multiple frequencies were sold (as described in Annex 12)
- 12.8 We are not ruling out using technical and cost modelling in addition to inform our decision on ALF levels. As we set out in the March 2011 and January 2012 consultations, spectrum values derived from technical and cost modelling are subject to a considerable margin of error and such modelling may therefore be of limited value. We will review the position on this after the Auction to consider whether such modelling is likely to result in information which is more reliable than that from other sources.
- 12.9 We recognise that we need to consider the calculations under each methodology and their outputs with care. They have some limitations both individually and in combination. However, by using a broad set of evidence, and by using market information in particular, we believe that our approach is likely to be appropriate to the circumstances. We believe that considering these three methodologies together sufficiently addresses the risks that might be introduced by a mechanistic link between Auction prices and ALF, while still allowing us to use a range of information to estimate full market value.

Balancing different risks

- 12.10 We recognise that there are both some risks to Auction efficiency and some risks that we might set inappropriate ALF levels after the Auction. The only way to remove all risk would be to put all of the 900 MHz and 1800 MHz spectrum into the Auction so that no ALF was payable after the Auction in any event. However, given the substantial use to which that spectrum is currently put by existing licensees, and the fact that their existing businesses are to a large extent based on such use, we do not consider that this would be likely to be either practical or proportionate. It is therefore in our view inevitable that some risks will remain and as a result, we have to balance those risks appropriately.
- 12.11 We accept that there may be some risk that some bidders who will be paying ALF will shade their bids or that bidders not paying ALF will try to push up ALF for their competitors. However, as set out above, bids in the Auction will not be the only source of information on which we intend to rely when setting ALF after the Auction. One important source of information we expect to take into account will, for example, be international Auction results. Because we intend to take account of a range of information and not to have a mechanistic link between Auction prices and ALF, we consider that the risk of a distortion to Auction bidding has been overstated by Vodafone. It would in our view be risky for bidders to alter their bids to try to influence ALF because we may place little weight on their bids if we consider there is better information available, or if we consider that they may have changed their bids for strategic reasons.
- 12.12 We do not consider that it would be appropriate to rule out taking account of bids in the Auction. Not only would this be inconsistent with the Direction, which expressly

requires us to have particular regard to the sums bid in the Auction, but it would in our view also risk ALF being set incorrectly. We consider that bids in the Auction could be an important source of information about the market value of spectrum in the Auction, which may be relevant to assessing the market value of the 900MHz and 1800MHz spectrum after the Auction.

- 12.13 We have also considered whether it would be appropriate to specify a precise methodology for how we will set ALF after the Auction. However, to the extent that this drew on bids in the Auction (as required by the Direction), this would risk re-introducing a mechanistic approach, which, as explained above, could distort bids in the Auction. We also consider that committing to a particular approach now would risk fettering our discretion to take account of all relevant factors or available evidence after the Auction.
- 12.14 We therefore consider that an appropriate way to balance these risks is to review the possible methodologies for setting ALF after the Auction, drawing on a range of different information whilst recognising the potential limitations of each source of such information. This will allow us to take account of all the factors that appear to us to be relevant at the time. In so doing, we consider that we are appropriately reducing the risk of inefficiency in the Auction by ensuring that there is no mechanistic link between Auction bids and ALF.
- 12.15 We have set out in Annex 12 our response to Stakeholders' responses, including further detail on how we anticipate setting ALF for 1800 MHz spectrum if the divested 1800 MHz spectrum is not in the Auction. ,

Next Steps

- 12.16 Our proposed next steps in our work on ALF are:
- a) following the Auction, to prepare detailed proposals including specific levels of ALF for consultation;
 - b) to make a decision on ALF levels in light of consultation responses and to consult on the corresponding change to the statutory instrument setting out spectrum fees.
- 12.17 As part of the consultation on specific ALF levels, we plan to consider in detail those issues raised in response to the March 2011 consultation and the January 2012 consultation that we have not addressed in full in this statement.
- 12.18 If new developments led to a delay in the Auction of the 800 MHz and 2.6 GHz bands, we would also expect to consider whether to update current fee levels for 900 MHz and 1800 MHz spectrum ahead of the Auction. We would therefore consider whether it might be suitable to introduce interim revised ALFs ahead of fully implementing the Direction after the Auction.

Section 13

Next steps

- 13.1 Ofcom intends to hold the auction as soon as possible. The key next step in the award process is for Ofcom to make the statutory instrument which sets out the auction rules. A draft of these regulations is one of the documents published alongside this statement; it is subject to a statutory consultation. The closing date for this consultation is 11 September 2012. After the closing date for responses to this statutory consultation, Ofcom will consider responses and assess whether we should amend the proposed regulations. We will then make the regulations and they will come into force on the date specified in them.
- 13.2 The timing of the auction cannot be finalised before the statutory consultations have closed and Ofcom has considered responses. Subject to this, Ofcom expects the auction regulations to be in force by a date that would allow the auction process to start in late 2012.
- 13.3 Ofcom will also:
- 13.3.1 consult on and make further statutory instruments amending (i) the mobile spectrum trading regulations, (ii) the limitations order, and (iii) the register regulations, to give effect to the decisions in this Statement in advance of the auction; and
 - 13.3.2 update the Information Memorandum shortly before the auction process commences, to ensure that potential bidders have the most up to date information available to them at that time. We will at the same time consider whether we need to make any amendments to the draft licence conditions, and publish any such amendments alongside the updated Information Memorandum.

Further events

- 13.4 Ofcom is planning to hold a number of events that will allow interested parties to familiarise themselves with the auction design and procedures. These are likely to include a seminar to explain the auction rules. Ofcom will also hold mock auctions for those interested in taking part in the auction.