



Second consultation on
assessment of future mobile
competition and proposals for the
award of 800 MHz and 2.6 GHz
spectrum and related issues

Consultation

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Section 1

Executive summary

- 1.1 In March 2011 we published a consultation setting out proposals for the auction of 800 MHz and 2.6 GHz spectrum which will be the largest ever single auction in the UK of internationally harmonised mobile spectrum. We did this pursuant to our statutory duties and the Government's Direction to Ofcom, made in December 2010 (the Direction)¹, the express purpose of which is to ensure the release of additional spectrum for use by providers of next generation mobile broadband, allowing early deployment and maximising the coverage of those services.
- 1.2 We received 71 responses to this consultation from stakeholders expressing a wide range of views on issues on which we consulted, and providing considerable analysis and evidence in that regard. We have considered all the responses received, and have as a result modified some of our proposals for how Ofcom should auction the spectrum to secure the best use for the benefit of citizens and consumers. We are now consulting on our new proposals before moving to a decision, in order to ensure that all stakeholders have a full opportunity to respond on our revised thinking.
- 1.3 The focus of this consultation is on:
 - our analysis of whether in light of our competition assessment we should put in place appropriate and proportionate measures in the auction to promote competition;
 - our consequent proposals for rules in the auction to promote competition;
 - our proposals for other aspects of the auction design; and
 - our proposals for measures to promote the widespread availability of next generation (4G) mobile broadband services, by which we mean high quality data services, throughout the UK.
- 1.4 Our final decisions on these matters will be given effect to by regulations.
- 1.5 We have developed our proposals in light of the purpose of the Direction in a manner that we consider will maximise benefits to citizens and consumers from optimal spectrum use, consistent with our statutory duties.
- 1.6 This document sets out for consultation revised proposals on which we are inviting stakeholder comments. In particular, whilst this consultation document contains a number of specific questions, we are not seeking to limit the issues on which respondents may wish to comment, and respondents are invited to include representations on any issues which they consider to be relevant. Stakeholders should note that although in a number of places we set out a preference for certain options, we are actively considering all options included in this document.
- 1.7 This document also contains further information about two further subjects:

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>

- 1.7.1 our likely approach to the revision of annual licence fees payable after the auction in respect of existing 900 MHz and 1800 MHz licences (in respect of which we will not be making any decisions until after the auction), and
 - 1.7.2 our current thinking on various matters relating to the technical licence conditions which will form part of the licences to be auctioned as part of the auction.
- 1.8 Whilst we are not formally consulting on these issues at this time, should any stakeholder wish to make comments on them, they are welcome to do so and we will take any such comments into account as and when we make final decisions in this regard.

The Direction and our March 2011 consultation

- 1.9 Our March 2011 consultation document set out our previous proposals for the award². This followed the Direction which requires us to:
- 1.9.1 assess likely future competition in markets for the provision of mobile electronic communication services after the conclusion of the award of 800 MHz and 2.6 GHz bands;
 - 1.9.2 in the light of that competition assessment, 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 the conclusion of the auction;
 - 1.9.3 hold an auction of the 800 MHz and 2.6 GHz bands as soon as reasonably practicable after concluding the competition assessment; and
 - 1.9.4 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

- 1.10 As part of our March 2011 consultation, we carried out a competition assessment as required by the Direction and as a consequence considered carefully whether in light of that assessment we think we should put in place appropriate and proportionate measures in the auction of the 800 MHz and 2.6 GHz bands to promote competition. We considered that there were risks to the future competitiveness of the mobile market if bidders could bid for and acquire any amount of spectrum in an open auction, and these were sufficient for us to take the view that we should put in place the following measures designed to promote national wholesale competition:
- 1.10.1 spectrum floors to ensure that after the auction, subject to demand, there are at least four holders of a minimum spectrum portfolio that mean they are credibly capable of providing high quality data services in the future; and

² We subsequently published two related documents as part of the preparations for the award which covered specific technical issues, in particular our proposals for technical conditions to manage the risk of interference into uses that are adjacent to the 800 MHz and 2.6 GHz bands including Digital Terrestrial Television (DTT).

- 1.10.2 safeguard spectrum caps which place restrictions on the amount of spectrum each participant could win in the auction.
- 1.11 We also included in the March 2011 consultation certain proposals for ensuring that bidders with an interest in shared low-power use at 2.6 GHz could compete in the auction with those bidders who have an interest in individual standard-power use for access to at least a part of the 2.6 GHz spectrum.

Rollout or coverage obligations in the new licences

- 1.12 We explained in the March 2011 consultation that although we expected that over time new mobile services using LTE and possibly other advanced technologies would become available to a large proportion of the UK population as a result of the competitive market we are seeking to promote, the speed at which such services are provided across the UK was uncertain. We therefore set out certain proposals for including coverage obligations in auctioned licences in order to guarantee a minimum coverage level for consumers and citizens.

Non-technical licence conditions likely to promote optimal use of this spectrum

- 1.13 Our March 2011 consultation also set out our proposals for non-technical conditions, consistent with our previous approach to licences granted through auction. Specifically, we proposed that:
 - 1.13.1 licences should be UK-wide and technology and service neutral;
 - 1.13.2 all types of spectrum trading should be permitted for individual standard-power licences, subject to a review of the impact of the proposed trade on competition and, 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 would be permitted;
 - 1.13.3 the licences be of indefinite duration (with an initial term of 20 years), continuing in force until relinquished or revoked.

Spectrum packaging and auction design likely to support the most efficient assignment of spectrum

- 1.14 We explained in our March 2011 consultation that we proposed to assign the rights to use the 800 MHz and 2.6 GHz bands using a combinatorial clock auction which followed the broad structure that had been used previously in other auctions. We also proposed to make the spectrum available in the auction by having several categories of 2x5 MHz lots at 800 MHz, a single category of 2x10 MHz lots for individual standard-power use at 2.6 GHz, and a potential category for low-power use by up to 10 concurrent licensees at 2.6 GHz.

Annual licence fees for 900 MHz and 1800 MHz spectrum in accordance with the Direction

- 1.15 In recognition that the Direction requires us to revise the level of annual licence fees for 900 MHz and 1800 MHz spectrum 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, our March 2011 consultation explained that we envisaged that the bids in the auction would provide the relevant basis for setting these fees. Although we included

a discussion of these issues in that consultation, we explained that we felt that we could not reasonably decide on the final approach until after the auction and made clear our intention to consult again.

Revised proposals to promote future competition in mobile markets

- 1.16 In the light of the responses we received to the March 2011 consultation, we have revised our competition assessment of the future prospects for competition in the mobile market.
- 1.17 This competition assessment has been informed by, and is consistent with, our duties, including those to further the interests of citizens, and the interests of consumers where appropriate by promoting competition, secure optimal use of spectrum, secure 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. This has led us to focus in particular on assessing whether measures are required in the auction to promote competition in markets for the provision of mobile services.
- 1.18 This competition analysis is forward looking to the prospects for competition shortly after the auction and also 5-10 years hence. It covers a period in which we expect new technologies to be rolled out. It is consequently subject to uncertainties about the underlying technical and market conditions which might exist in future, some of which are dependent on choices which operators themselves decide to make.
- 1.19 Accordingly, in carrying out the competition assessment as required by the Direction, in order to determine whether we think we should put in place measures to promote competition, we have looked at the evidence which is available to us now, so as to make reasoned and informed decisions while allowing for the uncertainty relating to future developments in the mobile sector. In light of the uncertainties identified, where we have a choice between options which we consider address our most significant competition concerns, it is our intention to favour the least interventionist option so as to minimise as far as possible the risks of regulatory failure. We consider that this option is likely to be the most proportionate option, consistent with our statutory duties.

Summary of our provisional conclusions on promotion of competition

- 1.20 The main level in the value chain at which we believe we should promote competition is the national wholesale level, because this 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 MVNOs). Our provisional conclusions are:
- UK consumers would be likely to benefit from better services at lower prices in future if there were at least four national wholesalers of mobile services, as at present, rather than fewer;
 - We consider that the national wholesale market is already highly concentrated, and we would be concerned if, as a result of the outcome of this auction, it were to become more concentrated. We consider that it would be preferable for any potential future consolidation in this sector to be subject to careful scrutiny at the time, rather than allowing the level of competition in the market to reduce as an unintended consequence of this auction;

- We consider that there is a material risk that there will be fewer than four credible national wholesalers of mobile services in future if neither Hutchison 3G UK (H3G) nor a new entrant were to acquire at least a minimum amount of spectrum in the auction³;
- 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 UK Limited (Telefónica) or Vodafone, notwithstanding that 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;
- We therefore think it is appropriate, and so propose to, in effect, reserve some of the available spectrum for a fourth national wholesaler, by which we mean a bidder other than Everything Everywhere, Telefónica or Vodafone;
- Bidders for the reserved spectrum will have to compete with each other, but provided that there is at least one bidder (other than Everything Everywhere, Telefónica or Vodafone) that is willing to pay the reserve price for this spectrum, one such bidder is guaranteed to win it. The exact quantities of spectrum that we consider likely to be necessary and therefore proportionate to reserve are set out below;
- Because 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. The exact level of the proposed safeguard caps is set out below.

Key changes in our views since the March 2011 Consultation Proposals

- 1.21 There are many similarities in our proposals to promote competition compared to those we suggested in March 2011. However, careful consideration of the responses and further analysis have led us to change our view in certain material respects.
- 1.22 In March we took the view that Everything Everywhere was likely to need access to a small amount of sub-1 GHz spectrum (2 x 5 MHz in our favoured option) in order for it to be a credible national wholesaler in the future. Given this view we, in effect, proposed to reserve such spectrum for Everything Everywhere as well as a fourth national wholesaler.
- 1.23 In light of the responses to our March 2011 consultation and our further analysis we now believe that there is significantly less risk that Everything Everywhere might not continue to be a credible national wholesaler after the auction. Our previous analysis focussed predominantly on one area of potential risk (namely the need to hold sub-1GHz spectrum in order to be able to offer the best quality coverage in hard to serve locations), whereas we now consider it appropriate to place more emphasis on

³ Unless they acquired sufficient spectrum by other means before the auction.

evaluating the capabilities of a national wholesaler's spectrum holdings in the round. In doing so we take greater account of the large amount of 1800 MHz spectrum that Everything Everywhere holds, which is in our view likely to enable it to have a sufficient quality of coverage and capacity, as well as providing it with a large bandwidth of spectrum suitable for LTE and the possibility to offer highest peak speed in both the near and longer term.

- 1.24 With regard to holdings of sub-1GHz spectrum, we now believe that the technical advantages of sub-1GHz spectrum are less clear and that the large quantity (2 x 45 MHz) of 1800 MHz spectrum which Everything Everywhere holds is likely to mean that there is only a fairly small gap between what Everything Everywhere and the holders of 800 MHz spectrum could deliver. This is principally because our technical analysis now reflects more fully the range of service quality that consumers are likely to experience across a range of locations, rather than just focussing on service quality in something approaching the worst case. This shows that in many locations a network with a sufficiently large amount of 1800 MHz spectrum coupled with a large network of base stations could match or even better the quality of a network with a smaller amount of 800 MHz spectrum, even if it is unlikely to be able to do this in the hardest to serve locations. Consequently, we do not consider that the evidence available to us demonstrates that the differences between an 800 MHz and an 1800 MHz network would be sufficiently important for Everything Everywhere not to be capable of being a credible national wholesaler without sub-1GHz spectrum.
- 1.25 The other important modification to our March 2011 proposals concerns the spectrum portfolios that we suggest should be reserved for a fourth national wholesaler. Here there are two modifications to note.
- 1.26 First, our revised portfolios do not guarantee that the fourth national wholesaler will win sub-1GHz spectrum through the auction. The reasons for this change are similar to those explained above in relation to Everything Everywhere's position.
- 1.27 The second is that none of our proposed spectrum portfolios contains 2 x 5 MHz of 800 MHz as one of their elements, whereas in March we suggested, for example, that 2 x 5 MHz of 800 MHz together with 2 x 20 MHz of 2.6 GHz might be sufficient to address our competition concerns. We have removed such portfolios because our further analysis suggests that such a small amount of 800 MHz spectrum may do little to enhance the coverage or capacity of a network with a larger amount of higher frequency spectrum, if in particular higher speed services were to prove important (as they may). Reservation of such a small amount of 800 MHz spectrum therefore risks inefficient use of this valuable spectrum resource.

Details of proposals to promote national wholesale competition

- 1.28 We propose safeguard caps as follows:
- An overall spectrum cap of 2 x 105 MHz; and
 - A sub-1GHz spectrum cap of 2 x 27.5 MHz.
- 1.29 These caps cover all the spectrum in the auction (i.e. the 800 MHz and 2.6 GHz bands) 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, so far as we are aware, elsewhere in Europe).

- 1.30 We have considered a number of alternatives for the amount and frequencies of spectrum that should be reserved for the fourth national wholesaler. In assessing these it is important to consider (i) whether the proposed spectrum reservation is sufficient to promote a fourth credible national wholesaler and (ii) the cost in terms of the implied restriction(s) on the spectrum available for other national wholesalers. The specific groups of portfolios that we consider most likely to be proportionate are set out below. However, it should be noted that we do not rule out the possibility that we may ultimately decide on some other combination of specific spectrum portfolios to implement in the auction as the most proportionate way to meet our aim to promote national wholesale competition.
- 1.31 The spectrum portfolios within each group are alternatives, i.e. bidding in the award would determine which specific portfolio would be acquired by the fourth national wholesaler. The groups assume in some cases that the 2x15 MHz of spectrum to be divested by Everything Everywhere, as a result of its parent companies' merger commitments, is to be allocated in the auction. If Everything Everywhere enters into a trade in advance of the auction, those portfolios containing 1800 MHz spectrum would fall away. This may however also remove the need for any spectrum reservation, depending on who acquires the spectrum and the view we finally take on the spectrum needed to be a credible national wholesaler.

Group 1 (Smaller portfolios)

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

Group 2 (Medium portfolios)

Portfolio	800 MHz	1800 MHz	2.6 GHz
3	2 x 15 MHz		
4	2x 10 MHz		2 x 10 MHz
5	2 x 10 MHz	2x 15 MHz	
6		2x 15 MHz	2 x 10 MHz

- 1.32 Our view, based on (i) the evidence available to us at this stage and our analysis thereof, and (ii) the inherent uncertainties surrounding some of that analysis, is that group 2 is our preferred option. We consider that the increase in the benefits that might be realised from this compared to group 1 is considerable, as it would materially increase the probability that four entities would hold sufficient spectrum to be credible national wholesalers after the auction. We consider there is a risk that the amount of reserved spectrum under group 1 may not be sufficient adequately to address our most significant competition concerns. By contrast we consider the comparative increase in cost as between groups 1 and 2 to be relatively small since group 2 still involves reservation of only a relatively small proportion of the available spectrum.⁴ Overall we consider that a spectrum reservation for a fourth national wholesaler as specified in group 2 is the least onerous way of achieving our policy aim of promoting national wholesale competition, given the uncertainties we have about the efficacy of group 1 in addressing our main concerns.

⁴ 13-22% of the paired spectrum in the auction (assuming 2x15 MHz of 1800 MHz is in the auction); or only 6-9% of total paired mobile spectrum (at 800 MHz, 900 MHz, 1800 MHz, 2100 MHz and 2600 MHz).

Promoting new entry by sub-national operators

- 1.33 We consider that there may be material benefits for consumers if part of the paired 2.6 GHz spectrum were to be available on a shared basis to facilitate the provision of innovative mobile services by a wide range of potential providers. These benefits might be greater than those that would flow from this spectrum being held by one or more of the national wholesalers given they will already hold significant amounts of other spectrum. We term these potential providers sub-national operators as we understand they are likely to build infrastructure to compete for only a sub set of the market. These new providers may adopt different business model(s) from existing national wholesalers, for example building what are termed “inside out” networks which focus on building infrastructure to provide service within businesses’ offices and consumers’ homes rather than to provide service over a wide area.
- 1.34 It is possible that this type of entry could come about without reservation of 2.6 GHz spectrum, through the sub-national operators outbidding national wholesalers for the relevant part of the 2.6 GHz band. However, we consider that there is a risk that it would not. The potential providers may, as new entrants, place a lower commercial value on the spectrum than existing operators would, even though the benefits to consumers could be higher than their valuation because of the greater competition and innovation that their entry might foster. It is also possible that the national wholesalers would have the incentive to act strategically to block potential new providers from acquiring the spectrum. Given these risks and the potential benefits to consumers of this entry we are minded to favour reservation of 2 x 10 MHz of 2.6 GHz spectrum but we would welcome more evidence on the costs and benefits of such an action which we recognise is a difficult judgement.

Revised proposals for promoting the availability of future mobile services for citizens and consumers

- 1.35 In the March 2011 consultation we recognised that the award 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 to an important degree but felt that they should be underpinned by a coverage obligation to guarantee that a future mobile broadband service was provided to a significant number of citizens and consumers on a reasonable timescale.
- 1.36 We proposed to include a coverage obligation in one licence for 800 MHz spectrum. This would have required the successful bidder to deploy an electronic communications network capable of providing mobile telecommunications services with a sustained downlink speed of not less than 2Mbps with a 90% probability of indoor reception to an area within which at least 95% of the UK population lives by the end of 2017. We believed that this should result in coverage of future mobile broadband services that approached today’s 2G coverage.
- 1.37 Many, but not all, of the responses to the consultation suggested that we should go further and, in particular impose a higher population target. The House of Commons Culture, Media and Sport Select Committee also recommended that we should impose a coverage obligation of 98% on one or more of the 800 MHz licences. In light of these responses, our further analysis of the costs of extending mobile broadband coverage in rural areas, and in particular the Government’s decision to invest £150m in a mobile infrastructure programme (“MIP”) to improve mobile coverage in rural areas, we believe that it would now be proportionate to include a

more extensive coverage obligation than we previously proposed, in at least one of the 800 MHz licences to be awarded through the auction.

- 1.38 One approach would be for this obligation to be a straightforward 98% (indoor) UK population coverage obligation as many responses advocated. We regard this as a credible way forward. However, given the Government's decision to invest £150m in infrastructure to improve mobile coverage more generally, we believe that possibly an even better approach would be to link the coverage obligation more directly to the MIP. The 800 MHz licensee(s) subject to the coverage obligation would be obliged to provide a 4G mobile broadband service with coverage comparable to the 2G mobile voice coverage delivered by today's 2G mobile networks (in combination) plus the extended mobile voice coverage achieved as a result of the MIP, to the extent that the MIP infrastructure is capable of supporting 4G network equipment.
- 1.39 This second approach would have two key advantages: it would increase the benefits flowing from the Government's investment in mobile infrastructure, leveraging this investment not only to provide better mobile voice coverage but also better mobile broadband coverage; it would also make it more likely that mobile broadband services would be provided in those locations where they were most valuable, rather than in those areas where it was easiest for a licensee to meet the obligation, which is a risk if the obligation refers simply to a population percentage.
- 1.40 We propose that just one 800 MHz licence contains the obligation. We believe that this is a proportionate measure that balances appropriately the risk of inefficient use of the spectrum against the benefits for consumers and citizens of wider coverage. It will ensure that consumers who buy their mobile broadband service from the designated provider will be able to receive a good quality mobile broadband service throughout the UK.
- 1.41 Our preferred approach effectively has two elements: (i) providing coverage that is comparable to the 2G mobile voice coverage delivered by today's 2G mobile networks (in combination); and (ii) providing coverage comparable to the extended mobile voice coverage achieved as a result of MIP, to the extent that the MIP infrastructure is capable of supporting the operator's 4G network equipment.
- 1.42 In relation to the first element, we do not consider it necessary to impose this requirement on all of the 800 MHz licensees. The key benefit of the requirement is to guarantee that this level of coverage is reached on a relatively quick timescale; we anticipate that other licensees are likely ultimately to provide mobile broadband services to a similar level of coverage, but may take longer to do so (and there could be consumer harm if we imposed what turned out to be an inappropriate timetable on all licensees).
- 1.43 In relation to the second requirement, we recognise that the issue is more difficult. We can see that if the obligation is only imposed on one licensee then there is a risk that consumers living in areas that receive service using the MIP infrastructure would not have a choice of provider. It is also the case that other consumers, who live elsewhere but visit such areas, may not be able to receive service in those areas. Clearly there would be some consumer benefit in addressing these issues but we also need to recognise that there would be costs and practical challenges to be overcome.
- 1.44 The presence of new infrastructure built under the MIP raises the possibility that licensees, other than the one holding the coverage obligation, may provide mobile broadband service in some or all of the MIP areas (depending on the nature of the

MIP infrastructure and the arrangements for access to it) as it may prove commercially beneficial to do that. However, we recognise that this is may not be the case in all areas or for all operators.

- 1.45 We have therefore considered two possible options to address the issue: either to impose the second obligation on all 800 MHz licensees; or to impose an additional requirement to offer wholesale access on the one licensee that has the coverage obligation. We consider that there are likely to be concerns with both approaches which mean that, on balance, we do not propose to adopt either option. Instead we favour the approach of imposing the coverage obligation on just one licensee and not imposing a wholesale access obligation on that licensee.
- 1.46 The key difficulty with imposing the obligation on all licensees is that it is only likely to be efficient (i.e. avoid wasteful duplication of sites) if the MIP infrastructure has the capacity to accommodate all holders of the obligation. We cannot be certain that this will be the case because it may not be efficient to build infrastructure that can house the mobile broadband network equipment of more than one provider⁵.
- 1.47 In relation to the possibility of imposing an access obligation, we recognise that some form of obligation could support public policy goals relating to the use of MIP infrastructure. However, there are some important difficulties, including the network costs involved in providing access and the need for a new regulated access regime to be put in place to set the terms and conditions of access, including price. The availability of wholesale access could also undermine the incentive for other operators to invest in rural areas. We are therefore not convinced, at present, that it would be proportionate to take such steps given our current assessment of the limited nature of the associated benefits. We would however welcome further comments and evidence from stakeholders on the potential benefits and costs of these or other measures to promote the availability of service from a wider range of operators in less commercially attractive areas.

Revised proposals on other issues

Spectrum packaging and auction design

- 1.48 This consultation document also sets out our further thinking on how the spectrum should be packaged and the rules of the auction. We have prepared our revised proposals in the light of responses to the March 2011 consultation, developments concerning the nature and extent of technical restrictions that may apply to the available spectrum, and to address the implications of proposed changes to our proposals for promoting competition and mobile coverage.
- 1.49 There remains some uncertainty over the impact of DTT co-existence on the 800 MHz band and therefore we are not yet able to be definitive in our packaging proposals. We discuss two options in this consultation comprising differing lot structures. Our preference is for the option with a simpler structure of lots, as this will simplify the auction for bidders if that proves to be compatible with the conclusions of the work on DTT co-existence.
- 1.50 In the case of the 2.6 GHz band, there was a consensus amongst responses from stakeholders to our March 2011 consultation that we should package the paired spectrum in 2 x 5 MHz lot sizes and not the 2 x 10 MHz we had proposed; and that

⁵ The design of MIP infrastructure will be established through the MIP procurement process. Access to that infrastructure will need to be compatible with state aid rules.

the unpaired spectrum should not be sold as a single lot. In March we made these proposals for purely pragmatic reasons to simplify the auction. Reflecting the feedback in responses from stakeholders our revised proposals are to auction the paired spectrum in 2 x 5 MHz lots and the unpaired spectrum in 5 MHz lots. This approach will allow bidders to aggregate the spectrum in their bids as they think appropriate, subject to any rules to promote competition.

- 1.51 In the March 2011 consultation we proposed using a combinatorial clock auction to award the spectrum with particular features reflecting the specific circumstances of the auction, in particular the proposal to promote competition. Responses from stakeholders broadly supported our approach to the auction design but raised some important issues of detail with the rules. In this consultation we set out detailed modifications to the rules that we believe both address the concerns of stakeholders and more generally improve the design such that the transparency and efficiency of the outcome are likely to be improved.

Availability of 800 MHz and 2.6 GHz

- 1.52 There is considerable ongoing work on spectrum clearance and co-existence with adjacent users, jointly overseen by Government and Ofcom, to make the 800 MHz and 2.6 GHz bands available. This consultation provides an update on that work. We will publish further information relating to these matters in the Information Memorandum. At present we expect that the 800 MHz band will be available for use across the UK from the end of 2013, and in the case of the 2.6 GHz band the majority of the UK by the end of 2013 and remaining areas as soon as possible after that.

Annual licence fees for 900 MHz and 1800 MHz spectrum

- 1.53 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.
- 1.54 In the March 2011 consultation, we set out our view that the bids in the auction would provide a sound basis for setting these fees as they are likely to provide the most reliable source of information on the value of similar spectrum. Based on this principle we set out some detailed proposals for how this should be done. We also noted that, while we felt it would be helpful to stakeholders to discuss how revised licence fees might be set ahead of the auction, no decisions on this matter would be taken until after the auction and we planned to consult again at that time.
- 1.55 We received a number of responses on this issue. Our position remains that we will consult on our approach to implementing this aspect of the Direction after the auction and make decisions following that consultation. However, we continue to believe that stakeholders are likely to find some discussion of possible approaches ahead of the auction helpful and therefore in this consultation we set out some further thinking on the issue.
- 1.56 In line with the Direction we continue to believe that bids in the auction are likely to be an important source of information about the full market value of spectrum and hence for revising annual licence fees. We recognise that a simple mechanistic approach relating annual fees to bids in the auction could create some undesirable incentives in the auction, but our proposal was and is to look at a range of benchmarks to assess full market value when setting revised annual licence fees.

- 1.57 In addition, in the March 2011 consultation we identified a particular approach for extracting information from the bids for the purpose of setting annual licence fees. In light of responses regarding this approach we have now identified an additional approach on which we are seeking comments in this consultation. Our approach to setting annual licence fees will not be to rely on a single methodology and source of information. Instead we expect to extract information from the bids in the auction using more than one methodology and use this alongside other evidence, such as the information on spectrum value that we use to set reserve prices, and information from auctions in other countries for similar spectrum.

Liberalisation of 900 MHz and 1800 MHz for LTE

- 1.58 In the March 2011 consultation, we announced proposals to liberalise the use of mobile frequencies at 900 MHz, 1800 MHz for LTE and WiMAX as soon as technical conditions had been agreed within Europe (see paragraphs 2.21 and 5.88 in that document). In our consultation of 2 June 2011 "Consultation and information on technical licence conditions for 800 MHz and 2.6 GHz spectrum and related matters", we noted that on 18 April 2011 the European Commission had adopted Decision 2011/251/EU, amending Decision 2009/766/EC which added technical conditions for LTE and WiMAX into the annex to that Decision. We also noted that the amending Decision set a deadline of 31 December 2011 for Member States to implement the technical conditions to allow LTE and WiMAX in these bands (see paragraphs 2.11 to 2.17 in that document).
- 1.59 It is clear from *Telefónica O2 UK Limited v Office of Communications (900 MHz Band)* [2010] CAT 25 that the obligation in the amended Commission Decision only extends to putting in place any measures necessary to ensure that, by 31 December 2011, the 900 MHz and 1800 MHz bands are available throughout EU Member States to be authorised for use with LTE and WiMAX technology, and are thereby capable of being made use of. However, authorisation of particular undertakings to use this spectrum for LTE and WiMAX only takes place after implementation of the necessary authorisations and licence amendments under the Authorisation Directive.
- 1.60 Following on from these developments we have received a request from Everything Everywhere for the relevant licences to be amended as soon as possible after the implementation deadline to give effect to the Commission Decision. We propose to consider this application outside of our proposals on the auction, in accordance with our obligations under the Directives and the Wireless Telegraphy Act 2006, in the first quarter of 2012.

Next steps

- 1.61 We are inviting responses to this consultation by 22 March 2012.
- 1.62 Following this consultation, and subject to responses to both this consultation and the March 2011 consultation, we plan to set out our decision for the award in a statement in Summer 2012. Alongside that statement, we plan to publish for statutory consultation draft auction regulations which will give effect to our decision, and an Information Memorandum containing details of the spectrum to be auctioned.
- 1.63 We plan then to make the regulations as soon as practicable thereafter. We will aim to start the award process at the earliest opportunity, having given sufficient time for potential participants to prepare. We believe the process could start in Q4 2012 with the submission of applications from prospective bidders.

Section 2

Introduction

- 2.1 In this consultation we set out revised proposals 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). These revised proposals take account of responses we received to proposals set out in the consultation on the combined award we published on 22 March 2011 (the March 2011 consultation)⁶. In this section we set out the scope of the present consultation.
- 2.2 On 7 October 2011 we published an update on our plans for the combined award⁷. This explained that we had received a number of substantial and strongly argued responses to the March 2011 consultation. In light of these responses and the significance of the decisions we needed to take we decided to undertake a further round of consultation around the end of 2011. The present consultation is the result of that decision.
- 2.3 Following the March 2011 consultation we published on 2 June two other consultations connected to the auction. One was on the potential for mobile use of the 800 MHz band to cause interference to adjacent Digital Terrestrial Television (DTT) use, which set out some initial proposals for handling coexistence of the two services⁸. We are currently considering whether we need to consult further on this issue - if we do, it will be in early 2012. The other consultation set out our proposals for the technical licence conditions that should apply to use of the 800 MHz and 2.6 GHz bands⁹.
- 2.4 This document sets out for consultation revised proposals on which we are inviting stakeholder comments. In particular, whilst this consultation document contains a number of specific questions, we are not seeking to limit the issues on which respondents may wish to comment, and respondents are invited to include representations on any issues which they consider to be relevant. Stakeholders should note that although in a number of places we set out a preference for certain options, we are actively considering all options included in this document.
- 2.5 This document also contains further information about two further subjects:
- 2.5.1 our likely approach to the revision of annual licence fees payable after the auction in respect of existing 900 MHz and 1800 MHz licences (in respect of which we will not be making any decisions until after the auction), and
- 2.5.2 our current thinking on various matters relating to the technical licence conditions which will form part of the licences to be auctioned as part of the auction.
- 2.6 Whilst we are not formally consulting on these issues at this time, should any stakeholders wish to make comments on them, they are welcome to do so and we will take any such comments into account as and when we make final decisions in this regard.

⁶ <http://stakeholders.ofcom.org.uk/consultations/combined-award/>

⁷ <http://stakeholders.ofcom.org.uk/consultations/combined-award/update>

⁸ <http://stakeholders.ofcom.org.uk/consultations/coexistence-with-dtt/>

⁹ <http://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/>

Responses to the March 2011 consultation

2.7 We received 71 responses to the March 2011 consultation. All of these, apart from six confidential responses, can be found on our website¹⁰. We cover in the following sections of this document the main points raised on our competition assessment, mobile coverage, spectrum packaging, auction design and annual licence fees.

Structure of this document

2.8 The rest of this document is structured as follows:

- In section 3, we provide an update on the factors that may affect the availability of the 800 MHz and 2.6 GHz bands after the award.
- In section 4, we explain our revised assessment of future competition in mobile markets and revised proposals for measures to promote competition in those markets after the conclusion of the award
- In section 5, we explain the further consideration we have given to mobile coverage issues and put forward a revised proposal on coverage obligations in 800 MHz licences.
- In section 6, we present our updated spectrum packaging proposals, explain our approach to eligibility points and provide a short update on our plan for how to set reserve prices.
- In section 7, we explain our further consideration of the detailed auction rules and revised proposals.
- In section 8, we discuss ways to estimate full market value of spectrum for the purpose of revising annual licence fees for 900 MHz and 1800 MHz after the auction, and the use of auction prices to derive it.
- In section 9, we explain the steps that will lead to the auction and provide indicative timings.

2.9 This document should be read together with the annexes that set out in detail our analysis on a number of issues. The document, together with those annexes, as a whole comprises an impact assessment, a summary of which is set out at Annex 5.

¹⁰ <http://stakeholders.ofcom.org.uk/consultations/combined-award/?showResponses=true>

Section 3

Update on availability of 800 MHz and 2.6 GHz bands

Introduction

3.1 In section 4 of the March 2011 consultation we described a number of factors that will or may affect the availability for use of the 800 MHz and 2.6 GHz bands after the auction. Here we update the position on those factors where it has changed.

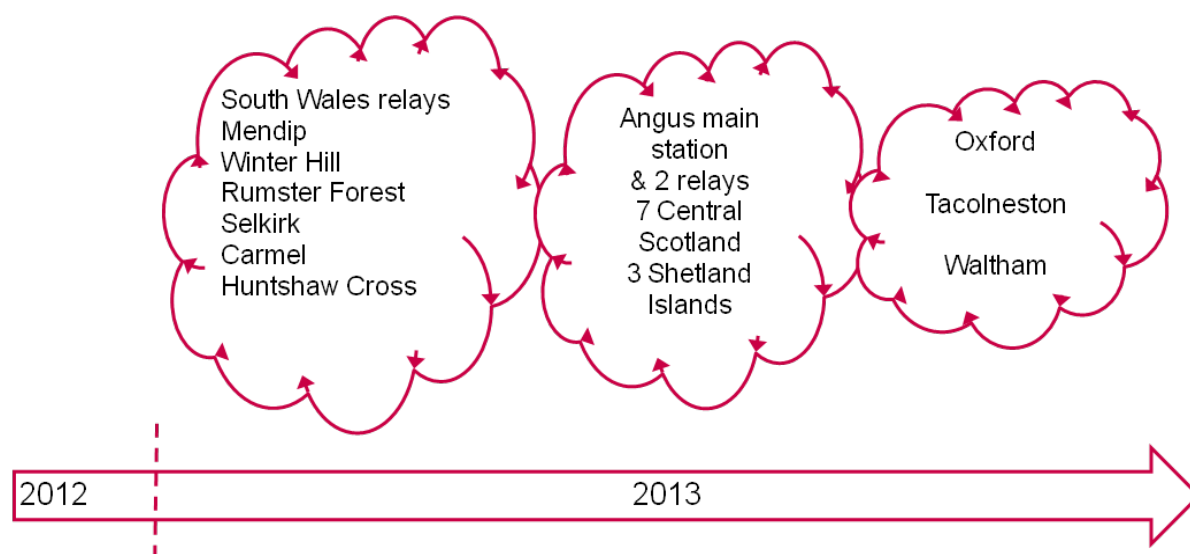
800 MHz: DTT clearance

3.2 In our statement of June 2009¹¹ on clearing the 800 MHz band we set out our decision to allow use of the whole band for new mobile services by clearing channels 61 and 62 (790 to 806 MHz) of DTT. Until the DTT user of these channels has been re-located to alternative spectrum the 800 MHz band will not be fully available for use by new services. Clearance will progress geographically, so that some parts of the UK will become available for new services earlier than others. Our current expectation is that Northern Ireland will be cleared by the end of 2012, Wales by October 2013, England and Scotland by the end of 2013.

3.3 Clearance will take place on a transmitter-by-transmitter basis. While a transmitter continues to operate in either channel 61 or 62 its DTT service will need to be protected from interference that mobile services in the band might cause. The protection requirement will be a condition of each licence issued following the award.

3.4 The figure below shows the stations that will continue to operate during 2013.

Figure 3.1: Transmitters that will continue to operate in channels 61 and 62 beyond 2012



¹¹ <http://stakeholders.ofcom.org.uk/consultations/800mhz/statement/>

- 3.5 In order to protect these stations we will include in licences for 800 MHz a technical restriction on equipment use. At present we expect such a restriction might be as follows:
- Cumulative LTE field strength should not exceed 29dBuV/m at the edge of the DTT coverage area.
 - DTT coverage area defined by Digital Preferred Service Area (DPSA), described by contour or test points.
 - Propagation model could be Rec 1546 or CRC.
- 3.6 Potential bidders should also note that while a DTT transmitter is in operation it may cause interference to mobile services in the band. At a workshop on 29 November 2011 we presented a set of maps illustrating preliminary DTT field strength predictions for the last main stations to be cleared in the fourth quarter of 2013, i.e. Waltham, Oxford and Tacolneston. These provide an insight into the interference into LTE from high power DTT transmitters operating on the same frequency. The presentation can be found at <http://stakeholders.ofcom.org.uk/binaries/consultations/combined-award/annexes/workshop.pdf> (see slides 10 to 18 in particular).
- 3.7 This presentation also covers the DTT clearance timetable, PMSE clearance and the other clearance and interference management issues discussed below.

800 MHz: PMSE clearance

- 3.8 Our decision to clear the 800 MHz band and release it for new services means that programme-making and special events (PMSE) users of channel 69 (854 to 862 MHz) must move to alternative spectrum. In our interim statement on the future management of PMSE spectrum published on 15 April 2010¹² we said:
- We had decided PMSE users should retain access to channel 69 until at least 1 July 2012 in all of the UK and at least 1 October 2012 in London, Northern Ireland and north-east England (the Tyne Tees television region).
 - We did not want to clear PMSE users from channel 69 unless it was to allow its use for new services. Many uncertainties remained around the launch of new services in the 800 MHz band and so we would review in 2011 whether PMSE access to channel 69 could be extended beyond the 1 July and 1 October 2012 dates.
 - Any extension would be up to 31 December 2012 at the latest.
- 3.9 In our March 2011 consultation we sought evidence from prospective users of the 800 MHz band of the likelihood that they would use the top 2x10 MHz of the band in the latter half of 2012. This would allow us to decide whether PMSE use could be extended beyond the dates shown in the first bullet above. We received no clear evidence that the band would be used for new services before the end of 2012. Also, as noted above the clearance of DTT from the band will not be sufficiently advanced to allow new uses in that timeframe. We have therefore decided to allow PMSE use of channel 69 to continue throughout the UK until 31 December 2012. Similarly,

¹² <http://stakeholders.ofcom.org.uk/binaries/consultations/bandmanager09/statement/statement.pdf>

PMSE use in channels 61 to 68, which JFMG¹³ co-ordinates, will continue until the end of 2012.

800 MHz: Availability of channels 63 to 68

3.10 While DSO is still under way one or more of channels 63 to 68 will remain in use for analogue TV in some parts of the UK. Use will continue until the second quarter of 2012 in London and south-east England and until the fourth quarter of 2012 in north-east England and Northern Ireland. In other parts of the UK these channels will be available, in principle, for new services from the beginning of 2012, although restrictions may remain due to continued use of neighbouring channels for terrestrial television.

800 MHz: Co-existence of new services with DTT below 790 MHz

3.11 In June 2011 we published a consultation on the co-existence of new mobile services in the 800 MHz band with DTT below 790 MHz¹⁴. We identified the potential for transmissions from mobile service base stations to interfere with DTT reception. In the consultation we set out a framework of proposals to address this issue that we considered best balanced the competing interests of those involved in using the 800 MHz spectrum and DTT. Our proposals centred on setting up an implementation body to manage the delivery of options for reducing the interference impacts on DTT viewers.

3.12 We noted in the consultation that some decisions would need to be taken in conjunction with Government and some would be for the Government itself to take. We are currently working closely with Government to assist them in taking these decisions. We will then need to take a view on what issues we might need to consult further on. If we do decide to consult again we would aim to do so in early 2012.

800 MHz: Emergency services in 862 to 863 MHz

3.13 The 862 to 863 MHz band is available for emergency services and supports a number of communication systems that are used throughout the UK by the police and fire and rescue services.

3.14 We recognise that potential disruption to these systems could have operational and safety of life implications. Our technical studies have suggested that, without plans to manage interference risks, there could be interference between the adjacent emergency services systems and mobile use in the 800 MHz band. Consequently we have been working with the Department of Culture Media and Sport (DCMS) and the relevant parties to assess the impact of interference on emergency services' operations and to develop plans to manage the interference risks.

3.15 Any justifiable costs which emergency service spectrum users incur as a result of any changes required to implement these plans, will be met by Government subject to the achievement of overall spectrum policy goals and value for money considerations.

3.16 We will provide further information in the Information Memorandum for the award about the outcomes of this work and any other information that may be relevant to potential bidders

¹³ JFMG is the dedicated band manager for programme-making, entertainment, special events and related activities.

¹⁴ <http://stakeholders.ofcom.org.uk/consultations/coexistence-with-dtt/>

Police

- 3.17 The Home Office has agreed a plan with DCMS for mitigating the risk of interference between the police system and mobile use in the 800 MHz band. DCMS will provide funding for the Home Office to mitigate the risk of interference. Mitigation will include interim measures to manage the interference risks in the short term. We are working with the Home Office, in collaboration with DCMS and other government departments, to identify the long-term solution for the system.

Fire Service

- 3.18 A Stakeholder Board and a Working Group have been established to assess the potential operational impact of future mobile use in the 800 MHz band on fire and rescue services and to find a solution. Members include practitioners representing the lead users from the Chief Fire Officers Association (CFOA) and experts from DCMS, Department of Communities and Local Government (DCLG) and Ofcom.

800 MHz: Short-range devices (SRDs) in 863 to 870 MHz

- 3.19 A number of short-range devices (SRDs) operate in the EU harmonised frequency band between 863 and 870 MHz. The deployment of mobile services in the 800 MHz band introduces a potential risk that these SRD applications may experience interference from mobile handsets transmitting in 832 to 862 MHz.
- 3.20 No licence is required to operate SRDs in the 863 to 870 MHz band and devices are deployed on a non-interference/non-protected basis, as defined by the European Commission¹⁵. Nevertheless, in taking proposals on the award of the 800 MHz band forward, we have considered the impact of its decisions on other spectrum users.
- 3.21 In June 2011 we published a preliminary technical analysis on the effect of the award on SRDs operating in the 863 to 870 MHz band¹⁶. We commissioned further technical work on the potential for interference to two particular categories of device: social alarms and audio devices¹⁷. Having considered the results of this further work - and in light of both the consultation responses and other stakeholder engagement - we do not consider it is appropriate to impose licence restrictions on the use of any portions of the 832 to 862 MHz block to protect SRDs.
- 3.22 We recognise that there is potential for some interference into the SRD band. However, these licence-exempt frequencies are harmonised across Europe and are available, as stated above, on a non-interference/non-protection basis. We believe the most appropriate mitigations are those available to the makers and users of SRD devices themselves. However, we will continue to engage with manufacturers and users of SRDs to explore what particular mitigations might be most suitable. We will also engage with European bodies to explore the establishment of EU-wide standards for safety-critical equipment. We have set out in an information update published on 30 November 2011 our views on the risk of interference into SRDs and the further work we plan to undertake with manufacturers and users¹⁸.

¹⁵ Commission Decision of 9 November 2006 on harmonisation of the radio spectrum for use by short-range devices (2006/771/EC) as amended (Article 3(1)).

¹⁶ <http://stakeholders.ofcom.org.uk/binaries/consultations/tlc/annexes/SRD-Study.pdf>

¹⁷ http://stakeholders.ofcom.org.uk/binaries/consultations/tlc/annexes/LTE_UE.pdf

¹⁸

http://stakeholders.ofcom.org.uk/binaries/consultations/tlc/annexes/Update.pdf?utm_source=updates&utm_medium=email&utm_campaign=1st-tues-short-range-update

2.6 GHz: S-band radar remediation

3.23 In our March 2011 consultation and our consultation in June on technical licence conditions¹⁹ we explained that there is significant potential for in-band emissions from systems operating in the 2.6 GHz band to cause interference to aeronautical radio navigation radar, mainly used for air traffic control (ATC), operating in the in the 2.7 to 3.1 GHz band (S-band). We have also assessed the potential impact on other users of this band, including maritime radar, where there is less of a risk. In the March 2011 consultation, we described the work we were doing in relation to S-band radar. This section provides an update on that work. We have arranged a stakeholder event to present our current thinking on coordination arrangements, which will take place shortly after publication of this consultation document. Our presentation will be available after the event on our website at <http://stakeholders.ofcom.org.uk/consultations/combined-award/>.

Air traffic control radar

- 3.24 We have commissioned research into the design of a solution that would mitigate the effects of affected ATC radars' low receiver selectivity. We expect this research to be concluded in mid-2012.
- 3.25 We expect most ATC radars will need to be modified in order to co-exist safely with systems operating in the 2.6 GHz band. Until radars are modified, there will be restrictions on deployment in the 2.6 GHz band in order to protect ATC radars. These restrictions will be reduced once radars have been modified. At that point, there will be some limited coordination requirements on 2.6 GHz use. We are working with the CAA and the MOD to define the coordination arrangements that licensees in the 2.6 GHz band will need to comply with when rolling out services.
- 3.26 The Department for Culture, Media and Sport (DCMS), the Department for Transport (DfT), the Ministry of Defence (MOD), the Civil Aviation Authority (CAA) and Ofcom are working together to facilitate the implementation of the necessary modifications to ATC radars.
- 3.27 The DfT has established an Industry Group, and will be working with ATC radar operators and other relevant parties in the aviation sector to agree a roll-out plan for modifications to civil ATC radars. Modifications to military ATC radars will be managed by the MOD. The aim is for modifications to civil and military ATC radars to be completed in areas covering the majority of the UK population by the end of 2013 and across the whole of the UK as soon as possible after that.
- 3.28 We have concluded detailed work to investigate the possibilities for deployment of 2.6 GHz networks at airports. The Airport Deployment Study shows that once radars have been modified, it will be possible, subject to some minor restrictions, to deploy networks for communications services even at busy airports. The study is available at http://www.ofcom.org.uk/static/spectrum/Airport_Deployment_Study.pdf.
- 3.29 We will include in the Information Memorandum for the award (and before if possible) details of the coordination requirements for 2.6 GHz network deployment considered necessary to protect ATC radars.

¹⁹ <http://stakeholders.ofcom.org.uk/consultations/technical-licence-conditions/>

Maritime radar

- 3.30 We have conducted a theoretical assessment of the likely scale of interference to maritime radar, and have consulted with industry on the impact this would have. On the basis of this technical analysis and consultation, we have not found any evidence which suggests that additional restrictions are required to manage interactions between 2.6 GHz transmissions and maritime radar operating in 2.9-3.1 GHz.

800 MHz and 2.6 GHz: Use at the London 2012 Games

- 3.31 We have been working closely with the Government and the London Organising Committee of the Olympic Games and Paralympic Games (LOCOG) to develop the spectrum plan to be used during the London 2012 Games. After consultation we published a Statement setting out the spectrum plan for the Games in October 2009²⁰; and, after further consultation, an update of the plan in October 2010²¹. In the light of consultation responses we published a further Statement in December 2010 about the reservation of the 2.6 GHz band for the Games²². The spectrum plan for the Games set out in these Statements reserves the frequencies 791 to 862 MHz and 2500 to 2690 MHz exclusively for Games use.
- 3.32 The licences to be awarded for these frequencies through the award process will exclude any right to use them between 28 June and 23 September 2012 within the M25 and at other locations depending on the demand for devices like wireless cameras and wireless microphones that may emerge nearer the time.
- 3.33 There may be some opportunity to permit other uses on a non-interference non-protected basis during this period, subject to careful co-ordination with Games users. However, any such usage will be granted under separate Non-Operational Licences and will not form part of the award. In such circumstances Games users will take priority. We believe it is unlikely that co-ordination would be possible within the M25 area or at Weymouth and Portland.
- 3.34 Potential bidders should be aware that the Government has given similar guarantees on spectrum for the Glasgow 2014 Commonwealth Games (the 'Glasgow Games'). While neither the Secretary of State nor Ofcom wish to fetter their discretion, but at this stage neither expects to exercise its power, without the consent of the relevant licensees, to vary or revoke the licences being awarded under this award process for the purpose of meeting the UK's international obligations relating to the Glasgow Games.

²⁰ <http://stakeholders.ofcom.org.uk/consultations/london2012/statement/>

²¹ <http://stakeholders.ofcom.org.uk/consultations/london2012/london2012-spectrum-plan-update/>

²² <http://stakeholders.ofcom.org.uk/binaries/consultations/band-2500-2690-london-2012-games/statement/statement.pdf>

Section 4

Competition assessment of future mobile markets: revised proposals

Introduction

- 4.1 In the March 2011 consultation we set out our provisional competition assessment of the likely future competition in markets for the provision of mobile electronic communications services after the conclusion of the auction, which we were required to undertake by the Direction. We sought comments and evidence relating to that assessment from interested stakeholders. We received significant useful input from stakeholders. In light of our review of all those responses and further information we consider it is appropriate to review our competition assessment.
- 4.2 This section sets out the provisional results of that further assessment and the measures that we now consider are appropriate and proportionate to put in place to promote competition. Throughout the discussion in this section we set out how our thinking has changed since the March 2011 consultation. As set out in Section 1, we do not respond in this consultation to every point made to us by stakeholders in response to the March 2011 consultation. We have considered those responses carefully, and address them here to the extent that the points raised have caused us to revisit elements of our previous thinking.
- 4.3 Our full revised competition assessment is set out in a number of Annexes to this document. Annex 6 sets out the main competition assessment. Annex 10 sets out a summary of the responses from stakeholders relating to our competition assessment and our comments on these. Annexes 7, 8 and 9 and the report by Real Wireless on standards and equipment availability for LTE and HSPA published alongside this consultation (available at <http://stakeholders.ofcom.org.uk/consultations/award-800mhz-2.6ghz/>) provide background analysis and evidence that is relevant to our assessment.
- 4.4 As we noted in the March 2011 consultation the auction will result in a significant increase in the supply of spectrum available for mobile services. The spectrum in the auction represents a significant increase in total mobile spectrum from about 350 MHz to about 600 MHz and is expected to be used for LTE technology. The auction is likely to be the last significant opportunity to obtain prime mobile spectrum for many years. The distribution of spectrum after the auction is therefore likely to shape the future competitiveness of the mobile sector for at least the next decade. Also, as we observed in the March 2011 consultation, we would typically expect the increase in supply of spectrum to have a strong positive impact on competition, facilitating the launch of new services, expansion of existing competitors and potentially the entry of new competitors. However, for the reasons explained in this section, we continue to have concerns that without measures in the auction, competition in mobile markets may not be promoted, resulting in a lower intensity of competition compared either to today or to the degree of future competition that could be promoted. We therefore continue to believe there is a case for putting in place appropriate and proportionate measures to promote competition. We welcome stakeholders' views and evidence on the further analysis and proposals set out in this assessment.

Government Direction and our statutory duties

- 4.5 The legal framework for the award derives from our duties under both European and domestic legislation, specifically from:
- 4.5.1 the Framework Directive²³ and the Authorisation Directive²⁴,
 - 4.5.2 the Communications Act 2003 and the Wireless Telegraphy Act 2006 which transpose the provisions of those directives into national law; and
 - 4.5.3 the Wireless Telegraphy Act 2006 (Directions to OFCOM) Order 2010 (the "Direction").
- 4.6 Article 8 of the Framework Directive sets out the objectives which national regulatory authorities must take all reasonable steps to achieve. These include:
- 4.6.1 the promotion of competition in the provision of electronic communications networks and services by, amongst other things encouraging efficient investment in infrastructure and promoting innovation, and encouraging efficient use of radio frequencies; and
 - 4.6.2 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, and ensuring that, in similar circumstances, there is no discrimination in the treatment of undertakings providing electronic communications networks and services.
- 4.7 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.
- 4.8 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 the allocation and assignment of radio frequencies is based on objective, transparent, non-discriminatory and proportionate criteria. Article 9 also requires Member States to ensure technology and service neutrality.
- 4.9 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, transparent and non-discriminatory procedures.
- 4.10 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 give due weight to the need to maximise benefits for users and to facilitate the development of competition.
- 4.11 Section 3 of the Communications Act 2003 sets out Ofcom's general duties including its principal duty:
- to further the interests of citizens in relation to communications matters, and

²³ Directive 2002/21/EC of 7 March 2002

²⁴ Directive 2002/20/EC of 7 March 2002

- to further the interests of consumers in relevant markets, where appropriate by promoting competition.
- 4.12 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 and the availability throughout the UK of a wide range of electronic communication services.
- 4.13 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.
- 4.14 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, and encouraging the availability and use of high speed data transfer services throughout the UK.
- 4.15 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.
- 4.16 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.
- 4.17 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.
- 4.18 The Direction requires us to:
- 4.18.1 assess likely future competition in markets for the provision of mobile electronic communication services after the conclusion of the award of 800 MHz and 2.6 GHz bands; and
 - 4.18.2 in the light of that competition assessment, 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 the conclusion of the auction.
- 4.19 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.
- 4.20 We also consider that our duties relating to:
- 4.20.1 the optimal use of the spectrum taking account of current and future demand;
 - 4.20.2 the desirability of encouraging investment and innovation;

4.20.3 the desirability of encouraging the availability and use of high speed data transfer services through the United Kingdom; and

4.20.4 having regard to the interests of consumers in respect of choice, price, quality of service and value for money;

are particularly relevant.

4.21 In carrying out this competition assessment, 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 proposals 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.

Terminology

4.22 As set out in the March 2011 consultation, we distinguish between three types of competitor who provide mobile services and use the following terminology to describe those types of competitor:

- national wholesaler;
- sub-national radio access network (“RAN”) operator; and
- other retailers.

4.23 We envisage that all three of these types of competitors will operate in the retail market in the future as occurs today.

4.24 We use the term “national wholesaler” in this section to refer to companies that control wholesale access to national RANs.²⁵ We prefer this term to the more traditional “Mobile Network Operator” (MNO). We find the more traditional terminology unhelpful in the current context, since owners of sub-national RANs are “network operators” on a 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.

4.25 National wholesalers could supply access to their RANs to a variety of downstream retail operations, including MVNOs, operators of smaller sub-national RANs and their own downstream retail operations. 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. On the basis of the above characterisation, there are currently four national wholesalers in the UK: Everything Everywhere, H3G, Telefónica and Vodafone.

4.26 In our competition assessment we use the term “fourth national wholesaler” to refer to a national wholesaler other than Everything Everywhere, Telefónica or Vodafone. We distinguish these national wholesalers from H3G and new entrants based on their respective existing spectrum holdings, which mean that H3G and new entrants have

²⁵ In practice this means RAN networks that provide coverage to a significant portion of the UK – see also paragraph 4.79 below.

a greater degree of dependence on acquiring spectrum in the auction to be credible national wholesalers (see below at paragraphs 4.39 – 4.45 for an explanation of what we mean by a credible national wholesaler).

- 4.27 We use the term “sub-national RAN operators” to refer to operators who own RANs but 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.
- 4.28 We use the term “other retailers” to refer to any competitor that is providing mobile services to consumers but is not a national wholesaler or a sub-national RAN operator. The main category of such competitors is the companies often called “mobile virtual network operators”. These retailers compete by buying wholesale services on a commercial basis 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.

Promoting competition in future mobile markets

- 4.29 As set out above, 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 consumers, where appropriate by promoting competition. In addition, article 8 of the Directive requires us, where we think fit, to put in place appropriate and proportionate measures to promote competition in the markets for the provision of mobile electronic communications services. In light of this, our policy aim, in summary, is to promote competition in future mobile markets to the benefit of consumers. We propose that this should be done largely by promoting competition at the national wholesale level. This underpins the promotion of competition at the retail level both directly, as national wholesalers are themselves significant retail competitors, and indirectly, through availability of wholesale access on reasonable commercial terms, which leads to access being successfully negotiated by parties who, as a result, become retail competitors. We also consider taking specific steps to promote competition at the retail level via sub-national RAN operators.
- 4.30 In the March 2011 consultation we suggested that, provided it is possible for retailers to obtain wholesale access in the future, we considered that the retail market was likely to be competitive in the future. We believe that the availability of wholesale access to other retailers today depends on competition between national wholesalers (to serve those wholesale customers). 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 it is very important to promote competition at the national wholesale level as this should foster a competitive retail market without the need for regulated access. It is competition at the national wholesale level that is the main focus of our competition assessment set out below.
- 4.31 In the March 2011 consultation we also considered the role that sub-national RAN operators using 2.6 GHz spectrum on a low power shared basis could play in improving competition at the retail level, particularly if they adopt alternative business models to those typically adopted by the national wholesalers. We suggested there was a potential competition concern that such operators might not win the spectrum they required to enter the retail market and therefore considered measures we could

put in place to facilitate such entry. We received a range of different responses on these measures and we set out below our further thinking on this in light of those responses.

Competition assessment: future national wholesale competition

March 2011 Consultation

4.32 In March we identified two risks for national wholesale competition which we believed would arise if there was an auction without any measures to promote competition. These were that there would be a risk of:

- fewer than four competitors holding minimum required spectrum portfolios; and
- overly concentrated or very asymmetric distributions of spectrum.

4.33 We set out a number of options for addressing these risks and favoured a proposal for one of these options.

4.34 In relation to the first risk we proposed a spectrum reservation so that at least four national wholesalers held a certain minimum spectrum portfolio, taking existing spectrum holdings into account. We set out two options and set out a preference for the first option:

Option 1: 5 possible portfolios [OUR MARCH 2011 PROPOSAL]

	Sub-1 GHz	1800 MHz	2.6 GHz	Total
a)	2x5 MHz	2x15 MHz		2x20 MHz
b)	2x5 MHz		2x20 MHz	2x25 MHz
c)	2x10 MHz	2x10 MHz		2x20 MHz
d)	2x10 MHz		2x15 MHz	2x25 MHz
e)	2x15 MHz			2x15 MHz

Option 2: 5 possible portfolios

	Sub-1 GHz	1800 MHz	2.6 GHz	Total
a)	2x10 MHz	2x15 MHz		2x25 MHz
b)	2x10 MHz		2x20 MHz	2x30 MHz
c)	2x15 MHz	2x10 MHz		2x25 MHz
d)	2x15 MHz		2x15 MHz	2x30 MHz
e)	2x20 MHz			2x20 MHz

4.35 In relation to the second risk we proposed imposing spectrum caps on sub-1GHz holdings and overall spectrum holdings that took into account existing spectrum holdings. We set out a number of options and expressed a preference for a particular level for each cap.

Sub-1 GHz (800 MHz and 900 MHz) holdings	<u>Option 1</u> : 2x22.5 MHz <u>Option 2</u> : 2x27.5 MHz [OUR MARCH 2011 PROPOSAL] <u>Option 3</u> : no cap
Overall holdings	<u>Option 1</u> : 2x105 MHz [OUR MARCH 2011 PROPOSAL] <u>Option 2</u> : 2x120 MHz (Spectrum included in options 1 and 2: 800 MHz, 900 MHz, 1800 MHz, 2.1 GHz (excluding unpaired 2.1 GHz) and 2.6 GHz (including both paired and unpaired 2.6 GHz, but excluding any reserved for low-power use) <u>Option 3</u> : no cap

Responses to March 2011 Consultation

- 4.36 We received many responses commenting on our competition assessment and have considered all these carefully. Annex 10 sets out a summary of the responses and our comments on these. Also Annex 6 which sets out our further analysis in detail is informed by our evaluation of the responses.
- 4.37 These responses raised a number of challenges to the proposals in our March 2011 consultation. The main challenges to our proposals came from the four existing national wholesalers and were:
- Vodafone, Telefónica and Everything Everywhere argued against measures to ensure at least four national wholesalers, while H3G was in favour.
 - Vodafone and Telefónica were concerned that we were, as they saw it, favouring Everything Everywhere and H3G. In particular, they thought it was unnecessary to take measures in relation to the spectrum held by Everything Everywhere. They saw Everything Everywhere as having a significant advantage over them in terms of its large holdings of 1800 MHz spectrum, providing large bandwidth for an early route to LTE.
 - Both H3G and Everything Everywhere argued that they should be ensured at least 2x10 MHz of 800 MHz spectrum rather than 2x5 MHz.
 - H3G also argued that we should do more to make the overall size of spectrum holdings more equal.

Concerns about future national wholesale competition

- 4.38 In the light of the responses to our March 2011 consultation and our further analysis we revisited the competition assessment and proposals set out in our March 2011 consultation. Having done so, we have identified two types of potential competition concerns for the national wholesale level. These are:
- the main concern that there will be fewer than four credible national wholesalers; and
 - a lesser concern that even if there were at least four credible national wholesalers, one or more national wholesalers will be at a disadvantage in competing across a wide range of services and customers.

- 4.39 Competitors may have advantages in different aspects of service. Such differentiation between rivals is a feature of many competitive markets, and is not necessarily a cause for concern. It can be a healthy aspect of competition to the benefit of consumers for rivals to seek to exploit their advantages compared to competitors and engage in various ways to mitigate their areas of disadvantage, some of which may be creative or open up new possibilities for consumers.
- 4.40 However, (a) we are concerned that a national wholesaler which had too many disadvantages, and too few or insufficiently important offsetting advantages over its rivals, would not be a credible competitor, and (b) we are concerned that there is a risk of consumer detriment if there is limited competition across the range of services. We consider these two points in turn.
- 4.41 A national wholesaler could be a credible competitor even though it is not in a strong position (i) in some dimensions of service, or (ii) for serving some particular service or customer segments. For example, a national wholesaler might be credible if it is able to provide good quality of service (such as high data rates and latency) in most indoor locations, even if it cannot compete as strongly for customers that particularly value having a connection in the most difficult to serve locations. Another example is that a national wholesaler might be credible if it can provide good HSPA+ services but not (for a period of time) LTE services, even if there are some customers that particularly value having LTE services.
- 4.42 However if the disadvantages suffered were large, were felt across a substantial part of the market, and were not compensated by other advantages, the national wholesaler could cease to be a credible competitor at the national wholesale level. So, whilst the sources of disadvantage may be similar as between (i) whether the national wholesaler was a credible competitor, and (ii) whether the national wholesaler could serve a wide range of services/customers, there is a difference in the degree of importance to consumers and competition.
- 4.43 Turning to our second concern: while recognising that a degree of differentiation is inevitable, and may have some benefits, we consider that competition between national wholesalers that is too limited across the range of services and customers is not desirable for consumers.
- 4.44 We consider that the first type of concern is likely to be more important in terms of potential consumer detriment than the second. This is because most or even all consumers may be affected by the first type of concern, whereas the second risk may be restricted to particular segments of services or customers. Furthermore, there is the possibility that there could be chains of substitution between various segments of the market. So even if for some particular services there are fewer competitors able to provide those services, the extent to which that limited competition can harm consumers through increased prices is likely to be constrained by the greater competition in the broader market. Consumers of those particular services are likely to be able to switch to other similar services which a greater number of competitors can provide. But material detriment may still arise from the absence of other types of benefits that competition can bring, such as increased choice and innovation.
- 4.45 These two competition concerns are similar to, although a little broader than, the risks to national wholesale competition we identified in the March 2011 consultation. In particular, we are now drawing a clearer distinction between risk to the credibility of a national wholesaler and the competitive disadvantage that a competitor may experience in competing in the provision of particular services or to particular

customer segments. In March in relation to this second concern we focussed on the risks posed by overly concentrated or very asymmetric distributions of spectrum. Now we have identified other sources for this competition concern including for example the capability to service consumers in the hardest to serve locations or the capability to have an early route to LTE deployment - these are discussed further below.

Fewer than four credible national wholesalers

- 4.46 Our main concern is the same concern as we identified in the March 2011 consultation. It stems from the position that there are currently four national wholesalers and until recently there were five. Competition has been strong in the UK mobile market up to now and consumers have benefited from this, for example in terms of lower prices than many other European countries. We are concerned that if as a result of the auction there were fewer than four entities capable of being credible national wholesalers the market would not be as competitive as it could be if there were four credible national wholesalers. The auction is likely to be particularly important in shaping future competition in mobile markets given the amount and importance of the spectrum in the auction.
- 4.47 We have considered the responses we received suggesting that there was no need to be concerned if there were fewer than four national wholesalers. Our consideration of these is set out in detail in Section 2 of Annex 6 and also in Annex 10. We summarise our analysis here.
- 4.48 In assessing the likely future competitiveness of markets for the provision of mobile services after the auction, we note the auction could effectively result in an increase in concentration in the market. We therefore consider it is useful to apply tools of assessment similar to those used in merger assessment, which also consider increases in market concentration. We recognise that there are some important differences between the consideration of mergers in which the market structure would reduce from 4 to 3 and the issues with which we are concerned here. In particular, unlike in a merger assessment, we are considering the effects of the release into the market of a key strategic asset (spectrum) that could change the market structure and is expected to be used for a new technology (LTE) and potentially to offer new services to consumers. The timeframe for our competition assessment is 5 to 10 years from the conclusion of the auction, which is significantly further into the future than is typically the case in merger assessment. Also, unlike a specific merger involving two identified merging entities, there is a greater degree of uncertainty as to the impact. For example, it is unclear which specific national wholesaler if any might exit, who might benefit and to what extent, and the timescales involved. These considerations put some limits on the extent of the analysis that can usefully be undertaken. Nevertheless given there are broad similarities in terms of the underlying economic issues, which both concern an increase in market concentration, we believe it is helpful to make use of the tools of merger assessment. Therefore we consider the following factors in our assessment of whether we think we should take measures to promote competition to avoid an outcome in which there are fewer than four credible national wholesalers: (a) the increase in market concentration; (b) the scope for firms unilaterally to raise prices or reduce quality; (c) the scope for coordinated behaviour between firms; (d) the extent of barriers to entering the market; (e) whether buyers have countervailing bargaining power and (f) whether the consolidation would give rise to greater efficiencies, which would be passed on to consumers e.g. in lower prices.
- 4.49 We consider each of these factors in turn, in relation to provision of mobile services:

- a) The increase in market concentration: The present market is already highly concentrated according to standard classifications (HHI is well over 2,000).²⁶ A consolidation from four to three, e.g. from the exit of the smallest player (H3G) would increase the HHI by around 450 points, well above 150 points which is the threshold for potential competition concern in merger control in highly concentrated markets.
- b) The scope for firms unilaterally to raise prices or reduce quality: In the context of a market with high barriers to entry, with the removal of a competitor, customers have fewer options and in the absence of offsetting effects are therefore less likely to switch in response to a price increase. Even in the absence of coordination, firms will tend to charge higher prices in a more concentrated market. Unilateral effects will tend to be greater with a larger increase in concentration. They will also depend on how many (and to what extent) customers of the acquiring firm, and other remaining firms, saw the exiting/acquired firm as a close substitute, and on whether the consolidation would involve the removal of a firm that was a strong competitive force. In this case, we consider that each of the four current national wholesalers has provided a strong competitive force in the UK mobile sector.
- c) The scope for coordinated behaviour: This will depend on factors such as the ability of firms to reach a (possibly tacit) coordinated agreement, and to monitor and punish cheating on this agreement, and the presence or otherwise of an effective competitive fringe. In this case the complexity of mobile tariffs may make coordinated behaviour more difficult, but there is some increased risk of coordinated behaviour, such as from a reduction in the number of competitors or greater symmetry between the remaining competitors.
- d) Entry barriers: in the extreme case, a market with very low entry barriers could be competitive with only one provider. However, entry as a national wholesaler is subject to high entry barriers, including infrastructure costs and the limited availability of spectrum.
- e) Countervailing buyer power: i.e. customers being able to bargain down prices by threatening to buy less or switch to another supplier. While MVNOs may have some scope to bargain down prices by threatening to switch wholesaler, this depends on a competitive wholesale market. Individual retail consumers are unlikely to have buyer power.
- f) Any efficiency benefits that may arise: The CC / OFT Guidelines consider a range of potential efficiencies from mergers, of which economies of scale appear most relevant to the present case. If the consolidation would allow firms to achieve greater economies of scale, and if these savings were likely to be passed on to consumers in lower prices, the net effect could be positive for consumers. However, in the present case, there is significant scope to achieve efficiencies through network sharing without a reduction in the number of national wholesalers.

4.50 In summary our provisional view is that a consolidation from four national wholesalers to three would represent a large increase in concentration in a highly

²⁶ HHI is the Hershman-Herfindahl index, which 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.

concentrated market. Other things being equal, this would be likely to give firms an incentive unilaterally to raise prices or to be less competitive in other ways. There is also some risk that coordination between suppliers would become easier, especially if a disruptive competitor were eliminated. This is in the context of a market where barriers to entry are high and there is little scope for buyers to exercise countervailing bargaining power. Finally, there is significant scope to achieve cost efficiencies without a reduction in the number of national wholesalers. As such, whilst alternative outcomes are possible, it appears credible, and perhaps likely, that a future consolidation from four to three players – and particularly one which eliminated a strong or disruptive competitive force – would lead to a reduction in competitive intensity.

- 4.51 We have considered the impact on consumers of a reduction in competitive intensity. A reduction in competition could allow 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 is likely to be to the advantage of those remaining national wholesalers. However, the result of such a change would be worse outcomes for consumers, such as in higher prices, reduced choice and delayed access to improved or new services.
- 4.52 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, for example £20.7 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 (see Section 2 of Annex 6 for further details).

Provisional conclusions on fewer than four national wholesalers

- 4.53 Our assessment of the likely future competitiveness in mobile markets above leads us provisionally to conclude that it is likely that a reduction in the market from four credible national wholesalers to three would lead to a reduction in competition, and hence to an adverse impact on consumers. In view of this, in order to promote wholesale competition, we consider that we should design the auction so as to seek to ensure it does not lead to an outcome which has a similar effect, provided we do so in an appropriate and proportionate manner.
- 4.54 In addition, we note that if future developments (such as consolidation) call into question whether the existence of four national wholesalers is in consumers' interests then this can be assessed at the time through the merger regime. By contrast, if, as a result of the auction, the market were to consolidate to three national wholesalers and this proved to be not in the interests of consumers then it is likely to be much more difficult effectively to reverse the situation.
- 4.55 Therefore, we continue to believe that there is a risk of an outcome from the auction in which there would be fewer than four credible national wholesalers and that such an outcome would not promote competition in the relevant markets after the auction. We therefore go on to consider why such an outcome might come about following the auction and how likely that is. It is then in that context that we consider whether we

think we should put in place appropriate and proportionate measures to reduce the risk that such an outcome does arise, and if so what those measures might be.

Overview of our approach to analysing our concerns

- 4.56 The approach we follow for considering the potential competition concerns we have identified is set out below. This is broadly the same as in the March 2011 consultation but we have adapted our approach in light of the responses and sought to set out the steps in our thinking more explicitly.
- 4.57 In light of our aim to promote competition in future mobile markets, we go on to consider how best to achieve this aim in order to fulfil our statutory duties and the specific requirements of us under the Direction. Our analysis consists of four steps:
- i) Step 1: we consider what auction outcomes, i.e. post auction distributions of spectrum holdings in which a particular national wholesaler does not acquire additional spectrum in the auction, 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 is it 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 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 might take to address our concerns and set out our provisional conclusions on what would be an appropriate and proportionate approach. We assess the likely effectiveness of particular options that comprise sets of measures that we might think fit to take to address our concerns, as well as their potential disadvantages.
- 4.58 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.
- 4.59 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. 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

- 4.60 Our first step is to consider what outcomes from the auction could be detrimental to competition.
- 4.61 Our approach to answering this question is to identify a number of dimensions to the capability of a national wholesaler that are affected by the spectrum they hold and how these relate to one another, including the trade offs between them. We reach a provisional conclusion on what combination of these dimensions is likely to be important for a national wholesaler 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 national wholesaler to deliver those quality dimensions. We then consider whether any technical advantages associated with holding particular spectrum portfolios are likely to translate into competitive advantages, taking into account the available evidence on the importance for consumers and competition of particular types of capability.
- 4.62 Using that assessment of the importance of the different capabilities we assess in the round whether a particular category of national wholesaler is likely to be credible in the circumstances where it did not acquire any additional spectrum in the auction. If we conclude that there is some concern that a category of national wholesaler might not be credible, we go on to consider what additional spectrum they might require to be credible. This analysis also enables us to identify the sources of risk for our second type of competition concern that a particular category of national wholesaler may be at a disadvantage in competing across a wide range of services and customers.
- 4.63 Our full analysis of this step is set out in Section 3 and Section 4 of Annex 6 (our revised competition assessment) which is further supported by the analysis described in Annex 7 (our LTE technical modelling results), Annex 8 (our analysis of the scope to refarm 900 MHz and 1800 MHz spectrum) and Annex 9 (our research on the spectrum holdings and auctions in other countries). We set out below a summary of that analysis.

Dimensions of capability of a national wholesaler

- 4.64 In the light of the responses to the March 2011 consultation we have identified four dimensions of capability of a mobile service 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 wholesaler has available and the average data rates it can provide;
 - the quality of coverage it can provide;
 - whether it can provide the highest peak data rates immediately following the auction and in the longer term; and

- whether it can offer services based on LTE technology immediately following the auction and in the longer term.
- 4.65 We have assessed how likely it is that having these capabilities could be important to competition. To do this we have considered the evidence we have 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 it which are not dependent on a certain type or quantity of spectrum. For example, we have considered whether the coverage advantages of sub 1GHz spectrum in a macro-cell network could be matched using higher-frequency spectrum by deploying small cells as an alternative.
- 4.66 We then consider 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 characteristic that the capability would allow the wholesaler to offer. For example, we consider the value consumers place on any gap in quality of coverage between higher-frequency networks (including small cells) and sub 1 GHz networks.
- 4.67 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. That said we consider that it is possible to draw on evidence available now to make some careful judgements about the future. However, in making those judgements we need to bear in mind this uncertainty.
- 4.68 We consider each of the dimensions in turn. Here we provide a summary and our more detailed analysis is in Section 3 of Annex 6.

Capacity and high average data rates

- 4.69 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.
- 4.70 We have considered the importance of this dimension to the credibility of a national wholesaler.
- 4.71 Our provisional conclusion is that we consider it necessary at a minimum for national wholesalers to have sufficient capacity in order to serve enough customers with sufficiently high data rates for them to be credible. However, there are other approaches to building capacity besides acquiring spectrum. These include: investing in macrocells; deploying small cells; buying capacity; and deploying more efficient technology. National wholesalers with smaller spectrum shares than their competitors may be able to deliver comparable levels of capacity by relying on these other approaches.
- 4.72 In any case, we consider that it is not necessary for national wholesalers to have the same capacity as the largest national wholesaler in order to be 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 a competitive constraint across a large proportion of the market. Therefore we do not consider that national wholesalers need the same, or close to the same, overall quantities of spectrum in order to act as credible national wholesalers. This is consistent with what we observe in other countries, where shares of spectrum held by operators vary considerably.

- 4.73 However, it will be increasingly important for national wholesalers to have sufficient spectrum and capacity in the longer term, given our expectations for increasing demand for data services. We also recognise that, while there are a number of substitutes available, spectrum is an important input to capacity and national wholesalers with very small quantities of spectrum may struggle to deliver the minimum level of capacity needed to provide a significant competitive constraint. This is also consistent with evidence from other European and non-European countries, showing that, in general, the minimum share of spectrum held by a national wholesaler is close to 10%. National wholesalers with very small spectrum shares may represent a weak competitive threat because their costs for expanding to serve more consumers or meeting increased expectations of existing customers may be substantially higher than for their competitors.
- 4.74 It is difficult to identify what the minimum level of spectrum a national wholesaler would need to be in order to be credible. To some extent this will depend on the frequency of spectrum held and the ability of national wholesalers to deliver other quality dimensions. But, broadly, we consider that there is some risk that a national wholesaler would not have enough capacity to be credible if it held less than 10-15% of total spectrum holdings. The smaller the share of spectrum held below 10-15% the greater the risk that a national wholesaler will not be credible and the risk reduces the higher that share is beyond 15%.
- 4.75 Finally, as regards our lesser concern about competition across a wide range of services and customers, we recognise that a national wholesaler with lower shares of spectrum relative to its competitors may be a weaker competitor in some particular of service or customer segments, even if it has enough spectrum to act as a credible national wholesaler. Later, we consider the extent to which there is a risk of consumer detriment associated with having some national wholesalers that are credible but weaker competitors due to constraints on capacity.

Ability to provide good quality coverage

- 4.76 Coverage is an important dimension of the quality of mobile data service available to consumers. 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.
- 4.77 From a technical perspective, we consider two distinct aspects of quality of coverage; breadth of coverage and depth of coverage.
- 4.78 In relation to breadth we consider that a national wholesaler needs to be able to deliver sufficient breadth of coverage in order to be credible. Depending on the measure chosen, existing 2G networks provide outdoor coverage to around 99% of UK premises and around 90% for 3G services. We consider that coverage similar to current 3G coverage would be likely to be sufficient to be regarded as being 'national'. While there are advantages of lower frequency spectrum in terms of

delivering breadth of coverage, it is likely to be possible to deliver sufficient coverage to be credible with 1800 MHz or 2.1 GHz spectrum but it would be more challenging to use 2.6 GHz spectrum alone because of the significant number of additional sites that would be needed. It is worth noting that this aspect of the coverage dimension was not raised as an important issue in terms of the competition analysis in responses to the March 2011 consultation.

- 4.79 In relation to depth of coverage our provisional conclusions are that there are some technical advantages associated with holding sub 1 GHz spectrum in terms of delivering good quality coverage when using a macrocell network. While there is uncertainty on the extent of any advantage, the technical evidence suggests that, deep in buildings or in other hard to serve locations, the degradation in quality of coverage could be higher for 2.6 GHz spectrum than 800 MHz spectrum, with 1800 MHz in between.
- 4.80 The more prevalent and important harder to serve locations are for consumers, the greater the potential advantages associated with lower frequency spectrum. We do not have specific evidence on the prevalence of locations that are particularly 'deep' indoors or difficult to serve. However, given the materially lower certainty of coverage, we consider there is a material risk that coverage at 2.6 GHz would be insufficient to provide a credible national wholesale service. There is also some risk that coverage at 2100 MHz or 1800 MHz is insufficient to provide a credible national wholesale service, however the risk is materially lower.
- 4.81 Aside from mobile networks operating exclusively with macrocells, there are a number of other technologies, such as Wi-Fi and femtocells, which may be used to deliver good quality mobile services. In general, these technologies seek to improve the quality of coverage by placing access equipment closer to the end user. We consider that use of such small cell solutions may help to address some of the gap in coverage faced by operators with higher frequency spectrum, particularly in terms of offering consumers good quality coverage in their home or office. However, it is likely to be challenging to deploy small cell solutions in all locations where coverage is poor. To the extent that consumers value good quality coverage in harder to serve locations and to the extent that there are challenges to using small cell solutions to serve consumers in those locations, there might be a significant competitive advantage to holding lower frequency spectrum.
- 4.82 Overall, we consider that there is a material risk that a national wholesaler with just 2.6 GHz spectrum would not act as a credible national wholesaler. We consider that, although there is some risk, a national wholesaler with just 1800 MHz or 2100 MHz spectrum is likely to be able to provide sufficient quality of coverage to be credible, particularly taking into account available mitigation techniques, such as small cell solutions.
- 4.83 Nevertheless, for our lesser concern about competition across a wide range of services and customers, we recognise that, even if a national wholesaler can provide sufficiently good quality coverage to act as a credible national wholesaler, if it does not hold sub 1 GHz spectrum it may be a weaker competitor in particular service or customer segments than a wholesaler with sub 1 GHz.

Interaction between capacity and coverage

- 4.84 To some extent there is a trade-off between capacity and coverage. However, this trade-off has limits. For even a large portfolio of 2.6 GHz spectrum there remains

considerable uncertainty over the depth of coverage that can be provided as compared with spectrum at 2100 MHz and below.

- 4.85 For a national wholesaler with 2.1 GHz as its lowest frequency spectrum (such as H3G with its existing holdings), when combined with 2.6 GHz spectrum, it is possible that this will be sufficient to provide a sufficient combination of capacity and quality of coverage. However as well as providing a lower quality of coverage than sub 1GHz spectrum (and perhaps also than 1800 MHz), the capacity delivered by 2.1 GHz is expected to be reduced by the lower spectral efficiency of HSPA compared to LTE for a longer period of time than other frequency bands. The adequacy of H3G's 2x15 MHz at 2.1 GHz and below will also depend on the prevalence and importance of locations that can be served with 2.1 GHz but which 2.6 GHz spectrum cannot easily reach with a macrocell network, as well as the extent to which small cell solutions can be used to offer capacity and good quality coverage in harder to serve locations.
- 4.86 Our provisional view is that there is a material risk that 2x15 MHz of 2.1 GHz may not be enough to provide a sufficient combination of capacity and quality of coverage necessary to be a credible national wholesaler.

Ability to provide services with highest peak data rates

- 4.87 There are three forms of data rate that can be considered:
- **The peak data rate** which the 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). We refer to this as the peak data rate.
 - **The single user throughput** is the maximum speed that a single user would theoretically be able to receive if 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 is very close to the base station, the single user throughput would be the same as the peak data rate.²⁷
 - **The average data rate** is the data rate which users actually experience under realistic conditions in a network shared with other users.
- 4.88 We have already discussed average data rates above when we considered capacity. Here we discuss peak data rates.
- 4.89 We have considered the importance of this dimension to the credibility of a national wholesaler.
- 4.90 Our provisional conclusion is that it is not clear to what extent consumers will value highest peak data rates. Whilst peak data rates indicate the 'top speed' of technologies, they are only achieved under the right conditions. This is where there is only one consumer's device being served per cell and that device has excellent channel conditions. Consumers are unlikely often to experience these 'right' conditions and therefore they are unlikely to experience the highest peak data rates very often in practice. They will normally be sharing a cell with other consumers and their channel conditions will be less than excellent due to interference from other cells or because the consumer is far away from the base station or inside a building. The right conditions for the highest data rates are more likely to occur in small cells than macrocells. On small cells there are likely to be fewer users and the channel

²⁷ We consider single user throughput in our technical modelling (see Annex 7)

conditions are more likely to be close to the 'excellent' levels needed for the highest data rates.

- 4.91 We consider that, in the near term, national wholesalers would need to hold at least 2x15 MHz of contiguous spectrum suitable for LTE in order to compete effectively for customers and national wholesalers that value peak speeds. While peak speeds delivered using HSPA are increasing, these are less than the peak speeds that can be delivered using the same standards release using LTE. Longer term the specific spectrum bands held by an operator are likely to become a less important determinant of the maximum peak data rates 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.
- 4.92 Overall it is unclear whether the capability to deliver highest peak speeds is necessary to be a credible national wholesaler.
- 4.93 However, in relation to our lesser concern about competition across a wide range of services and customers, even if it is not important for acting as a credible national wholesaler, national wholesalers that do not hold the spectrum necessary for delivering highest peak speeds may act as weaker competitors in some particular service or customer segments than national wholesalers that are able to deliver highest peak speeds.

Ability to provide LTE services

- 4.94 The key issue raised by responses in relation to this dimension is the question of whether a national wholesaler needs to be able to provide mobile services using specifically LTE technology soon or whether another technology, such as HSPA would be adequate to ensure that a national wholesaler would be credible. We term this capability "an early route to LTE". The issue arises because not all the spectrum suitable for mobile spectrum 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 and therefore we focus on the near term issue.
- 4.95 We have considered the importance of this dimension to the credibility of a national wholesaler.
- 4.96 Our provisional conclusions are that there are some advantages of LTE over HSPA, both from the perspective of the operator and the consumer. The key advantages delivered are in terms of 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.
- 4.97 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 deploy LTE in 800 MHz, 1800 MHz and 2.6 GHz spectrum earlier than in other bands. The evidence suggests that LTE will not be available in the 900 MHz band until some years later and LTE in the 2.1 GHz band is unlikely to be available until even further into the future.
- 4.98 It is unclear the extent to which consumers are likely to value the features that LTE can deliver over and above HSPA, and therefore the extent to which holding spectrum suitable for early deployment of LTE will deliver a significant competitive

advantage. It is possible that any competitive advantage associated with holding spectrum suitable for early deployment of LTE could last for some years. However, it may be that the features associated with LTE are only valued by a small group of consumers, particularly in the early stages of LTE deployment. Indeed, for a period, there could also be advantages of HSPA over LTE because of a larger range or stock of compatible devices. Overall it is unclear that a national wholesaler will need an early route to LTE in order to be credible. However, in the longer term it may be more important to be able to offer LTE services.

- 4.99 Also, in relation to our lesser concern about competition across a wide range of services and customers, even if having an early route to LTE is not important for acting as a credible national wholesaler, national wholesalers that do not hold the spectrum necessary for an early route to LTE may act as weaker competitors in some particular service or customer segments than national wholesalers that are able to offer LTE services soon.

Summary of our provisional conclusions on importance of each of the dimensions

- 4.100 The table below sets out a summary of our provisional conclusions of the importance of the different dimensions for the credibility of a national wholesaler. However, as noted above, we consider that a national wholesaler can be a credible competitor at the national wholesale level even if it is disadvantaged in some areas relative to others. This is provided the disadvantages are not too large or are compensated by advantages in other dimensions. We therefore consider below whether a spectrum portfolio is sufficient for a national wholesaler to be credible in the future 'in the round' taking account of any advantages and disadvantages of its spectrum portfolio and their relative importance.

Figure 4.1 Provisional conclusions on what is necessary to be a credible national wholesaler

	Importance for credibility	Implications for spectrum
Capacity and average data rates	Sufficient capacity to deliver a competitive average data rate is necessary to be a credible national wholesaler	Material risk if hold less than 10-15% of paired spectrum after auction
Quality of coverage	Sufficient quality of coverage (including capacity to serve harder to serve locations) is necessary to be a credible national wholesaler	Material risk if do not hold a sufficient quantity of sub-2.1 GHz spectrum
Highest peak data rates	Unclear that inability to deliver highest peak speeds undermines credibility as a national wholesaler	Unclear that access to a 2x15 MHz or 2x20 MHz contiguous block of 800 MHz, 1800 MHz or 2.6 GHz spectrum is necessary to be credible
Early route to LTE	Unclear that absence of an early route to LTE undermines credibility as a national wholesaler in the longer term. However, longer term, no route to LTE might be a problem in terms of credibility.	Unclear that access to 800 MHz, 1800 MHz or 2.6 GHz spectrum is necessary to be credible

4.101 The assessment in the table above is in terms of whether the quality dimensions are essential to enable a national wholesaler to be credible. But even if they are not essential for this, some quality dimensions could be very important to particular consumer groups, and a lack of competition for the provision of services to such consumers might be a concern. We consider this lesser concern about competition across a wide range of services and customers further below.

Modifications to March 2011 consultation analysis

4.102 We comment below on how these provisional conclusions compare to views we set out in the March 2011 consultation. In March we suggested:

For national wholesalers to be credible competitors in terms of providing higher quality data services, we considered it likely that they need to have a spectrum portfolio that includes at least:

- a reasonable overall portfolio of spectrum suitable for LTE that allows them to offer higher quality data services and is of sufficient size for them to be able to cover the fixed costs of being national wholesalers; and
- in particular, we considered that a national wholesaler is likely to need to have some sub 1 GHz spectrum to be able to credibly offer higher quality data services, particularly indoors.²⁸

4.103 In March, we focused on competition concerns in relation to fewer than four credible national wholesalers emerging from the auction. We now distinguish between two competition concerns for the national wholesale level which could undermine our overall policy aim of promoting competition:

- The main concern that there will be fewer than four credible national wholesalers; and
- A lesser concern that even if there were at least four credible national wholesalers, one or more national wholesalers will be at a disadvantage in competing across a wide range of services and customers.

4.104 In March we identified the ability to provide service deep indoors as important to the credibility of a national wholesaler and that some sub-1GHz spectrum would be likely to be needed to offer such services. We now consider that it is less certain that the locations that can only be realistically served with a macrocell network using sub-1GHz spectrum (and cannot be served using other technologies such as Wi-Fi and femtocells) are likely to be sufficiently important in the overall market that not having a capability to serve them would be likely to bring into question the credibility of the national wholesaler. Also in making our judgement about the credibility of a particular category of national wholesaler, we believe it is necessary to look at that national wholesaler's capabilities in the round and consider if there are offsetting advantages in other capabilities such as a large amount of capacity and or ability to offer highest peak speeds. We still recognise that there might be a lower level of competition concern relating to the ability to provide good quality coverage in a wide range of locations.

²⁸ March 2011 consultation, paragraph 5.101 in Annex 6.

- 4.105 In March we suggested that to be credible the spectrum portfolio needed to be “of sufficient size to cover the fixed costs of being a national wholesaler”. By this we were drawing attention to the need to have sufficient spectrum capacity to serve enough of the market to be credible and we remain of the view that this is a key requisite of being a credible national wholesaler. But not all frequency bands are perfect substitutes for one another due to the linkage between capacity and coverage dimensions. We remain of the view that holdings of 2.6 GHz only may not be sufficient for a national wholesaler to be credible due to the significantly poorer quality of coverage associated with that band compared to 2.1 GHz, 1800 MHz and sub 1 GHz.
- 4.106 In March we identified that, to be credible, a national wholesaler did need access to spectrum to allow it to deploy an LTE network. In reaching this view we were focusing on the longer term and this remains our view, namely that at some point all national wholesalers are likely to need to be able to move to the latest generation of mobile technologies. We do not think that it is clear that to be a credible national wholesaler in the period of time immediately following the auction it is necessary to hold spectrum in the first set of frequency bands for which LTE user equipment is being built. This is because HSPA technology seems likely to be able to allow a national wholesaler to offer services that are similar to those offered using LTE in the near term, whilst recognising that LTE technology gives some advantages in terms for example of latency, prioritisation and highest peak speeds. Based on the available evidence, it is unclear to us that such differences in the services that could be offered to consumers using HSPA will be sufficiently important to be detrimental to competition in the near term such that they could impact the credibility of a national wholesaler. However, even if having an early route to LTE is not important for acting as a credible national wholesaler, we recognise that there might be a lower level of competition concern if some national wholesalers do not hold the spectrum necessary for an early route to LTE.

Evaluation of the risks faced by national wholesalers

- 4.107 Using our provisional conclusions on the importance of the different capabilities, we now evaluate the sources and extent of the risk faced by each of the existing national wholesalers and a potential new entrant as to whether they are likely to be credible national wholesalers in the future. Also, if they are, we evaluate whether there are areas in which they may be at a competitive disadvantage in competing across a wide range of services and customers. Our analysis leads us to the following three categories of national wholesaler:
- Fourth national wholesaler, i.e. H3G or a new entrant (holding the least or no existing spectrum);
 - Everything Everywhere (holding the highest amount of spectrum among current national wholesalers but no sub 1 GHz spectrum); and
 - Vodafone and Telefónica (holding sub 1 GHz spectrum and having similar total spectrum holdings as each other).

Figure 4.2: Current spectrum holdings for each of the existing national wholesalers

	900 MHz	1800 MHz	2100 MHz
Everything Everywhere		2 x 45	2 x 20
Telefónica	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 Everything Everywhere agreed to release as part of the agreement of the merger

4.108 We have identified above (see paragraph 4.64), there are four dimensions of capability that could be important to the credibility of a national wholesaler:

- Available capacity and average data rates;
- Ability to deliver good quality coverage;
- Ability to deliver highest peak data rates; and
- Ability to deliver LTE services.

4.109 There are interactions between these dimensions, especially between good quality coverage and the other three. For example, with 2.6 GHz spectrum it will be possible to deliver an LTE service soon, but not to provide good quality of coverage with LTE.

4.110 We have also set out above our provisional conclusions on the importance of each of these dimensions. Using those conclusions we now assess the strengths and weaknesses of the spectrum portfolios of different categories of national wholesalers. We set out this analysis by first presenting 'traffic light' tables to indicate at a high level the areas of strength and weakness for a particular spectrum portfolio. The purpose of these traffic light tables is to summarise the risk in terms of what can be delivered with a macrocell network, i.e. they abstract from the importance of particular dimensions of capability and in some cases alternatives to use of macro cell networks. So, to draw conclusions, we need to combine them with that further analysis, and then assess in the round the position of the holder of that portfolio reflecting the importance of the capabilities and the scope to mitigate areas of weakness.

Figure 4.3: Format of the ‘traffic light’ table to assess strengths and weaknesses of spectrum portfolios

	A: 2.6 GHz & below	B: 2.1 GHz & below	C: Sub 1GHz
1. Capacity and average data rate – near term			
2. Capacity and average data rate – longer term			
3. Early route to LTE			
4. Highest peak data rate with early LTE			

4.111 The columns in the traffic light table help to inform the assessment of the ability to deliver good quality coverage. They show whether holdings of spectrum at different frequencies are capable of delivering the quality dimensions in each of the rows. There is a correlation between frequency and quality of coverage, and showing the other quality dimensions by frequency helps to show how they may vary with quality of coverage. We provisionally concluded above that there is a material risk of not being a credible national wholesaler without sufficient spectrum at 2.1GHz and below.

4.112 The rows show the other three quality dimensions we described above in our assessment above. But we have broken down (i) available capacity and average data rates and (ii) the ability to deliver peak data rates to distinguish how they may change over time. The rows consider:

- **Capacity and average data rate – near term:** capacity suitable for data services soon after the auction. This will include the auctioned spectrum, the divested spectrum, but not all of the 900 MHz and other 1800 MHz spectrum, some of which we expect would still be used for 2G.
- **Capacity and average data rate – longer term:** capacity suitable for data services in the longer term, when it would be possible to reform all the 900 MHz and 1800 MHz to LTE (whether or not national wholesalers actually find it more profitable to retain a small amount of this for 2G or 3G use).
- **Early route to LTE:** the ability to launch an LTE service either before or soon after the auction. It will be possible to do this with the 800 MHz and 2.6 GHz spectrum in the auction, with the divested 1800 MHz spectrum, and we expect that Everything Everywhere will be able to do this using some of its retained 1800 MHz spectrum.
- **Highest peak data rate with early LTE:** 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. With early LTE the maximum peak data rates can be delivered in contiguous blocks of 2x20 MHz.

4.113 We do not have a row in the traffic light table that considers the highest peak data rate after early LTE. Later releases of LTE allow higher peak data rates, such as through aggregation of carriers within the same frequency and between different bands. But we consider there is considerable uncertainty on exactly what combinations of bands the standards will support, how quickly, and the extent of compatible user devices. We have therefore not included this in the table above.

Eventually, we anticipate that highest peak data rates will be determined by overall spectrum holdings. This means that the scores would be the same as that shown for the second row of the table above.

- 4.114 For each spectrum portfolio that we assess, we use a traffic light scoring system for the ability to deliver different combinations of service:
- Cells marked green imply that the spectrum would allow a national wholesaler to deliver the relevant dimension of service.
 - Cells are marked amber where the assessment is not clear, or where the spectrum may be sufficient to deliver the relevant dimension of service to a partial extent.
 - Cells marked red imply the spectrum is not sufficient to allow the national wholesaler to deliver the dimension of service.
- 4.115 We recognise that the colour-coding approach masks some of the more subtle differences between capabilities. Cells may be scored the same colour even when the risk over whether the spectrum is sufficient is able to deliver the service is not identical. The risk might be higher for one cell than another, but both could have the same colour because the difference is not sufficiently large.
- 4.116 When we use the colour coded scoring of the capabilities of different spectrum portfolios we merely assess whether the portfolio allows a particular service dimension to be met. We are not making any judgement about the importance of that service dimension or the extent to which weaknesses can be mitigated.
- 4.117 However, when we assess whether a spectrum portfolio may be sufficient to enable a national wholesaler to be credible, we take into account the importance of the four quality dimensions we considered. This draws on our preliminary conclusions on the importance of the four quality dimensions for credibility as set out above in Figure 4.1. As explained earlier, we consider the credibility of a national wholesaler 'in the round' taking account of the relative strength and importance of different advantages and disadvantages of its spectrum portfolio.
- 4.118 Whether a national wholesaler is credible may depend on how the remaining spectrum is distributed. However, this does not mean that all national wholesalers need an equal amount of spectrum in order to be credible national wholesalers. But when we consider whether a national wholesaler is likely to be credible we do not assume that the remaining spectrum is held in a highly asymmetric way. Rather we assume that there are at least three credible national wholesalers and that the remaining spectrum in the auction is not all obtained by a single company.²⁹

²⁹ At paragraph 4.250 below, we explain that we propose to put in place safeguard caps in order to avoid such very asymmetric outcomes that would be damaging to competition.

Everything Everywhere

4.119 When we consider Everything Everywhere's existing spectrum holdings, we exclude the 2x15 MHz of 1800 MHz spectrum that Everything Everywhere will divest.³⁰ We therefore consider its existing holdings to be:

- 2x45 MHz of 1800 MHz spectrum, and
- 2x20MHz of 2.1 GHz spectrum.

4.120 Our assessment of these holdings is summarised in Figure 4.4, with colour coded scores. The reasons for the scores are explained in the paragraphs below the table.

Figure 4.4: Assessment of Everything Everywhere's existing spectrum holdings

	A: 2.6 GHz & below	B: 2.1 GHz & below	C: Sub 1GHz
1. Capacity and average data rate – near term	2x40MHz	2x40MHz	-
2. Capacity and average data rate – longer term	2x65MHz (after refarming complete) (24%)	2x65MHz (after refarming complete) (33%)	(0%)
3. Early route to LTE	2x20MHz	2x20MHz	-
4. Highest peak data rate with early LTE	2x20MHz	2x20MHz	-

4.121 As we explain in Annex 8, we anticipate that Everything Everywhere will be able to start refarming 1800 MHz spectrum to LTE quickly, and is likely to be able to refarm at least 2x10 MHz by the time of the first tranche of divestment in September 2013. We also consider that it is likely to be able to deploy a 2x20 MHz LTE carrier relatively quickly. We consider it is likely to be able to progressively refarm most of the 2x45 MHz of 1800 MHz over time, as 2G-only devices rapidly fall in importance over the next few years (with the continued growth of smartphones). We have therefore scored all of the first two columns as green. The right hand column is red as Everything Everywhere does not have any sub 1 GHz spectrum.

4.122 Everything Everywhere's existing spectrum portfolio has important strengths. It is currently the largest of the existing national wholesalers' holdings. After the auction, this still represents a significant share of spectrum, with 24% of the total paired spectrum and 33% of the spectrum at 2.1GHz spectrum and below. It also has an early route to LTE with its large amount of 1800 MHz spectrum and the ability to deploy a 2x20 MHz LTE carrier, though it is unclear how important these potential advantages will be. Compared to spectrum used for HSPA, this will give Everything Everywhere's capacity a further boost, because LTE is more spectrally efficient than HSPA. Everything Everywhere also has a current advantage in terms of its large site base, with more than 18,000 sites. But over time other national wholesalers could vary their site numbers to match or exceed this.

4.123 The weakness of Everything Everywhere's spectrum portfolio is that it has no sub 1GHz spectrum. This means that it may be more challenging to deliver a consistent

³⁰ Everything Everywhere has agreed to divest 2x15 MHz of its current 2x60 MHz of 1800 MHz spectrum. It will release 2x10 MHz of this in September 2013 and the remaining 2x5 MHz in September 2015.

high quality service in locations that are harder to serve such as deep inside buildings.

4.124 Overall therefore, Everything Everywhere's existing spectrum portfolio has strengths and weaknesses. It has no sub 1GHz spectrum, but we consider its is likely to be able to deliver sufficient quality of coverage to be a credible national wholesaler with its significant holdings of 1800 MHz and 2.1 GHz spectrum. Its potential advantages include its share of spectrum, early route to LTE, ability to deploy a 2x20 MHz LTE carrier and its large number of exiting sites. On balance we consider its existing holdings are likely to be sufficient for it to be credible national wholesaler in the future even if it wins no additional spectrum in the auction.

Telefónica

4.125 Telefónica currently holds:

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

4.126 We score Telefónica's existing spectrum holdings as shown in Figure 4.5, which we explain in the following paragraphs.

Figure 4.5: Assessment of Telefónica's existing spectrum holdings

	A: 2.6 GHz & below	B: 2.1 GHz & below	C: Sub 1GHz
1. Capacity and average data rate – near term	2x15-20MHz	2x15-20MHz	2x5-10MHz
2. Capacity and average data rate – longer term	2x33MHz (after refarming complete) (12%)	2x33MHz (after refarming complete) (17%)	2x17.4MHz (27%)
3. Early route to LTE	-	-	-
4. Highest peak data rate with early LTE	-	-	-

4.127 We have scored A1 and B1 in the first row as amber because Telefónica has relatively limited capacity currently, though this will increase as it refarms more 900 MHz spectrum. It 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 (as we set out in Annex 8).

4.128 We have scored A2 in the second row amber because Telefónica has relatively limited capacity even in the longer term, with 12% of paired spectrum overall post auction. It has a higher share of the lower frequency spectrum, so we have scored the other columns green in this row (B2 and C2). We recognise that while Telefónica uses its spectrum for HSPA it will add less capacity than spectrum used for LTE. However there is a potential off-setting effect because there may, at least for a period, be a larger stock of UMTS900 capable handsets compared to LTE handsets.

4.129 The third and fourth rows are red because we do not consider that the 900 MHz or 2.1 GHz spectrum that Telefónica holds will 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. We therefore do not consider that Telefónica has a credible early route to LTE.

- 4.130 An important strength of Telefónica's existing spectrum portfolio is its 900 MHz spectrum, which represents over 25% of sub 1GHz spectrum post auction. It is therefore well placed to deliver consistency of coverage even in the hardest to serve locations, especially in the longer term. We also consider that the rapidly growing stock of UMTS900 handsets may give those with 900 MHz spectrum an advantage until there is a reasonable selection of LTE handsets. Longer term, we consider that Telefónica is likely to be able to refarm 900 MHz for LTE, which will give it an advantage given its significant share of sub 1GHz spectrum.
- 4.131 One weakness of Telefónica's existing spectrum is the overall share of spectrum, at 12%. At this level, we consider there is a risk that it is insufficient to enable Telefónica to be credible in the longer term. Another weakness is that the 900 MHz and 2.1GHz spectrum are not suitable for an early route to LTE or for high peak data rates with early LTE, though the importance of these is unclear. If they were important, these disadvantages for Telefónica would last until it could deploy LTE at 900 MHz, which may not be for some years. We consider that the timing is, to some extent, likely to depend on whether LTE is significantly better than HSPA: the better LTE is, the more quickly we might expect 900 MHz to move to LTE. But we recognise that this may depend on international demand for LTE900 rather than just demand in the UK.
- 4.132 We also recognise that 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 used 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. We consider the importance of high peak speeds is unclear in terms of ensuring a national wholesaler is credible.
- 4.133 There are important strengths and weaknesses of Telefónica's existing spectrum portfolio. On balance, we consider that Telefónica's existing holdings are likely to be sufficient for it to be credible in the near term, for at least as long as HSPA900 is competitive with LTE. But there is some potential risk of it not being credible in the longer term if LTE900 equipment is not available soon thereafter, or because of the relatively limited overall spectrum share it will hold if it did not win spectrum in the auction.

Vodafone

- 4.134 Vodafone's spectrum holdings are the same as Telefónica's except that it acquired 2x5 MHz more 2.1 GHz spectrum in the 2000 auction. Compared to Telefónica, its overall spectrum share is 14% rather than 12%.
- 4.135 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 preliminary conclusion is also the same.

Fourth national wholesaler

- 4.136 Figure 4.6 summarises our assessment of the sources of risk that H3G might not be a credible national wholesaler after the auction if it did not acquire any additional

spectrum. We do not consider a new entrant at this point in the analysis as it would by definition need to acquire spectrum in the auction to be credible.

4.137 H3G currently holds 2x15 MHz of 2.1 GHz spectrum. We score H3G's existing spectrum holdings as shown in Figure 4.6, which we explain in the following paragraphs.

Figure 4.6: Assessment of H3G's existing spectrum holdings

	A: 2.6 GHz & below	B: 2.1 GHz & below	C: Sub 1GHz
1. Capacity and average data rate – near term	2x15MHz	2x15MHz	-
2. Capacity and average data rate – longer term	2x15MHz (6%)	2x15MHz (8%)	- (0%)
3. Early route to LTE	-	-	-
4. Highest peak data rate with early LTE	-	-	-

4.138 With just 2x15 MHz of 2.1GHz spectrum, we consider that H3G's existing spectrum holdings are red in all these dimensions. It has limited capacity in the near term and longer term, no early route to LTE, no highest peak data rate and no sub 1GHz spectrum.

4.139 H3G's spectrum is already used for HSPA and can be upgraded to future versions. It has 2x15 MHz of 2.1 GHz, compared to 2x10 MHz for Telefónica, 2x15 MHz for Vodafone and 2x20 MHz for Everything Everywhere at this frequency band.

4.140 With only 6% of paired spectrum overall, we consider there is a significant risk that H3G would not be credible with its existing spectrum holdings. This is reinforced by H3G's 2.1 GHz spectrum being likely to be used for HSPA for some time, as HSPA has lower capacity per MHz than LTE. However, there is a potential off-setting effect because there may, at least for a period, be a larger stock of UMTS2100 capable handsets compared to LTE handsets. We consider the limited spectrum amount to be an important weakness of H3G's current holdings. As illustrated in Figure 4.6, H3G's current spectrum holdings will also leave it weak in other respects. There is a material risk that its holdings are insufficient to provide sufficient combination of capacity and quality of coverage (including capacity to serve harder to serve locations) that is necessary to be a credible national wholesaler. It also has no early route to LTE and is unable to deliver the highest peak speeds, though we regard the importance of these as unclear. We consider that taken together these represent very significant disadvantages.

4.141 Overall, we consider that H3G is unlikely to be credible without additional spectrum in the auction.

Step 1: provisional conclusions

4.142 As we have noted above, there is significant uncertainty regarding which auction outcomes (in which particular national wholesalers do not acquire additional spectrum) 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 also consider that some judgements are relatively clear. We provisionally conclude 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 are likely to be sufficient for them to be credible in the near term, for at least as long as HSPA900 is competitive with LTE. But there is some potential risk of them not being credible in the longer term if LTE900 equipment is not available soon thereafter, or because of the relatively limited overall spectrum share they would hold if they did not win spectrum in the auction;
- H3G is unlikely to be credible without additional spectrum; and
- A new entrant obviously needs to obtain spectrum in the auction to be credible.

4.143 Even if a national wholesaler is credible, it may not be well placed to deliver certain dimensions of service, or for serving some particular niche products or customers that may develop. This is our second type of competition concern we identified above. We have identified 5 ways in which competition could be weaker. The first 4 are if one or more competitors does not have:

- sub 1GHz spectrum (which particularly affects Everything Everywhere, H3G and a new entrant);
- early route to LTE (which particularly affects Telefónica, Vodafone, H3G and a new entrant);
- 2x15 MHz or 2x20 MHz of contiguous block for LTE (which particularly affects Telefónica, Vodafone, H3G and a new entrant); or
- enough spectrum for capacity and average data rates for all service and customer segments (which particularly affects H3G, a new entrant and also Telefónica and Vodafone to a lesser extent).

The 5th source of weaker competition is if one competitor has a very large share of spectrum (to which potentially all national wholesalers are vulnerable).

Step 2: how likely is it that auction outcomes that could give rise to competition concerns will occur

4.144 Under the previous step we identified that there are some potential auction outcomes in which different national wholesalers do not acquire additional spectrum that might give rise to competition concerns. In this step we consider how likely those outcomes are to come about, if there were no measures to promote competition in the auction. By this we mean: whether a national wholesaler, that needs additional spectrum of a particular type and quantity in order to be credible or to mitigate a specific competitive disadvantage in relation to a particular service or customer segment, will be able to acquire such spectrum in the auction.

4.145 Our main concern relates to outcomes in which a fourth national wholesaler does not acquire the spectrum it needs to continue to be or to become a credible competitor. Given we have identified there is some risk for the other three existing national wholesalers we have also considered outcomes in which these national wholesalers do not acquire the spectrum they might need to address the risks to their credibility. In each case there is also a further competition concern about the national

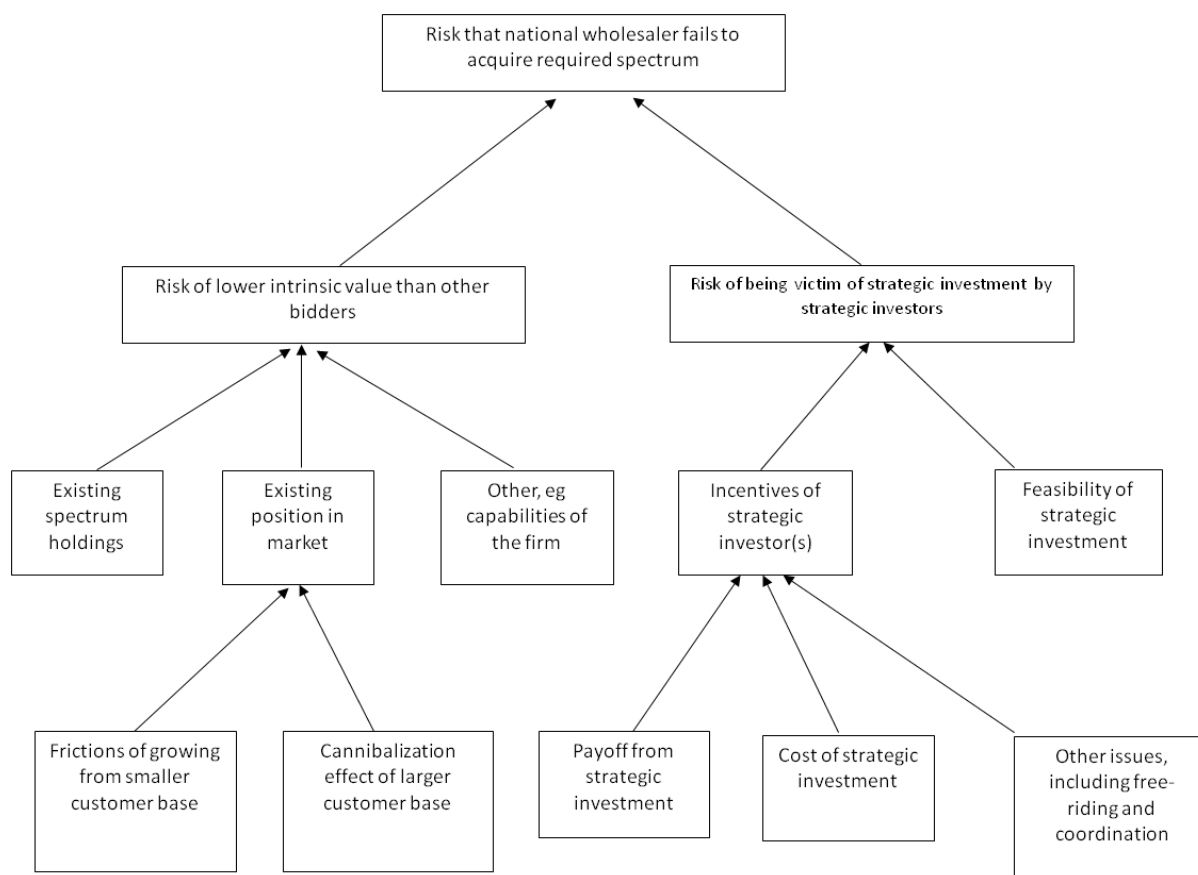
wholesalers' ability to compete across as wide a range of services and customers as would be desirable. We consider the position of each category of national wholesaler below.

- 4.146 Before discussing the likelihood of these particular auction outcomes we explain our framework for considering the determinants of auction outcomes.

Likely determinants of auction outcomes

- 4.147 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.
- 4.148 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 the market by depriving one or more competitors of spectrum.
- 4.149 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 is likely to be the sole opportunity to access additional spectrum resources for many years. 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.
- 4.150 In considering strategic investment in this way, we are not suggesting that any bidder, either individually or collectively, would act or intend to act in any prohibited manner. Indeed, strategic investment may be an entirely rational and legitimate course of action from a commercial perspective. Our concern is to consider whether such behaviour by one or more bidders 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.
- 4.151 The framework we have used to analyse whether a particular national wholesaler will acquire spectrum in the auction is illustrated in Figure 4.7.

Figure 4.7: Illustration of the analytical framework for acquisition of spectrum in the auction



4.152 The risk of national wholesalers failing to acquire the spectrum they may require can be caused by: (i) a lower intrinsic value compared to other bidders; or (ii) strategic investment by competitors deliberately aimed at denying the victim access to the required spectrum (when the latter would be expected to obtain it based on its intrinsic value):

- *Lower intrinsic value*: the value placed by bidders on a given frequency and amount of spectrum is affected by a number of factors, including the existing holdings of spectrum, the existing position in the market, and other aspects, such as the general technical and organisational capabilities of the bidders and their expectation over the profits they can generate from the spectrum. Frictions in the switching process, on the one side, and cannibalisation effect, on the other side, are relevant factors that may determine the extent to which unequal existing market positions result in different intrinsic values.
- *Strategic investment*: even if the national wholesaler has 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. the existence of auction outcomes that can result in the victim being squeezed out, and incentives, i.e. the profitability of the strategy for the strategic investors. Incentives for strategic investment are in turn affected by three factors: (i) the payoff, i.e. the incremental profits arising from the exclusion of the victim; (ii) the costs, i.e. the additional price that strategic investors have to pay to achieve the exclusion; and (iii) other issues, such as free-riding and coordination, that may jeopardize the probability of success of the

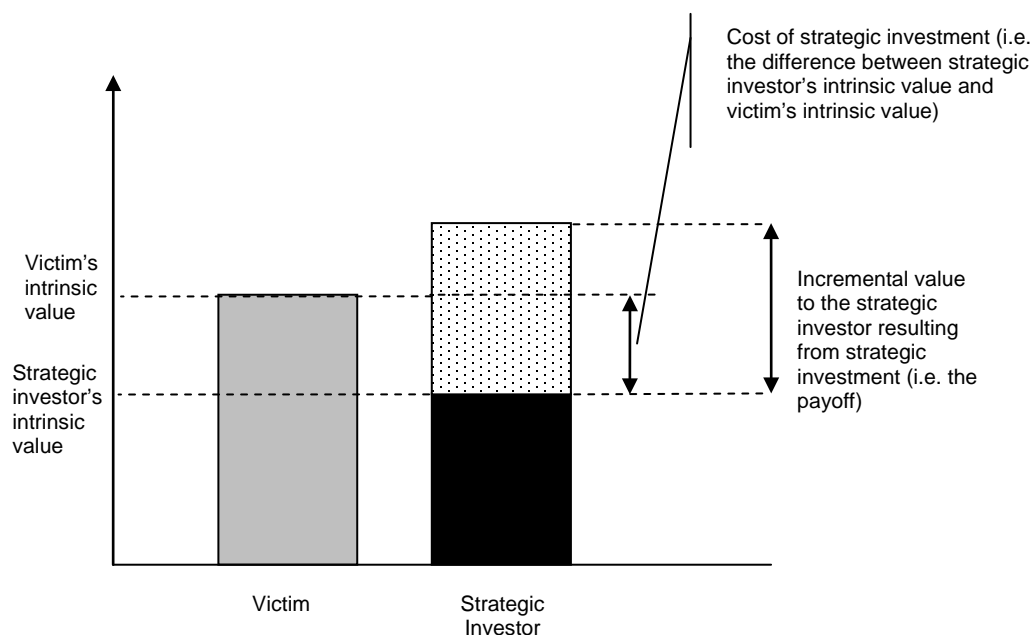
strategy, thereby affecting the incentives to engage in strategic investment in the first place.

- 4.153 Using this framework we now consider whether particular national wholesalers would be likely to be able to acquire the spectrum they might need to compete in the future. Our analysis is set out in detail in section 5 of Annex 6, here we set out a short summary.

Likelihood that a fourth national wholesaler does not acquire the spectrum it needs to continue to be or to become a credible national wholesaler without measures to promote competition in the auction

- 4.154 We have considered whether there is a risk that a fourth national wholesaler does not acquire the spectrum it needs to continue to be or to become a credible national wholesaler absent measures in the auction.
- 4.155 We consider that absent measures, there is a material risk that H3G or a new entrant may have a lower intrinsic value to the other existing national wholesalers which, if this was the case, could lead it to fail to acquire as much spectrum in the auction as it might need to be a credible national wholesaler (either immediately after the auction or at some point in the future).
- 4.156 The reasons why H3G might have a lower intrinsic value relate to the fact that it 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. These considerations also apply to a new entrant (e.g. unless it has an existing customer base in another market that it can easily exploit). It is also important to note that even if there was only a small difference in intrinsic value between a fourth national wholesaler and the other national wholesalers then this may be enough for it to fail to acquire spectrum and have a significant detrimental impact on competition and consumers.
- 4.157 We now consider the opposite case in which a fourth national wholesaler has a higher intrinsic value than other national wholesalers. This might arise since, as we noted above (see paragraph 4.138), H3G's spectrum holdings are much smaller than other existing national wholesalers. This could mean that it placed a higher value on the spectrum since acquiring more spectrum in the auction might be even more important for its ability to compete in the future. In this case the risk that a fourth national wholesaler does not acquire spectrum in the auction is due to strategic investment by its competitors. Those competitors might increase their bids to reflect the strategic value that they would expect to gain from weakening competition and so a combination of their intrinsic and strategic value exceeds the fourth national wholesaler's value. This case is illustrated in the diagram below

Figure 4.8: Illustration of cost of strategic investment and expected payoff



4.158 The grey area represents the victim's intrinsic value while the black area identifies the lower intrinsic value of the strategic investor absent any strategic investment incentives (i.e. the diagram illustrates the case of interest for strategic investment where the victim would be expected to win the spectrum in the absence of strategic investment). The dotted area above the black one illustrates the incremental benefits to the strategic investor potentially arising from the exclusion of the victim (i.e. the payoff). This is the difference in profit for the strategic investor with and without the reduction in competition caused by the strategic investment in spectrum.

4.159 Finally, the difference between the victim's and strategic investor's intrinsic value represents the costs of the strategic investment behaviour.³¹ This is because the strategic investor will have to be prepared to pay more for the spectrum than the victim 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, which is higher than the strategic investor's intrinsic value. In this illustration, we show only the case where strategic payoffs are higher than the corresponding costs, but of course this may not always be the case.

4.160 We have considered a range of different spectrum portfolios that a fourth national wholesaler might need to acquire in the auction to be a credible competitor and assessed the likelihood that it might be prevented from acquiring these by strategic investment. This involves a consideration of:

- *Feasibility*: whether it is possible for strategic investors to acquire spectrum in a way that prevents a fourth national wholesaler from acquiring the spectrum they require in order to compete as a credible national wholesaler; and

³¹ 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. That is because the winning price in the auction is set according to a second-price rule. None the less uncertainty over the victim's intrinsic value may modify the expected profitability of strategic investment and thereby the incentives to engage in it in the first place.

- *Incentives*: whether the expected profits to the strategic investor as a result of lower competition, i.e. the payoff from strategic investment, outweigh the costs of acquiring the additional spectrum.

4.161 Our consideration of the various scenarios is set out in Section 5 of Annex 6. Overall our assessment is that there are many considerations that 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. There are plausible ways in which coordination could occur in this scenario of Vodafone, Telefónica and/or Everything Everywhere strategically investing to deny a fourth national wholesaler from acquiring the spectrum it needs to be credible. For example, to exclude a fourth national wholesaler from obtaining 800 MHz, Vodafone, Telefónica and Everything Everywhere could each acquire 2x10 MHz of 800 MHz. All three have suggested in their responses to our March 2011 consultation that acquiring 800 MHz is important to them (albeit for differing reasons). Moreover, we note three companies each buying 2x10 MHz has been the outcome of all six of the European auctions held so far for 800 MHz. In addition, 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 all of the available sub 2 GHz spectrum. On balance, therefore, whilst incentives may not be present in all circumstances, we consider that the risk of such strategic investment is realistic.

4.162 Our provisional conclusion is, that absent measures in the auction, there is a material risk that a fourth national wholesaler does not acquire the spectrum it needs to acquire to continue to be or to become a credible national wholesaler. This could be because it has a lower intrinsic value than its competitors for some or all of the spectrum or even if it has a higher intrinsic value it fails to acquire the spectrum needed to be credible as a result of strategic investment by its competitors.

Likelihood that other national wholesalers do not win the spectrum they may need to be credible without measures in the auction

4.163 As we discussed above we believe there is a much lower risk that Everything Everywhere, Telefónica and Vodafone will need additional spectrum to be credible compared to a fourth national wholesaler.

4.164 In the case of Everything Everywhere we provisionally conclude that it is unlikely to need to win spectrum to be credible, but we cannot rule out the possibility that it does need sub 1 GHz spectrum. In the case of Telefónica and Vodafone we provisionally conclude that there is some risk that they may need to win additional spectrum to be credible. In both cases, even if the absence of further spectrum did not undermine their credibility, it might hamper their ability to compete widely across a wide range of services and customers.

4.165 Accordingly, we have considered for both these categories of national wholesalers whether they are likely to be able to obtain the further spectrum they might need in the auction. We undertake this evaluation using the same framework as for the fourth national wholesaler.

Everything Everywhere

4.166 Given Everything Everywhere's relatively large spectrum holdings especially at 1800 MHz, the only auction outcomes in which it might not be credible or not able to compete as widely as possible would most likely be ones in which it did not win sub 1 GHz spectrum.

- 4.167 We do not consider it very likely that Everything Everywhere will have a lower intrinsic value for 800 MHz spectrum in the auction than other bidders since it is an established national wholesaler with a large customer base. Therefore if Everything Everywhere believes that sub 1 GHz spectrum is very important to its competitive position and might impact its credibility then we would expect its value to reflect this view. The value of the spectrum to Everything Everywhere could be greater than to others who already have this type of spectrum.
- 4.168 While we consider that Everything Everywhere is likely to be credible with its existing spectrum holdings, if it did need to obtain sub 1GHz spectrum we consider that the risk that it would be unable to obtain it cannot be ruled out. Vodafone and Telefónica may strategically invest to deny it access to the 800 MHz band, given the potentially large payoff from strategic investment. However, we consider that the risk of Everything Everywhere being the victim of strategic investment may be smaller than for a fourth national wholesaler because of the material risk that a fourth national wholesaler has a lower intrinsic value (which means a lower cost of strategic investment in that case). Also the limited information available to bidders during the auction makes it difficult to target the conduct against a specific bidder which implies that when more than one wholesaler is potentially exposed to strategic investment the victim is likely to be the most vulnerable irrespective of whether it was the initial target of the strategic investment. As explained above, we consider that it is more likely that a fourth national wholesaler needs spectrum to be credible than Everything Everywhere. Therefore, we consider that overall Everything Everywhere is less likely to be a victim of strategic investment.

Vodafone or Telefónica

- 4.169 In the case of Vodafone or Telefónica, the auction outcomes in which each might not be credible or not able to compete as widely as possible would most likely be those in which they do not acquire spectrum that provides additional capacity, and possibly access to a large contiguous bandwidth and an early route to LTE.
- 4.170 For analogous reasons as for Everything Everywhere, we do not consider it very likely that Vodafone or Telefónica will have a lower intrinsic value for the spectrum they may require in the auction than other bidders since they are both established national wholesalers with large customer bases.
- 4.171 We have also considered how likely it is that Vodafone or Telefónica could be victims of strategic investment. Our preliminary conclusion is that it would be unrealistic for strategic investment to prevent them from obtaining the minimum amount of spectrum they might require (i.e. 2 x 5 MHz of 800 MHz or 2 x 10 MHz of 2.6 GHz). Even, if they needed more spectrum (such as 2 x 10 MHz of 800 MHz or 2 x 20 MHz of 2.6 GHz or 2 x 15 MHz of 1800 MHz) or even more spectrum at higher frequencies to be credible, we do not consider it very likely that either of them could be a victim of strategic investment, given the large amount of spectrum that strategic investor(s) would need to acquire. However, we recognise that if they needed 2x10 MHz of 800 MHz or 2x15 MHz of 1800 MHz (i.e. additional 2.6 GHz spectrum was not sufficient), then we consider that strategic investment would not be as unlikely. It is however, far from certain that such portfolios are required for their credibility. Also as explained above, we consider that it is more likely that a fourth national wholesaler needs spectrum to be credible than Vodafone or Telefónica. Therefore, we consider that overall Vodafone or are less likely to be victim of strategic investment.

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

4.172 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, the other part being a consideration of the costs and disadvantages of the particular measure.

4.173 As discussed above we have two types of competition concern:

- i) fewer than four credible national wholesalers; and
- ii) even if there are four national wholesalers, one or more is at a disadvantage in competing across a wide range of services and customers.

Fewer than four national wholesalers

4.174 The first of these is our greater concern. This is because it would have a higher magnitude of effect were it to arise, since we believe there would be a significant reduction in consumer benefits if there were fewer than four national wholesalers. In the light of our analysis of the potential auction outcomes that could give rise to this concern we have provisionally 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.

4.175 We recognise that there is some risk that this concern could arise through the failure of one of Everything Everywhere, Vodafone or Telefónica to be credible after the auction but we provisionally conclude that this risk is much lower. This is for a combination of reasons: first, since it is much less clear that additional spectrum is needed to ensure credibility, 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.

4.176 We note that our provisional conclusion here is different in part from that we reached in the March 2011 consultation. There we suggested that Everything Everywhere might not be credible after the auction if it did not obtain a small amount of sub-1GHz spectrum (2 x 5 MHz in our favoured option).

4.177 In light of the responses to our March 2011 consultation and our further analysis we now believe that there is significantly less risk that Everything Everywhere might not continue to be a credible national wholesaler after the auction. Our previous analysis focussed predominantly on one area of potential risk (namely the need to hold sub-1GHz spectrum in order to be able to offer the best quality coverage in hard to serve locations), whereas we now consider it appropriate to place more emphasis on evaluating the capabilities of a national wholesaler's spectrum holdings in the round. In doing so we take greater account of the large amount of 1800 MHz spectrum that Everything Everywhere holds, which is in our view likely to enable it to have a sufficient quality of coverage and capacity, as well as providing it with a large bandwidth of spectrum suitable for LTE and the possibility to offer highest peak speed in both the near and longer term.

- 4.178 With regard to holdings of sub 1GHz spectrum, we now believe that the technical advantages of sub-1GHz spectrum are less clear and that the large quantity (2 x 45 MHz) of 1800 MHz spectrum which Everything Everywhere holds could mean that there is only a fairly small gap between what Everything Everywhere and the holders of 800 MHz spectrum could deliver. This is principally because our technical analysis now reflects more fully the range of service quality that consumers are likely to experience across a range of locations, rather than just focussing on service quality in something approaching the worst case. This shows that in many locations a network with a sufficiently large amount of 1800 MHz spectrum coupled with a large network of base stations, including small cells, could match or even better the quality of a network with a smaller amount of 800 MHz spectrum, even if it is unlikely to be able to do this in the hardest to serve locations. Consequently, we do not consider that the evidence available to us demonstrates that the differences between an 800 MHz and an 1800 MHz network would be sufficiently important for Everything Everywhere not to be capable of being a credible national wholesaler without sub-1 GHz spectrum.
- 4.179 This is not to say that there is no competition concern related to Everything Everywhere's lack of sub-1GHz spectrum. We identify below there is a potential concern (see competition concern 4 in Figure 4.10) but our assessment is that the importance of this concern is not likely to be sufficient to impair Everything Everywhere's credibility to be a national wholesaler.
- 4.180 The implication of these provisional conclusions is that we are minded to consider taking measures that focus on mitigating the main source of risk to prevent this first type of competition concern arising (namely that the auction might result in fewer than four credible national wholesalers because of the material risk for a fourth national wholesaler), provided that any such measures are proportionate. We consider such measures in the step 4 of our analysis below.
- 4.181 Figure 4.9 set outs our provisional conclusions in more detail. A full discussion can be found in Sections 4 and 5 of Annex 6. 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 continue 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 spectrum for early route LTE or high peak data rates with early LTE	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 2100MHz spectrum, which we consider mean it is likely to be credible even without spectrum in the auction. (But if it did need sub 1GHz spectrum to be credible, there is a risk that it could be the victim of strategic investment).	Low to Medium
3. Telefónica/Vodafone not credible because no spectrum for early route to LTE, high peak data rates with early LTE or greater capacity	While the potential magnitude of this concern is high (as with concern 1), we consider the likelihood is low. This is because while there is some risk that Vodafone & Telefónica may not be credible in the longer term without spectrum in the auction, we consider they are likely to obtain the spectrum they need to be credible. If they are not credible with existing holdings, given the range of spectrum they could obtain to be credible (including 2x20MHz at 2.6GHz), we consider that strategic investment is unlikely. (But if technical/market conditions were such that Vodafone & Telefónica specifically needed 1800MHz or 800MHz spectrum to be credible, there is a risk that they could be the victim of strategic investment).	Low to Medium

One or more national wholesalers is at a disadvantage in competing across a wide range of services and customers

4.182 In relation to our second type of concern, by definition the magnitude of this concern is lower as it only relates 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, spectrum to provide an early route to LTE, a large contiguous bandwidth for LTE, 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 second type of competition concern: one or more national wholesalers are at a disadvantage in competing across a wide range of 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 1GHz spectrum	Although there could be material consumer detriment, we consider that this is a lesser concern than not having 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 early route to LTE	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 900MHz and even 2.1GHz spectrum will be suitable for LTE. We are also not certain that LTE will offer significant competitive advantages over evolving HSPA standards. (Divestment of 2x15MHz of 1800MHz spectrum also clearly helps this concern and 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 2x15 or 2x20 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.	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 same reasons as concern 4.	Low

4.183 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 second set of 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 proportionate to adopt them.

Question 4.1 Do you agree with our assessment of the competition concerns relating to national wholesale competition that could arise if the auction took place with no measures to promote competition? Please state your reasons for your views.

Step 4: Potential sets of measures to promote national wholesale competition

4.184 The final step in our analysis is to consider in the round what measures it is appropriate and proportionate to adopt to promote national wholesale competition in the auction. In the light of the responses to our March 2011 consultation, we have considered a wider range of measures than we considered in that consultation. We believe the range of options encompass at a high level the suggestions that have been made to us for how we should proceed.

4.185 We have not attempted to set out an exhaustive list of potential packages of measures, and we are not ruling out any specific combination at this stage. To facilitate engagement on the issues we have however identified and therefore

focused on those combinations that we currently consider to be the most credible options. The options we have evaluated are:

- Option 1: No measures in the auction to promote national wholesale competition;
- Option 2: Safeguard caps only (a cap on the overall amount of spectrum held by any one party and a specific cap on the holding of sub-1GHz spectrum, sufficient to prevent highly asymmetric spectrum holdings but insufficient to guarantee the availability of spectrum for a fourth national wholesaler);
- Option 3: Tight spectrum caps to promote at least four national wholesalers;
- Option 4: Reservation of spectrum for a fourth national wholesaler plus safeguard caps;
- Option 5: Reservation of spectrum for a fourth national wholesaler (to include sub-1GHz spectrum) plus reservation of sub-1GHz spectrum for one other (such as Everything Everywhere or a new entrant); also safeguard caps (NB: this is similar to the approach we favoured in the March 2011 consultation);
- Option 6: Reservation of spectrum for a fourth national wholesaler plus reservation of spectrum for two others (such as Vodafone and Telefónica or new entrants) to provide an early route to LTE; also safeguard caps; and
- Option 7: Reservations of spectrum to mitigate all risks to national wholesalers – combination of options 4, 5 and 6, and safeguard caps.

4.186 In options 3 – 7 an additional measure that we suggest that should be part of the option would be to set the reserve price for the spectrum at a much higher level than in previous auctions (which was simply to deter frivolous bidders), namely at a level set by reference to the estimated market value (but with a discount). This is to strike a trade-off between the potential static efficiency cost of reserving spectrum for a national wholesaler with lower intrinsic value and the dynamic benefits to competition and consumers if they acquire the spectrum.

4.187 Section 8 of Annex 6 sets out our full consideration of the merits of each of these options.

Our approach to comparing the options

4.188 In order to reach a provisional conclusion as to which option we consider is the most effective and proportionate to address our overall aim of promoting competition, we have assessed the options on the basis of:

- a) which are effective to achieve the policy aim identified at paragraphs [x to y] above;
- b) for those options that are effective at addressing those concerns, which is the least onerous one required to achieve that policy aim; and
- c) whether the least onerous option identified produces adverse effects arising which are disproportionate to the aim pursued.

4.189 In comparing the options, it is important to stress that we are comparing options 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 judgment, but one informed by the analysis we have undertaken.

4.190 The following discussion first considers broadly which option is most appropriate and proportionate, and then having reached a provisional conclusion on that option it considers, using the same framework, how best to specify the details of that option

Comparison of effectiveness of options to achieve the policy aim identified

4.191 Given that we judge the first competition concern in Figure 4.9 (i.e. a fourth national wholesaler not being credible) as the single most significant competition concern relevant to our policy aim of promoting competition in future mobile markets, it follows that:

- Option 1 (No measures) is not effective because it fails to address this competition concern at all, and does not address any of the other concerns.
- Option 2 (Safeguard caps only) is unlikely to be effective since it does not in our view address this key concern sufficiently; and
- Options 3 to 7 all appear effective since they potentially address our key competition concern to a sufficient degree.

4.192 In relation to options 1 and 2, we note that in principle, while they are not likely to be effective in addressing our concerns, they could nevertheless be the most appropriate and proportionate options if the costs of the other options proved to be too high. However, as we explain below we believe there is an option (Option 4) which is effective at addressing our concerns and which does not have particularly high costs and so overall is better than these first two options.

Comparison of magnitude of restrictions imposed by options to assess which option is the least onerous required to achieve our policy aim

4.193 Given our provisional view that Options 3 to 7 all appear, at least to some degree, effective in addressing our main competition concern relevant to achieving our policy aim, it is necessary to consider the proportionality of imposing each of these options by assessing which option is the least onerous required to achieve our policy aim. In undertaking such an assessment, we have taken into account the considerable uncertainty around each option.

4.194 There are two rather different responses we could adopt to this uncertainty:

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

4.195 These different responses have fundamentally different implications.

4.196 The first response implies a highly interventionist approach in which regulation determines major aspects of the allocation of the spectrum to be awarded. For instance, Option 3 (tight caps) and Option 7 (mitigate all risks) address all the more

important competition concerns about ensuring at least four credible national wholesalers well. They also address many of the lesser competition concerns (about ensuring that one or more wholesalers are not at a disadvantage in competing across a wide range of services and customers) reasonably well.

- 4.197 However, this comes at the cost of being highly restrictive in terms of the outcomes they allow from the auction. This increases the risk of an inefficient spectrum outcome. We consider these options are likely to be disproportionate, given our view of (i) the relatively low likelihood that some of the competition concerns will materialise, and/or (ii) the extent of uncertainty about the significance of some of these competition concerns and (iii) the difficulty of being sufficiently confident that the extensive detailed judgements made in these options about how much spectrum particular national wholesalers are likely to require are correct.
- 4.198 Option 5 (concerned with sub 1GHz reservation) and Option 6 (concerned with an early route to LTE) are focussed on particular competition concerns. These suffer from similar disadvantages to Options 3 and 7 but in some sense are more risky because they rely on a particular view that certain competition concerns are more important than others. While we are confident that we can make such a judgement in relation to our first concern (i.e. risk of a fourth national wholesaler not being a credible competitor in the future) we are much less confident we can make such relative judgements about the other concerns. The downside is that if the concerns that Option 5 and 6 focus on prove to be not well founded or important, then these options may worsen the position in relation to some of the other competition concerns we have identified.
- 4.199 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 as in Option 4 (reservation for a fourth national wholesaler). This is effective in addressing the competition concern at which it is targeted and carries a much lower risk of regulatory failure, but it does not address (or may even worsen) other competition concerns which are currently assessed as being of lower significance.
- 4.200 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 disproportionate intervention, given that the costs of such an interventionist approach may lead to our intervention being more onerous than is required to achieve our policy aim. It therefore, follows from this that we are currently of the view that it would not be proportionate to put in place restrictions in the auction which would attempt to mitigate more or as many risks as possible (i.e. Options 3, 5, 6 and 7).
- 4.201 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 regarding there being fewer than four national wholesalers 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 than for the other current national wholesalers. These considerations point towards Option 4 (reservation for a fourth national wholesaler) as being the most appropriate and proportionate measure.

- 4.202 That said we do not believe we should disregard the other potential competition concerns completely and propose to impose safeguard caps on both sub 1 GHz and overall spectrum as a way to mitigate some of them. The costs and risks associated with these caps are likely to be low as they do not tightly prescribe what bidders may win and so we consider them to be proportionate. We propose the same levels for these caps as we suggested in the March 2011 consultation (see paragraphs 4.205 below for details).
- 4.203 Accordingly, our provisional view is that Option 4, including a reservation of spectrum to promote the existence of a fourth national wholesaler plus safeguard spectrum caps is the least onerous option required to achieve our policy aim.

Option 4 - Reservation of spectrum for a fourth national wholesaler plus safeguard caps

- 4.204 Option 4 comprises the following measures to promote competition: safeguard caps on the holding of sub 1 GHz spectrum and on the overall holding of spectrum; a reservation of spectrum for a fourth national wholesaler; and reserve prices set by reference to the estimated market value with a discount. Again in order to assess proportionality, it is necessary for us to consider which particular combination of these measures is the least onerous required to achieve our policy aim.
- 4.205 We propose to impose the same safeguard caps that we suggested in the March 2011 consultation. These are:
- sub 1GHz safeguard cap of 2x27.5 MHz; and
 - overall spectrum cap of 2x105 MHz.
- 4.206 We continue to consider these particular caps to be the minimum necessary to avoid very asymmetric distributions of spectrum.
- 4.207 We have considered a number of different ways in which we might specify the details for the spectrum reservation element of this option. In determining the appropriate and proportionate approach 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 use of spectrum. Reservation, by limiting the amount of spectrum that would be available to other national wholesalers could facilitate strategic investment in spectrum in the auction such that one or more of them 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.
- 4.208 We have identified three alternative groups of portfolios for this option relating to the different spectrum which could be reserved for the fourth national wholesaler. The mechanism we are proposing to use in the auction to implement this reservation is essentially the same as in the March 2011 consultation, though we propose some detailed modifications to the auction rules designed to make it more efficient - see Section 7 for a discussion of these.
- 4.209 The three groups are shown in Figure 4.11 in the circumstances where the 2 x 15 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. The Figure also indicates the share of total spectrum that H3G or a new entrant would hold if it obtained the portfolio in question (such as by outbidding others eligible for the reserved spectrum). The share of H3G would be larger because of its 2.1GHz spectrum holding of 2 x 15 MHz.

4.210 There are two important changes to the specification of the portfolios compared to the March 2011 consultation:

- The portfolios do not guarantee sub-1 GHz spectrum. This is because as identified above we now do not believe that it is clear that it is necessary to hold sub-1GHz spectrum to be a credible national wholesaler. We recognise that this provisional conclusion involves judgement on the available evidence and so we consider variants in which the fourth national wholesaler would be guaranteed sub 1 GHz spectrum in our detailed discussion of Option 4 in Section 8 of Annex 6.
- The other important change is that we are less confident about the credibility of portfolios which include just 2 x 5 MHz of 800 MHz spectrum together with, for example, 2 x 20 MHz of 2.6 GHz spectrum. We have removed such portfolios from our favoured option because our further analysis suggests that such a small amount of 800 MHz spectrum may do little to enhance the coverage or capacity of a network with a larger amount of higher frequency spectrum, if in particular higher speed services were to prove important (as they may). Reservation of such a small amount of 800 MHz spectrum therefore risks inefficient use of this valuable spectrum resource. However, as it may support coverage for lower speed services we include portfolios with 2x5 MHz of 800 MHz spectrum in our detailed discussion of variants of Option 4 in Section 8 of Annex 6.

4.211 There are two important points regarding the interpretation of the groups of portfolios:

- Within each group of portfolios, bidding in the auction would determine which particular portfolio a fourth national wholesaler obtained (and also which bidder obtained it), but it would be guaranteed one of the portfolios (as long as it was willing to pay the reserve price).
- The portfolios within each group are not intended to give precisely the same capability but rather to constitute portfolios that may provide a comparably viable basis for being a credible national wholesaler (although the business model adopted may vary with the portfolio).

Figure 4.11: Proposed alternative groups of portfolios in Option 4

	800 MHz	1800 MHz	2.6 GHz	Implied share for H3G	Implied share for a new entrant
Group 1 (Smaller portfolios)					
Portfolio 1	2 x10 MHz			9%	4%
Portfolio 2		2x 15 MHz		11%	6%
Group 2 (Medium portfolios)					
Portfolio 3	2 x15 MHz			11%	6%
Portfolio 4	2x 10 MHz		2 x 10 MHz	13%	8%
Portfolio 5	2 x10 MHz	2x 15 MHz		15%	9%
Portfolio 6		2x 15 MHz	2 x 10 MHz	15%	9%
Group 3 (Larger portfolios)					
Portfolio 7	2x20 MHz			13%	8%
Portfolio 8	2 x15 MHz		2 x 10 MHz	15%	9%
Portfolio 9	2 x10 MHz		2x 20 MHz	17%	11%
Portfolio 10	2 x10 MHz	2 x 15 MHz		15%	9%
Portfolio 11		2 x 15 MHz	2x 20 MHz	19%	13%

Note: the shares in the table are shares for all mobile spectrum, which we define as including the 800 MHz, 900 MHz 1800 MHz, 2.1 GHz (paired), 2.6 GHz (paired) bands.

Same reservation for a new entrant as for H3G

- 4.212 For this option, we propose to have the same reservation for H3G or a new entrant. This is despite H3G already having 2x15 MHz of 2.1GHz spectrum and that the portfolios for a new entrant would leave it (assuming it acquired no further spectrum) which a share of spectrum that is below the 10-15% range we identified earlier as the minimum share that was likely to be necessary for credibility.
- 4.213 We have considered whether a group of larger portfolios should be specified for a potential new entrant than for H3G. This would not necessarily make it easier for the new entrant to obtain any reserved spectrum. As the winning set of bids would be those that maximised value (as reflected in auction bids), subject to meeting the constraint of one reserved portfolio going to either H3G or a new entrant, if the new entrant's group of portfolios were bigger than H3G's, in order to win it would need to outbid other bidders (including Everything Everywhere, Telefónica and Vodafone) for the additional spectrum. This could make it harder for the new entrant to obtain reserved spectrum in competition in the auction against H3G. In other words, the new entrant would not have the option of only obtaining a small amount of reserved spectrum, and this might make it less likely to obtain a larger amount of reserved spectrum. Larger portfolios could therefore make it harder for the new entrant.
- 4.214 When the amount of reserved spectrum is the same for H3G and a new entrant, then the new entrant can compete on equal terms for the reserved spectrum and has the option of buying any additional spectrum it needs in the normal way in the auction. We would expect the reserved spectrum to be obtained by the eligible bidder with the highest intrinsic value. This seems appropriate as we do not have a prior preference as between H3G or a new entrant obtaining the spectrum reserved for a fourth national wholesaler.

- 4.215 Moreover, to promote at least four credible national wholesalers, it may be excessive to reserve more spectrum than the minimum necessary to be credible when combined with H3G's 2x15 MHz of 2.1GHz spectrum. It may be possible for a new entrant to buy the spectrum in one of the portfolios and to launch a successful LTE service soon after the auction. In the near term this could lead to stronger competition, as there would be five competitors. In the longer term, H3G and the new entrant may not each have sufficient spectrum to be credible. However, if necessary at that point, it might be possible for the two spectrum holdings to be brought together in some way, by network sharing, a trade or a merger, while still retaining at least four credible national wholesalers. In this way we consider that it may be possible for a new entrant to obtain only the reserved spectrum and to become credible in the longer term. We recognise that there could be a strategic incentive on Everything Everywhere, Telefónica or Vodafone to obtain one of these two spectrum holdings to prevent a fourth credible national wholesaler in the longer term. However, if this were through a spectrum trade, it would be subject to a competition assessment at that time.³²
- 4.216 We recognise that if spectrum holdings were more dispersed there is some risk that they do not come together to enable at least four credible national wholesalers in the longer term. However, the risk of unnecessary restrictions on spectrum outcomes leading to an inefficient spectrum allocation is higher if we reserve more than the minimum necessary to enable at least four national wholesalers to be credible in the longer term.
- 4.217 On balance, we therefore 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. This does not preclude a new entrant obtaining sufficient spectrum in the auction to be credible even in the longer term, but it may need to obtain more than the reserved spectrum (either in the auction or subsequently).

Comparison of the different ways of specifying Option 4

- 4.218 We have compared the three different groups of portfolios to assess which is most likely to be appropriate and proportionate using the framework we set out above. The three parts of that framework are:
- effectiveness in addressing our main competition concern: a credible fourth national wholesaler;
 - magnitude of restrictions imposed; and
 - possibility of adverse effects.
- 4.219 Our assessment is set out in Figure 4.12.

³² See: <http://stakeholders.ofcom.org.uk/binaries/consultations/trading-900-1800-2100/statement/900-1800-2100-statement.pdf>

Figure 4.12 Assessment of variants of Option 4- spectrum portfolios proposed to be reserved for fourth national wholesaler

Group	Effectiveness in addressing our main competition concern: a credible fourth national wholesaler	Magnitude of restrictions imposed	Possibility of adverse effects
1 (Smaller portfolios)	Low likelihood since there remains significant residual risks, so reliant on fourth national wholesaler acquiring additional spectrum in the auction when potentially still vulnerable to strategic investment	Low since 9-13% of the paired spectrum in the auction (including 1800 MHz divestment) is set aside for a fourth national wholesaler.	Low possibility since risk of unintentionally weakening competition or reducing spectrum efficiency is small as other national wholesalers can still acquire spectrum both at sub-1GHz and overall
2 (Medium portfolios)	Medium likelihood that these are sufficient. Also if not sufficient and fourth national wholesaler needs additional spectrum then the risks regarding its ability to do this are more similar to other national wholesalers than for Group 1 (especially if portfolio 6 is omitted)	Medium since a greater amount of the available spectrum is set aside for a fourth national wholesale. It amounts to 13-22% of the paired spectrum in the auction (or 6-9% of total paired mobile spectrum, including existing holdings).	Medium possibility, since some increased risk of worsening competition and inefficient allocation. For example, the net effect on Everything Everywhere is not completely clear but it may make it more difficult for it to acquire sub 1 GHz spectrum. There could be an increased risk of and Telefónica and Vodafone being victims of strategic investment in acquiring spectrum needed for an early route to LTE or more capacity, but overall this risk is not very high. Depending on the winner of the reserved spectrum, the share of total spectrum guaranteed to H3G would be 11-15% depending on the particular portfolio, and clearly lower if the winner were a new entrant.
3 (Larger portfolios)	High likelihood.	High since it would set aside the greatest amount of spectrum. It amounts to 17-30% of the paired spectrum in the auction.	High possibility, e.g. in some cases it would reserve for a fourth wholesaler a greater quantity of spectrum than the existing holdings of, for example, Telefónica. Also by reducing the amount of spectrum which the others can bid for it increases the risk of an inefficient outcome and of creating an unintended consequence of weakened competition.

4.220 Group 2 (medium portfolios) is our preferred option, based on (i) the evidence available to us at this stage and our analysis thereof, and (ii) the inherent uncertainties surrounding some of that analysis.. We consider that the increase in the benefits that might be realised from this compared to Group 1 (smaller portfolios) is

considerable, as it would materially increase the probability that four entities would hold sufficient spectrum to be credible national wholesalers after the auction. We are much less certain that the amount of reserved spectrum under Group 1 (smaller portfolios) is likely to be sufficient adequately to address our most significant competition concern. By contrast we consider the comparative increase in the risk of adverse effects as between Groups 1 and 2 to be relatively small since Group 2 still involves reservation of only a relatively small proportion of the available spectrum. Group 3 (larger portfolios) would increase the likelihood of reserving sufficient spectrum for a fourth national wholesaler, but at the cost of a more interventionist approach and a greater risk of adverse effects. Overall we consider that a spectrum reservation for a fourth national wholesaler as specified in Group 2 as the least onerous way of achieving our policy aim of promoting national wholesale competition, given the uncertainties we have about the efficacy of Group 1 in addressing our main concerns.

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

- 4.221 It is also necessary to consider more generally whether our proposed option produces adverse effects which are disproportionate to the aim pursued.
- 4.222 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 securing at least four credible national wholesalers in the future are the risks of (i) unintentionally weakening competition or (ii) causing spectrum inefficiency. We consider that the extent of these risks is dependent on the particular spectrum reservation and we have considered these risks above in Figure 4.12.
- 4.223 We do not consider the effects of Option 4 are disproportionate to the aim pursued. There are two scenarios to consider: first where a fourth national wholesaler would have obtained the spectrum reserved for it any case even in the absence of the measures; and second where it obtains the spectrum as a result of the reservation. In the first scenario the cost of the measure is clearly low. 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 the greater intensity of competition from seeking to ensure at least four credible national wholesalers outweigh such cost. 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 be addressed later through, for example, market consolidation, subject to scrutiny under merger control at that time as appropriate. By contrast if measures are not put in place in the auction to promote four 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.
- 4.224 We therefore provisionally consider that it is appropriate to put in place some measures 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 as a credible national wholesaler. We consider that Option 4 (with Group 2 portfolios) is the most proportionate way in which to address this risk.

Question 4.2 Do you agree that option 4 should be adopted to promote national wholesale competition? Please state the reasons for your views.

Question 4.3 Do you agree that the portfolios in group 2 (medium portfolios) of option 4 are likely to be most appropriate and proportionate implementation of this option?

Competition Assessment: future retail competition

March 2011 consultation

- 4.225 In the March 2011 consultation, we considered that market entry by sub-national RAN operators – using shared spectrum for low-powered cells that cover small areas – could potentially deliver innovative services to consumers, and increase competition. This was the only form of potential entry that stakeholders had identified to date. However, there was a risk that such entry, even if socially beneficial, would not occur without our support.
- 4.226 We provisionally concluded there was a strong case for aggregating bids amongst low power users for 2.6 GHz spectrum to ameliorate the coordination problems. However, we recognised that this might not be enough to secure new entry.
- 4.227 Therefore we considered going further and reserving spectrum for low power use. We said that there might be a case for reserving 2x10 MHz, but reserving 2x20 MHz exclusively for low power use was unlikely to be proportionate.
- 4.228 We also considered hybrid use allowing standard power and low power users to share a 2x10 MHz block if the low power users already had access to a 2x10 MHz block, but this was subject to further technical work.

Responses to March 2011 consultation

- 4.229 Responses to the consultation confirmed shared low power use of 2.6 GHz as the only potential form of market entry that respondents identified.
- 4.230 Proponents of low power shared use supported the proposal to aggregate bids but suggested it would not be sufficient and so argued for reservation of spectrum for this use.
- 4.231 National wholesalers either supported, or did not specifically object to the proposal to aggregate bids. However, they opposed reservation of spectrum for low power shared use.

Further analysis

- 4.232 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 continue to consider that competition will be promoted by entry or expansion by sub-national RAN operators. In particular, such entry could allow competition over more of the value chain than entry by other retailers, and facilitate innovative business models, including through the deployment of 'inside-out' networks. In light of the responses to the consultation document we believe the key issue in this regard is whether we should reserve spectrum for low power use.

- 4.233 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 is a better auction outcome than no such market entry – i.e. the benefits of such entry are likely to exceed the opportunity cost; and
 - b) there is a significant risk that such entry would not occur in the absence of reservation.
- 4.234 Our view is that market entry by sub-national RAN operators could deliver substantial benefits to consumers. By adding mobile services to a fixed high speed broadband network they could potentially 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. In either case sub-national RAN operators could provide a disruptive competitive force to the benefit of consumers.
- 4.235 That said we recognise if the spectrum were not acquired by such operators but by national wholesalers this would also create value by allowing increased capacity and higher average data rates or in the extreme the deployment of, for example, 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.
- 4.236 It is very difficult to assess whether the benefits of new entry are likely to outweigh the opportunity costs in this case. We consider that it is possible that they could do so. Looking at the evidence on potential opportunity costs based on prices paid for 2.6 GHz spectrum in other countries, we consider those costs could range from £25 - 150m for 2x10 MHz. We consider that it is quite plausible that the additional benefits of greater competition brought about by entry using low power shared 2.6 GHz spectrum could exceed these costs. The market for mobile services has annual retail revenues of £15.1 billion.³³ An innovative service which substantially improved consumer outcomes in this market, or even a segment of it, over a five or ten year period could be worth tens or hundreds of millions in consumer value. Care is needed in comparing the costs and benefits since there is likely to be much more certainty as to the costs than the benefits. It seems relatively clear that there will be costs associated with 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. Nevertheless, we believe that it is possible that the benefits could exceed the costs since as observed above relatively small increases in competitive intensity can bring large increases in benefits to consumers due to the significant size of the mobile market.
- 4.237 The second issue concerns the level of risk that low power shared users would not acquire spectrum in the auction even though 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);

³³ See Ofcom's Communications Market Report, August 2011.

- these bidders have a lower intrinsic value (in aggregate) compared to national wholesalers; and
- these bidders (even if they have a higher intrinsic value in aggregate) are victims of strategic investment by national wholesalers.

4.238 Our provisional conclusion is that there does not seem to be very strong evidence to support the first reason. On the second reason, arguments can be made in both directions as to the relative intrinsic value of low power bidders (in aggregate) and national wholesalers. On the third reason, whilst there is not clear evidence, we do not consider that we can rule out the possibility of strategic investment by national wholesalers.

4.239 Overall, our provisional conclusion is it is possible that shared low power use of 2.6 GHz might constitute an opportunity for disruptive entry into the mobile market bringing significant benefits to consumers which could be greater than the value that use of that spectrum in the hands of the existing national wholesalers might generate. We note, for example, that 2x10 MHz for shared low power users represents less than 4% of total paired mobile spectrum and that national wholesalers may hold all or the vast majority of the remaining 96% after the auction. While it is possible that such entry could occur without reservation we have identified that there is some risk that it might not. Accordingly, we are minded to favour reservation of 2.6 GHz for shared low power use but we would welcome further evidence on both the costs and benefits of such action.

Possible hybrid approach

4.240 In the March 2011 consultation we identified a possible hybrid option in which some spectrum was shared between high and low power uses. In our subsequent June 2011 consultation³⁴ on Technical Licence Conditions we set out two options for how this could work: sensing, and geolocation. The former would require base stations to have measurement and reporting capabilities, while the latter would require functionality for querying a geolocation database.

4.241 We have conducted further analysis of the possibility of a hybrid approach. A hybrid approach based on spectrum sensing is theoretically possible, but depends on implementation of particular measurement capabilities and UK-specific formulae for power back-off in base stations. The time scale for delivery is unpredictable and we do not believe that we can rely on the implementation of these requirements in equipment. The only other policy area where sensing has been studied extensively is in the development of white space technologies, and those applications are not pursuing approaches based purely on sensing. A geolocation database approach to implementing the hybrid approach also does not seem to us to be viable as we do not believe that the issues relating to such an approach can be resolved on the timescales for this award. We have therefore provisionally decided not to proceed with the hybrid approaches.

Shared high and low power use: possible geographical split approach

4.242 Instead of the hybrid approach, we have identified a possible alternative approach in which one block of 2.6 GHz spectrum, for example 2 x 10 MHz, is dedicated for either the low power networks or a standard power network in predefined geographic

³⁴ <http://stakeholders.ofcom.org.uk/binaries/consultations/tlc/summary/>

areas. The model that we are considering is a geographic division between rural and non-rural areas. The licences would define:

- a) the set of rural areas where low power networks may establish base stations using the shared 2 x 10 MHz block; and
- b) the set of non-rural areas where the standard power network may establish base stations using the shared 2 x 10 MHz block.

4.243 It is not clear to us whether this model would be of interest to potential users of the 2.6 GHz spectrum. Unless there is clear evidence that this is something that would increase the benefits for consumers that would be created through the award of the spectrum we are not minded to pursue it further as it would require further work to specify fully and it would increase the complexity of the award.

Question 4.4: Do you believe that geographically split licences for a particular block of 2.6 GHz spectrum between standard power use and lower power use is likely to create significant additional benefits for consumers?

Potential measures to promote retail competition

4.244 We have considered a wide range of options for the measures we might take to promote retail competition through promoting low power shared use of the 2.6 GHz spectrum. These are set out in Section 9 of Annex 6. If we assume that we would not propose to pursue the possibility of geographical split licences, the key distinction between the options is whether or not spectrum is reserved for low power use.

Option A – Reservation of spectrum

4.245 As we provisionally concluded above, we see there may be a case for reservation of spectrum. We consider the case is likely to be much stronger for 2 x 10 MHz of spectrum since the opportunity costs of 2 x 20 MHz are likely to be much higher than for 2 x 10 MHz. Therefore we are minded to favour pursuing this option in relation to 2 x 10 MHz of 2.6 GHz spectrum.

4.246 We have identified a variant of this option in which in addition to the reservation of 2 x 10 MHz of 2.6 GHz spectrum, a further 2 x 10 MHz is identified to be competed for between low power users and national wholesalers or other bidders, where the bids of the low power users would be aggregated as in option B below.

Option B – Aggregation of bids

4.247 Were we to conclude in the light of the responses to this consultation that we should not reserve any spectrum for low power shared use, we suggest that we would put in place measures in the auction to aggregate bids from low power shared users and allow such bids to compete with the bids from national wholesalers or other bidders to determine which type of user acquires the spectrum. We do not consider there are any convincing arguments against doing this. The only potential concern is complexity in terms of the implementation and we do not believe that this should present a problem, nor have any stakeholders suggested that it should.

4.248 This measure could apply to either 2 x 10 MHz or 2 x 20 MHz of 2.6 GHz spectrum, in the case of the 2 x 20 MHz we suggest this would be best achieved by having competition for two separate 2 x 10 MHz lots so a greater range of outcomes are possible. We welcome views on which of options A and B should be favoured.

Question 4.5 Please provide your views including the reasons for them on which options you believe should be taken in relation to promoting low power shared use of 2.6 GHz spectrum.

Provisional conclusions

4.249 In this section we have set out our revised views in light of the further evidence and information available to us following the March 2011 consultation on the competition concerns that arise in the context of the award of 800 MHz and 2.6 GHz and measures that we consider are likely to be the most appropriate and proportionate to address those concerns.

4.250 In summary our proposals are:

- 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 reserve 2 x 10 MHz of 2.6 GHz spectrum for shared low power use.

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

4.252 We have also taken account of our duty to secure optimal use of the spectrum, and consider that our proposals 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.

4.253 We have considered the likely impact of our proposals 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 proposed options which are most likely to promote competition and thereby investment, innovation and wide availability of such services in the future. In our view, our proposals 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.

4.254 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 proposing measures 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.

4.255 Finally, we consider that our proposals 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 ensure that the auction should not result in overall spectrum holdings which distort competition. In setting out each of our proposals, as described above and in Annex 6, we have considered whether our proposals 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.

Liberalisation of 900 MHz and 1800 MHz for LTE

- 4.256 In the March 2011 consultation, we announced proposals to liberalise the use of mobile frequencies at 900 MHz, 1800 MHz for LTE and WiMAX as soon as technical conditions had been agreed within Europe (see paragraphs 2.21 and 5.88 in that document). In our consultation of 2 June 2011 “Consultation and information on technical licence conditions for 800 MHz and 2.6 GHz spectrum and related matters”, we noted that on 18 April 2011 the European Commission had adopted Decision 2011/251/EU, amending Decision 2009/766/EC which added technical conditions for LTE and WiMAX into the annex to that Decision. We also noted that the amending Decision set a deadline of 31 December 2011 for Member States to implement the technical conditions to allow LTE and WiMAX in these bands (see paragraphs 2.11 to 2.17 in that document).
- 4.257 It is clear from *Telefónica O2 UK Limited v Office of Communications (900 MHz Band)* [2010] CAT 25 that the obligation in the amended Commission Decision only extends to putting in place any measures necessary to ensure that, by 31 December 2011, the 900 MHz and 1800 MHz bands are available throughout EU Member States to be authorised for use with LTE and WiMAX technology, and are thereby capable of being made use of. However, authorisation of particular undertakings to use this spectrum for LTE and WiMAX only takes place after implementation of the necessary authorisations and licence amendments under the Authorisation Directive.
- 4.258 Following on from these developments we have received a request from Everything Everywhere for the relevant licences to be amended as soon as possible after the implementation deadline to give effect to the Commission Decision. We propose to consider this application outside of our proposals on the auction, in accordance with our obligations under the Directives and the Wireless Telegraphy Act 2006, in the first quarter of 2012.

Section 5

Mobile coverage and related issues: revised proposals

Introduction

- 5.1 In section 6 of the March 2011 consultation we considered the potential role of the auction in promoting future mobile coverage for citizens and consumers. We sought views on the proposal to include in one of the 800 MHz licences an obligation to serve, by the end of 2017, an area in which 95% of the UK population lives. We believed that this should result in coverage of future mobile broadband services (i.e. higher quality data services, which may be provided via devices such as mobile handsets and dongles) that approaches today's 2G coverage. In this section we explain the further consideration we have given to this subject and we put forward a revised proposal. In reviewing our March 2011 proposals we have taken into account consultation responses and undertaken further technical analysis.
- 5.2 An important development since March has been the Government's establishment of its Mobile Infrastructure Project. On 3 October it announced its decision 'to invest £150m in infrastructure to improve the coverage and quality of mobile services for the 5 to 10 per cent of consumers and businesses in areas of the UK where existing mobile coverage is poor or non-existent'³⁵. This has opened up the possibility of additional infrastructure being available to support the delivery of new mobile broadband services into rural areas. We have taken this into account in reviewing our March proposals, though we recognise that the Mobile Infrastructure Project is at an early stage of development and the nature of the new infrastructure is yet to be specified.

Proposals in the March 2011 consultation

- 5.3 In the March 2011 consultation we reached a provisional conclusion that we should include a coverage obligation in one 800 MHz licence. We proposed this should be an obligation to serve, by the end of 2017, an area in which 95% of the UK population lives, while providing a sustained downlink speed of 2Mbps with a 90% probability of indoor reception. We asked whether stakeholders thought there was another way of specifying a coverage obligation that would be preferable.
- 5.4 We set out our view that such an obligation (i) should guarantee that a future mobile broadband service would be provided to a significant number of citizens and consumers and on a reasonable timescale, and (ii) balanced the costs and benefits and addressed risks of regulatory failure arising from a poorly specified obligation or unintended consequences such as distorting investment decisions or deterring new entry. We also sought views and evidence on the costs and benefits of imposing an additional coverage obligation focussed on particular geographical areas, and if such an obligation were to be imposed what might be the appropriate specification of geographic areas.
- 5.5 We also asked for comments or evidence on whether an additional obligation should be imposed to require coverage on specific roads.

³⁵ http://www.hm-treasury.gov.uk/press_112_11.htm

Summary of responses

- 5.6 We received 71 responses. All but ten of them commented on coverage issues and only three of the responses opposed or had reservations about the case for imposing a coverage obligation.
- 5.7 The main points made in responses were:
- Many respondents argued for more extensive coverage obligations. The figure of 98% of the UK population was widely proposed. Some respondents wanted obligations based on coverage within each constituent nation. Some respondents suggested a coverage obligation should specify coverage of roads but this was not a particularly strong theme.
 - Some responses suggested the coverage obligation could only be met with a spectrum holding of at least 2x10 MHz in the 800 MHz band.
 - There was some support for mandating a higher data rate of 5Mbps.
 - Many responses argued that an obligation on one licence was not sufficient, or if it were limited to one licence there should be in addition a national roaming or wholesale access obligation to ensure coverage across more than one network.
 - On the proposed target date of 2017, four responses suggested this was unambitious and that 2015 would be better, while two other responses suggested it would be difficult for a new entrant to meet the 2017 date.
 - Some responses suggested that a procurement process would be a more appropriate way of ensuring wide coverage. A number of them suggested part of the auction proceeds be used to finance procurement.

We cover in this section, under the relevant headings, the points raised in responses.

Summary of our work since March and provisional conclusions

- 5.8 We have reviewed our proposals in the light of responses and the announcement of the Government's Mobile Infrastructure Project, and in the process have undertaken further technical analysis. This analysis has centred on understanding the nature of existing coverage not-spots and how coverage might be extended. It has included an assessment of how mobile broadband services provided by fourth generation (4G) mobile technologies such as LTE using 800 MHz spectrum might be rolled out to a level approaching the current 2G coverage and beyond.
- 5.9 We have worked with the consultants Real Wireless to undertake this further technical analysis. This focussed on four areas of the UK that have relatively poor mobile coverage: north- and mid-Wales, the west of Northern Ireland, south-east Scotland and northern England (the 'focus areas'). These areas include about 63% of the total not-spots population underlying the mobile phone coverage estimates in our 2010 Communications Market report³⁶. We considered that they were likely to be representative of areas of poor or non-existent coverage. Outputs from this work include:

³⁶ <http://stakeholders.ofcom.org.uk/market-data-research/market-data/communications-market-reports/cmr10/>

- Estimates of prospective LTE coverage that could be provided from existing mobile sites in the focus areas using 800 MHz.
- Estimates of the number of additional sites that would be needed to extend coverage to various levels up to 100% of residential and business addresses ('delivery addresses') in the focus areas. The number of additional sites has been estimated for a variety of scenarios with differing parameters such as bandwidth, power and network topology.
- Cost estimates for additional sites in the focus areas.

We are publishing alongside this consultation a report setting out the results of this technical analysis (available at <http://stakeholders.ofcom.org.uk/consultations/award-800mhz-2.6ghz/>).

5.10 The analysis looked at a number of different technical approaches to providing LTE coverage:

- Additional standard macro cells (based on towers 25 metres above ground level).
- Additional 'community' cells, which are likely to be either (i) 'metrocells' that have lower antenna height (12 metres), power and capacity compared with standard macro cells, or (ii) transmitters based on street furniture such as lampposts, phone boxes and side walls of buildings.
- Using additional equipment in customer premises to improve indoor coverage when outdoor coverage is already available.
- The impact of various technical parameters on the number of new base stations required and costs of coverage:
- Bandwidth available (5 MHz or 10 MHz)
- Base station transmitter power (normal power of 64dBm/5MHz or higher power of 67dBm/5MHz)
- Downlink throughput of 2Mbps and 5Mbps with 90% coverage confidence.

5.11 The analysis has led us to a number of provisional conclusions:

- An existing 2G network upgraded for LTE using 800 MHz could achieve coverage in the focus areas approaching the current 2G coverage level.
- To meet this level LTE would have to operate on a 10 MHz channel in order to limit the number of base stations needed to a commercially acceptable level.
- There is little benefit in using a power higher than that seen as the norm of 64dBm/5MHz as it would have little impact on the number of sites needed and complicate further the interference issues with adjacent users.
- The most cost-effective network topology for extending coverage beyond what can be achieved using existing infrastructure seems to be one based on community cells. Although more sites are needed than macro cells the capital and operating costs of community cells are estimated to be less than half those of macro cells.

- A significant number of new sites would be needed to extend coverage in the north- and mid-Wales focus area from the level that could be provided by upgrading an existing 2G network. The number of new sites needed to raise coverage levels in the other focus areas would be lower.
- The cost of extending coverage in the focus areas increases steeply as coverage is pushed out towards 100%.
- A cost-effective approach to indoor coverage might be the provision of window-ledge customer premises equipment (CPE) at those delivery addresses that do not receive indoor coverage directly from outdoor LTE cells.
- We have found a significant proportion of the costs of rolling out infrastructure is independent of the services that are rolled out, i.e. whether 2G voice or LTE. Hence a common infrastructure supporting both could be the basis for a cost effective approach.

5.12 The focus areas are not representative of the UK as a whole and we have not attempted to extrapolate the findings to quantify the costs for the UK of upgrading a network to LTE while providing coverage comparable to a current 2G network. Current coverage in the focus areas is generally below the overall UK level. As our analysis indicates, upgrading sites in the focus areas would provide coverage approaching current 2G coverage in those areas but a significant number of new sites would be needed, particularly in the north- and mid-Wales focus area, to raise coverage to the level experienced in other parts of the UK. This has implications for having a geographic coverage obligation at a sub-UK level and for setting the coverage target in such an obligation. We discuss this further in paragraph 5.62.

5.13 In considering the results of our technical work care is needed in comparing coverage levels derived from different sources. Basic data, assumptions and modelling techniques may all differ, producing results that may not be directly comparable. For example we published figures on 2G coverage in our Infrastructure Report on 1 November³⁷ and annex 1 of the report explains the data assumptions used. The report summarising the technical work we carried out during the consultation period, which we are publishing alongside this consultation, includes an explanation of the modelling approach used, which differs from that used to derive the results in the Infrastructure Report.

5.14 It is also important to note that the 2G coverage reported in our infrastructure report relates to coverage outdoors while in the March 2011 consultation we proposed an indoor 800 MHz coverage obligation. We discuss this further in paragraphs 5.54ff.

Review of our proposals for securing future mobile broadband coverage

5.15 In the light of responses and our further work we have reviewed the proposals in the March 2011 consultation. We consider three main questions:

- Is there need for an obligation?
- If so, what is the most appropriate coverage target?

³⁷ <http://stakeholders.ofcom.org.uk/market-data-research/telecoms-research/broadband-speeds/comms-infrastructure-report/>

- Should the target be set at a UK level or at a national level or on some other basis, and should it include for example coverage of roads?

5.16 We have also looked at other aspects that affect consumer choice and the timely provision of future mobile broadband services, in particular the number of licences that should include a coverage obligation and the target date for meeting the obligation.

Mobile broadband coverage – the wider context

5.17 There is widespread consumer and stakeholder concern about poor mobile coverage and this is an important issue for us. With the growing importance of communications services to consumers and to businesses, mobile and broadband not-spots are increasingly significant issues, notably in rural areas. A strategic priority in our draft annual plan for 2012-2013³⁸ is to work in collaboration with the Government and industry to promote widespread superfast broadband coverage and reduce mobile not-spots. We are currently considering what additional information we may be able to provide to consumers on coverage issues, as well as examining the scope for improved coverage for consumers as they travel. We are also supporting the Government on its Mobile Infrastructure Project. Freeing up the use of existing mobile spectrum and making additional spectrum available fits in with this work programme.

5.18 Our aims in managing the spectrum available and becoming available for mobile broadband include facilitating the introduction of new services and technologies and promoting competition in mobile services. Over the past year we have taken important steps to further these aims. In particular, in accordance with the Government's Direction³⁹ we have:

- Varied the existing 900 MHz and 1800 MHz licences to allow their use for 3G mobile broadband delivery, as well as GSM voice services.
- Decided to vary the existing 3G 2100 MHz licences, providing licensees consent, to include a new coverage obligation requiring the licensee to provide, by mid-2013, an electronic communications network that is capable of providing mobile telecommunications services to an area within which at least 90% of the UK population lives, and to change the termination date to allow the licences to run until revoked by Ofcom. We have so far varied H3G's licence at its request.
- Made spectrum trading regulations for 900 MHz, 1800 MHz and 2100 MHz licences. These permit the current licensees to transfer all or part of the licence rights and obligations to other operators, subject to our consent, taking into account various factors including whether competition is likely to be distorted as a result of the transfer.

The Direction required us to assess likely future competition in markets for the provision of mobile electronic communications services and, in light of our assessment, put in place measures that would promote competition in these markets after completion of the auction. In section 4 we set out our proposals to promote competition.

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http://stakeholders.ofcom.org.uk/consultations/draftap1213/?utm_source=updates&utm_medium=email&utm_campaign=draftannplan1213

³⁹ <http://www.legislation.gov.uk/uksi/2010/3024/introduction/made>

- 5.19 The auction of 800 MHz provides an opportunity to support the deployment of mobile broadband services to a large proportion of UK consumers. These services are becoming increasingly important to consumers. The past year has seen significant change in the way consumers are accessing communications services particularly in relation to mobile broadband, for example there has been a rapid take-up of smartphones, used by 38% of all mobile customers, and 32% of mobile subscribers use their mobile phones to access the internet. 74% of smartphone users access the internet via their phones. As growth in fixed-line broadband take-up slows mobile broadband is enabling some households to get online for the first time. We expect this trend in the increasing importance of mobile broadband to accelerate when 4G services become available, as a result of the enhanced consumer experience those services will support.
- 5.20 There are substantial benefits to consumers from access to mobile broadband services. Smartphones, laptops and tablets used on the move may not be suitable for large file downloads and video streaming, which represent a significant proportion of fixed line traffic. However, many of the benefits of mobile broadband are similar to those that fixed broadband gives, such as access to social networking sites, availability of e-mail, a wide range of information sources and ability to download data. The ability to take advantage of these benefits on a mobile device gives an additional dimension - it allows users to remain always connected and provides a choice of access methods. For premises without a fixed line it gives internet access and for some households it may represent a cheaper option than fixed broadband.
- 5.21 A further important aspect of mobile broadband coverage is its link with the Government's broadband strategy. We expect the availability of 800 MHz and 2.6 GHz spectrum will contribute to the delivery of the wireless element of this strategy. The Government's vision is for the UK to have the best superfast broadband network in Europe by 2015⁴⁰. It is also committed to ensuring virtually all homes will have access to a minimum level of service of 2Mbps - its universal service commitment. It sees a mix of technologies being needed to deliver superfast broadband throughout the UK. These are likely to be primarily fixed technologies, given the nature of superfast broadband, with fibre deeper into the network being the main technology. However, wireless technologies, both fixed and mobile, have an important role in serving rural areas. They may not allow the same broadband speeds as fibre but are potentially more practical and cost-effective in reaching consumers in remote areas.

Options for a coverage obligation

- 5.22 We have reviewed the options for a coverage obligation against this background. We have also taken into account the incentive to widespread mobile broadband coverage that will be provided by a competitive market, which our proposals for the auction set out in section 4 are designed to promote. We consider in this section the need for further measures to promote wider availability of future mobile broadband services and review the proposals in our March 2011 consultation for a coverage obligation. The options we have considered are as follows:
- i) No coverage obligation.
 - ii) An obligation below the 95% proposed in the March 2011 consultation.
 - iii) An obligation to provide 95% population coverage (comparable with the mobile voice coverage of individual 2G networks today).

⁴⁰ <http://www.culture.gov.uk/images/publications/britainsSuperfastBroadbandFuture.pdf>

- iv) An obligation to provide a specific level of population coverage materially in excess of 95%, e.g. 98%.
- v) An obligation to provide coverage approaching 100% of the population

No coverage obligation

- 5.23 One option would be not to include a coverage obligation in any of the 800 MHz licences to be awarded.
- 5.24 Three responses to the March consultation thought that including a coverage obligation would be unnecessary or inappropriate. BT suggested we omit a rural coverage obligation as it was inappropriate on policy and technical grounds; it considered rural coverage should be handled on a technology neutral basis via an open broadband procurement process in partnership with Broadband Delivery UK (BDUK)⁴¹. UK Broadband said a combination of market opportunity and the incentives under the BDUK scheme would provide a better way to address areas of poor coverage. Telefónica had no objection to a proportionate coverage obligation on one 800 MHz licensee, but pointed out an obligation would be inconsistent with the position we had taken in previous awards and consultations and we provided no cogent evidence for our change in approach.
- 5.25 We note the suggestion that working with BDUK offers an alternative to a licence obligation. We consider that the two can complement each other and discuss the possibility later in this section. On Telefónica's point, while we have in the past decided not to impose coverage obligations, we consider each individual case on its merits in light of the particular circumstances at the time. As such, we may - as here - consider such a licence obligation where the benefits of the additional coverage are likely to exceed the costs, i.e. it would be proportionate to include a coverage obligation. In respect of 800 MHz spectrum we need to take into account the wider context of the auction as set out above. In particular it is likely that it will be the most significant release of mobile spectrum for some time. It provides the opportunity to promote the development of mobile broadband services for the benefit of citizens and consumers across the UK. Our approach in the March 2011 consultation to identifying a proportionate coverage obligation was to explore what level of service might be achieved by upgrading existing 2G mobile network sites, as this would be much cheaper than building new sites. This was the basis on which we proposed to include a coverage obligation in one of the licences to be awarded.
- 5.26 As we said in the March 2011 consultation, we expect that, over time, new mobile services using LTE and possibly other advanced technologies will become available to a large proportion of the UK population as a result of the competitive market we are seeking to promote. However, we recognise that, in the absence of a coverage obligation, this may be on a longer timescale than is desirable for consumers and citizens.
- 5.27 It remains our position that there is a case for including a coverage obligation in order to guarantee a minimum coverage level for consumers and citizens that is achieved relatively quickly. However, in specifying the obligation we need to ensure that it is proportionate and does not impose too great a cost relative to its benefits.

⁴¹ BDUK is a team within DCMS set up to deliver the Government's broadband strategy - see http://www.culture.gov.uk/what_we_do/telecommunications_and_online/7781.aspx

An obligation below 95%

- 5.28 We have also considered whether it would be appropriate to impose a coverage obligation substantially lower than the 95% of the UK population we proposed in the March 2011 consultation.
- 5.29 No responses suggested setting the coverage obligation at a level below 95% of the UK population. However, Vodafone believed that the percentage population level would need to be reduced significantly below 95% in order to keep the costs of compliance relatively low.
- 5.30 We recognise that setting the precise level for a coverage obligation is challenging. If we were to set it too low, it could fail to secure the benefits of improved coverage for a significant number of consumers and citizens. On the other hand, if we were to set it too high, the additional costs could materially outweigh any additional social benefit. We consider that a target substantially below our proposed 95% of UK population would risk denying or delaying the benefits of next generation mobile broadband to a substantial number of consumers and citizens in the UK.

An obligation to provide 95% population coverage

- 5.31 In the March consultation we proposed an obligation that targeted coverage of an area in which 95% of the UK population lives (noting that this target was for indoor coverage). Such an obligation would ensure a large proportion of UK consumers would enjoy mobile broadband coverage within a reasonable timescale. The majority of responses welcomed the inclusion of a coverage obligation and while not opposed to the 95% target many argued for a higher target. In contrast, H3G supported the 95% obligation so long as the minimum spectrum portfolio was increased to 2x10 MHz. Everything Everywhere said a service obligation could be an effective way to encourage investment and regarded the proposal to include the proposed obligation as appropriate, although it did not think it was necessary. It welcomed our proposal to set a coverage obligation at a level no higher than could be achieved on a site portfolio equivalent to today's mobile network operators'.
- 5.32 In considering the level of a coverage obligation we have taken into account the risk of regulatory failure and in particular the risk of distorting investment or roll-out decisions. Our provisional conclusion in the March 2011 consultation was that the costs of a requirement to serve 95% of the UK population should be relatively low as it was likely that this level of coverage could be achieved through upgrading the existing sites of a network used to provide 2G services. We set out our view that this would be a proportionate approach to setting the level of the obligation whereas an obligation that required the operator to build a significant number of new base stations might not be proportionate. There is a business case for the current level of 2G coverage and we consider it likely there will also be a business case for rolling out 4G mobile broadband services to a similar extent. A 95% coverage obligation would not force an operator to deploy additional infrastructure that it would not otherwise deploy, but it might encourage it to bring forward investment in 4G technology.
- 5.33 Underlying the coverage proposal in the March 2011 consultation was the suggestion emerging from our technical modelling that a network on the lines of an existing 2G network but using LTE technology and 800 MHz spectrum could deliver indoor mobile broadband coverage to an area within which 95% of the UK population lives. Our further technical analysis during the consultation period broadly supports this. We have found, in the four focus areas studied, that upgrading an existing 2G

network to provide mobile broadband using LTE 800 would provide a similar level of coverage to the current 2G footprint in those areas, both outdoors and indoors.

- 5.34 We therefore consider that there remains a strong case for including in at least one 800 MHz licence an obligation to provide 4G coverage comparable to the 2G mobile voice coverage of any one of today's 2G mobile networks, e.g. to provide a mobile broadband service reaching indoors covering 95% of the UK population.

An obligation to provide coverage materially in excess of 95%

- 5.35 In the March 2011 consultation our view was that the incremental costs of imposing a requirement to meet coverage levels materially above 95% were likely to be disproportionate given the likelihood that a significant number of new sites would need to be built. Everything Everywhere in its response agreed with this view. H3G considered 96% to 97% could be achieved by using contiguous 2x10 MHz spectrum in 800 MHz without affecting auction prices, but more detailed analysis was required for coverage obligations beyond 97%. Vodafone in its oral evidence to the House of Commons Culture, Media and Sport (CMS) Committee said it would cost £200m to get from 95% to 98%.
- 5.36 However, many other responses to the March 2011 consultation suggested a higher target than the 95% population coverage we proposed. As noted above, we proposed the 95% obligation on the basis that it could be achieved by upgrading the existing sites of an existing network used to provide 2G services. In considering the case for a higher target we have therefore looked at the feasibility and cost of setting a coverage obligation extending beyond the coverage of a single existing 2G network.
- 5.37 The responses that favoured an enhanced coverage obligation suggested a 98% target should be included in licences in order to ensure those living in rural or less densely populated areas would be covered. One conclusion of the House of Commons debate on rural broadband and mobile coverage in May 2011 was to urge Ofcom to increase the coverage obligation attached to the 800 MHz spectrum licence to 98%⁴². We also note that the CMS Committee in its report on Spectrum⁴³ supported this conclusion and recommended that we impose a coverage obligation of 98% on one or more of the 800 MHz licences to be auctioned.
- 5.38 A number of responses also suggested the use of a procurement process as an alternative to, or in addition to, a coverage obligation in licences. BT and UK Broadband said a procurement process under BDUK would be more appropriate. North Yorkshire County Council and the Broadband Borders Project suggested gap funding as an additional or alternative way of stimulating coverage, the latter seeing it as a way of targeting investment where it was most needed. The Department of Enterprise, Trade and Investment supported a coverage obligation and saw the value of an additional funding mechanism to improve coverage and upgrade infrastructure.
- 5.39 In the March 2011 consultation we recognised the role direct funding could play but considered a coverage obligation would be better suited to securing our objective of ensuring mobile broadband coverage of a substantial section of the UK population, dispersed over large geographic areas. Nevertheless we recognised that direct

⁴² <http://www.publications.parliament.uk/pa/cm201011/cmhansrd/cm110519/debtext/110519-0002.htm#11051950000003>

⁴³ <http://www.parliament.uk/business/committees/committees-a-z/commons-select/culture-media-and-sport-committee/news/committee-publishes-report-on-spectrum/>

funding could have an important role in supporting the achievement of more challenging coverage targets and that there was the option of combining the two.

- 5.40 The possibility of using direct funding to promote provision of infrastructure has been boosted by the Government's decision to invest up to £150m to improve mobile coverage in the UK⁴⁴. In announcing its decision the Government stated that:

'This investment will improve the coverage and quality of mobile services for the 5 to 10 per cent of consumers and businesses that live and work in areas of the UK where existing mobile coverage is poor or non-existent. The Government will aim to extend mobile service coverage to 99 per cent of the UK population.

'The procurement of additional mobile phone mast sites to increase coverage will begin in 2012.'

- 5.41 Following the Government's announcement, DCMS has established a Mobile Infrastructure Project (MIP), under which BDUK is running the procurement process, and will announce further details in due course. We are supporting BDUK in its development of the project, including the provision of coverage information and technical analysis
- 5.42 BDUK is currently developing the delivery model and procurement options for the use of the government funding, in order to develop or extend mobile infrastructure in areas where there is an insufficient commercial case. Given the early stage of the process several procurement options are under consideration, including, but not limited to: (a) the procurement of the appropriate support infrastructure to enable increased mobile network coverage and service quality, or (b) the procurement of increased mobile coverage and service quality as a service.
- 5.43 The Government's programme will allow development of new infrastructure independently of the auction. There may be a number of organisations that could be interested in building the basic infrastructure needed to support extended mobile coverage but might not be interested or successful in bidding for an 800 MHz licence. It is therefore possible that the organisation (or organisations) appointed to develop new infrastructure will not be a (4G) mobile service provider. Regardless of the identify of the infrastructure builder, it is likely that there will need to be arrangements that allow network operators access to the new infrastructure, and this is likely to provide a means for one or more network operators to deploy network equipment capable of supporting mobile broadband at least at some of the MIP sites. More particularly, we expect that MIP funding will be targeted at those areas at the edges of or outside the current 2G coverage footprint. The primary focus of the MIP is likely to be on extension of mobile voice coverage but some if not all of the resulting infrastructure is likely to be capable of supporting the provision of mobile broadband services in the same areas⁴⁵.
- 5.44 In light of the responses to the March 2011 consultation and the Government's initiative we have looked at options for a coverage obligation materially in excess of 95% indoors.

⁴⁴ http://www.hm-treasury.gov.uk/press_112_11.htm

⁴⁵ The Government will release more information on the MIP as it develops. In the information memorandum (IM) for the auction we will provide details of the MIP and provide any further details in an IM update before the application date for the auction.

- 5.45 The establishment of the MIP materially changes the case for a coverage obligation more extensive than the one we proposed in the March 2011 consultation. Although the contribution of £150m is likely to be focused on delivering improved voice coverage, the MIP is also likely to support the delivery of mobile broadband on infrastructure that does not form part of existing 2G networks, and could therefore materially reduce the costs of extending coverage beyond 95%. It could therefore support an obligation that goes materially further than the 95% UK population target we previously proposed.
- 5.46 One way of specifying a more extensive obligation would be to set the target as coverage of an area in which 98% of the UK population lives, as suggested by most responses that favoured a coverage obligation. It would be open to operators to determine the most efficient means of meeting this obligation, for example through use of the MIP infrastructure where possible and potentially by negotiating access to existing MNO sites where the operator needed additional sites and access was a cheaper alternative than deployment of new sites.
- 5.47 Another way of specifying a more extensive coverage obligation would be to link it more directly to the coverage that the MIP will provide through the establishment of new infrastructure. This obligation would require coverage comparable to the combination of both the coverage delivered by existing 2G networks (in combination) and the extended coverage achieved as a result of the MIP, to the extent that the MIP infrastructure is capable of supporting 4G network equipment.

An obligation to provide coverage approaching 100% of the population

- 5.48 A more extreme option would be to have an obligation that targets coverage of an area in which 99% or 100% of the UK population lives. A few responses suggested such a target: CMA suggested it should be 100%; Wiltshire Council and a confidential response suggested 99%.
- 5.49 We believe that 100% coverage is very unlikely to be achievable in practice and even if it were the number of delivery addresses served by each additional base station would be in single figures. Hence, the incremental costs of covering 99% or 100% of the UK population would be high and we do not propose to specify an obligation that specifically requires coverage at that level.⁴⁶

Summary of the options

- 5.50 The table below summarises the main factors for assessing the options.

Table 5.1: Assessment of options for a coverage obligation

Option	Assessment
1. Do not include a coverage obligation in 800 MHz licences.	<ul style="list-style-type: none"> • Three consultation responses thought that including a coverage obligation would be unnecessary or inappropriate. • We provisionally consider it would be proportionate to include a coverage obligation and the arguments put forward do not justify abandoning our proposal. • We believe there is a possibility that, notwithstanding what we

⁴⁶ It is important to note in this context that we are talking about indoor mobile broadband coverage, for reasons that are discussed further below; in the case of mobile voice coverage it may be more relevant to consider outdoor coverage, in which case it may be more practical to think about coverage levels more closely approaching 100% of premises (and indeed, existing coverage of 2G networks outdoors may well already be in excess of 98% or even 99%).

	<p>expect will be a competitive market, commercial levels of coverage using LTE technology would fail to deliver the benefits of next generation mobile broadband to a substantial number of consumers and citizens in the UK, within an acceptable period of time.</p>
<p>2. Have a coverage obligation substantially lower than 95% of the UK population</p>	<ul style="list-style-type: none"> • No responses suggested setting the coverage obligation at a level below 95% of the UK population. • One response suggested the level would need to be reduced to ensure costs were relatively low. • We provisionally consider that a target substantially below our proposed 95% of UK population would risk denying or delaying the benefits of next generation mobile broadband to a substantial number of consumers and citizens in the UK, within an acceptable period of time.
<p>3. Have an obligation to provide coverage to 95% of the UK population</p>	<ul style="list-style-type: none"> • Our provisional conclusion in the March 2011 consultation was that the costs of a requirement to serve 95% of the UK population should be relatively low as it broadly equated to the coverage that could be provided using existing mobile infrastructure. • The majority of responses welcomed the inclusion of a coverage obligation and while not opposed to a 95% obligation many of them wanted a higher target. • Technical analysis during the consultation period supports our provisional conclusion in the March 2011 consultation that upgrading an existing 2G network to provide mobile broadband using LTE would provide a similar level of coverage to the current 2G footprint. • A 95% obligation should not require the operator to build a significant number of new base stations. There is likely to be a business case for providing 4G services to a coverage level similar to today's 2G level. This coverage obligation would not force an operator to deploy additional infrastructure that it would not otherwise deploy, but it might require it to bring forward investment in a 4G network. • We provisionally consider this would be a proportionate approach as the cost of upgrading would be significantly less than building new base stations.
<p>4. Have an obligation to provide coverage to materially more than 95% of the UK population</p>	<ul style="list-style-type: none"> • Most responses argued for a coverage obligation going beyond 95% population coverage; many suggested a 98% target should be included in licences. This would ensure many living in rural or less densely populated areas would be served. • The Government's MIP will provide a basis for extending coverage beyond the existing 2G footprint and hence for an obligation that exceeds 95% population coverage. • Such an obligation could be specified either as coverage of 98% of the UK population or as coverage comparable to that delivered by today's 2G networks (in combination) plus the additional coverage delivered by the MIP, where the MIP infrastructure is capable of supporting 4G network equipment.
<p>5. Have an obligation to provide coverage approaching 100% of the UK population</p>	<ul style="list-style-type: none"> • Only a few responses suggested a 99% or 100% coverage obligation. • Reaching 100% is very unlikely to be achievable in practice and the incremental costs of even 99% would be extremely high.

Preferred option

- 5.51 Most responses favouring a mobile broadband coverage obligation suggested 95% UK population coverage would not be enough to ensure a significant number of people living in rural or less densely populated areas would be covered. We have re-considered what level it would be proportionate to set in a coverage obligation, taking into account our further analysis of the costs of extending mobile broadband coverage in rural areas and the Government's decision to invest £150m to improve mobile coverage in rural areas via the MIP. In light of these developments we now consider it would be proportionate to include a more extensive coverage obligation than proposed in the March 2011 consultation.
- 5.52 One approach ('Approach A') would be for this obligation to be a straightforward 98% UK population coverage obligation, as many responses advocated. Under this option, it would be open to a licensee to make use of suitable infrastructure provided as part of the MIP to reach the 98% target, although there would not be any obligation to do so. While this could afford the licensee flexibility, there would be a risk that the licensee would not make use of some MIP sites even though the MIP had determined that those sites delivered significant benefits to consumers and citizens.
- 5.53 An alternative approach ('Approach B') would be to link the coverage obligation more directly to the MIP. The licensee or licensees with the coverage obligation would be required to provide a mobile broadband service (to a quality standard to be defined) with coverage comparable to the 2G mobile voice coverage delivered by today's 2G mobile networks (in combination) plus the extended mobile voice coverage achieved as a result of the MIP, to the extent that the MIP infrastructure is capable of supporting 4G network equipment. On balance, we prefer this approach. It has two key advantages: it would increase the benefits flowing from the Government's investment in mobile infrastructure, leveraging this investment not only to provide better mobile voice coverage but also better mobile broadband coverage; it would also make it more likely that mobile broadband services would be provided in those locations where they were most valuable.

Indoor coverage

- 5.54 Besides the overall coverage level to be achieved we proposed in the March 2011 consultation to set a minimum service level, i.e. delivery of an indoor service and a minimum data speed. Our proposal was that the coverage obligation should relate to indoor coverage. BT's response argued that an indoor coverage target was the wrong policy goal as most of the 95% of the population targeted would have access to fixed broadband. Intellect also pointed out that the fixed broadband network plus WiFi could already provide indoor coverage.
- 5.55 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' time. In these circumstances an indoor coverage target would seem more appropriate than one limited to outdoors, and our technical analysis examined different methods of providing indoor coverage. While WiFi can be used to provide good depth of coverage in specific locations there may be practical challenges to using them as a means to providing consistently good coverage depth across all locations.
- 5.56 Consumers' experience of indoor reception can be highly dependent on the nature of the buildings in which they expect to receive an acceptable signal and where they are

within a building. In these circumstances it is very difficult to set a licence obligation that is realistic while at the same time is likely to result in an acceptable level of service for consumers. We welcome views on how we might define an indoor coverage obligation.

- 5.57 Providing an indoor service is, of course, more challenging and we have looked into cost-effective ways of meeting the challenge. Our technical analysis examined two different methods of providing indoor coverage: directly to mobile terminals from outdoor cells, and via window-ledge CPEs that route the LTE signal to mobile terminals. It found a possible cost-effective approach was a hybrid that involved combining the two methods. Initially, new sites would be built targeting indoor coverage directly to indoor mobile terminals. When the cost per premises of delivering a service by this means rose above the cost of delivering via a CPE the service would be provided via the latter. Additional sites would then be built to target additional outdoor coverage, which would be sufficient to ensure service to CPEs, which have higher height and antenna gain than conventional mobile terminals. The cost of this approach compare favourably with the conventional method of relying solely on delivering directly to indoor mobile terminals. For example, our technical analysis found the cost of meeting an indoor coverage target using the hybrid approach was roughly half that of delivering directly to indoor mobile terminals. Operators may have other views on the most cost-effective way of delivering an indoor service and it would be for the licensee to decide how it would meet its obligation.

Data rate

- 5.58 A 2Mbps minimum data rate is seen by the Government as the minimum level of service acceptable to deliver a reasonable broadband experience for users. Seven responses suggested that we should specify a higher data rate, with 5Mbps being generally seen as the appropriate level. Our technical analysis considered the consequences for a network of having to deliver this level of service. It found delivering the higher data rate resulted in lower coverage from a given number of sites and in approximately 50% higher costs per premises. We do not consider it would be proportionate to set an obligation based on a 5Mbps data rate, bearing in mind the 2Mbps data rate we propose is only the minimum level and most locations in a coverage area will benefit from higher speeds.

Bandwidth

- 5.59 There is a question of what bandwidth an operator would need to deliver a service meeting the obligation. In the March 2011 consultation we proposed attaching the coverage obligation to one 5 MHz lot in the auction. Seven responses argued that this would not be an adequate bandwidth to deliver a 2Mbps service across a cell. Everything Everywhere, H3G and a confidential response suggested a 10 MHz channel would be required. Our technical work since the March 2011 consultation supports this view. Therefore, we propose to design the spectrum auction to ensure that the coverage obligation attaches to a licence with at least 2x10 MHz of 800 MHz spectrum. Licensees required to meet the coverage obligation would not be restricted to do so solely using the 800 MHz band; it would be our intention that they might use suitable spectrum in other bands for which they were licensed.

Geographic coverage

- 5.60 An obligation targeted at a specific percentage of the UK population would not necessarily secure that level of coverage in all constituent nations of the UK, given

the distribution of population between them. There is a risk that, for example, some less populated areas of the UK might not receive any mobile broadband service at all.

- 5.61 In the March 2011 consultation we sought views on imposing a coverage obligation focussed on particular geographical areas and how these areas might be specified. 24 of the responses commented on these questions. Vodafone suggested additional obligations of this kind would be costly and might reduce overall network coverage. It also saw little prospect of the specified less densely populated areas being defined before the auction was set to take place. Everything Everywhere also saw significant complications in defining precise coverage target areas, which could delay the auction. However, most of the responses favoured some form of geographical coverage obligation. Suggestions were mainly for national and/or rural coverage, but there was also some call for regional or more granular obligations.
- 5.62 The options we are now proposing for a coverage obligation go beyond those set out in the March 2011 consultation. We consider that both Approaches A and B would address coverage issues in the nations and rural areas. An obligation to cover 98% of the UK population – Approach A - is likely to result in a high level of coverage in each of the nations and in all but the most remote rural areas, for example we anticipate coverage of at least 95% of the population of each nation. Approach B is designed more explicitly to take advantage of the new infrastructure developed under the MIP to deliver services to areas outside the current 2G footprint. We consider this approach is also likely to address coverage issues in the nations and rural areas and to do so in a more targeted way than a simple coverage obligation by nation or region. Nevertheless, we have considered whether the coverage obligation might be extended so that a target is set for each constituent nation of the UK in order ensure each enjoys a good level of coverage. Our analysis suggests 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. We invite views on this suggestion.
- 5.63 A specific aspect of the rural coverage issue is coverage on major roads. In the March 2011 consultation we asked stakeholders whether they had any comments or evidence on the need for an additional obligation to provide coverage on specific roads. We received 17 responses to this question. Most were in favour of an obligation to cover specified roads, variously defined as strategic routes, major roads and A/B roads. Four responses considered such an obligation was either unnecessary or would be expensive and divert investment from overall coverage provision.
- 5.64 In the March 2011 consultation we considered an obligation that would broadly replicate current 2G coverage might indirectly help address mobile broadband coverage on roads. As with rural coverage generally, we consider a targeted approach is best suited to addressing these specific problems. If coverage of rural roads were a priority the MIP would be one route to achieving this, and our second option for the specification of an extended coverage obligation would then ensure that 4G coverage matched this where this was cost effective (where MIP infrastructure was capable of supporting 4G service provision). We therefore do not propose to include an obligation to cover particular roads.
- 5.65 Three responses suggested coverage should be extended to railways. We are addressing this independently of the auction. As part of our work on mobile not-spots we are exploring with the rail industry in the context of wider industry issues ways to improve mobile coverage on the rail network.

Number of licences with a coverage obligation

- 5.66 In the March 2011 consultation we proposed that just one of the licences to be awarded should include the 95% UK population coverage obligation. We recognised this might lead to consumers' and citizens' choice of supplier being somewhat limited but considered in practice other operators might also offer similar levels of coverage. Twelve responses commented on this. H3G and Vodafone explicitly supported the proposal. Ten responses suggested one licensee with the obligation would not be sufficient as it would limit consumer choice and possibly lead to local monopolies.
- 5.67 We are now proposing to include a more extensive coverage obligation than proposed in the March consultation and, in light of concerns about consumers having a limited choice of supplier, have looked again at how many licences awarded in the auction should include the obligation.
- 5.68 Our preferred approach has two elements: (i) a requirement to meet a basic obligation comparable to the 2G mobile voice coverage delivered by today's 2G mobile networks (in combination); and, (ii) a requirement to provide coverage comparable to the extended mobile voice coverage achieved as a result of the MIP, to the extent that the MIP infrastructure is capable of supporting 4G network equipment.
- 5.69 In the March 2011 consultation we suggested it would be sufficient to place the obligation to serve 95% of the UK population on just one licensee. This was on the basis that rolling out 4G mobile broadband services to this level, which is similar to the current 2G coverage of each 2G network, could be achieved by upgrading an existing network. There will be a business case for doing so but it is uncertain whether relying on commercial incentives alone would ensure the timely provision of 4G services to this level. A licence obligation would be necessary to ensure consumers in most areas had access to new mobile broadband services within a reasonable period. In time we expected that other operators were likely to roll out services that matched the coverage of the operator with the obligation and this would provide consumers with a choice of supplier. We still consider, on this basis, it would not be necessary to place on more than one licensee the obligation to roll out 4G services to a level similar to the 2G coverage or any one of today's 2G networks.
- 5.70 We believe the extended coverage obligation we propose, both to provide 4G coverage comparable to the combined mobile voice coverage of today's 2G networks, and to go beyond that, either to deliver 98% population coverage or to deliver coverage comparable with the mobile voice coverage achieved through the MIP, should be placed on at least one licensee in order to secure within a reasonable timescale a 4G service in those areas beyond the current 2G footprint. We have considered whether additional licences should also contain this obligation in order to ensure consumers have a choice of supplier in those areas.
- 5.71 An important factor here is the extent to which the provision of new infrastructure under the MIP might improve the business case for rolling out 4G services in areas beyond the current 2G footprint. An improved business case could provide an incentive for multiple operators to serve those areas, thus matching the coverage of the operator with the obligation and providing consumers with a choice of supplier. However, the details of the MIP procurement are yet to be finalised. It will not necessarily be the case that every site in the MIP infrastructure will support all technologies and it is unlikely to be cost-effective to oblige an operator to use unsuitable sites. Also, it is possible that some sites will support only one 4G operator. The existence of the MIP infrastructure may therefore help provide a choice of 4G

service provider in some of the areas currently unserved by 2G but it may not be the complete answer.

- 5.72 We have therefore considered whether we should include in all licences the obligation to provide service beyond 95% in order to guarantee a choice of supplier, and to ensure that consumers from other areas, irrespective of their supplier, could access services in areas currently outside their supplier's 2G footprint. There is the risk that imposing the obligation on all would be inefficient as it could require the duplication of network equipment in areas where there was no commercial justification. It could also be difficult to enforce compliance with the obligation if it applied to multiple operators where there was limited access to infrastructure in particular areas and it was impractical or inefficient for all operators to install their own equipment.
- 5.73 In any case, we will need to ensure that our approach to the coverage obligation is consistent with the arrangements for access to the MIP infrastructure, and with state aid rules. It may not necessarily be the case, for example, that the holder of the coverage obligation would have preferential rights of access to MIP sites. This could mean that an operator other than the one with the coverage obligation might deploy 4G network equipment at an MIP site such that the operator with the obligation was unable to use that site for mobile broadband (because the site had limited space for 4G network equipment). In such circumstances, it might be appropriate to waive the coverage obligation at that site.
- 5.74 Given our concerns with the approaches set out in the preceding three paragraphs we have also considered whether it would be proportionate to supplement the primary coverage obligation with an obligation on the relevant licensee to provide other operators with wholesale access to its network in those areas beyond existing 2G coverage which it was obliged to serve. There may be a case for requiring wholesale access in order to ensure that there is the potential for consumers in such areas to have a choice of suppliers, without the need for inefficient duplication of sites. However, there may be costs and regulatory difficulties with such a wholesale access obligation. These costs include the additional costs of ensuring the network equipment is capable of supporting wholesale access. They also include the potential for the availability of wholesale access to undermine the incentive for wider network roll-out by others. This is one of our principal reasons for believing that wholesale access would not be appropriate in the case of coverage provided across most of the population of the UK, albeit we consider this likely to be less of an issue in the case of roll-out beyond existing network coverage. On the regulatory side there would be the costs of specifying the obligation and dealing with any disputes between operators over the terms of such access. Also, the relevant areas would need to be defined in the access obligation. It would also be necessary to specify, at some level, the scope of access to be provided and the terms on which it was to be provided including price (e.g. retail minus versus cost plus). In light of these costs and regulatory difficulties, our current assessment is that such an obligation would not be proportionate, but we remain open to imposing such an obligation if we receive evidence from stakeholders that the benefits would outweigh the costs.
- 5.75 In conclusion, we believe an extended coverage obligation should be placed on one licensee only. This would meet our primary objective of ensuring the provision of 4G services to the vast majority of the UK population within a reasonable timescale. Commercial incentives, we believe, will drive other operators to provide competing services in most areas, thereby providing consumers with a choice of supplier. We accept that consumers in some areas will not have such a choice, though this may be mitigated to some extent by the existence of a single operator obliged to provide a

service in areas within the current 2G footprint and beyond (so customers of this operator will receive good coverage in all areas, rather than having to make their choice of operator on the basis of the areas where each operator provides good coverage). However, our current assessment is that the various regulatory approaches to ensuring that consumers in all areas had a choice of supplier, and visitors were able to receive service from their preferred supplier in all areas, would be disproportionate to the likely scale of the problem.

Target date

- 5.76 In the March 2011 consultation we proposed 2017 as the target date for meeting the coverage obligation. In proposing 2017 we took into account the desirability of consumers and citizens across the UK being able to enjoy as soon as practicable the benefits of the wide range of applications that 4G technologies would provide. We also took into account when the spectrum will be available. At that time we estimated that most of the UK would be cleared of DTT in the 800 MHz band by the end of 2013, with Scotland being cleared by October 2014. Clearance of the whole of the UK by the end of 2013 now looks more plausible. (For more information see section 3 above.)
- 5.77 Six responses commented on the 2017 target date. Four of them thought this was unambitious and suggested 2015 as a target date or at least a progress milestone. Telefónica and UK Broadband thought that 2017 would be more difficult for a new entrant to meet.
- 5.78 In setting a target date of 2017 we have taken into account the time needed to plan and test a network and the rate at which it would be practicable to upgrade existing sites to LTE and where necessary build new sites. This is likely to be in the region of 3,500 sites per annum, which suggests it might take about three years to have a network capable of serving 95% plus of the UK population, after the initial planning and testing phase. We therefore believe the end of 2017 is the earliest reasonable date for meeting the coverage obligation and propose to maintain it as the target date.
- 5.79 We recognise this target date may be more challenging for a new entrant. All bidders, whether they have existing networks or not, will no doubt take into account whether they wish to bid for the spectrum to which the obligation will be attached. Our proposed auction design takes this into account.

Implementation of coverage obligations

- 5.80 In the March 2011 consultation we raised several issues related to implementation of the proposed coverage obligation, in particular how it should be specified. We considered three ways of specifying the obligation:
- By reference to a set of technical characteristics networks must meet that were consistent with a number of different consumer services. We considered the difficulty with setting technical characteristics was that in order to specify a particular SINR level and signal strength level it becomes necessary to be very technology- (in terms of the particular LTE deployment) and frequency-specific. It seemed unattractive to be this specific in defining the obligation ahead of the auction of the spectrum and roll out of the networks.
 - By reference to a minimum number of base stations to be enabled. We considered the outcome for citizens and consumers of such a measure would not

be clear and outcomes could be very different depending on the technical characteristics of the sites an operator actually established.

- In terms of the service to be provided. This is the approach we proposed to take. Our proposed specification was an obligation to serve, by the end of 2017, an area in which 95% of the UK population lives, capable of providing a sustained downlink speed of 2Mbps with a 90% probability of indoor reception.

5.81 We invited views on the different ways of specifying the obligation to ensure that that was most likely to meet our objective. No response to the consultation suggested an alternative way of specifying the obligation from the one we proposed. Though, as discussed earlier in this section, not every response agreed with the need for an obligation or its precise formulation of the coverage and service levels.

5.82 Related to the way in which the obligation might be specified is the approach we should take to monitoring compliance. Telefónica, in its response, suggested it would be administratively efficient to treat compliance in a way consistent with how we propose to measure compliance with the new 3G retail service obligation. We set out this approach in the notice we published on 2 February 2011 on the proposed variation of 3G licences.⁴⁷ As we said in the statement on the consultation⁴⁸, we have established a working group with the operators to discuss issues raised in responses. We will take into account the outcome of these discussions in deciding how we should monitor compliance with any coverage obligations we included in 800 MHz licences.

5.83 It has been suggested that monitoring compliance based on technical criteria would not truly reflect consumer experience. In particular this approach might show compliance while a substantial number of consumers did not in practice receive the level of service or coverage set out in the obligation. In order to address this, technical assessment of compliance might be complemented by some testing of actual experience. This could be on the lines of the drive tests we have conducted, such as the mobile signal strength measurement campaign in Devon⁴⁹. We would welcome views on the value of such approaches to compliance monitoring.

Provisional conclusion

5.84 We propose to include in one of the 800 MHz licences to be awarded through the auction an obligation to provide a mobile broadband service for indoor reception to significantly more than 95% of the UK population. We have looked at how to specify such an enhanced coverage obligation. We see two main options:

- Setting a higher but specific population coverage obligation that the licensee must meet by using any infrastructure available to it, including relevant MIP infrastructure where available. Our provisional view is that the obligation should be to cover an area of the UK within which 98% of the UK population coverage.
- Specifying a coverage obligation by reference to existing 2G coverage (of all existing 2G networks in combination) *plus* the additional mobile voice coverage

⁴⁷ <http://stakeholders.ofcom.org.uk/binaries/consultations/2100-MHz-Third-Generation-Mobile/summary/main.pdf>

⁴⁸ <http://stakeholders.ofcom.org.uk/binaries/consultations/2100-MHz-Third-Generation-Mobile/statement/statement.pdf>

⁴⁹ http://www.ofcom.org.uk/static/research/CRFS_report.pdf

achieved through the Government's MIP (to the extent that MIP infrastructure is capable of supporting 4G service provision).

- 5.85 We have a preference for the second option, which we consider has two key advantages: it would increase the benefits flowing from the Government's investment in mobile infrastructure, leveraging this investment not only to provide better mobile voice coverage but also better mobile broadband coverage; it would also make it more likely that mobile broadband services would be provided in those locations where they were most valuable.
- 5.86 We propose that just one 800 MHz licence contains the obligation. We believe that this is a proportionate measure that balances appropriately the risk of inefficient use of the spectrum against the benefits for consumers and citizens of wider coverage. In order to address concerns regarding lack of consumer choice in the areas where commercial deployment is unlikely we have considered whether to supplement the coverage obligation with one that requires the licensee to provide other operators with wholesale access to its network. We invite stakeholders' views on the costs and benefits of such a wholesale access obligation.

Question 5.1: Do you have any comments on the proposal to include a coverage obligation in at least one of the 800 MHz licences, and the proposed extent of such a coverage obligation?

Question 5.2: Do you have any comments on which of the two approaches proposed for the specification of such an obligation would be preferable: 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; or 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 MIP, in those areas where MIP infrastructure is capable of supporting a 4G mobile data service?

Question 5.3: Do you have any comments on our assessment that it is unlikely to be proportionate to impose such a coverage obligation on more than one licensee?

Question 5.4: Do you have any views on the costs and benefits of a wholesale access obligation on the licensee with the coverage obligation in respect to those areas beyond existing 2G mobile voice coverage?

Partial revocation

- 5.87 In the March 2011 consultation we said we would consider including as a licence condition a power for Ofcom to partially revoke the licence if use of the spectrum were needed to deliver a specific policy goal, such as the provision of rural broadband. There were some consultation responses on this issue: four thought an additional revocation power was either impracticable or unnecessary; ten broadly supported the idea.
- 5.88 We have given this matter further consideration. In particular we have examined 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. None of the options that involve the inclusion of licence conditions in this regard appears to be either practicable or effective, taking into account in particular the need for clarity in defining a suitable licence condition and the need for potential bidders to be able to assess the risk of partial revocation of their spectrum rights (should they be successful in the auction). Therefore we do not propose to include in the licences to be awarded a 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.

- 5.89 We note however 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. It therefore remains open to us, in certain circumstances, to consider granting additional (concurrent) licences to use the spectrum that will be the subject of the auction.
- 5.90 Our current view is that we would only consider doing so 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.
- 5.91 Any such grant would also have to be compatible with our statutory duties, taking into account not only the benefits of the grant but also the costs, including for example any potential impact on customers or prospective customers of the licensee.
- 5.92 Any licence granted in the above circumstances would run concurrently with the licences awarded through the auction, which would remain unvaried. We would anticipate requiring both licensees to comply with a co-ordination procedure that we notified to them, to ensure that each licensee's system did not interfere with the operation of the other. Co-ordination would need to take into account both an existing licensee's current operations and any that it intended to establish within a reasonable period of time in the relevant area. Recognising that a licensee winning rights to use spectrum in the auction may require some years to roll out a network covering a high proportion of the UK, particularly rural areas, we would certainly not expect to consider granting any concurrent licences within the first five years of the licence term (and would hope not to have to do so at any time).
- 5.93 For the avoidance of doubt, the above is not intended to fetter our discretion to authorise any use of these or any other frequencies, for any purpose, in line with our statutory duties, whether through licensing or licence exemption.

Question 5.5: Do you have any comments on the possibility that we may in certain limited circumstances consider granting concurrent licences as set out in paragraphs 5.88 to 5.93?

Section 6

Spectrum packaging: revised proposals

- 6.1 In the March 2011 Consultation, we set out proposals for the packaging of the spectrum available for auction. We described the main factors relevant to spectrum packaging and how we proposed to approach each of them. This resulted in proposals for the packaging of spectrum in each of the bands that will be or may be available in the auction, while allowing for uncertainty in respect of certain aspects (such as potential differences between blocks in the 800 MHz band or whether there may be a reservation for low power use at 2.6 GHz).
- 6.2 A number of respondents provided feedback on our proposals, including BT, David Hall Systems, Everything Everywhere, the Federation of Communication Services (FCS), H3G, Intel, Intellect, ip.access, NATS, Skype, Stephen Temple, Telefónica, Turquoise Mobile, UK Broadband, Vodafone and five confidential respondents. The majority of responses were broadly supportive of our preferred approach, in particular regarding the main factors we are taking into account for our packaging proposals and how we develop proposals on the basis of these factors.
- 6.3 There were also concerns raised in responses that have led us to prepare updated proposals for some aspects of the packaging arrangements, in particular the lot size for both paired and unpaired lots at 2.6 GHz.
- 6.4 In this section, we summarise our March proposals and the responses we received and we present our updated packaging proposals in four areas:
- a) the general principles we are proposing to apply in packaging the available spectrum.
 - b) our updated proposals for the packaging of lots in the three relevant categories of spectrum:
 - o the 800 MHz band,
 - o the 2.6 GHz band, and
 - o the 900 MHz, 1800 MHz and 2.1 GHz bands; and
 - c) a short update on our plan for how to set reserve prices.

General principles for spectrum packaging

- 6.5 Consultation responses relevant to spectrum packaging showed general support for our high level approach, for example from BT, H3G, C&WW, Everything Everywhere, Intellect, UK Broadband and Vodafone. They also included some specific comments on the application of the principles we had set out from some of these respondents as well as from David Hall Systems and FCS and some confidential respondents.
- 6.6 BT, H3G, Everything Everywhere and a confidential respondent in particular confirmed that they were not aware of factors other than those we had set out that are relevant to spectrum packaging issues.
- 6.7 We cover the issues in the following order.

- a) Band plans – supporting economies of scale in equipment manufacture
- b) Lot size in each category – minimum useful block size for combinatorial bidding
- c) Number of categories of lots –as few categories as possible given the technical characteristics
- d) Contiguity of lots – licensees will benefit from contiguous assignments in each band
- e) Geographical reach of lots – UK-wide lots

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

- 6.8 Respondents did not express any concern regarding our proposal to use fixed band plans consistent with European spectrum decisions and international equipment standards for both the 800 MHz and the 2.6 GHz bands. By fixed band plan, we mean, in a given band:
- a) a fixed amount of paired (FDD) 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 (TDD) spectrum suitable for both uplink and downlink use, at specified frequencies.
- 6.9 In particular, there was no request from stakeholders to have flexibility in the amounts of paired and unpaired spectrum in the 2.6 GHz band in the auction.
- 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 as required under EC merger decision COMP/M.5650.
- 6.11 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.
- 6.12 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.
- 6.13 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. Both in our pre-consultation research ahead of publishing the March 2011 consultation and in stakeholder feedback to that consultation, we have not identified any evidence of demand for potentially different band plans at 2.6 GHz.

There would therefore be 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 proposing to have flexible band plan arrangements.

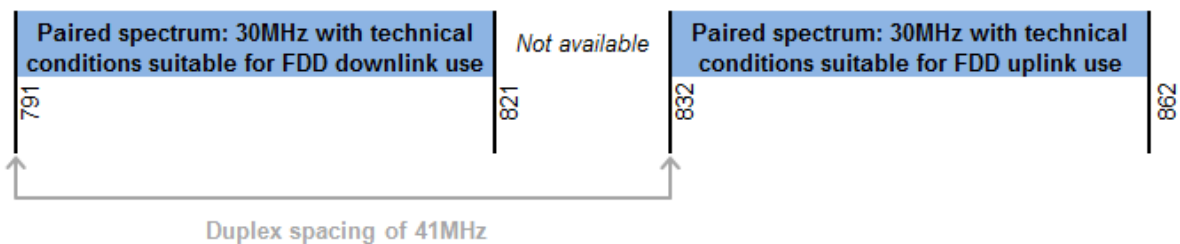
6.14 In the case of the 900 MHz and 1800 MHz bands, the relevant EC decision and international standards set out a fixed band plan for each band.⁵⁰ In addition, the EC decision on the merger of Orange and T-Mobile identifies specific frequencies at 1800 MHz for Everything Everywhere to divest.

6.15 For the available spectrum, the proposed fixed band plans are as follows.

a) 800 MHz

- Paired (FDD) spectrum suitable for downlink: 791-821 MHz.
- Paired (FDD) spectrum suitable for uplink: 832-862 MHz.
- Duplex spacing of 41 MHz.
- Unpaired (TDD) 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

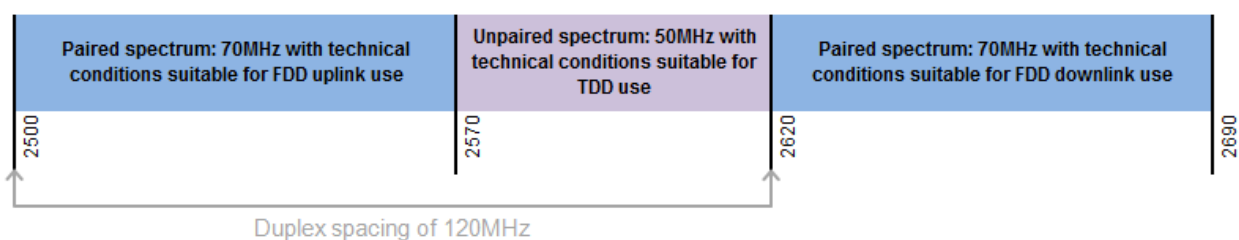


b) 2.6 GHz

- Paired (FDD) spectrum suitable for uplink: 2500-2570 MHz.
- Paired (FDD) spectrum suitable for downlink: 2620-2690 MHz.
- Duplex spacing of 120 MHz.
- Unpaired (TDD) spectrum suitable for both uplink and downlink: 2570-2620 MHz.

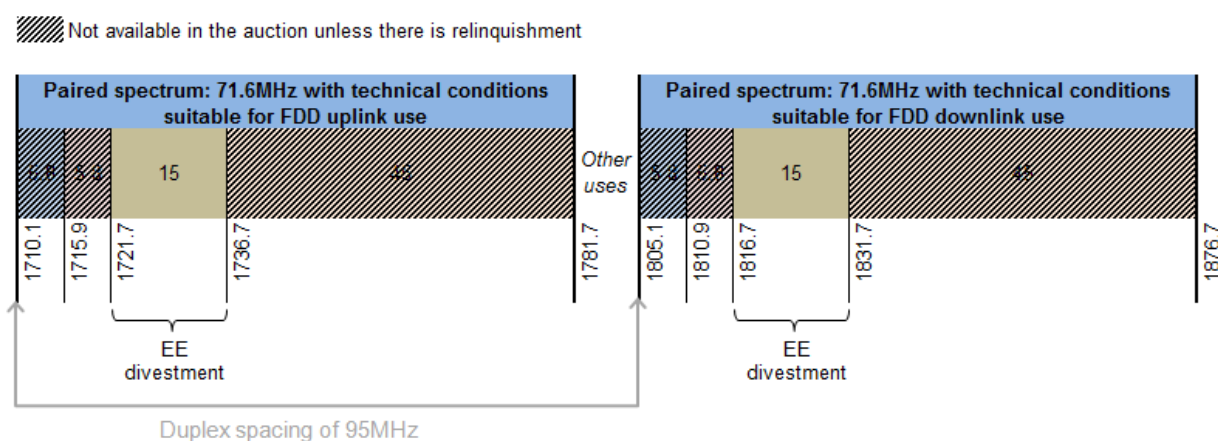
⁵⁰ 900 MHz will only be available in the auction if (i) we allow relinquishment into the auction, and (ii) a current 900 MHz licensee decides to relinquish some 900 MHz spectrum into the auction. The same applies to 1800 MHz spectrum, save that in addition, it is possible that the 2x15 MHz of 1800 MHz spectrum that Everything Everywhere must divest as a result of merger commitments to the European Commission will be available in the auction.

Figure 6.2: Band plan for the 2.6 GHz band



- c) 1800 MHz divestment and potential relinquished spectrum (if available in the auction)
- o Paired (FDD) 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 (FDD) 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 Any additional or alternative spectrum in the band that might be available as a result of relinquishment ahead of the auction would have to be consistent with the band plan below (from 1710.1-1721.7 MHz paired with 1805.1-1816.7 MHz and 1736.7-1781.7 MHz paired 1831.7-1876.7 MHz).
 - o Duplex spacing of 95 MHz.
 - o Unpaired (TDD) spectrum: not applicable.

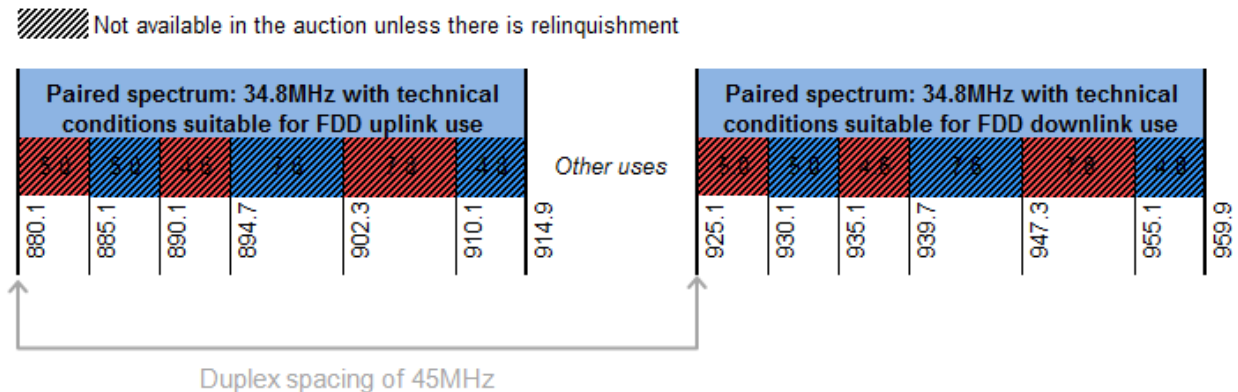
Figure 6.3: Band plan for the 1800 MHz band



- d) 900 MHz potential relinquished spectrum (if available in the auction)
- o Paired (FDD) spectrum suitable for uplink: from 880.1-914.9 MHz.
 - o Paired (FDD) spectrum suitable for downlink: from 925.1-959.9 MHz.
 - o Duplex spacing of 45 MHz.

- Unpaired (TDD) spectrum: not applicable.

Figure 6.4: Band plan for the 900 MHz band



- 6.16 We set out proposals for technical licence conditions for each of the bands in our June 2011 Consultation.

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

- 6.17 We explained in the March 2011 consultation that we were seeking to identify a balance between two factors:
- 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
 - 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 then proposed specific unit sizes for lots in each category (paired; unpaired) in each band (800 MHz; 2.6 GHz). The lot size for the 1800 MHz divestment (if available in the auction) forms part of the requirements of EC merger decision COMP/M.5650.
- 6.19 When commenting on this issue, stakeholders supported our view that it was not necessary to accommodate smaller block sizes such as 2x1.4 MHz for paired spectrum. Instead, they supported a unit size of 2x5 MHz for paired spectrum. This was on the understanding that bidders would be able to bid for large channels that support high mobile broadband speeds, consistent with our proposals.
- 6.20 There was one exception, as the FCS was in favour of 2x10 MHz lots as this was the minimum size necessary in their view to reap the benefits from technologies such as LTE.
- 6.21 Some stakeholders agreed with our principles but commented on the way we were proposing to apply them. They identified some potential costs from our proposed lot size for 2.6 GHz paired and unpaired spectrum, indicating that we had gone too far in attempting to simplify lot structures. We set out our updated proposals for each band and category later in this section.

- 6.22 The FCS proposed a radically different approach. This proposal would involve making all of the available spectrum as a single package for a regulated monopoly to exploit. This issue relates primarily to the assessment of future mobile competition which we discuss in section 4 and section 2 of annex 6 in particular.

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

- 6.23 In March, we proposed multiple categories of lots for the available spectrum, so that blocks of spectrum that had similar properties and were therefore sufficiently close substitutes were in the same category for the purpose of the Principal Stage:
- a) Paired use and unpaired use are structurally different and distinct technology choices.
 - 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) to justify different lot categories. If any 900 MHz spectrum were relinquished into the auction, the timing of its availability and potential issues regarding the contiguity of blocks larger than 2x5 MHz would likely justify a separate category.
 - c) Within the 800 MHz and 2.6 GHz band, our proposals included distinct types of lots:
 - o At 800 MHz, some lots would not have a coverage obligation attached while a coverage obligation would attach to one lot. Some lots might also have certain technical restrictions to manage the risk of interference with adjacent bands.
 - o At 2.6 GHz, for paired spectrum, we proposed to have lots for individual, standard power use as well as lots for concurrent use by a number of users at low powers. There are also unpaired lots in this band. (The need to manage risks of interference with adjacent users was not expected to lead to technical restrictions that differed materially between blocks in the band.)
 - d) We expected any relinquished spectrum in the 900 MHz band to be in a generic category of 2x5 MHz (or equivalent) lots, all with the same date of availability.
 - e) If the 1800 MHz divestment was available in the auction, it would be as a single lot given the requirement for a single winner of the 2x15 MHz. We expected any relinquished spectrum in the 1800 MHz to be in a generic category of 2x5 MHz (or equivalent) lots, all with the same date of availability.
 - f) It appeared highly unlikely that any current licensee would seek to relinquish paired spectrum in the 2.1 GHz band.
- 6.24 We had also envisaged that, in principle, differences in the timing of availability of certain parts of each band might justify differentiating between lots on that basis. However, as discussed in section 3 and in light of consultation responses on this issue, we do not believe that there are likely to be material differences in timing of availability that would justify using different lot categories for that reason.
- 6.25 However, we also explained that, to the extent that it is appropriate and reflects the conditions of use of different blocks of spectrum, having as few categories of lots as possible is beneficial. The benefits take the form of reduced auction complexity,

greater ease of expression of demand, ease of choice for bidders and a more efficient demand and price revelation process. Having few categories of lots works particularly well in the context of combinatorial clock auctions even if it is not a necessary condition for this type of auction format. Any differences between specific frequency blocks in the same lot category would be relatively small and bidders would have the opportunity to reflect these second order differences in the Assignment Stage (see section 7 and annex 11 for more detail on auction design issues).

- 6.26 Respondents supported our approach. C&WW and some confidential respondents emphasised the need to ensure suitable coexistence between new uses at 800MHz and 2.6 GHz and existing adjacent uses, in particular for Digital Terrestrial Television and aeronautical radars respectively. Turquoise Mobile was keen for us to review all potential interference scenarios to develop technical conditions and lot categories. A confidential respondent argued that adjacency conditions could lead to a requirement for specific categories of lots at one or more edges of the available bands, as we had envisaged in March. Some welcomed the forthcoming consultations (at the time) on DTT coexistence and technical licence conditions for the available spectrum and reserved their views on adjacency issues until they had considered these documents. One respondent encouraged Ofcom to make as much information available as possible regarding adjacent uses and radar use above 2.6 GHz in particular.
- 6.27 We set out our updated proposals at paragraphs 6.63 to 6.69 below taking account of the latest information on coexistence with adjacent uses. We agree with stakeholders that we need to develop technical conditions to ensure appropriate coexistence between all new and existing uses. We are still conducting our detailed analysis of the technical licence conditions following the June 2011 Consultation and the May 2011 Consultation. Our proposals in this document therefore constitute our best view of the range of possibilities at this stage subject to this on-going work, with Government, on the options for managing coexistence between uses.
- 6.28 Section 5 provides our analysis of the size of spectrum block to which the coverage obligation should attach at 800MHz.
- 6.29 Later in this section, we set out how we propose to apply these principles in respect of each band, recognising where there are uncertainties. This includes our current view of the implications of coexistence between uses at 800 MHz on the number lot categories.

Relinquishment into the auction of spectrum currently licensed

- 6.30 We considered whether there might be a case for allowing relinquishment into the auction of spectrum that existing national wholesalers of mobile services currently hold. The main reason for doing so relates to our competition analysis and the potential for spectrum caps to restrict the amount of spectrum that each auction participant can acquire. In principle, a bidder already holding mobile spectrum might prefer to relinquish some of its licensed spectrum in order to acquire newly available spectrum at 800 MHz or 2.6 GHz if caps would otherwise prevent them from doing so.
- 6.31 We proposed that the cap levels that we were considering in March were unlikely to bring bidders to choose between retaining current holdings and buying additional spectrum in the auction. Respondents supported this view with only Everything Everywhere expressing an interest in being able to relinquish 1800 MHz spectrum that they hold whether in advance of the auction or during the auction in light of

bidding. No respondent disagreed with our view that relinquishment of 2.1 GHz spectrum was highly unlikely. Some respondents, such as BT, David Hall Systems and Vodafone, expressed support for the proposal not to allow relinquishment of licensed spectrum in the auction.

- 6.32 However, Everything Everywhere explained that they would welcome the opportunity to be able to bid for 900 MHz spectrum and therefore disagreed with our proposal. They were also in favour of being allowed to relinquish more spectrum than the divestment required under the EC merger decision. H3G was also of the view that we should have required relinquishment of 900 MHz and 1800 MHz spectrum into the auction.
- 6.33 The competition analysis in sections 4 and annex 6 considers whether relinquishment of 900 MHz or 1800 MHz spectrum should be part of the measures we are putting forward to promote competition. We are also not precluding Everything Everywhere or others from relinquishing spectrum ahead of the auction. However we note that, absent a requirement for existing national wholesalers to relinquish spectrum ahead of the auction, it seems unlikely that 900 MHz or 1800MHz (other than potentially Everything Everywhere's divestment) would be available in the auction.
- 6.34 For those sets of measures in our competition assessment that include relinquishment of spectrum that is currently licensed, the requirement we propose is to make available in the auction an amount of spectrum that will be known ahead of bidding. We are not proposing to allow relinquishment of spectrum during the auction because there would be significant complications in the auction design compared to a scenario in which any relinquishment occurs ahead of the auction.
- 6.35 If one or more licensees relinquished some spectrum at 900 MHz or 1800 MHz (or 2.1GHz) ahead of the auction, we would intend to make it available in the auction in a way consistent with the principles set out in this section (band plans consistent with international standards such as for that for LTE; lot sizes such that 2x5 MHz are effectively useable given the need to manage interference with adjacent blocks; generic lots in each band as far as possible subject to adjacency conditions and timing of availability; UK-wide reach).

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

Proposal to ensure contiguity for each bidder in each band

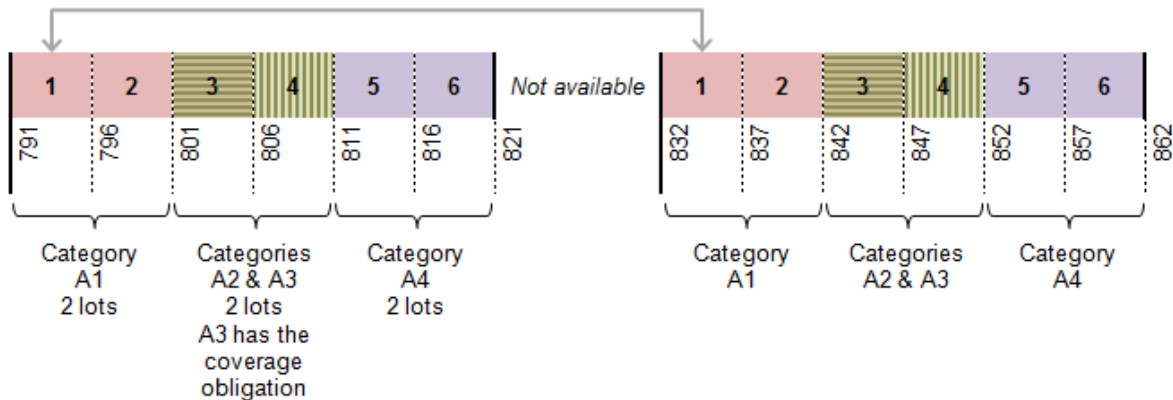
- 6.36 In our proposals, we identified consumer benefits that contiguous spectrum supported in the form of higher service performance and fewer frequency adjacencies to manage amongst users of a band (i.e. reduced risk of interference and reduced cost of delivering a given quality of service).
- 6.37 Several respondents highlighted these benefits for technologies such as LTE. They therefore agreed that any lots awarded to a given bidder should be contiguous in each band.
- 6.38 Some respondents highlighted an issue we had raised during a seminar on spectrum packaging and auction design in May.⁵¹ The issue was that with certain numbers of

⁵¹ <http://stakeholders.ofcom.org.uk/binaries/consultations/combined-award/annexes/slides.pdf>

lot categories, it would be difficult to implement the proposed contiguity requirement in the 800 MHz band.

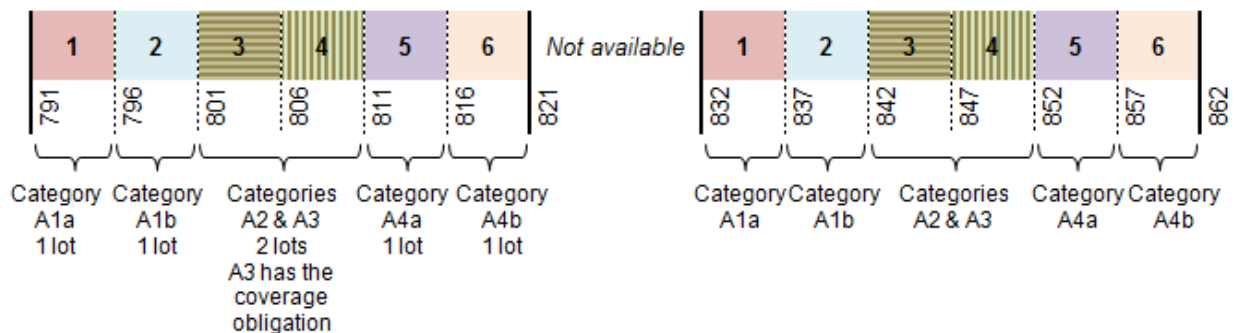
- 6.39 The lot structure for 800 MHz envisaged in the March 2011 consultation involved four categories of lots: two generic lots in category A1 (the bottom two blocks of 2x5MHz); two specific lots A2 (without coverage obligation) and A3 (with coverage obligation) that could be in either of the middle blocks; and two generic lots in category A4 (the top two blocks). See Figure 6.5 below.

Figure 6.5: Band plan for the 800 MHz band with four illustrative lot categories as proposed in the March 2011 consultation



- 6.40 With such a structure, one bidder could bid for one A1 lot and the A3 lot while another could bid for one A1 lot and the A2 lot. These bids could not be both consistent with contiguous assignments while they could be individually consistent with a contiguous assignment.
- 6.41 This was why, for the purpose of the seminar and subsequent mock auctions at the end of May and in early June, we modified the lot structure to six categories of lots of 2x5 MHz each as per Figure 6.6 below (instead of four categories).

Figure 6.6: Band plan for the 800 MHz band with six lot categories as used for the purpose of the consultation mock auctions in May and June 2011



- 6.42 With this new arrangement, it was simple to ensure that lots in a bid were contiguous. Stakeholders supported this approach if it proved necessary to have more than two lot categories. We propose to adopt it if necessary as it makes implementing contiguity requirements much more transparent and simple.
- 6.43 A confidential response also raised a specific case related to packaging proposals such as the main option set out in March for the 800 MHz band when, it argued,

there might be benefits to awarding non-contiguous lots in a band to one or more bidders:

- a) The stakeholder's example involved two bidders each making one bid only. Bidder 1 bid for the A2 lot and one A4 lot. Bidder 2 bid for the A3 lot and one A4 lot for a lower amount.
- b) These bids are mutually incompatible if contiguous assignments were required: A2 cannot be contiguous with an A4 lot while at the same time A3 being contiguous with an A4 lot. The consequence of the contiguity requirement, given a lot structure with some specific lots, was that only one bidder could win and spectrum for which there was apparent demand would be unsold.
- c) The respondent argued in favour of considering the possibility of non-contiguous assignments to deal with such situations.

6.44 This issue arises because of the multiplicity of lot categories. Under this type of lot structure, it is also true for example that a bidder could not bid for two lots, one A1 lot and one A4 lot, if there was a contiguity requirement for each assignment in the band. If there was only one category of lots then the issue would not arise. If there are multiple categories, the likelihood that it would arise is also reduced when there are few categories of lots compared to the number of unit blocks available in a band. We discuss the number of lot categories in each band later in this section.

6.45 Our preferred approach, subject to further stakeholder comments, would be to introduce different categories of lots to the extent that it appears justified on the basis of the underlying usability of the blocks involved. With few (two) categories of lots, offering bidders the opportunity to bid for contiguous and non-contiguous assignments would (i) seem unlikely to bring any clear efficiency benefits and (ii) come at a cost in terms of complexity for bidders and complexity for the auction design and implementation.

6.46 According to our information and in particular stakeholder feedback on our March proposals, it is not clear that potential bidders would be likely to have a greater value for non-contiguous blocks than for alternative packages of contiguous lots (in a context where lot categories reflect material differences between blocks). Indeed the stakeholder that raised this issue did so with a particular concern regarding the lot structure set out in March 2011 (which we have since proposed to change) and did not argue that they were likely to have higher valuations for non-contiguous packages than for contiguous packages.

6.47 A relevant mitigation for the issues that the respondent raised is for bidders to make sure that they bid on all packages for which they have a value. In the example that the stakeholder raised, if bidder 1 and/or bidder 2 had bid on other packages such as say A1+A2 or two A4 lots, then both bidders would have won spectrum. The example where each bidder only has a positive value for a single package seems to be an extreme case.

6.48 Bidders would have to consider what their valuations would be for contiguous and non-contiguous assignments. It would also be prudent for them to consider the potential impact on their strategy and prospects of winning spectrum from other bidders being able to bid for contiguous and non-contiguous assignments.

6.49 From the auctioneer's perspective, it would mean changes to the rules and software implementation for winner determination and pricing, to incorporate non-contiguous

bids. It would also mean facilitating the collection of new types of bids in the software interface. The consequential increase in complexity and development costs do not appear justified when benefits seem so unlikely.

- 6.50 We are therefore proposing to include a contiguity requirement for each individual assignment in each band if we were to use two categories of generic lots (with and without coverage obligation). If we were to use more categories of lots in a way that would support contiguous bids, we could require all bids to be for contiguous blocks of spectrum. There would also be scope for accommodating certain non-contiguous bids. Considering the lot structure in Figure 6.6 above, we could allow bids, for example, for two lots such as a bid for the A1a lot and the A3 lot. These two lots would necessarily be non-contiguous and it would be up to the bidder to select such a package. This raises the question of the risks for overall efficiency (and potential strategic motivations) if non-contiguous assignments could isolate certain lots. For example, a bid for lots A1b, A3 and A4a would, if successful, isolate lot A2.
- 6.51 We would welcome stakeholder's comments on the importance and benefits of being able to make bids for non-contiguous blocks of spectrum in the 800MHz band under an approach with two lot categories and an approach with more lot categories. It is not clear to us that such benefits would be likely to be material and we have identified above some potential risks.

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

- 6.52 Some stakeholders also raised the issue of contiguity of lots across bidders, i.e. ensuring for example that bidder 1's assignment and bidder 2's assignment in a band are contiguous, with a view to facilitating subsequent spectrum sharing.
- 6.53 We consider this issue in detail in section 7 on auction design, in relation to the Assignment Stage of the auction.

Geographical reach of lots – UK-wide lots

- 6.54 Very few respondents commented on our proposal for the geographical reach of lots to be UK-wide. We explained that, in principle, there might be efficient uses of the spectrum that involved different licensees in different parts of the UK for the same frequencies. However, we considered that it would be very difficult for us to identify in advance how to divide lots geographically to support such potential efficient use and that designing an efficient process capable of dealing with a potentially large range of combinations of geographical subdivisions would be a challenge, probably a disproportionate one. Other avenues are likely to provide some scope for regional use of spectrum available in the auction subsequent to the award. The two main options are the possibility of 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).
- 6.55 David Hall Systems argued that we should have given more consideration to the possibility of regional lots in the auction, recognising that some operators may be interested in serving only specific parts of the country.
- 6.56 As explained above, we recognise that there may be demand for non-UK-wide use of some of the available spectrum and that such use might, in principle, contribute to overall efficiency. However, the difficulty of identifying how to combine various potential geographical demands is very high and the risks of failing to identify an

efficient combination are also high, as some demands are likely to be incompatible and certain combinations would likely lead to reduced efficiency. We have not received any specific information detailing what demand there may be for regional use of the available spectrum and where exactly regional use might take place (or views on what conditions might be appropriate to manage interference risks at the boundary between geographical areas).

- 6.57 Trying to engineer regional use for this award in a granular way would therefore raise potentially large risks of getting regional divisions wrong. Consequently, the outcome of the award could be less efficient, which could be very costly to consumers.
- 6.58 This would also have an impact on the design of auction rules and their implementation.
- 6.59 We are therefore continuing to propose to make UK-wide lots available. Spectrum trading post-award will remain an option for licensees and interested parties to explore options for localised use. We have also raised in the competition assessment (see section 9 of annex 6,) the possibility of having a simple geographical split for one or more licences for concurrent low power use at 2.6 GHz).
- 6.60 There was also an issue specific to the concurrent type of licence we proposed at 2.6 GHz. A confidential respondent argued that, in the case of 2.6 GHz concurrent low power lots, it would be beneficial to allow regional divisions of lots, as long as interference conditions remained manageable. The argument relates to the less challenging environment for interference management between users at the boundary between two areas, because of the relatively low powers for use of these lots.
- 6.61 However, we are not proposing to allow regional lots in the award for the reasons set out above. In addition, we are not proposing to allow spectrum trading for parts of the UK for this type of licence. This is because the costs of coordination between concurrent low power licensees depend in part on the number of licensees that will be coordinating with each other as a result of their concurrent access to the same frequencies. Divisions of licences by geography would make it possible for the number of licensees for concurrent low power spectrum to increase, potentially without limit. This creates risks to participation from prospective low power licensees and risks to the efficiency of their use post-award were they to win rights to spectrum. Geographical trading would cause uncertainty regarding coordination costs and would risk undermining the scope for concurrent use.
- 6.62 The only type of trade we are proposing to allow 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.

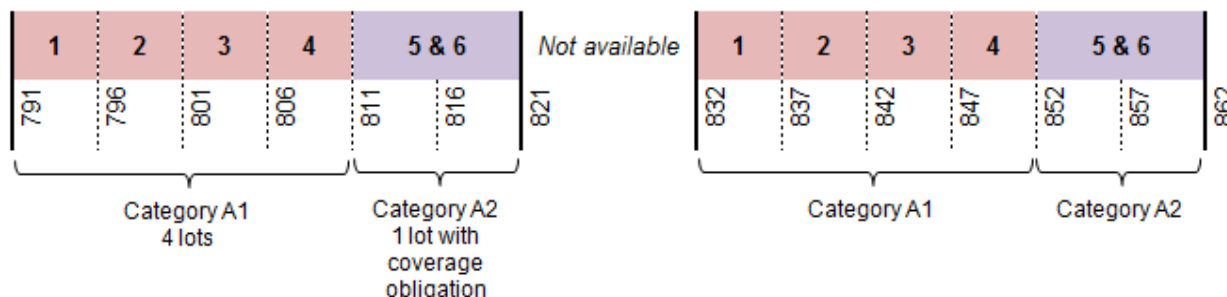
Packaging proposals for the 800 MHz band

- 6.63 Most respondents to the March 2011 Consultation agreed that a 2x5 MHz lot size is desirable for the 800 MHz band and it is the lot size we are proposing to use. We noted above that there was no interest in smaller lots. With the combinatorial auction format we are proposing in section 7, it is possible and very simple for bidders to bid on larger packages only (2x10 MHz and above), with the guarantee that, if they win, they will only win packages of lots that they bid for in their entirety.

- 6.64 There was broad agreement with using as few lot categories as possible, subject to differences between lots being sufficiently small. Telefónica argued that there should be one or at most two categories for the band and whether there should be a second one depended on coexistence with DTT. Everything Everywhere and a confidential respondent also highlighted the importance of a clear understanding of coexistence with DTT to decide on lot categories for the 800 MHz band.
- 6.65 We explain above that we are providing updated proposals on the basis of the best view we can formulate now of coexistence issues with adjacent uses. We still need to conduct analysis, continue our work with Government and conclude consultation processes before taking a view on how to manage coexistence. Ahead of this point, our proposals reflect the range of possibilities that appear likely. As far as coexistence with adjacent uses is concerned, we estimate that there are two main scenarios, which both relate to coexistence with DTT. We believe that it is already relatively clear that coexistence with uses above the 800 MHz band is unlikely to result in material differences for the purpose of defining lot categories. In respect of DTT use below the 800 MHz band, the first scenario is that managing coexistence does not result in material differences and the second is that it does. In the second scenario, we would expect at most two blocks of 2x5 MHz at the bottom of the 800 MHz band to be affected.
- 6.66 As discussed in section 5, six respondents suggested that the coverage obligations should be extended to more than 2x5 MHz spectrum. Everything Everywhere, H3G and a confidential response suggested that delivering the coverage obligation would require a 2x10 MHz channel. Some supported the view that the spectrum with the coverage obligation should be treated as a separate lot category. The technical work we have undertaken since March suggests that it is appropriate to attach the coverage obligation to a 2x10 MHz block. We also set out our proposals for which parts of the band the obligation can attach to, i.e. any of the top four blocks of 2x5 MHz in the 800 MHz band.
- 6.67 Given this latest view, we believe that it is appropriate to define a specific category for the 2x10 MHz lot to which the coverage obligation attaches (assuming we decide to impose a coverage obligation, in accordance with our current proposals). Indeed, if we were not to do so, the risks that bidders would face by discovering only in the Assignment Stage whether they were going to win spectrum with the coverage obligation would likely impact on auction efficiency.
- 6.68 Taking all factors into account, we think that, on the basis of current information, there are two main options for how to package the band.
- a) The first option is relevant to the case where coexistence with adjacent uses including DTT does not result in material differences between lots. There would then be two categories of lots: four generic lots of 2x5 MHz without the coverage obligation and one lot of 2x10 MHz with the coverage obligation. In this case, where it would be suitable to treat blocks 1 to 4 generically, we could fix the A2 lot with the coverage obligation at the top of the band. This would avoid raising issues of coexistence with DTT (as distinct from the question as to whether lots may be generic). There would not be any material efficiency loss from restricted choices of specific frequencies in the Assignment Stage (as it would not matter greatly to the winner of A2 where that lot was and if another bidder had a preference for being next to the winner of A2, it would not matter greatly to that other bidder that they had to hold block 4 to achieve contiguity). We are not aware of reasons why this would have any negative impact on outcome efficiency, while it would simplify the lot structure and assignment options.

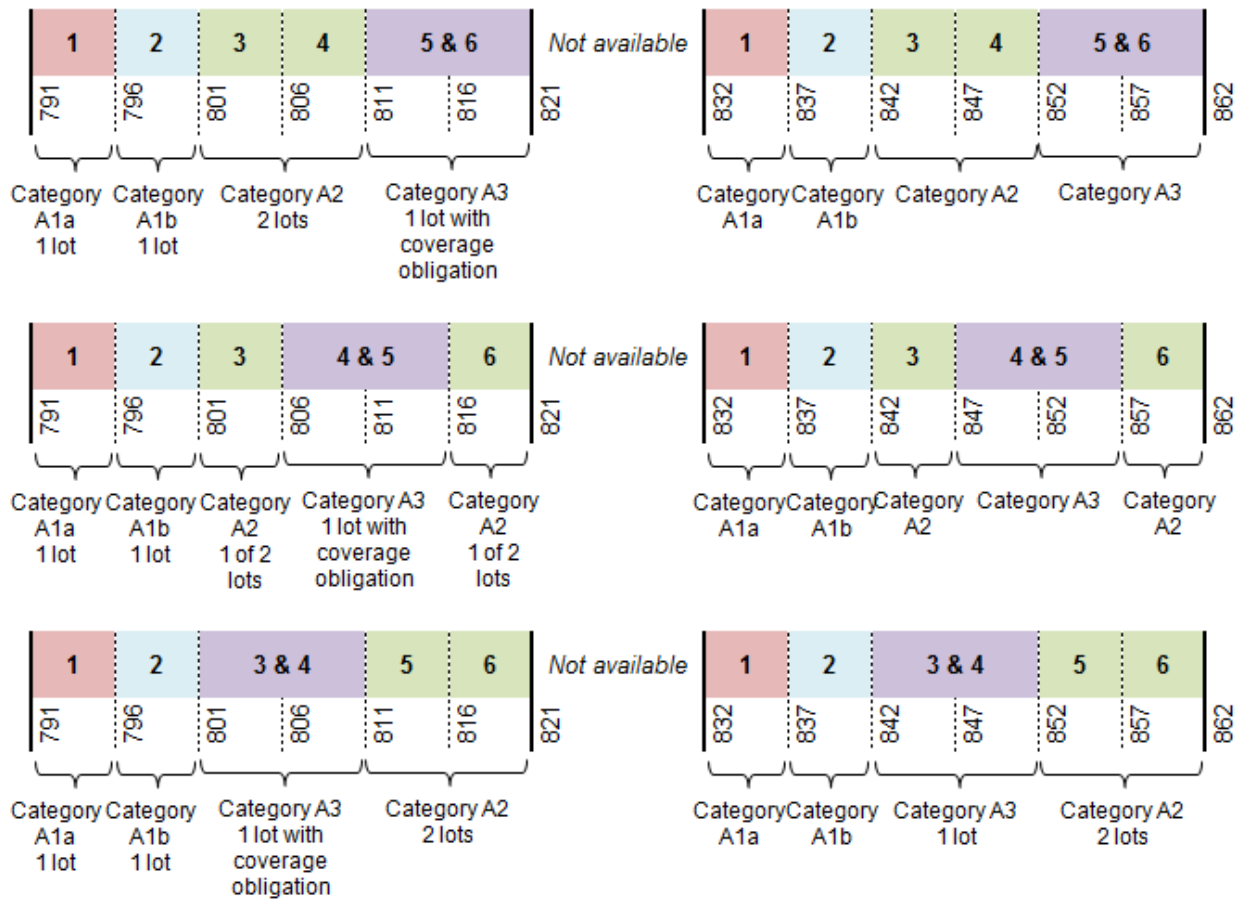
Alternatively, we could allow the A2 lot to be in one of three positions (blocks 3 and 4; blocks 4 and 5; blocks 5 and 6, assuming that it would be preferable for the A2 lot not to be on the bottom two blocks because of coexistence issues).

Figure 6.7: Band plan for the 800 MHz band with illustrative lot categories as proposed in option 1



- b) The second option is relevant to the case where coexistence with adjacent uses, in particular DTT, results in material differences between lots. As per the proposals we set out during our seminar on 19 May, this option involves defining three specific lot categories within two distinct groups: the first group – categories A1a, A1b and A2 – has a lot size of 2x5 MHz and no coverage obligation; the second group includes lot A3 only, with a lot size of 2x10 MHz and the coverage obligation. In addition to reflecting differences between blocks in the band if that were appropriate, this option facilitates the implementation of the proposed contiguity requirement for each assignment. Figure 6.8 sets out the organisation of lots under this option and the possible permutations. In this case, there would also be an option to fix the A3 lot at the top of the band for simplicity (and only the first of the three options in Figure 6.8 would then be relevant).

Figure 6.8: Band plan for the 800 MHz band with illustrative lot categories as proposed in option 2



Question 6.1: Do you agree with our revised proposals for the packaging of the 800 MHz band? Please state the reasons for your preference.

6.69 In section 9, we set out our plans for providing further information on coexistence with adjacent uses.

Packaging proposals for the 2.6 GHz band

6.70 Respondents supported our proposed approach to the band plan (as discussed above) and there was also broad support for treating lots generically in each category in the band.

Paired spectrum (for individual use at standard powers) – lots of 2x5 MHz for aggregation

6.71 In the March 2011 consultation, we proposed to use lots of 2x10 MHz, reflecting the likely interest in wider channels for delivering high quality services. This also allowed a degree of simplification for the auction design, with a reduction in complexity.

6.72 Some stakeholders supported our proposal on lot size. However, several others including BT, H3G, Everything Everywhere and a confidential respondent argued that using a lot size of 2x5 MHz would be preferable. The main reason for doing so would

be to allow bids for packages including 2x15 MHz of 2.6 GHz, which would be consistent with some of the minimum spectrum portfolios proposed in the March 2011 consultation.

- 6.73 In light of feedback on the March 2011 consultation, we propose to use 2x5 MHz lots for 2.6 GHz paired spectrum for individual use at standard powers. The increase in complexity is only modest, while it enables a richer set of bids in the auction and is likely to increase the scope for efficient use of the spectrum.

Unpaired spectrum – lots of 5 MHz for aggregation

- 6.74 Our March proposals were to award the unpaired part at the centre of the band as a single block (including restricted blocks at the bottom and at the top to manage the risk of interference between paired and unpaired use). On the basis of the information available to us then, it seemed to be the best compromise between likely interest for use of those frequencies and simplicity for the award.
- 6.75 A confidential respondent supported our proposal to have a single block of unpaired spectrum. H3G preferred using two lots as in the equivalent auction in Germany and Austria. Others, including David Hall Systems, Everything Everywhere, Telefónica and Vodafone, explained that there were potentially valuable options for use of parts of the unpaired 50MHz and that use as a single block might not be in best interests of consumers. Under their preferred approach, there would be the prospect of having several users of TDD technology at 2.6 GHz should the market deliver this outcome. The auction could determine which option was likely to generate the greatest value. Allowing bidders to aggregate small blocks would allow use of smaller blocks and use of a single block of 50 MHz to compete in the auction, without limiting options unduly.
- 6.76 In light of the expressions of demand in responses to the March 2011 Consultation and results of auctions of the 2.6 GHz band in European countries where there were multiple winners of the unpaired part, we consider that there are good arguments to enable multiple winners in the unpaired 2.6 GHz spectrum.
- 6.77 Allowing bidders to aggregate lots in the unpaired spectrum increases auction complexity somewhat, principally because of the need to deal with interference between unpaired users (through use of a restricted block between two adjacent unpaired users) as well as between paired and unpaired users (through two restricted blocks, one at each end of the unpaired range, as proposed in March). With the potential for multiple winners of unpaired spectrum, the number of restricted lots in the unpaired spectrum is a variable and this brings a degree of complexity. However, this complexity is relatively modest. We also recognise the risk of regulatory failure in the alternative approach, i.e. for us to define a suitable number of fixed-size lots and their respective size.
- 6.78 In light of the above considerations, we propose to use lots of 1x5 MHz for unpaired spectrum and let bidders aggregate them in their bids according to their preferences (subject to any relevant restrictions on bids). Each bid for unpaired spectrum will, under this proposal, include at least two lots, the lowest of which will have restricted rights for the purpose of interference management. The top block at 2615-2620 MHz will be a restricted block and will not be available in the Principal Stage; it will be granted to the winner of the adjacent unpaired frequencies.
- 6.79 Following a request from Everything Everywhere to allow bids for a single 5 MHz lot of unpaired spectrum (which would necessarily have to have restricted usage rights),

we also specifically invite stakeholders to comment on the merits of allowing bids for a single unpaired lot that would have restricted technical conditions. If there were clear benefits from this approach, it would be a minor change to the packaging provisions and the auctions rules.

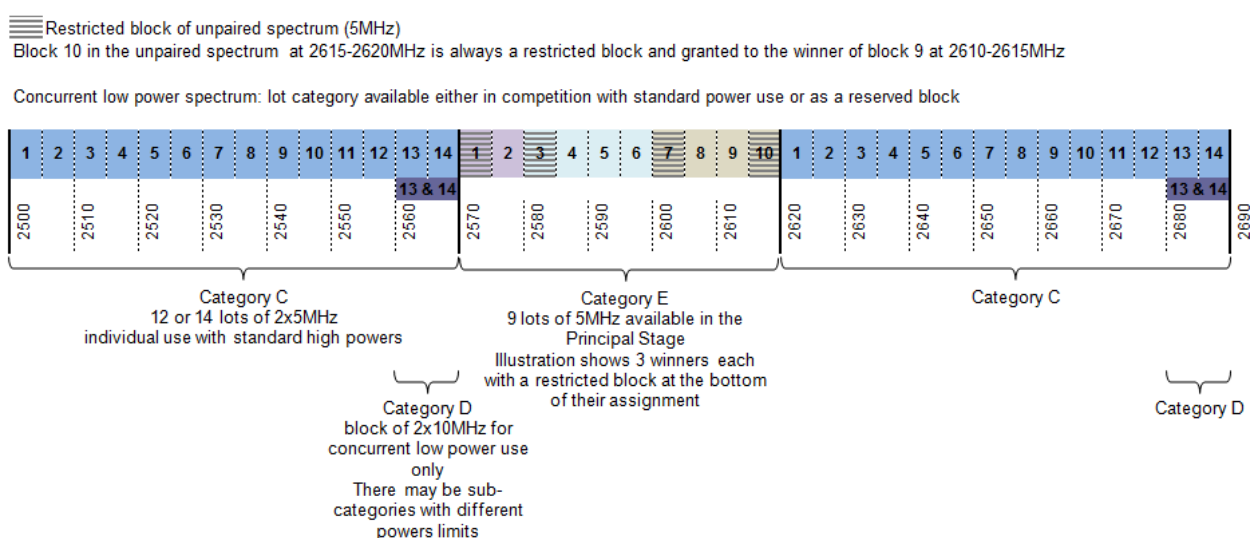
Paired spectrum for concurrent low power use – focussing on option with a 2x10 MHz lot in competition with individual use at standard powers

- 6.80 In the March 2011 consultation, we considered a number of options for concurrent low power lots at 2.6 GHz, all involving paired spectrum. In particular, we envisaged a contiguous block of 2x10 MHz or a contiguous block of 2x20 MHz for low power use only, and hybrid approach with 2x10 MHz for low power use only, adjacent to a block of 2x10 MHz for both individual use at standard powers and concurrent low power use (with a set of principles for coordination between the various users).
- 6.81 As discussed in section 4 and section 9 of annex 6, we are no longer proposing a hybrid approach following further analysis and stakeholder feedback on the challenges of this approach.
- 6.82 We explain in section 9 of annex 6 that there are ten main options that we are considering regarding low power use. For simplicity, for the purpose of this section on our packaging proposals, we use only one of these options to illustrate packaging provisions regarding concurrent low power use. The option that we illustrate is option III, aggregating bids for national low power use in one 2x10 MHz block. For the same illustrative purposes, we also consider 10 concurrent low power licences.
- 6.83 BT suggested defining two types of concurrent low power lots: one with a lower power level and one with a higher power level. They argued that this would make it possible to manage the risk of interference in the case of outdoor use, as the lower power level would be appropriate for indoor applications but sufficiently low as not to risk interference issues for potential outdoor use.
- 6.84 This seems to us to be a potentially interesting approach and we would welcome feedback on it. It would be simple to implement through spectrum packaging. This would involve having two different types of low power lots for the same 2x10 MHz block: a first one with a power level that provides scope for some outdoor coverage (e.g. 30dBm under BT's proposal) and a second one that has less scope for outdoor coverage and is more suited to providing coverage in a typical UK dwelling (e.g. 10dBm under BT's proposal). The two types of low power lots would be identical in all other ways. The number of lots with some scope for outdoor coverage would be lower, to manage interference risks, e.g. 3 to 5. The more restricted power level for the second type of concurrent lot would provide scope for a larger number of users, e.g. 10 to 15.
- 6.85 We would be interested in hearing from stakeholders on potential disadvantages for consumers from managing power restrictions for concurrent users in a way similar to BT's proposal. Stakeholders may have views on power levels for the two categories of licences, the number of categories and the number of licences per category for example.
- 6.86 We also note that in the competition assessment (see section 9, of annex 6), we raise the possibility of having one or more 2.6 GHz licences split geographically, with concurrent low power use in rural areas and individual use at standard powers in non-rural areas. Implementing this approach would be relatively simple, with the introduction of one or more lot categories for concurrent low power use in rural areas.

Diagram of proposed lots categories and organisation

6.87 Figure 6.9 below provides an illustration of the lots categories and organisation in the 2.6 GHz band, consistent with the discussion above and the band plan structure set out earlier in this section. As discussed in section 7, any concurrent low power lot could be located at one end of the 2.6 GHz band if we fixed its position ahead of the auction or could have its position determined in the Assignment Stage (e.g. on the basis of bids subject to the nature of the assignment process). For the purpose of the diagram below, we use an illustration in which any low power lot would be at the top of the band and may be in competition with individual use at standard powers (as such competition illustrates the most complex case in respect of concurrent low power use for auction design).

Figure 6.9: Proposed lots categories and band plan at 2.6 GHz (illustration with three winners of unpaired spectrum showing restricted blocks)



Question 6.2: Do you agree with our revised proposals for the packaging of the 2.6 GHz band? Please state the reasons for your views.

Packaging proposals for 900 MHz, 1800 MHz and 2.1 GHz spectrum

6.88 If any relinquishment of spectrum in the 900 MHz, 1800 MHz or 2.1 GHz bands took place ahead of the auction, we would make that spectrum available in the auction and have corresponding lot categories consistent with the underlying characteristics of the relinquished blocks (size and in particular whether they are multiples of 2x5 MHz of useable spectrum; adjacency conditions; timing of availability). We also consider the issue of contiguity between relinquished lots and between relinquished lots and the 1800 MHz divestment.

6.89 We anticipate that any relinquishment would be as a result of competition measures for the auction. Therefore we do not consider packaging of relinquished spectrum that is not consistent with the relevant requirements of proposed competition measures (e.g. relinquishment in blocks of less than 2x5 MHz of useable spectrum).

900 MHz

- 6.90 It would be for any 900 MHz licensee who was relinquishing spectrum into the auction to identify the relevant frequencies being relinquished. We are not proposing to require contiguity given the current band plan and the likely difficulty of achieving contiguity. Relinquishers would also need to ensure that they comply with the requirements regarding size (multiples of 2x5 MHz) and timing of availability (see paragraphs 8.144-8.146 of Annex 6 for a discussion).
- 6.91 Adjacency conditions would need to be consistent with Commission Decision 2009/766/EC on the 900 MHz and 1800 MHz bands. It includes specific requirements regarding frequency separation between carriers depending on the technologies used in two adjacent blocks. This means that a block that is suitable for the use of 2x5 MHz (or multiples of 2x5 MHz for multiple lots) may be either:
- a) a 2x5 MHz block for which the relinquisher has secured a suitable agreement from adjacent user(s) for the carrier separation to be reduced consistently with that block size; or
 - b) a larger block of up to 2x5.4 MHz that does not require further agreement of adjacent users for the operation of a UMTS or LTE channel of 2x5 MHz.

1800 MHz

- 6.92 Relinquishers would also need to ensure that they comply with the requirements regarding size (multiples of 2x5 MHz) and timing of availability (see paragraphs 8.144-8.146 of Annex 6 for a discussion). Adjacency conditions would need to be consistent with Commission Decision 2009/766/EC on the 900 MHz and 1800 MHz bands and its requirements regarding frequency separation between carriers depending on the technologies used in two adjacent blocks. This means that a block that is suitable for the use of 2x5 MHz (or multiples of 2x5 MHz for multiple lots) may be either:
- a) a 2x5 MHz block for which the relinquisher has secured a suitable agreement from adjacent user(s) for the frequency separation to be reduced consistently with that block size; or
 - b) a larger block of up to 2x5.4 MHz that does not require further agreement of adjacent users for the operation of a UMTS or LTE channel of 2x5 MHz.
- 6.93 Given the size of Telefónica and Vodafone's holdings in this band, we propose to require that any relinquishment they make is of 2x5.8 MHz. This would avoid any further fragmentation of the band. For the same reason, there would be no contiguity requirement on any relinquishment by Telefónica or Vodafone.
- 6.94 In the case of Everything Everywhere relinquishing spectrum over and above its 2x15 MHz divestment, we would require the corresponding lot(s) to be contiguous with the divestment, again to limit the scope for further fragmentation of the band.

2.1 GHz

- 6.95 We are not setting out specific proposals for the packaging of relinquished 2.1 GHz spectrum in light of the general agreement from stakeholders that this was not necessary. For the avoidance of doubt, for any relinquished 2.1 GHz spectrum to be

included in the auction, it would have to be in multiples of 2x5 MHz blocks, each with specific dates of availability.

Overview of packaging proposals

6.96 Figure 6.10 below provides an overview of the packaging proposals discussed in this section.

Figure 6.10: Overview of spectrum packaging proposals

Band	Main options for lot categories	No. of lots	Lot size (MHz)	Eligibility per MHz (**)	Eligibility per lot
800 MHz	Option 1) Some specific lots 4 categories: 3 with lots of 2x5 MHz each - A1a (1 lot), A1b (1 lot), A2 (2 lots); 1 with a lot of 2x10 MHz - A3.				
	A1a and A1b relate to fixed frequencies (bottom two blocks). A1a, A1b and A2 lots are for 2x5 MHz.	4	2x5	3	30
	The coverage obligation attaches to A3, which is for 2x10MHz and relates to fixed frequencies at the top of the band.	1	2x10	3	60
	Option 2) two categories of lots 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 4 2x5MHz blocks. There are five A1 lots if the size of lot A2 is 2x5 MHz and four A1 lots if its size is 2x10 MHz.	4	2x5	3	30
	The A2 lot relates to the 2 blocks of 2x5 MHz at the top of the band.	1	2x10	3	60
1800 MHz (*)	Category B: single lot for specific frequencies as per the EC decision on the Everything Everywhere merger	1	2x15	2	60
2.6 GHz paired	Category C: paired lots for individual use at standard powers 12 generic lots available as a minimum and up to 14 depending on there is a reservation for lot D	12 or 14	2x5	0.5	5
	Category D: paired lots for concurrent low power use If there is no reservation for lots D, then whether there are any category D lots in the outcome depends on competition between demand for these lots and for category C lots.	0 or 10	2x10	0.05	1
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 may be a requirement for n to be equal to or greater than 2. 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).	9	5	0.5 (standard power); 0 (restricted)	2.5 (standard power); 0 (restricted)

(*) if available in the auction

(**) see section 7, paragraphs 7.14 – 7.27 for more detail

Reserve prices

- 6.97 In the March 2011 consultation, we considered three main options for reserve prices. These could be set at:
- a) “nominal” values, i.e. only sufficiently high so as to deter frivolous bidders;
 - b) a higher level that would ensure the recovery of costs of clearing spectrum and enabling the award; or
 - c) a level reflecting likely market value estimated in a conservative way.
- 6.98 We also raised the possibility of applying different reserve prices to different categories of spectrum, mentioning 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. During our May seminar, we explained that we never intended that bidders eligible to opt in under the proposed competition measures could pay a reserve price higher than the market price for other spectrum in the same lot categories. We also explained that it was likely to be difficult to implement differentiated reserve prices but that we would consider the issue further for completeness.
- 6.99 We have considered further the implementation of differentiated reserve prices and believe that it would be particularly complex to implement such an approach. The challenges include addressing the potential for a market price for non-reserved spectrum to be lower than the reserve price for reserved spectrum. We note a confidential respondent’s view that complexity should not lead us to abandon this approach. However, the reasons for using a level of reserve price that is close to market value for spectrum that is reserved under the proposed competition measures are also relevant to other spectrum in the auction. We do not believe that there are strong arguments for using a lower reserve price for spectrum that all bidders could compete for than for spectrum that only opted-in bidders can win. Therefore, we do not propose to seek to develop a set of auction rules that implement different reserve prices for these two categories of spectrum.
- 6.100 Several respondents highlighted concerns regarding the effect of reserve prices that are too high on participation and potentially unsold spectrum; many noted the difficulty of estimating market values. There were particular concerns in respect of concurrent low power spectrum at 2.6 GHz. A confidential respondent considered the illustrative levels in the March 2011 Consultation to be too high, focusing in particular on 800 MHz reserve prices and proposing £100m per 2x5 MHz lot instead. UK Broadband argued in favour of a lower reserve price for spectrum to which a coverage obligation attaches. C&WW also noted the benefits of having reserve prices that reflect the likely value of the spectrum consistent with our analysis. Everything Everywhere did not share our concern that a low reserve price was likely to result in frivolous bidding; they were in favour of an approach based on cost recovery for spectrum clearance activities. H3G was concerned about the possibility of dual reserve prices and the lack of justification for distinguishing between opted-in bidders eligible to benefit from the competition measures and others such that the former could pay more for spectrum.
- 6.101 We are mindful of two important effects of reserve prices that pull in opposite directions. On the one hand, there are likely efficiency benefits from higher reserve prices, in that they 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 combined award when it would have been in consumers' interests to have more. There is also a risk that spectrum may remain unsold if reserve prices are too high. In the competition assessment we recognise that there is a further option to those considered in the March 2011 Consultation, which strikes a balance between these effects. This is to set reserve prices by reference to estimated market value but with a discount.

- 6.102 We have engaged specialist advisers to help us (i) with identifying likely market values for the available spectrum and (ii) with identifying options to turn these market values into appropriate reserve prices. This work will take into account how to strike a balance between these two effects. We plan to incorporate the results of their analysis in specific proposals for reserve price levels in advance of, or in parallel with, our statutory consultation on the auction regulations.
- 6.103 We note that, consistent with stakeholder feedback, we plan to review our approach to reserve prices alongside the approaches to eligibility points to ensure suitable consistency across these various areas.

Section 7

Auction design: revised proposals

7.1 The March 2011 consultation included detailed proposals for auction rules with the following properties. The format proposed was a Combinatorial Clock Auction (CCA) involving a Principal Stage and an Assignment Stage:

- a) The Principal Stage consisted of three parts that take place in sequence:
 - o an opt-in round during which those bidders that are eligible decide whether to make bids at the reserve price for all the packages that would be sufficient to bring them to hold a minimum spectrum portfolio (“MSP”);
 - 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 proposed measures to promote competition involved requiring that the outcome of the Principal Stage included a sufficient number of winners such that, subject to demand, there would be at least four holders of MSPs following the auction.
- c) Each package bid made in the auction stood in its entirety. Winner determination for the Principal Stage therefore involved exploring all the combinations of bids (from the Primary Bid Rounds and Supplementary Bids Round) that involved at most one bid from each bidder, would have awarded no more lots in each category than were available, were consistent with restrictions on bids (e.g. caps or contiguity requirements) and satisfied the competition measure. The winning combination was to be the combination for which the sum of bid amounts was highest. We proposed to identify the price that each winner needed to pay according to a ‘second-price’ rule. Winner determination as well as pricing rules included provisions for tie-breaking.
- d) Under the option where we aggregate demand for low power use of 2x10 MHz of 2.6 GHz spectrum (as one of the range of approaches to this type of use that we consulted on), the Principal Stage would have determined what level of demand there was for concurrent low power use at 2.6 GHz and therefore whether 2x60 MHz or 2x70 MHz of spectrum were available for individual use at standard powers.⁵² This would have depended on competition between bids for concurrent low power use for a pre-determined number of licences in aggregate and bids for individual use at standard powers.

⁵² By standard power, we mean a power limit in licences that is typical of licences for terrestrial mobile networks providing wide-area coverage.

- e) The Assignment Stage was a single round of bidding in which Principal Stage winners could, if they wished, bid on preferred frequencies in each category of lots that they had won (where there were different options for where their lots could fall in a given band). The identification of the winning combination of bids and prices for this stage followed similar principles to those for the Principal Stage.
- 7.2 The large majority of respondents to the March 2011 consultation expressed clear support for the proposed CCA format and our general approach, highlighting a number of its strengths and its suitability to the circumstances. We note that since we first set out proposals to use this format for spectrum auctions, other European authorities have used this structure for high value spectrum auctions, for example in Austria,⁵³ Denmark⁵⁴ and the Netherlands.⁵⁵ Australia's ACMA also recently selected this format for its award of digital dividend spectrum and the 2.6 GHz band.⁵⁶
- 7.3 However, FCS did not support the use of auctions to award all types of licences. One respondent had reservations about the complexity of the auction design and considered that too many relevant factors remained unclear to express a full view. C&WW echoed concerns on complexity for bidders who focus primarily on low power spectrum. At the same time BT urged us not to simplify the design if this came at a cost to efficiency.
- 7.4 During the seminar on auction design we held in May, we explained that there were certain aspects of the design that we were still considering ahead of receiving consultation responses, as we had identified the potential for improvements. We felt however that the specification of the auction rules set out in March was sufficiently detailed and representative of a good implementation of our pro-competitive policy and our objectives for the award that it was right to consult on it then.
- 7.5 Respondents also provided comments and suggested changes regarding some important aspects of the design within the CCA structure. We have been considering these carefully and are updating our proposals in several respects to make the CCA format even more appropriate to the requirements for this auction.
- 7.6 The implementation of proposed measures to promote competition discussed in section 4, in particular spectrum floors, would be an important part of the auction rules if included. Section 4 sets out various options for what measures might be included in the auction. We provide a description of the proposed approach for implementing these various options, noting that they may or may not form part of the final package of measures that we decide to implement and therefore of the resulting set of auction rules.
- 7.7 The rest of this section covers our revised proposals in the following order:
- a) Our general principles in developing auction design proposals.
 - b) Eligibility points.
 - c) Proposal to bar bids on packages that cannot win because of any competition measure.

⁵³ See http://www.rtr.at/en/tk/FRQ_2600MHz.

⁵⁴ See <http://en.itst.dk/spectrum-equipment/Auctions-and-calls-for-tenders/2-5-ghz>.

⁵⁵ See <http://www.agentschaptelcom.nl/onderwerpen/mobiele-communicatie/2%2C6+GHz+veiling>.

⁵⁶ See ACMA's update of 9 September 2011 at <http://engage.acma.gov.au/digitaldividend/the-combinatorial-clock-auction/>.

- d) Proposals to improve demand and price information in the clock phase, including to ensure that bidders have information about demand from opted-in bidders.
 - e) Proposals to provide further incentives for truthful bidding through activity rules in the Primary Bid Rounds and Supplementary Bids Round.
 - f) Proposal on the scope for facilitating spectrum sharing, the approach to joint bidding and options for the Assignment Stage.
 - g) Discussion of the two pricing rules we have been considering, Vickrey-nearest and linear reference, with the conclusion that they are both valid options.
 - h) Discussion of the relevant process requirements involving the EC if the 1800MHz divestment is in the auction.
- 7.8 Annexes 11 and 12 set out the detailed rules that we are now proposing for the auction. They identify which parts of the proposed rules depend upon the measures that we ultimately adopt to promote competition.
- 7.9 Throughout this section, we refer to the requirement on the auction outcome that results from the measures to promote competition under some of our proposals, i.e. spectrum floors, as the Competition Constraint.

Our general principles in developing auction design proposals

- 7.10 At a high level, our general principles for designing the auction are straightforward, and are designed to ensure, among others, that our duty to secure the optimal use of the spectrum is achieved. First, we seek to make the price and demand revelation process as clear, useful and efficient as possible subject to controlling the risks of facilitating strategic behaviour (e.g. signalling or coordinated strategies, including tacit coordination).
- 7.11 Second, we seek to make sure that there are incentives that are as strong as possible for bidders only to make bids that reflect their true preferences, while giving flexibility for bidders to update those preferences for genuine reasons as they receive information on likely values from the open rounds of the auction.
- 7.12 Third, we seek to develop a set of rules that, in its totality, strikes a reasonable balance between these first two principles and ensuring the rules have a manageable level of complexity for bidders and auctioneer alike, allowing a workable implementation.
- 7.13 We continue to believe that the CCA auction format, and the specific rules set out in this consultation, represent the best choice to meet our objectives. Whilst we recognise that other choices might have advantages in certain regards – for example use of a first price, “pay-what-you-bid” rule might further reduce the incentive for strategic behaviour (in particular strategic investment) – in our view all such choices have offsetting disadvantages that out-weigh any such advantages – for example use of a first price, “pay-what-you-bid” rule risks an inefficient allocation of spectrum amongst bidders as a result of bidders shading their bids in an attempt to reduce what they will have to pay. Any auction design that, for example, attempted to eliminate, or at least very materially reduce, the risk of strategic behaviour – for example a first-price single-round sealed bid auction perhaps – would in our analysis raise serious concerns as regards other of our objectives – for example the efficient allocation of the spectrum to support optimal use. We would nonetheless welcome

any further suggestions from stakeholders as to how the proposed auction design might be yet further improved.

Eligibility points

- 7.14 In March 2011, we proposed to set eligibility points with two main guiding principles:
- a) Because of their function in constraining bidders' decisions so as to incentivise truthful value revelation and bids on most preferred packages, we considered that eligibility points should provide a reasonable reflection of likely relative values of the different categories of available spectrum.
 - b) At the same time, we want bidders to be able to respond to price changes to reflect genuine preferences. This suggests making sure that bidders have scope for switching demand between similar categories of lots as prices change, without an undue risk of facing subsequent restrictions in their ability to express genuine preferences.
- 7.15 We put forward a set of illustrative values for eligibility points for each lot category corresponding to these guiding principles.
- 7.16 BT, C&WW, David Hall Systems and Vodafone supported our proposals. Turquoise Mobile questioned whether they were overly complex.
- 7.17 A confidential respondent considered that the March proposals should have reflected the impact of requirements for coexistence with DTT on eligibility points for the lowest 800MHz lots (and reserve prices).
- 7.18 H3G supported the properties of the proposed eligibility points which allowed switching between certain quantities of 2.6 GHz and 800 MHz spectrum and of the two standard power categories at 2.6 GHz without reducing eligibility. However, they considered that the proposed points for the 1800 MHz lot did not support switching without loss of eligibility points and risked creating inefficiencies.
- 7.19 A confidential respondent suggested that, at 2.6 GHz, the likely value of the 40 MHz of useable unpaired spectrum was likely to be lower than that of 2x20 MHz of paired spectrum (for individual use at standard powers).
- 7.20 Skype noted that our illustration of eligibility points did not incorporate the results of the 2.6 GHz auction in the Netherlands. We did not incorporate those results because they were representative of specific circumstances for that auction, including stringent caps on existing mobile operators, such that the information was in our view less relevant in the UK context.
- 7.21 Everything Everywhere expressed a concern regarding the way in which eligibility points could adversely restrict their bidding choices given our proposal to impose an overall spectrum cap. We believe that our updated proposals for activity rules in the auction, in particular relaxation of the activity rule in the Primary Bid Rounds, are likely to address the underlying concern. We discuss this below and in Annex 11.
- 7.22 On the basis of available evidence (in particular results from other European auctions) including consultation responses, we consider that the likely value of 800 MHz lots is greater than other lots in the auction and that it is important to reflect this in eligibility points. Deciding the ratio of eligibility points between 800 MHz lots and other categories involves judgment. In our view, the ratio of one 800 MHz lot of 2x5

MHz for six 2.6 GHz paired (standard power) lots of 2x5 MHz each seems reasonable, bearing in mind that there are uncertainties. It reflects a much higher value for 800 MHz spectrum and constrains switching options without ruling out completely switching from 2.6 GHz lots to 800 MHz lots (subject to other constraints e.g. spectrum caps).

- 7.23 So far as the 2x15 MHz of 1800 MHz spectrum that might be available in the auction is concerned (if Everything Everywhere does not sell it privately before the auction), our previous analysis suggested that this spectrum was likely to have a value somewhere between that of 800 MHz spectrum and 2.6 GHz spectrum, but we chose to err more towards equating its value with that of 2.6 GHz spectrum than 800 MHz spectrum for the purpose of eligibility points. (In the March 2011 consultation we proposed 15 points for this 2x15 MHz lot compared to the 10 points that we proposed for each 2x10 MHz lot of 2.6 GHz spectrum; we subsequently said that it might be more appropriate to increase this to 20 points so that it would be easier for bidders to switch between this lot and two 2x10 MHz lots of 2.6 GHz spectrum). Our updated analysis suggests however that it might be more appropriate to equate 2x15 MHz of 1800 MHz spectrum with 2x10 MHz of 800 MHz spectrum e.g. to associate 60 eligibility points with such a lot (if it were available in the auction). In particular we are now of the view that an operator may not need sub-1GHz (800 MHz or 900 MHz) spectrum to be a credible national wholesaler, but if they don't hold such spectrum then they may need a sufficiently large block of 1800 MHz spectrum to be credible. In other words sub-1GHz and 1800 MHz spectrum are to some extent substitutes so far as credibility as a national wholesaler is concerned, in a way that 2.6 GHz spectrum probably isn't⁵⁷. We are therefore now proposing that there should be 60 eligibility points associated with the 2x15 MHz of 1800 MHz spectrum to be divested by Everything Everywhere if this is included in the auction⁵⁸.
- 7.24 If any 900 MHz spectrum were available in the auction, we would also expect eligibility points to facilitate switching opportunities with 800 MHz lots, so long as differences between categories were not too large. Therefore, we would propose to have the same eligibility for a 900 MHz lot corresponding to 2x5 MHz of useable spectrum as for an 800 MHz lot of 2x5 MHz, subject to the timing of availability of the 900 MHz being sufficiently similar to that of the 800 MHz lot.
- 7.25 It is also important to reflect differences between concurrent low power lots at 2.6 GHz and other lots including at 2.6 GHz. Consistent with respondents' general acceptance, we consider that it is appropriate to establish eligibility for any

⁵⁷ This is not to say that 800 MHz, 1800 MHz and 2.6 GHz spectrum are not substitutes in other contexts; in particular they are almost certainly substitutes so far as overall capacity is concerned. But given the limited amount of 800 MHz and 1800 MHz spectrum that will be available in the auction, and the minimum amounts of this spectrum likely to be needed to be a credible national wholesaler, we consider it more likely that the principal driver of the value of 800 MHz and 1800 MHz spectrum in the auction will be the need to acquire sufficient of this spectrum to be a credible national wholesaler, rather than its lesser value as a source of general capacity.

⁵⁸ An important benefit of our proposal to relax the activity rule that applies in the Primary Bid Rounds (see below), to allow bidders to bid on their more preferred package compatible with their previous bids even if it is larger than their current eligibility, is that bidders would have greater flexibility to switch between packages of spectrum in different spectrum bands irrespective of the associated eligibility. This would, for example, allow a bidder to switch back and forth between 2x15 MHz at 1800 MHz and 2x20 MHz at 2.6 GHz notwithstanding that the former would have an eligibility of 60 points and the latter only 20 points, provided that the bidder only tried to switch into the package with the greater eligibility (in this case the 2x15 MHz of 1800 MHz spectrum) when the price of that package had risen less than the price of the package with the lesser eligibility since the bidder first switched into the package with the lesser eligibility.

concurrent low power lots with the following principle: it should not be possible to switch from a concurrent low power lot to any other lot for individual use at standard powers, in particular unpaired lots at 2.6 GHz (the category for individual use with the lowest proposed eligibility per lot). Any eligibility value that is consistent with this principle and so reflects the different value of concurrent low power lots would be appropriate. We also note that, if we used eligibility points as the basis for an initial deposit, it would seem sensible for the combined value of all concurrent low power lots at 2.6 GHz (relating to 2x10 MHz) to attract the same deposit requirement as the 2.6 GHz lots for individual use with which they are in competition (2 lots of 2x5 MHz each). This would suggest an eligibility ratio of 1 to 5 if ten licences were available.

- 7.26 In the 2.6 GHz band, we agree that there is a question regarding the basis on which to allow switching between paired lots at standard powers and unpaired lots. Unpaired spectrum has a relatively uncertain value and has tended to attract lower prices than paired spectrum in recent auctions. On that basis, we would tend to favour setting the same eligibility for 40 MHz of unpaired spectrum excluding restricted blocks and a 2x20 MHz paired block or less. A smaller quantity of 2x15 MHz would be a potential option. Smaller amounts such as 2x10 MHz or less would raise the risk of underestimating the relative value of unpaired spectrum.
- 7.27 Figure 6.10 in section 6 sets out specific eligibility point values to illustrate the relativities that we are proposing to reflect. These values for eligibility points are based on relative values per MHz across the bands, so for example if lot sizes changed, eligibility points would change in accordance with values per MHz.

Question 7.1: Do you agree with our revised proposals for the number of eligibility points that should attach to each lot? Please state the reasons for your views.

A bar on bids on packages that cannot win because of a competition measure

- 7.28 BT, H3G and a confidential respondent commented that it was important to prohibit bidders from making certain bids if the measures in the auction to promote competition included spectrum floors. This is because without specific restrictions, bidders would have the possibility of knowingly making bids that cannot win but that could influence prices. This possibility arises because bids on certain packages might be incompatible with satisfaction of the Competition Constraint.
- 7.29 One respondent expressed concern regarding the risk that information given about what bids were allowed and not allowed might create asymmetries between bidders and create potential options for strategic behaviour.
- 7.30 The nature of the bids that cannot win depends on whether a bidder is eligible to opt-in and has opted-in, and on what spectrum they need to acquire to win a Minimum Portfolio Package (MPP)⁵⁹ if they have opted-in.
- 7.31 We agree with consultation responses on this issue that it is desirable, and important for the purpose of meeting our objectives for the auction, to prevent bids that cannot win from influencing prices. We therefore propose to prevent bidders from making such bids by identifying ahead of the first Primary Bid Round a list of packages (Permissible Packages) for each bidder that excludes those packages that cannot

⁵⁹ A Minimum Portfolio Package is a package such that, if an opted-in bidder won it, that bidder would in our view hold sufficient spectrum to be a credible national wholesaler.

win in any circumstances. The list would remain the same throughout the Principal Stage.

- 7.32 Under our proposal, as discussed in more detail in annex 11, each bidder has its own list of Permissible Packages which no other bidders see. All bidders have a list of Permissible Packages, whether they opted in or not. Any bid has to be for a package that is included in the bidder's list of Permissible Packages.
- 7.33 We have considered the risks that might result from providing each bidder with a list of their own Permissible Packages. It would reveal some information on how many and possibly which bidders had opted-in, particularly if there were few opted-in bidders. However, the information that bidders may be able to deduce from their own list of Permissible Packages is not a significant increment on that revealed by the additional information we are proposing to provide below (number of bidders that opt-in; Competition Credit) compared with our March 2011 proposals. By contrast, the risks to demand and price discovery from bids for packages that cannot win but could influence prices are relatively high.
- 7.34 We therefore propose to introduce the use of Permissible Package lists as described above. We would welcome further information on any potential reasons for concerns and the likely extent of these concerns if we introduced this change.
- 7.35 H3G also proposed that we should add restrictions on primary bids that opted-in bidders could make in the Primary Bid Rounds once the number of remaining opted-in bidders was equal to the number of Minimum Portfolio Package winners necessary to satisfy the Competition Constraint. The proposal was to prevent them from making any bid that is not at least a Minimum Portfolio Package. We do not believe that this is a necessary restriction in light of our proposals for excess demand assessment and the new Primary Bid Round closing condition set out below. It would be an unnecessary restriction on bidders.

Better demand and price information in the clock phase where measures include spectrum floors

- 7.36 The draft rules we set out in March did not include any particular provision for information revelation during the Primary Bid Rounds on the level of demand from bidders that might benefit from spectrum floors or associated effects on prices. Bids from opted-in bidders were to be treated like bids from any other bidder and reported as part of the overall demand for each category of lots. This was one of the areas we had identified for further consideration.
- 7.37 Under such a set of rules, demand from opted-in bidders might not be reflected in aggregate demand and price revelation affected. A simplified example illustrates this issue. Assume that three bidders A, B and C take part in an auction for four lots in a single category; one of the bidders, C, is opted-in and needs to form part of the winning combination, say with two lots. After a few rounds, C drops out, while A continues to bid for three lots and B continues to bid for two lots, so that there is still excess demand. C needs to form part of the winning combination, but from the time that it drops out, this requirement is not reflected in the information on aggregate demand that is available to A and B and the Primary Bid Rounds can close without resolving which of A or B should lose to make way for C. Price revelation would be affected, as the fact that C needs to form part of the winning combination has not been taken into account when assessing excess demand.

- 7.38 We have continued to consider this issue and reviewed the inputs respondents provided on suggested improvements to the rules. We have in particular considered H3G's detailed proposals for changes designed to improve demand and price information and incentives for truthful bidding (i.e. new measure of aggregate demand for the Primary Bid Rounds and revelation of information about opted-in bidders that are still active, which we discuss below). All these potential changes are relevant only where we decide to include spectrum floors in the auction rules.
- 7.39 We are making three proposals that work in combination to improve efficiency through better demand and price discovery. As a package, we believe that they address legitimate concerns that some stakeholders had identified. We cover these proposals in the following order:
- a) Revealing the number of bidders that opted in ahead of the first Primary Bid Round.
 - b) Allowing opted-in bidders to bid in the Primary Bid Rounds in a way that reflects the prices they are ultimately likely to have to pay given the operation of the Competition Constraint – a proposed Competition Credit.
 - c) Continuing the Primary Bid Rounds until such point that the likely effect of the Competition Constraint on the final outcome of the auction is transparent to all bidders – an updated stopping rule.

Revealing the number of bidders that are opted in ahead of the first Primary Bid Round

- 7.40 Everything Everywhere, H3G and another respondent asked for disclosure to all bidders, after each round, of the number of opted-in bidders that were still bidding on packages including at least a Minimum Portfolio Package.
- 7.41 We have considered this suggestion and agree that there would likely be some merit in letting all bidders know how many bidders have opted in ahead of the first Primary Bid Round. Under our revised proposals which include a Competition Credit, described below, bidders would likely be able to infer some information on the number of opted-in bidders. Therefore, revealing the number of opted-in bidders ahead of the first Primary Bid Round would provide all bidders with the same information on this issue and mitigate risks of inaccurate inferences. However, we do not believe that it is necessary to reveal who the opted-in bidders are. On the contrary, revealing the identity of opted-in bidders might create opportunities for strategic behaviour e.g. by facilitating strategies that seek to force an opted-in bidder to win a particular Minimum Portfolio Package (which might not be the one that the opted-in bidder would prefer).
- 7.42 We would welcome comments on any risk of unintended consequences from making the number of opted-in bidders available ahead of the first Primary Bid Round.
- 7.43 We are not proposing to release any further information regarding the number of opted-in bidders (or their identity) following the first Primary Bid Round. Our proposed approach to the provision of information about demand from opted-in bidders during the Primary Bid Rounds takes a different form. It involves a proposed Competition Credit and a revised stopping rule, which we describe below.

Allowing opted-in bidders to bid in the Primary Bid Rounds in a way that reflects the prices they are ultimately likely to have to pay given the operation of the Competition Constraint – a proposed Competition Credit

- 7.44 In light of stakeholder feedback on the issues discussed at paragraphs 7.36 and 7.37, we have considered ways in which to reflect, in the demand and price revelation process, the effect of the measures we might put in place to promote competition. We want to avoid demand being “hidden”, in the sense that some bid or bids made prior to the current Primary Bid Round may need to win to satisfy the Competition Constraint given the other bids received so far.
- 7.45 The option we have developed to remove the risk of this potentially hidden demand is designed to provide opted-in bidders, where relevant, with an estimate of the discount on the price they would have to pay for a package that is at least a Minimum Portfolio Package relative to current round prices in each Primary Bid Round. This mechanism would allow opted-in bidders to bid in the Primary Bid Rounds in a way that reflects the likely effect of the Competition Constraint on the prices they will have to pay ultimately if they win.
- 7.46 Our proposed mechanism, which we refer to as a Competition Credit, would reflect the likely size of the discount between round prices and the price that an opted-in bidder would pay for winning at least a Minimum Portfolio Package in a round where the Competition Constraint would lead to the opted-in bidder being required to win at least a Minimum Portfolio Package. This provides each opted-in bidder individually with better information of the likely cost of winning a package that is at least a Minimum Portfolio Package.
- 7.47 The proposed Competition Credit is bidder-specific, private to the bidder concerned and is a single value that applies in the forthcoming Primary Bid Round to any package that is a Minimum Portfolio Package or includes a Minimum Portfolio Package. Annex 11 sets out how we propose to calculate the Competition Credit for each opted-in bidder in each Primary Bid Round.
- 7.48 We consider that this approach, as part of the wider set of measures discussed here, would contribute to addressing the problem of “hidden” demand in an effective way.

Continuing the Primary Bid Rounds until the point that the likely effect of the Competition Constraint on the final outcome of the auction is transparent to all bidders – an updated stopping rule

- 7.49 H3G considered that the March 2011 consultation proposals should be amended to reflect the effect of the Competition Constraint on demand that might otherwise be hidden. It proposed a new approach to assessing excess demand, involving use of the winner determination algorithm to reflect the effect of the Competition Constraint.
- 7.50 We agree with the principles that H3G set out for assessing whether there is excess demand after a Primary Bid Round and whether to end the Primary Bid Rounds. We therefore propose to run the winner determination algorithm provisionally, reflecting the requirement of the Competition Constraint, at the end of each Primary Bid Round using all bids made up to and including in the latest round. If it is not possible to identify a provisionally winning combination of bids that includes, for each bidder active in the latest Primary Bid Round, a package that includes at least the package they bid on in that round, then we would hold another Primary Bid Round. (The auction rules would still allow us to use our discretion to end the Primary Bid Rounds

under exceptional circumstances if we found that it was in the interests of the efficient running of the auction.)

- 7.51 We also propose to assess the level of excess demand in a way that consistently takes account of the effect of the Competition Constraint. Our preferred approach is to determine total demand in the following way. We propose to take account of demand both from bids in the last Primary Bid Round and potentially from earlier bids that might be necessary to satisfy the Competition Constraint. Total demand in each lot category would be the sum across all bidders of the greater, for each bidder, of the number lots in that category included in its latest bid and the number of lots in that category included in its provisional winning bid.
- 7.52 This would lead to two potential cases at the end of a round. The first case is where not all bidders active in the latest round have a provisional winning package that contains at least their latest primary round bid, in which case we would hold another Primary Bid Round. The second case is where all bidders active in the latest round have a provisional winning package that contains at least their latest primary round bid, in which case the Primary Bid Rounds end.
- 7.53 Annex 11 provides a detailed description of the process for determining whether to have a further Primary Bid Round and specification of excess demand we would take into account when setting Round Prices.

Changes to activity rules in the Primary Bid Rounds and Supplementary Bids Round further to incentivise truthful bidding

- 7.54 H3G considered that, under the March 2011 consultation proposals, bidders who were active in the final Primary Bid Round lacked a clear route to secure spectrum equal to their final Primary Bid Round package (if there were no unsold lots) or a package including at least their final Primary Bid Round package (if there were unsold lots). Everything Everywhere was concerned about the rule requiring that bids in Primary Bid Rounds be for packages that were the same size as, or smaller than, that in the previous round and about the effect of the overall spectrum cap, as this could prevent them from responding to relative price changes and still select their most preferred package.
- 7.55 H3G also raised an argument regarding opted-in bidders that drop out of the Primary Bid Rounds before the final round, while there are still enough opted-in bidders continuing to bid to meet the Competition Constraint. They argued that bidders who dropped out early should not be allowed back into contention for the purpose of satisfying the Competition Constraint as a result of their supplementary bids.
- 7.56 We do not see any efficiency reason for preventing bidders from making any of the bids that would be allowed under our updated proposals in this consultation (bearing in mind our proposals above to bar bids that cannot win in any circumstances). However, we can clarify that only bids that are consistent with an opted-in bidder's Minimum Portfolio Packages can count towards the satisfaction of the Competition Constraint. An opted-in bidder might win spectrum with a bid for a package that is not a Minimum Portfolio Package, or is not a superset of a Minimum Portfolio Package. However this would then not be as one of the required winners of a Minimum Portfolio Package; rather it would have been as a result of competition between all bidders for those lots, without benefiting from the effect of the Competition Constraint.

- 7.57 Below we consider changes to the activity rules that constrain bids in the Primary Bid Rounds and in the Supplementary Bids Round. The first aspect concerns the general ability of a bidder to express its preferences across packages and to bid on its most preferred package. The second aspect is directly relevant to the issue that H3G raised. Our proposals work in combination with other changes above to improve incentives and demand and price revelation in the auction.
- 7.58 We discuss proposals:
- a) that would allow bidders to bid on their most preferred package in all Primary Bid Rounds, through a relaxation to the requirement to bid on packages of same or smaller size in each Primary Bid Round; and
 - b) to provide bidders with more certainty that the auction outcome will be similar to the outcome of the final Primary Bid Round, through tighter restrictions on supplementary bids with a price cap (the “Final Price Cap”) linked to a bidder’s final Primary Bid Round package (subject to implementing the activity rule relaxation above).

Allowing bidders to bid on their most preferred package in all Primary Bid Rounds – relaxed activity rule

- 7.59 Under the March 2011 consultation proposals, the key rule that governed activity from one Primary Bid Round to the next was that a bidder could only bid on a package that was the same size as, or smaller than, the package they bid on in the previous Primary Bid Round (where we measure size in eligibility points).
- 7.60 Subject to the way demand evolves in the auction and causes prices for each lot category to change, it is possible that a package with a larger eligibility than the package bid on in the previous round might be a bidder’s most preferred package (i.e. the package that it would extract the greatest profit from if it won it at the current round prices). This can occur where the relative price of lot categories change across Primary Bid Rounds, making certain lot categories relatively more expensive in one round, yet relatively less expensive in a later round (at the same time as the prices of all lot categories are increasing).
- 7.61 Because of such a possibility, we see a case for relaxing the activity rule for primary round bids. The aim is to increase the scope for bidders to bid on their most preferred package and thereby improve demand and price discovery in all Primary Bid Rounds. This would help the efficiency of the process and would make it generally easier for bidders to participate in the award process, with the Primary Bid Rounds being capable of achieving more of the auction outcome identification, and leaving less to the subsequent Supplementary Bids Round.
- 7.62 The proposed relaxation makes it possible for a bidder to bid on a package that is larger than its previous primary bid (has greater associated eligibility), so long as making this bid is consistent with the preferences across packages it has expressed through its earlier bids. This consistency with earlier revealed preferences would be achieved through imposition of a similar cap as we have previously proposed should apply to Supplementary Bids. The relative cap would apply to any primary round bid on a package that was larger than the bidder’s current eligibility (a “Capped Primary Bid”), ensuring consistency with previous preferences.

- 7.63 If a bidder makes a Capped Primary Bid, this does not change the bidder's eligibility. The bidder's eligibility does not increase to reflect the higher eligibility of the Capped Primary Bid but remains the same as before.
- 7.64 If a bidder submits a Capped Primary Bid, there may be a requirement for the bidder to increase bids (so-called Chain Bids) for certain packages for which the bidder has already submitted Primary Bids. These will only be packages bid for in previous Primary Rounds in which the bidder reduced eligibility (so-called Constraining Primary Bids). The bid amount for such packages may need to be increased to the minimum level to ensure that all bids remain consistent with the preferences the bidder has expressed when dropping eligibility.
- 7.65 Annex 11 sets out the details of the proposed relaxation to the rules for making Primary Bids.
- 7.66 It is up to bidders in each round to decide whether to bid on a package exceeding their current eligibility, in light of their preferences. However, as a result of the Final Price Cap on Supplementary Bids (discussed in the subsequent subsection) failing to bid for one's most preferred package in a round may result in constraints on subsequent bids, in particular in the Supplementary Bids Round.
- 7.67 We have considered whether this relaxation might have unintended consequences and, by virtue of the greater freedom it provides to bidders, whether it might create opportunities for strategic bidding. Considering it as part of the set of activity rules we are now proposing, including the additional restriction discussed below, we have not identified any material risks to efficiency from the proposed relaxation and believe that it would have material benefits. We would welcome feedback from respondents on the merits of the proposed change and whether there are potential detrimental behaviours that it might allow.

More certainty for bidders that the auction outcome will be similar to the outcome of the final Primary Bid Round – a proposed Final Price Cap (subject to implementing the relaxed activity rule)

- 7.68 The activity rule for supplementary bids proposed in the March 2011 consultation was the relative cap. It involved placing a cap on the maximum amount of a supplementary bid, in light of preferences expressed in the Primary Bid Rounds. Each reduction in eligibility in the Primary Bid Round created a constraint on bids for packages of greater eligibility than the package bid on in that Primary Bid Round. The relative cap limits the amount by which a bid for a package X can exceed the bid made for the package that the bidder chose when last eligible to bid for package X, by reference to prices in the round when the bidder dropped eligibility.
- 7.69 We are now proposing to strengthen incentives for bidders to bid on their most preferred package in each Primary Bid Round, through a further cap on supplementary bids (the Final Price Cap). The effect of the proposed rule is that bids in the Supplementary Bids Round need to be consistent with the underlying preference for the package bid on in the final Primary Bid Round.
- 7.70 Because of this new cap, bidders would face a risk of restrictions if the current round turned out to be the final Primary Bid Round. Therefore, they would have an added incentive to bid on their most preferred package in each Primary Bid Round, particularly as the level of excess demand declines and there is a material chance that any given Primary Round might be the last. Furthermore, as a consequence of

the activity rule, there would be more certainty for bidders that the auction outcome will be similar to the outcome of the final Primary Bid Round.

- 7.71 For the Final Price Cap to have the desired effect on incentives, bidders must be able to bid on their most preferred package in each Primary Bid Round. This is why we are only proposing to use the Final Price Cap if the relaxation of the activity rules for Primary Bids described above is in place.
- 7.72 Our proposed implementation is that the amount of each supplementary bid must be no greater than the sum of:
- a) the highest bid (i.e. either the final primary round bid or the supplementary bid for that package) for the package bid for in the final Primary Bid Round (the "Final Primary Package"); and
 - b) the difference in price, at the final Primary Bid Round prices, between the package that is the subject of the supplementary bid and the Final Primary Bid Round package.
- 7.73 This proposed cap is intended to be additional to the relative cap of our March 2011 consultation proposals. In combination, the two caps provide strong incentives for bidders to bid for their most preferred package in each Primary Bid Round.
- 7.74 The full description of the rules for the Supplementary Bids Round in annex 11 includes details of the interaction between the Final Price Cap, the Relative Cap and the proposed relaxation of eligibility requirements in the Primary Bid Rounds.
- 7.75 We consider that the combination of our proposals for better demand and price information and additional activity rules address the issues that Everything Everywhere and H3G raised.

General approach to joint bidding, Assignment Stage rules and opportunity to facilitate spectrum sharing

- 7.76 Our March 2011 consultation proposals did not include any specific proposals to facilitate either joint bidding (whether in the Principal Stage or the Assignment Stage) or spectrum sharing. The proposals also did not include a way for bidders to express preferences for winning spectrum next to another bidder. The proposed auction structure allowed them to bid for quantities of lots in each category in the Principal Stage and then, if they had won spectrum, for specific frequencies in each category (if that was not already determined in the Principal Stage) independently from whom their neighbour(s) might be. Winners of lots in the auction wishing to share spectrum in the future would face the possibility that their respective assignments may or may not be contiguous.
- 7.77 One respondent explained that it may well want to participate in multiple bid vehicles. Other respondents made comments that are specifically relevant to the Assignment Stage.
- 7.78 Some respondents considered that there were potentially material benefits from spectrum sharing, such as higher speeds for end users in parts of the networks involved. Spectrum sharing would involve two operators with adjacent frequencies combining their respective smaller channels in a spectrum band in order to be able to use a wider channel resulting from this combination.

- 7.79 Responses indicated that certain factors are likely to need to exist for a commercial spectrum sharing deal to be successful. In particular, they mentioned compatible network assets (in terms of footprint for the frequencies to be shared) and other synergies for spectrum sharing to be workable and to bring benefits quickly. It was therefore important in their view to be able to reflect in Assignment Stage bids the value of being next to a particular bidder. They noted that the proposals in the March 2011 consultation did not allow bidders to reflect these preferences.
- 7.80 Telefónica proposed that we adapt the Assignment Stage in order to allow bidders to express preferences in the Assignment Stage regarding whether a particular bidder was going to be their neighbour. In outline, the proposal was to allow each Assignment Stage bidder to make bids for full assignments. Each bid would be for a unique combination of locations in the band across all Principal Stage winners. Such bids would therefore allow the bidder to express preferences regarding whether a particular bidder was going to be their neighbour, but also to express preferences regarding where all the other bidders were in each band. Telefónica recognised that its proposal required lots in each band to be sufficiently generic, so that there remained real flexibility in the Assignment Stage as to which frequencies that winners in the Principal Stage could receive.
- 7.81 One respondent also argued that it was important to facilitate potential spectrum sharing agreements. It considered that there may be strategic incentives on some bidders to preclude some of their competitors from being able to achieve contiguous assignments, thereby denying them the possibility to share spectrum. It highlighted the implications for the efficiency of the Assignment Stage. It also considered that the lack of a reliable path to spectrum sharing under the March 2011 proposals may affect the efficiency of the Principal Stage, as bidders may not bid as much as would be efficient by not reflecting the potential value of spectrum sharing. The respondent noted that using specific lots in a given spectrum band facilitated strategies that would affect the scope for spectrum sharing, such as one in which a bidder for a large package sought to win specific lots that would necessarily be in-between two smaller allocations.
- 7.82 One respondent suggested that facilitating joint bidding vehicles might be a way to address the obstacles to spectrum sharing.
- 7.83 We discuss three categories of issues in these responses:
- a) Potential relaxation of rules regarding the relationship between bidders for “passive” shareholders;
 - b) No proposal to facilitate joint bidding between competitors in the Principal Stage of the auction; and
 - c) Options for facilitating spectrum sharing through the Assignment Stage.
- 7.84 It is important to consider the discussion below in light of the provisions in the auctions rules regarding the exchange of information that is confidential for the purposes of the auction. Prospective applicants should take particular care when discussing with other parties information that constitute confidential information under the terms of the final auction regulations (notwithstanding that such discussions might take place before the regulations are made or come into force). We will assess such discussions in determining whether applicants may qualify to bid in the auction. Clearly, certain types of information are likely to raise concerns, e.g. any information

relating to values or preferences for lots in the auction. More generally, any such discussion would also need to be compatible with competition law.

Potential rules regarding the relationship between applicants to account for “passive” investors

- 7.85 We explained in the March 2011 consultation that we expected to use rules for the qualification of applicants in the auction similar to those we used for previous awards, such as that of the L-band in 2008.⁶⁰ These rules include restrictions on which applicants can qualify to become bidders, in particular on cross-ownership and flow of confidential information.
- 7.86 In the context of our work on a stand-alone award for the 2.6 GHz band, we received representations asking for an adaptation of the rules we had used for spectrum awards thus far. The requests were for the adaptation to reflect two elements:
- a) that some investors may want to help finance several bidders, which could promote competition; and
 - b) that some investors may not be directly and actively involved in the oversight or the direction of the applicant’s business and may not be in receipt of any confidential information relevant to the applicant’s participation in the auction (“passive” investors).
- 7.87 Our view was that we needed to be very careful in considering these issues in order to protect the integrity of the auction. Trying to develop a pre-defined rule to deal with such cases created the risk of loopholes. We considered that any adaptation of the rules would have to allow us to review each case on its merits and to ascertain that the efficiency of the auction would not be at risk.
- 7.88 Following consultation, and in light of demand for such adaptation that offered real scope for consumer benefits, we decided that it would be appropriate in the circumstances to adapt qualification rules for the case of “passive” investors. The relevant mechanism was to create an opportunity for members of an applicant group to apply to opt out of that group in order to remove overlaps between applicant groups. These rules did not allow an associate that held more than 50% of an applicant’s shares or was able to remove or appoint the majority of its board to opt out of that applicant’s group. Our view was that in the circumstances of that award, it was appropriate to include the opt-out mechanism.
- 7.89 We would welcome evidence regarding the case for introducing the opt-out mechanism for this award as set out above. Our proposal is to do so only if there were clear benefits in the form of increased probability of wider participation in the auction from parties with a clear interest in bidding and plans for providing services, and if the risks for the integrity of the auction were sufficiently small.
- 7.90 We do not propose to consider significant variations of the potential rules as set out in 2008 (e.g. greater relaxation) as we believe that they would raise risks of gaming opportunities.

⁶⁰ <http://www.legislation.gov.uk/ukxi/2008/686/contents/made>

No proposal to facilitate joint bidding between competitors in the Principal Stage of the auction

- 7.91 We understand that there are two main sources of potential benefits from spectrum sharing. The first source of benefits comes from the pooling of capacity resources that offers scope for some underused resources to become more utilised, according to time or locations.
- 7.92 The second source of benefits relates to the performance gains that are available from larger channels. For example, by combining two channels of 2x5 MHz each to form a 2x10 MHz channel, the operators' quality of service can benefit from two improvements. The first improvement comes from a reduction in some of the overheads in managing the resource; these overheads take up a smaller proportion of the combined capacity in a larger channel. The second improvement is an increase in the maximum (and potentially average) quality of service that becomes available to each user. This is because a given user can access at most one channel at any given time. In the example involving two channels of 2x5 MHz, with separate spectrum resources, a user of either of the operators can only access a single channel of 2x5 MHz. Where operators share this spectrum, each user can access a channel of 2x10 MHz. Of course, each user will share the resources with other users active at the same time as them, but (assuming a suitable implementation) each user can only be as well or better off with spectrum sharing. These effects arise when spectrum sharers use a single RAN.
- 7.93 At present, the benefits from larger channels also require that the channels being combined be contiguous. This is why respondents who commented on spectrum sharing highlighted the importance to them of being able to express preferences as to whether they are next to a specific party.
- 7.94 There is the prospect of standardised solutions for spectrum sharing that do not involve contiguous spectrum. This would lessen, or even possibly remove, the importance for potential sharers of holding rights to adjacent spectrum. However, it is not currently clear when such technical solutions might become practical and commercially available. There could be a relatively long period between the availability of the 800 MHz and 2.6 GHz bands and the availability of spectrum sharing using non-contiguous frequencies as a practical solution.
- 7.95 There are two possibilities for the importance to potential spectrum sharers of holding contiguous frequencies. First, it could be a large component of the potential overall value of the spectrum to sharers, if the benefits from sharing were large and contiguous spectrum was necessary to achieve efficient and effective sharing. Second, it could be a relatively small source of the potential overall value, if the benefits from sharing were large but contiguous spectrum was not necessary to achieve efficient and effective sharing or if the benefits from sharing were more modest.

If the benefits from sharing were large and contiguous spectrum was necessary to achieve efficient and effective sharing or if there are many lot categories

- 7.96 In this first case, there would be material risks for the bidders involved, and resulting risks of inefficiencies for the process, if they were not able to bid from the outset in the knowledge that they could hold contiguous frequencies. A large part of the value they could derive from using the spectrum would be at risk if their bids reflected the benefits of sharing. This is because, as discussed above, the March 2011

consultation proposals do not include any measures to facilitate spectrum sharing options in the Principal Stage.

- 7.97 To seek to realise the value from sharing, potential partners would need to seek to secure this value collectively. There are two main routes to achieve this. The first would be to strike a commercial agreement ahead of the auction, for example the establishment of a joint venture that would bid in the auction on behalf of two competitors. There would be the possibility that this agreement could result in a reduction of competition in the auction and/or in the provision of services following the auction. Furthermore, any potential competition investigation into such a joint venture would risk being very disruptive to the auction process (whether or not any such co-operation fell to be considered under the merger control rules or competition law).
- 7.98 The second route would be to allow bidders to make bids that are contingent on whether they are next to a potential sharing partner throughout the Principal Stage.
- 7.99 We consider that attempting to facilitate spectrum sharing in this context, i.e. in respect of the Principal Stage of the auction, would raise significant risks. We do not consider that it would be appropriate or indeed necessarily possible to specify a detailed set of rules setting out whether or not complex pre-auction agreements might be consistent with our objectives for the auction and competition law. We are however concerned that agreements to bid jointly may raise questions as to their compatibility with competition law, the consideration of which could pose risks to the auction timetable and process. We also consider that the complexity (both for bidders and the auctioneer) that would result from seeking to allow contingent bidding for this purpose would be too great. It would also risk creating opportunities for strategic behaviour (e.g. strategies that seek to force competitors to win spectrum that is seen as less desirable).
- 7.100 In our view, the risk of getting the rules under either route wrong and facing unintended and damaging consequences would be too high to justify their inclusion.
- 7.101 A potential mitigation of the risks for prospective spectrum sharers, if there are many lot categories in a band, might be to make information available to bidders on the bids made in each Primary Bid Round. This would allow prospective sharers to observe bids and adjust their lot selection to seek to be next to their potential partner of choice.
- 7.102 However, there are also limitations and risks with this approach. There are two main limitations. First, coordination across bidders might be difficult depending on how their iterative decisions compare. Second, the information could only be available in respect of the Primary Bid Rounds; there would remain uncertainty regarding the impact of the supplementary bids on contiguity. The risks include that this provides opportunities for strategic behaviour. An example is that it would be possible to observe which bidders were seeking to achieve contiguity and to seek to prevent them from doing so. There would also be other opportunities with broader consequences than in respect of contiguity, for example as strategic investment could be easier to implement (e.g. one or more bidders deciding to continue bidding until one or more of their potential competitors dropped out).
- 7.103 As a result, we do not consider that full transparency for primary bids would be a desirable option.

- 7.104 In summary, we do not consider that there is an appropriate route for facilitating spectrum sharing options through the auction design in the case where there are many categories of lots in a given band.
- 7.105 We are therefore not proposing to take measures to facilitate joint bidding and/or spectrum sharing between competitors in the context of the Principal Stage of the auction. Should any potential bidders enter into agreements with each other in this context in advance of the auction, we would need to consider them as part of our process for deciding whether applicants should be qualified as bidders in the auction. Each such case would depend on its particular circumstances, taking account of factors such as those set out in this section.
- 7.106 As set out above, we consider that any joint application from two or more existing holders of licences for mobile spectrum could potentially raise competition law questions. Consideration by us as the competent national competition authority of such matters, or by any other competition authority with jurisdiction, would in our view be very likely to impact the timeline of the award by causing a significant delay. We do not consider that this is likely to be in consumers' interests. We are therefore minded to preclude explicitly in the auction rules joint applications from two or more existing mobile spectrum licensees.

If the benefits from sharing were large but contiguous spectrum was not necessary to achieve efficient and effective sharing or if the benefits from sharing were more modest

- 7.107 In this second case, the value associated with sharing would be of a sufficiently small order that it would be appropriate to let bidders express their preferences in relation to sharing in the Assignment Stage and not seek to do so earlier in the auction. This is what one of the two respondents who commented on the Assignment Stage envisaged.
- 7.108 In light of this analysis, we propose that, if we wanted to facilitate spectrum sharing, we would do so in the context of the Assignment Stage. We discuss the options for doing this below.

Options for facilitating spectrum sharing in the Assignment Stage

- 7.109 The scope for the Assignment Stage to facilitate spectrum sharing depends on the extent to which lots are generic.
- 7.110 As described above at paragraph 7.76, our March 2011 consultation proposals for the Assignment Stage allow a bidder in that stage to bid only on its own position in the band, not whether a specific party is next to it. This is for those categories for which the Principal Stage has not already resolved the specific frequency assignments which each bidder will receive. The 1800 MHz lot will not be part of the Assignment Stage in any case. There may also not be a need for an Assignment Stage in respect of the 800 MHz lots, as a result of the lot structure and contiguity requirements.
- 7.111 Below, we consider options to allow Assignment Stage bidders to reflect preferences for being both at particular frequencies and next to another specific bidder. Competition in the Assignment Stage would then determine whether those seeking to achieve contiguity with one or more potential spectrum sharing partners were successful. Variations on the options below would be possible whereby bids in respect of a particular band would be contingent on the outcome in another band.

However, we do not consider this in any detail as we are not aware of any demand for such an approach and we have concerns about the degree of complexity involved.

- 7.112 Following on from our discussion above of circumstances where there are many lot categories in a band, this would only be relevant for cases in which the lot structure is sufficiently generic. As discussed in section 6, the extent to which lots may or may not be generic is primarily relevant to the 800 MHz band. As we are no longer proposing the option of a “hybrid” approach to concurrent low power use in the 2.6 GHz band, lots in each category in this band would be generic under our proposals and we are proposing either to leave the identification of any frequencies for concurrent low power use to the Assignment Stage, or to have these frequencies at one end of the paired range.
- 7.113 We consider in more detail when there will likely be sufficient flexibility for bidders in the Assignment Stage to explore spectrum sharing options and we then consider how we might facilitate such exploration.
- 7.114 Sufficient flexibility means, for each band, having a small number of categories of lots and links between lot categories and specific frequencies that do not raise material obstacles to attempts to ensure contiguity amongst multiple winners. We consider the circumstances for each band.
- 7.115 For the 800 MHz band, there are two key questions relevant to Assignment Stage options: how many lot categories there are and what the approach to any coverage obligation is. In this section, we assume that there are at most two categories of lots – lots with and without a coverage obligation, as envisaged under one option in section 6:
- a) Any coverage obligation may attach only to a subset of specific blocks. From the point of view of facilitating spectrum sharing, that subset would ideally be such that there would be multiple options for the specific frequencies to which the coverage obligation could attach, such that the list of feasible band plans would include at least one option for each pair of bidders to be adjacent.
 - b) But having two categories of lots and multiple possible locations for the lot with the coverage obligation avoids the limitations on Assignment Stage options from bidders winning lots across multiple fixed categories.
 - c) By way of example, consider the limiting case of an outcome with three winners in the 800 MHz band, and relatively constraining assumptions regarding a coverage obligation, to see whether it is possible for two of the winners never to have the opportunity to be next to each other.
 - d) For the purpose of the example assume a winner of block A of 2x15 MHz, a winner of block B of 2x5 MHz and a winner of block C of 2x10 MHz.
 - e) Also assume that only the top four blocks of 2x5 MHz are suitable for the purpose of meeting the coverage obligation, that a coverage obligation attaches to 2x10 MHz and that it attaches to block C.
 - f) Given the restrictions on where C can be in this example because of the coverage obligation, there are three possible band plans, with the following orders for the blocks: (A, B, C), or (A, C, B), or (B, A, C). This means each of the winners has the opportunity to be adjacent to any of the other two winners.

However there are restrictions on where they can be while also being adjacent to a particular bidder. This is a trade-off, but one that may be relatively modest.

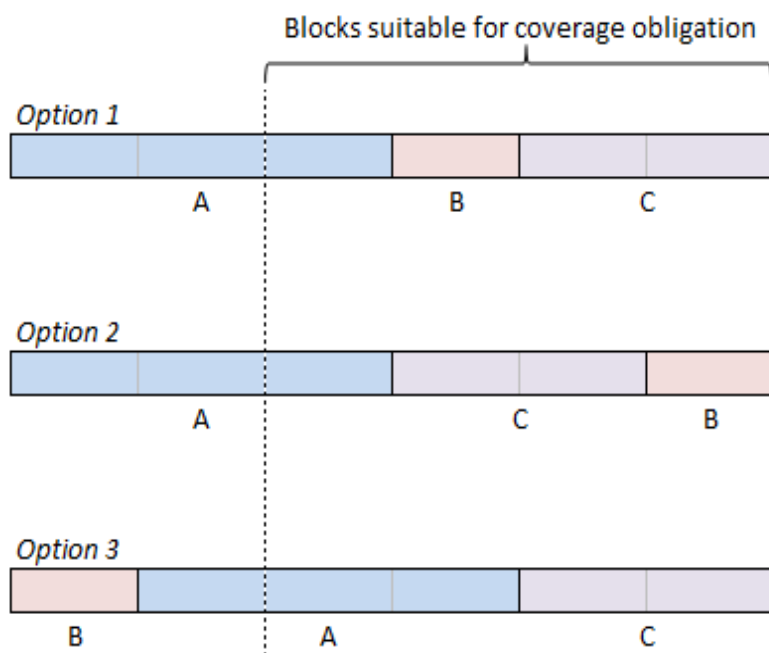
Figure 7.1: Example of Assignment Stage options with three winners at 800MHz

A won 2x15MHz

B won 2x5MHz

C has the coverage obligation and won 2x10MHz

The coverage obligation can only fall on one of the top four blocks



- g) If there were a case for potentially stricter limitations than those illustrated here on which specific frequencies could be associated with the coverage obligations, then there could be a (stronger) tension between the objectives relating to the coverage obligation and the objectives relating to options for spectrum sharing.

7.116 For the 2.6 GHz band, there are no potential constraints on Assignment Stage flexibility as long as any concurrent low power lot can only fall at either end of the paired range or its position can be determined on the basis of bids in the Assignment Stage.

7.117 For the purpose of the rest of this discussion, we assume that the packaging provisions for both bands are sufficiently flexible that each bidder will at least have one Assignment Stage option such that it is adjacent to any one of the other Principal Stage winners. In such a scenario, to the extent that there would be restrictions on which specific frequencies a bidder can hold while being next to one or two specific bidders, the overall benefit derived from a bidder choosing specific frequencies would be secondary to the overall benefit from facilitating options for spectrum sharing.

7.118 We consider three main options for facilitating spectrum sharing in the Assignment Stage, where we assume that contiguity between sharers is important:

- a) letting Principal Stage winners negotiate amongst themselves to agree on their respective positions;

- b) allowing the creation of joint bidding vehicles for the purpose of the Assignment Stage only; or
- c) allowing bids that are contingent on whether a bidder is next to another bidder.

7.119 We also consider the scope that spectrum trading offers to improve the opportunities for facilitating spectrum sharing subsequent to the award.

Option to let winners negotiate specific assignments amongst themselves

- 7.120 We could let bidders negotiate amongst themselves to identify collectively the specific frequency assignment they would each receive. This process would not involve bids or further payments made to Ofcom (although the parties involved would be free to explore mechanisms that involved bids).
- 7.121 This approach offers a potentially large degree of freedom to Principal Stage winners (subject to compliance with competition law). However, there are also risks that any agreement might risk breaching competition law or that bidders fail to achieve a consensus and that one or more bidders may frustrate the process.
- 7.122 We would have to establish a timeline for the negotiations to conclude and how Ofcom would step in the absence of a negotiated solution by the relevant deadline. A solution that Ofcom imposes might be through an Assignment Stage bidding round or a method of random selection.
- 7.123 We believe that the risk that no consensus emerges from discussions between Principal Stage winners is likely to be high. This would likely have an impact on timelines for the exploitation of the spectrum and consequent availability of services to consumers. This does not therefore seem to us to be an appropriate approach.

Option to allow joint bidding vehicles for the purpose of the Assignment Stage

- 7.124 This option involves allowing bidders to pursue spectrum sharing options in the Assignment Stage through the creation of joint bidding vehicles (JBVs) with a relatively narrow objective. JBVs would be entities created solely for the purpose of bidding in the Assignment Stage. We consider that the narrower the scope of the JBVs (e.g. solely for the purpose of bidding in the Assignment Stage), the lower the likelihood of risks arising either in relation to the auction rules or competition law. We envisage that the process might work in the following way:
- a) Bidders would take part in the Principal Stage individually, competing to win a package of lots across the available categories. The Principal Stage would not include provisions designed to facilitate options for spectrum sharing.
 - b) At the end of the Principal Stage, there would be an opportunity for winners to explore options to set up JBVs for the purpose of bidding as a single entity in the Assignment Stage. The effect of such JBVs would be that the spectrum won in the Principal Stage by their members in a given band would be treated in the Assignment Stage as needing to be contiguous and the Assignment Stage options available to each bidder (with each JBV counting as a single bidder for these purposes) would reflect this.
 - c) The JBVs may be specific to each band or there may be a requirement for two bidders forming a JBV to have a JBV for all bands. For example, imagine that bidder M had won 2x5 MHz of 800 MHz and 2x20 MHz of 2.6 GHz and bidder N

had won 2x5 MHz of 800 MHz and 2x15 MHz of 2.6 GHz. Bidders M and N could form a JBV to bid jointly in the Assignment Stage for 800 MHz, to ensure that their specific frequencies would feature in Assignment Stage options as a single contiguous blocks of 2x10 MHz. We would welcome feedback on whether it might be appropriate to give them the option to bid independently in the Assignment Stage for 2.6 GHz.

- d) The discussions around the formation of JBVs would need to be conducted in such a way as to protect the integrity of the Assignment Stage, for example in case these discussions failed and did not lead to the formation of a JBV and because two prospective members of a JBV for one band may not be in the same JBV for another band. (Parties would also need to assess how broader competition law requirements would apply to these discussions.)
- e) Assignment Stage bidders, whether individually or as JBVs, would only be able to bid on their location in a band, not on who their neighbours were or on full band plan options.

7.125 This approach raises potentially difficult questions relating to both the potential for anti-competitive consequences to arise from discussions between competitors being structurally part of the auction process and as to how the process of forming joint ventures might reasonably work in practice.

7.126 In principle, if the scope of a JBV were limited only to deciding to bid jointly for the purpose of the Assignment Stage, negotiations to set up JBVs might be manageable and the risk of anti-competitive consequences may be limited. However, we are concerned about including in the auction rules a mechanism that might somehow subsequently help to lead to reduced competition in the auction or in downstream markets. The consequences of forming JBVs may also lead to uncertainty in the auction and its outcome where the anti-competitive consequences of forming the JBV were not clear from the outset.

7.127 From a practical perspective, for the process to be practicable, JBVs would have to be agreed and set up in a short space of time. The process may need to allow for the possibility that bidders might want to pursue multiple opportunities in parallel (e.g. two options for a given band or different partners for different bands). This would suggest allowing a number of weeks for bidders properly to conduct the investigations necessary for striking agreements, notwithstanding any initial discussions that might have taken place ahead of the application date for the award (which would necessarily have to be limited in order to comply with the rules of the auction on the exchange of confidential information for example). At the same time, the period available for Assignment Stage JBV negotiations during the auction should not be so long as to disrupt the auction process, lead to uncertainty in the auction and lead to undue participation costs, including for bidders that are not interested in forming JBVs.

7.128 Such a system of joint bidding would remove the risk that one or more bidders could seek to prevent competitors from holding adjacent spectrum by bidding high amounts for assignments likely to be in-between these competitors. If a JBV is formed then the partners' spectrum would be treated as a single contiguous block. However, there is a risk that a JBV might seek to win spectrum that is in-between two of its competitors to prevent them from being able to explore options to share contiguous spectrum in future. This would only arise where those competitors had failed or not sought to conclude a JBV deal for the purpose of the Assignment Stage. It would seem unlikely to be an issue if parties that were kept apart had not sought to form a JBV. If they

had sought to do so, then there may be an argument that allowing for a practical process to form a JBV would be a proportionate mitigation, given the likely uncertainties around potential benefits from adjacency in a case where commercial negotiations had failed.

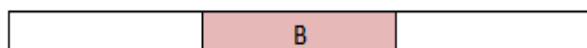
- 7.129 On balance, it appears to us that facilitating JBVs raises potentially serious risks for the integrity of the auction and, ultimately, for consumers, and significant additional complexity to the process alongside posing a timing risk to the auction. We are therefore not minded to adopt such an approach.

Option to allow contingent bidding in the Assignment Stage

- 7.130 An alternative option would be similar to the one proposed by Telefónica. The broad idea would be to let bidders make bids in the Assignment Stage contingent on whom their immediate neighbours would be. For example, bidder A would make a bid of £x for holding rights to use specific frequencies subject to bidder C winning rights to use frequencies adjacent to it.
- 7.131 Unlike the case of a JBV as in the option above where the parties involved would agree to bid jointly, such contingent bidding would not require that the parties potentially interested in holding adjacent spectrum set up a JBV (indeed, the setting up of such a JBV during the auction could well be contrary to the auction rules). A contingent bid would be a unilateral decision by a bidder. This means that the full information on potential efficiency gains that may come from commercial discussions as envisaged under a JBV approach may be unlikely to be available to bidders where contingent bidding applies. However, it seems likely that they would still be able to reflect some of the potential efficiency gains from possible future sharing agreements without exchanging confidential information.
- 7.132 If any potential bidders discussed contingent bidding in advance of the auction, we would need to consider the implications of such discussions as part of our process for deciding whether applicants should be qualified as bidders in the auction. Each such case would depend on its particular circumstances. Any such discussions would need to be mindful of the proposed provisions in the auction rules regarding the exchange between applicants and bidders of confidential information. For example, we would not expect these discussions to lead to any binding commercial agreement nor should any such discussions cover bidding strategies or any aspect of spectrum valuations. Any such discussions would also clearly need to be consistent with competition law.
- 7.133 The case for allowing bidders to express preferences for the location in a band of bidders other than immediate neighbours (as in Telefónica's proposal) would depend on the likelihood and potential benefits of spectrum sharing between more than two or three parties. We are not aware of likely interest in this kind of possibility. In addition, we can see potential downsides to allowing bids on the position of bidders other than immediate neighbours (e.g. bids on full band plans). These would include in particular strategies to attempt to force competitors into positions that may weaken them. Furthermore, we do not believe that it is necessary to let a bidder express a preference of exactly what spectrum its immediate neighbours win (i.e. whether they are directly above or below it in the band plan). Figure 7.2 illustrates this, with the case of the 800 MHz band, assumed to comprise generic lots only, with three bidders (A, B, C) who have each won two lots. If we assume that bidder B wants to make a bid on being in the middle of a band, then it would not have the opportunity to bid on A receiving the bottom two blocks and C receiving the top two blocks as opposed to C receiving the bottom two blocks and A receiving the top two blocks.

Figure 7.2: Illustration of the options available to a bidder with contingent bidding – B can bid on who its neighbour(s) are but not which side of B’s holding they are ultimately positioned

If B bids on being in the middle

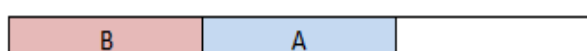


It cannot specify in its bid where B or C would go because the identity of its neighbours is fixed

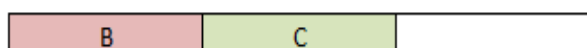
If B bids on being at one end, e.g. the bottom end



It can bid on A being next to it



It can bid on C being next to it



7.134 The introduction of contingent bids would make bidder choices more complex in the Assignment Stage. Bidders would have more options to consider, and potentially a large number of options if they had an interest in spectrum sharing with different parties. This would also make the winner determination and pricing algorithm more complex, with potential impacts on difficulty for bidders that wish to make contingent bids in developing bidding strategies and/or interpret results. There would also be a cost to Ofcom in developing and testing a suitable implementation for this approach.

7.135 However, the effect of contingent bids would apply only for the purpose of the Assignment Stage, i.e. once the identity of the winners and the amount of spectrum they won in each category was known. Only the exact frequency assignments for each Principal Stage winner would need to be resolved and therefore the complexity for the Assignment Stage might be manageable.

7.136 This option appears to us to offer the best scope for facilitating through the auction better prospects for future spectrum sharing where desirable, as it may not raise the same competition risks as the alternatives considered above.

Trading offers some scope to improve spectrum sharing prospects in the case where there are many lot categories in a band

7.137 In the March 2011 consultation, we proposed to make the licences for 800 MHz and 2.6 GHz tradable subject to a process that includes a competition check. Trading may help auction winners achieve the adjacencies that the auction design might not have allowed them to secure.

7.138 Depending on where all winners in a band are, and subject to their respective objectives for adjacencies being compatible, this might involve more or less complex sets of spectrum trades.

- 7.139 Therefore, while there may be barriers, spectrum trading might provide a secondary and complementary route to spectrum sharing, particularly in the longer term.
- 7.140 As described above, if there are many lot categories in a band it is not currently clear to us that there are workable auction design measures practicably to allow bidders to express preferences as to their future neighbours. In this case, spectrum trading might act as a fall back and mitigation measure, recognising that it has potential costs.

Vickrey-nearest and linear reference pricing are both valid options

- 7.141 Respondents generally supported the use of a second price rule. Some commented on specific aspects.
- 7.142 Everything Everywhere considered that the pricing rule description lacked clarity and that it was not clear how the Competition Constraint would impact on price calculation. One respondent also queried some of the details of the pricing rule description set out in the March 2011 consultation (in respect of the possibility of reduced bids used in the process being negative or below reserve prices and of the formula for one of the parameters). The full description of the pricing rules in Annex 12 addresses these points.

We do not consider that possible incentives for strategic bidding linked to the pricing rule are likely to affect outcomes in practice

- 7.143 Telefónica argued, on the basis of a paper prepared by Dr Ian Jewitt, that the proposed linear reference pricing rule creates incentives to bid on lots for which a bidder has limited or possibly no value. This is because the pricing rule may have the effect of a lower price for the lots that a bidder really wants if it makes bids for packages on which it does not place as high a value. This raised risks of inefficiencies and bidder errors. Another respondent was similarly concerned about the scope for bidders to “manipulate” their prices under the linear reference rule. The respondent thought these effects were also relevant to the calculation of ALF.
- 7.144 Telefónica set out its preference for the alternative in the March 2011 Consultation, the Vickrey-nearest rule. It also emphasised that the Direction did not require us to identify linear prices for the purpose of identifying auction prices.
- 7.145 As discussed in more detail at annex 12, we agree that, in theory and for certain settings, the issues that Dr Jewitt raises are relevant to the linear reference pricing rule. We note, however, that similar issues may affect the alternative Vickrey-nearest rule in some circumstances.
- 7.146 When taking account of the kind of circumstances that we are most likely to face in practice, i.e. many bidders making a relatively large range of bids, the strength of these concerns is unlikely to be material. This is because it would be very difficult for a bidder to anticipate whether bidding strategically with respect to the pricing rule would be likely to result in a pay-off. The risks that the strategy could fail are likely to be high, whether the pricing rule is a linear reference one or a Vickrey-nearest one.
- 7.147 Our proposal therefore remains that both the Vickrey-nearest rule and the linear reference pricing rule, as set out at annex 12, would be suitable.

Clarification regarding prices where there are only as many opted-in bidders as are required to satisfy the Competition Constraint

- 7.148 A confidential respondent asked for a clarification regarding the pricing rule. It was interested in understanding what prices would be if there was no competition for reserved spectrum and the number of opted-in bidders was the same as needed to satisfy the Competition Constraint. The respondent wanted to clarify whether they would pay the reserve price for what they won, even if they won a package larger than a Minimum Portfolio Package.
- 7.149 We can clarify that this would depend on competition in the auction. The scope for opted-in bidders in this case and more generally to win a superset of a Minimum Portfolio Package will be constrained by bids from other bidders. Notionally, opted-in bidders compete amongst themselves for Minimum Portfolio Packages and with all other bidders for additional lots over and above Minimum Portfolio Packages. If an opted-in bidder paid the reserve price for a package that is a strict superset of a Minimum Portfolio Package, this would reflect an absence of demand for all relevant lots, not just those in the Minimum Portfolio Package.

The full set of rules will incorporate relevant process requirements involving the EC if the 1800 MHz divestment is in the auction

- 7.150 BT pointed out that the full set of rules will need to take account the necessary steps involving the European Commission should the 1800 MHz divestment be part of the supply in the auction.
- 7.151 We agree with BT's point and will address this as required as part of the draft Statutory Instrument for the auction rules on which we will be consulting later in the process.

Question 7.2: Do you have any comments on the proposed auction rules as explained in section 7, Annex 11 and Annex 12? Please state the reasons for your views.

Section 8

Annual licence fees: further discussion

- 8.1 In the March 2011 Consultation, we set out proposals for how we were planning to fulfil the requirement under the Direction regarding the revision of Annual Licence Fees for 900 MHz and 1800 MHz spectrum (ALF). The Direction requirement is as follows (article 6 (1) and (2)):
- After completion of the auction Ofcom must revise the sums prescribed by regulations under section 12 of the Wireless Telegraphy Act 2006 for 900 MHz and 1800 MHz licences so that they reflect the full market value of the frequencies in those bands.
 - In revising the sums prescribed Ofcom must have particular regard to the sums bid for licences in the auction.
- 8.2 Our proposal was to consider several sources of information to assess full market value and hence revise ALF, including in particular, if the auction was sufficiently competitive, linear reference prices paid for spectrum available in the auction, but also, for example, international benchmarks.
- 8.3 This section summarises our updated thinking in light of responses, covering the following issues:
- a) our proposed response to concerns that a mechanistic link between auction prices and ALF could risk reducing the efficiency of the auction;
 - b) a wider set of methodologies that we might use to determine the full market value of spectrum as part of our ALF calculations;
 - c) consistency with the European regulatory framework; and
 - d) our intended next steps for the process of determining specific ALF values.
- 8.4 As in the March 2011 Consultation, it is important to stress that our provisional thinking set out here will have to be reviewed after the auction, when we will consult specifically on the revision of ALF for 900 MHz and 1800 MHz spectrum. Nonetheless we consider that it likely to be helpful for stakeholders to understand in advance of the auction our likely approach and we are therefore including a discussion of the key issues raised in responses to our March 2011 consultation in this consultation. We will however deal with all these and other relevant issues comprehensively when we consult on the revision of ALF after the auction.
- 8.5 Annex 13 sets out our March 2011 consultation proposals and discusses the issues in more detail.

We have updated our intended approach in response to a concern from respondents that a direct link between prices in the auction and ALF could result in incentives that reduce auction efficiency

It is appropriate to consider ways to mitigate potential distortion of bidding incentives from a link between auction prices and ALF although mitigating factors are likely in practice

- 8.6 Several respondents expressed a concern regarding our proposed approach. They argued that a mechanistic link between auction prices and ALF would create inappropriate incentives, leading bidders in the auction that would have to pay ALF to shade their bids to manage the impact of their own bids on the ALF they would have to pay.
- 8.7 We note at the outset that we did not intend our proposals in the March 2011 consultation to be read as implying that we would adopt a mechanistic link between auction prices and ALF. Nevertheless, as certain stakeholders appear to have interpreted our proposals in this way, we have considered this issue further. In particular, we have considered in detail the question of incentives for bidders to shade bids, and believe that there are mitigating factors that materially reduce the likelihood of this risk crystallising. In particular, at Annex 13, we illustrate how bidders' expectation of a minimum level of ALF (e.g. one inferred from reserve prices in the UK auction or from prices in comparable auctions in other countries) is likely to reduce bid-shading incentives, and the closer this expected value is to market prices, the higher the mitigation effect.
- 8.8 We also illustrate how having high demand for the spectrum, with more bidders than can be accommodated and valuations that are relatively close, is also likely to reduce any pay-off from bid-shading for ALF payers.
- 8.9 These mitigating factors and our intention to use several sources of information to determine full market value for the purposes of setting ALF explain why we still think that the methodology using linear reference prices set out in March 2011 is a relevant and helpful input to ALF.
- 8.10 However, we agree that the underlying concern might in principle affect the efficiency of the auction in certain circumstances and that it is appropriate to consider how we might further mitigate this potential risk.

We intend to take additional information derived from bids in the auction into consideration when setting ALF

- 8.11 In light of the Direction's requirements, we have 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.
- 8.12 We have in consequence developed another methodology, set out in more detail at Annex 13, for estimating full market value on the basis of bids in the auction. This involves calculating an estimate of the opportunity cost of an ALF payer retaining the spectrum to which the ALF applies, on the basis of bids made in the auction. This calculation 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. The approach involves calculating the aggregate value of what would be the winning

combination of bids if spectrum equivalent to the ALF spectrum had hypothetically been available in the auction, excluding those bids made by the bidder whose existing spectrum we are estimate the value of. We refer to this as the Additional Spectrum Methodology.

- 8.13 In our fuller description, we identify that the values so obtained may not be linear with quantity of spectrum and indeed may be bidder-specific (with the spectrum held by two bidders holding the same amount of spectrum in the same band being valued differently).
- 8.14 Our intention is to use this approach alongside other approaches to take a rounded view in exercising our judgement as to the full market value of spectrum relevant to the setting of ALF.

Question 8.1: Do you have any comments on the Additional Spectrum Methodology as one of several sources of information for estimating the full market value of spectrum?

We intend to use three main methodologies to inform our decision on ALF

- 8.15 In order to address the potential risk that may exist if there is a mechanistic link between auction prices and ALF, and to anticipate the possibility of an auction that is not sufficiently competitive, we propose to use three methodologies to estimate full market value.
- 8.16 The three methodologies are:
- 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 referred to above and described at Annex 13; and
 - c) values from auctions for comparable spectrum in other countries that we consider to be sufficiently competitive, adapted to reflect UK circumstances.
- 8.17 We recognise that we need to consider the calculations under each methodology and their outputs with care. They have limitations individually and in combination. However, by using a broad set of relevant data and by using market transaction information in particular, we believe that our approach is likely to be appropriate to the circumstances.
- 8.18 If the 2x15 MHz of 1800 MHz spectrum to be divested by Everything Everywhere is sold in the auction, we now clarify that we would expect to include bids for this lot as part of any auction information we might consider for the purpose of assessing ALF. This information might be sufficient for the purpose of using bid information to inform the ALF for other 1800 MHz spectrum, or it might be part of a wider pool of relevant bids, as one of a range of sources of information.

Question 8.2: Do you have any comments on our updated thinking on estimating full market value for the purpose of revising ALF as set out in this section and Annex 13?

Our proposals are consistent with the European regulatory framework

- 8.19 Vodafone queried whether our March 2011 consultation proposals were consistent with Ofcom's duties under the European regulatory framework relevant to spectrum management.
- 8.20 Vodafone made the following main arguments:
- that we have previously set spectrum licence fees using a methodology known as "administrative incentive pricing" (AIP) on the basis that this methodology would promote the efficient use of spectrum by giving incentives for spectrum to be allocated to those who value it the most;
 - that we did not explain why we had proposed setting the revised fees for the spectrum in question using a different methodology than AIP other than because of the provisions of the Direction;
 - that if the Direction was the reason for our proposal to move to a new fee setting methodology, we would have to be satisfied that the new approach (and implicitly therefore the provisions of the Direction) was consistent with our duties under the Common Regulatory Framework Directives, as European law takes precedence over domestic law in the case of any contradiction between the two;
 - and that, as a result, we must interpret the Direction in a way that does not result in the bidding process in the auction being distorted by virtue of our proposals in relation to the revision of annual licence fees, so as to ensure that competition is not distorted in the mobile market.
- 8.21 We consider that our proposals for calculating ALFs, which amongst other things take account of article 6 of the Direction, are compatible with our statutory duties under the domestic and EU legislative framework. As we have said, we will consult on our exact proposal for calculating ALFs after the auction.
- 8.22 Regarding Vodafone's concern that our approach as proposed might distort bidding in the auction, we consider the risk to be low. As is clear from the March 2011 consultation and the discussion in this section, we do not propose to adopt a mechanistic link between ALFs and prices paid in the auction and for the avoidance of doubt our March 2011 proposals did not include such a mechanistic link. Rather we intend to use various sources of information to determine full market value for these purposes. However, in light of concerns expressed by some respondents as regards the potential impact on bidding incentives of the specific methodology for deriving estimates of full market value from bids in the auction that we set out in our March 2011 consultation, we have set out in Annex 13 an additional approach to the estimation of full market value which we might use alongside other estimates.

We will be consulting on specific ALF levels following the auction

- 8.23 Our proposed next steps in our work on ALF are:
- a) to consider any further feedback from stakeholders and whether to make any further information available ahead of the auction;

- b) following the auction, to prepare detailed proposals including specific levels of ALF for consultation;
 - c) 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.
- 8.24 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 that we have not addressed in full in this consultation.
- 8.25 If new developments led to a delay in the award 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 9

Next steps

Consideration of responses

- 9.1 We will consider all responses received by the closing date for this consultation of 22 March 2012 and, in finalising the award process, consider them against our statutory duties.

Stakeholder events

- 9.2 We plan to hold one or more seminars during the consultation period to present our revised proposals for the auction design and receive early feedback from stakeholders.

Further consultations

- 9.3 We may publish in early 2012 a second consultation on the co-existence of new mobile services in the 800 MHz band with DTT below 790 MHz. A key aspect of our proposals on this issue involves setting up an implementation body to manage the delivery of options for reducing the interference impacts on DTT viewers. The Government need to take decisions on this and we are working closely with them. In light of their decisions we will need to take a view on what issues we might need to consult on further.

Publication of statement, Information Memorandum and draft auction regulations

- 9.4 Following the current consultation and subject to stakeholders' comments, we plan to issue a statement in the summer of 2012 setting out our conclusions.
- 9.5 Alongside that statement we plan to publish an Information Memorandum for the award. This will be designed to give bidders as much information as necessary for them to decide whether to enter the auction and how they would prepare for participation. It may be modified or complemented by the publication of updates and answers to specific questions.
- 9.6 At the same time we plan to publish draft auction regulations for consultation. These regulations will give effect to our decisions, provide the legal basis for the auction and contain detailed and comprehensive rules and procedures for its running. The regulations are made by means of a statutory instrument. They must be published in draft with a minimum of one month allowed for comments. When all comments have been considered and necessary amendments made the regulations are made in final form; they come into force approximately one month after being made.
- 9.7 According to our provisional timetable, the final version of the regulations would be made to allow the auction process to begin, with the submission of applications, possibly in the fourth quarter of 2012.

Other regulations and documents for publication

- 9.8 As part of the preparations for the award and before prospective bidders are invited to consider participating in the award process, we will publish new regulatory documents and amend existing regulations to incorporate the conclusions of this consultation where appropriate. This will include:
- amending the mobile spectrum trading regulations (Statutory Instrument 2011 No. 1507) before the award process to apply to the 800 MHz and 2.6 GHz bands;
 - publishing interface requirements for the bands before the award process to reflect the technical conditions to be included in the licences;
 - amending the order limiting the number of licences for certain categories (Statutory Instrument 2003 No. 1902) at the next relevant regular update;
 - amending the UK Frequency Allocation Table at the next relevant regular update and UK Frequency Allocation Plan after the award to include the new assignments for the bands.

Annex 1

Responding to this consultation

How to respond

- A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 22 March 2012**.
- A1.2 Ofcom strongly prefers to receive responses using the online web form at <http://stakeholders.ofcom.org.uk/consultations/award-800mhz-2.6ghz>, as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see Annex 3), to indicate whether or not there are confidentiality issues. This response coversheet is incorporated into the online web form questionnaire.
- A1.3 For larger consultation responses - particularly those with supporting charts, tables or other data - please email combined.award@ofcom.org.uk attaching your response in Microsoft Word format, together with a consultation response coversheet.
- A1.4 Responses may alternatively be posted or faxed to the address below, marked with the title of the consultation.
- Ofcom
Mobile & Auctions Team
3rd Floor
Spectrum Policy Group
Riverside House
2A Southwark Bridge Road
London SE1 9HA
- A1.5 Note that we do not need a hard copy in addition to an electronic version. Ofcom will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.
- A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 4. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

Further information

- A1.7 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Robert Emson on 020 7783 4375.

Confidentiality

- A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, can you please specify what part or whether

all of your response should be kept confidential, and specify why. Please also place such parts in a separate annex.

- A1.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and will try to respect this. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A1.10 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to Ofcom to use. Ofcom's approach on intellectual property rights is explained further on its website at <http://www.ofcom.org.uk/about/accoun/disclaimer/>

Next steps

- A1.11 Following the end of the consultation period, Ofcom intends to publish a statement in summer 2012.
- A1.12 Please note that you can register to receive free mail Updates alerting you to the publications of relevant Ofcom documents. For more details please see: http://www.ofcom.org.uk/static/subscribe/select_list.htm

Ofcom's consultation processes

- A1.13 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 2.
- A1.14 If you have any comments or suggestions on how Ofcom conducts its consultations, please call our consultation helpdesk on 020 7981 3003 or e-mail us at consult@ofcom.org.uk . We would particularly welcome thoughts on how Ofcom could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.
- A1.15 If you would like to discuss these issues or Ofcom's consultation processes more generally you can alternatively contact Graham Howell, Secretary to the Corporation, who is Ofcom's consultation champion:

Graham Howell
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Tel: 020 7981 3601

Email Graham.Howell@ofcom.org.uk

Annex 2

Ofcom's consultation principles

A2.1 Ofcom has published the following seven principles that it will follow for each public written consultation:

Before the consultation

A2.2 Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. If we do not have enough time to do this, we will hold an open meeting to explain our proposals shortly after announcing the consultation.

During the consultation

A2.3 We will be clear about who we are consulting, why, on what questions and for how long.

A2.4 We will make the consultation document as short and simple as possible with a summary of no more than two pages. We will try to make it as easy as possible to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5 We will consult for up to 10 weeks depending on the potential impact of our proposals.

A2.6 A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Ofcom's 'Consultation Champion' will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why.

After the consultation

A2.8 We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and will give an account of how the views of those concerned helped shape those decisions.

Annex 3

Consultation response cover sheet

- A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses in full on our website, www.ofcom.org.uk.
- A3.2 We have produced a coversheet for responses (see below) and would be very grateful if you could send one with your response (this is incorporated into the online web form if you respond in this way). This will speed up our processing of responses, and help to maintain confidentiality where appropriate.
- A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore Ofcom would encourage respondents to complete their coversheet in a way that allows Ofcom to publish their responses upon receipt, rather than waiting until the consultation period has ended.
- A3.4 We strongly prefer to receive responses via the online web form which incorporates the coversheet. If you are responding via email, post or fax you can download an electronic copy of this coversheet in Word or RTF format from the 'Consultations' section of our website at www.ofcom.org.uk/consult/.
- A3.5 Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details, or job title to remain confidential, please provide them in your cover sheet only, so that we don't have to edit your response.

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

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

Nothing Name/contact details/job title

Whole response Organisation

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

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

DECLARATION

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

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

Name

Signed (if hard copy)

Annex 4

Consultation questions

A4.1 We are inviting responses to the following questions set out throughout the sections of this consultation and welcome views from stakeholders on any aspect of the proposed award which they would like to raise with us.

Question 4.1: Do you agree with our assessment of the competition concerns relating to national wholesale competition that could arise if the auction took place with no measures to promote competition? Please state your reasons for your views.

Question 4.2: Do you agree that option 4 should be adopted to promote national wholesale competition? Please state the reasons for your views.

Question 4.3: Do you agree that the portfolios in group 2 (middle portfolios) of option 4 are likely to be most appropriate and proportionate implementation of this option?

Question 4.4: Do you believe that geographically split licences for a particular block of 2.6 GHz spectrum between standard power use and lower power use is likely to create significant additional benefits for consumers?

Question 4.5: Please provide your views including the reasons for them on which options you believe should be taken in relation to promoting low power shared use of 2.6 GHz spectrum.

Question 5.1: Do you have any comments on the proposal to include a coverage obligation in at least one of the 800 MHz licences, and the proposed extent of such a coverage obligation?

Question 5.2: Do you have any comments on which of the two approaches proposed for the specification of such an obligation would be preferable: 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; or 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 MIP, in those areas where MIP infrastructure is capable of supporting a 4G mobile data service?

Question 5.3: Do you have any comments on our assessment that it is unlikely to be proportionate to impose such a coverage obligation on more than one licensee?

Question 5.4: Do you have any views on the costs and benefits of a wholesale access obligation on the licensee with the coverage obligation in respect to those areas beyond existing 2G mobile voice coverage?

Question 5.5: Do you have any comments on the possibility that we may in certain limited circumstances consider granting concurrent licences as set out in paragraphs 5.88 to 5.93?

Question 6.1: Do you agree with our revised proposals for the packaging of the 800 MHz band? Please state the reasons for your preference.

Question 6.2: Do you agree with our revised proposals for the packaging of the 2.6 GHz band? Please state the reasons for your views.

Question 7.1: Do you agree with our revised proposals for the number of eligibility points that should attach to each lot? Please state the reasons for your views.

Question 7.2: Do you have any comments on the proposed auction rules as explained in section 7, Annex 11 and Annex 12? Please state the reasons for your views.

Question 8.1: Do you have any comments on the Additional Spectrum Methodology as one of several sources of information for estimating the full market value of spectrum?

Question 8.2: Do you have any comments on our updated thinking on estimating full market value for the purpose of revising ALF as set out in this section and Annex 13?

Question A7.1: We would welcome comments on any aspect of the data, assumptions and modelling methodology we have used in our technical analysis, in particular our approach to serving users in a range of both easier and harder to serve locations.

Question A7.2: We would welcome any additional information, in particular from current operators, on the choice of parameters making up our 'Min var' and 'Max var' cases.

Question A8.1: Do you agree with our assessment of when Everything Everywhere, Vodafone and Telefónica are likely to be able to refarm their existing 2G spectrum? In particular, do you agree with our views on the importance of user devices and the likely availability and take-up of devices that use different technologies and bands? Please state the reasons for your views, including if appropriate your views on handset roadmaps and the practical constraints which apply to those roadmaps.

Annex 5

Summary of impact assessment

A5.1 Ofcom has considered and assessed the likely impact of implementing its proposals throughout this consultation document, and therefore the document as a whole constitutes our impact assessment. This assessment is set out in particular in sections 4, 5, 6, 7 and 8, and annexes 6, 10, 11, 12 and 13.

A5.2 For ease of reference, we have set out in the table below a summary of the main proposals made in this consultation and details of where the impacts of those proposals are considered.

Consultation proposals	Impacts discussed in
Promotion of competition	
Ensure at least four national wholesalers after the Auction	Section 4; Annex 6, especially section 2; and Annex 10
Reserve spectrum for the fourth national wholesaler	Section 4; Annex 6, especially section 8
Impose constraints on the total amount of sub 1 GHz mobile spectrum that any one licensee can hold after the Auction	Section 4; Annex 6, especially section 8
Impose constraints on the total amount of mobile spectrum that any one licensee can hold after the Auction	Section 4; Annex 6, especially section 8
Reserve 2 x 10 MHz of 2.6 GHz spectrum for shared low power use	Section 4; Annex 6, section 9
Promotion of mobile coverage	
Impose a coverage obligation on one 800 MHz licence	Section 5
In certain limited circumstances consider granting concurrent licences	Section 5
Spectrum packaging	
2.6 GHz band: 2 x 5MHz lots for paired spectrum for individual use at standard powers	Section 6
2.6 GHz band: 1 x 5MHz lots for unpaired spectrum	Section 6
800 MHz band: to package the spectrum in as few separate categories as is compatible with the DTT co-existence issue	Section 6
Auction design	
Eligibility points per lot	Section 7
Use of a combinatorial clock auction design for the auction with	Section 7, Annex 11 and

particular changes to the detailed rules compared to those set out in the March 2011 consultation, in particular in relation to the implementation of our competition proposals and activity rules	Annex 12
Annual licence fees for 900 MHz and 1800 MHz spectrum	
To set the fees at full market value using information derived from the bids for 800 MHz and 2.6 GHz spectrum in the Auction, by the use of two different methodologies, and information from auctions of similar spectrum in other countries.	Section 8 and Annex 13