

Annex 8

Assessment of impact and likelihood of wider access to 900MHz spectrum

Introduction

- A8.1 In order to produce a comprehensive cost-benefit analysis and a fully-informed policy, we need to understand what may happen once 900MHz spectrum is liberalised.
- A8.2 The effects of liberalisation will be influenced by the significance of the affected spectrum in the provision of services. There are three key factors which we believe are key in characterising the importance of 900MHz spectrum relative to other spectrum: the level of demand for mobile broadband services and the importance of quality to consumers of those services; the number of operators with similar spectrum and the availability of substitutes; and the scale of differences between 900MHz spectrum and other frequencies.
- A8.3 Given that the exact circumstances of the market in the future are as yet unclear, we analyse what may happen in three different scenarios – where low frequency spectrum is of high significance, medium significance and low significance.
- A8.4 For each scenario we consider the potential costs and benefits of wider access to 900MHz spectrum. This will allow us to determine whether, on balance, wider access to the spectrum is likely to be beneficial in capturing all of the potential welfare gains available from liberalisation. “Wider access” in this annex refers to trading as well as other forms of access such as roaming and spectrum sharing. The analysis is primarily focused on trading for the sake of simplicity.
- A8.5 We then examine, given these costs and benefits, the likely market outcome of each of the three scenarios. Where the incentives present in the market are conducive to providing wider access, the market mechanism should ensure an efficient outcome. However, if such incentives are not aligned towards providing access where this would be beneficial, intervention in the market may be required.
- A8.6 In conducting our assessment, we have reflected upon the responses we received from stakeholders following our previous consultation in September 2007. We explain how we have reacted to these responses in setting up our analysis.
- A8.7 In the medium and high significance scenarios, wider access could plausibly be beneficial. In the medium significance scenario, the market may bring about the efficient level of access, depending on exactly how costs and benefits are distributed. However, in the high significance scenario, incentives could be aligned such that the market alone may be unlikely to bring about the level of access which would maximise welfare.
- A8.8 Our analysis shows that in the low significance scenario, wider access may not be beneficial. However, given the market circumstances necessary for this to be the case, we believe that we are more likely to be in the high or medium significance scenarios (in aggregate) than the low significance scenario.

- A8.9 Thus, there are plausible risks that the market may not bring about wider access where this is likely to be beneficial. This risk should be reflected in our assessment of the options available.

Approach

- A8.10 The purpose of this annex is to determine what may happen to the provision of mobile broadband following liberalisation. We do this firstly by assessing the circumstances under which wider access to 900MHz spectrum is likely to be beneficial. We then aim to assess whether, under these circumstances, market incentives are aligned such that this is likely to occur.
- A8.11 We approach this analysis in a number of stages. Firstly, given the inherent uncertainty over how such an immature market will develop, we set out the factors we believe will influence its development in the future.
- A8.12 We then consider what the market will look like with different variations in these factors. In doing this, we have produced three scenarios: where low frequency spectrum is of high significance, medium significance and low significance.
- A8.13 We can then assess whether, under each scenario, wider access is likely to be beneficial. We also use the scenario structure to analyse whether the incentives of private individuals are likely to lead to the socially optimal outcome.

Would wider access be beneficial?

- A8.14 We determine whether wider access will be beneficial by comparing its costs and benefits. For wider access to be considered beneficial, the costs (to society) of providing wider access must be lower than its benefits (to society).
- A8.15 The costs, and particularly the benefits, of wider access depend, to some extent, on what would happen without wider access. For example, if the same welfare effect would be achieved both with and without access, this welfare effect could not be considered a benefit of access. In the main, benefits from wider access arise from changes in the circumstances of operators who do not currently have access to 900MHz spectrum, and so vary depending on what they would do with and without access. For most of the following analysis, we assume that 2100MHz operators will either match the quality of service of 900MHz operators, or will not make any effort to match quality and will continue with their current deployment plans for mobile broadband. However, in paragraphs A8.77-A8.82 below, we examine the possibility of a 2100MHz operator partially matching the quality of a 900MHz operator's service.
- A8.16 Throughout our analysis in this annex, for simplicity we consider only the case of trading, but we accept that other outcomes, such as commercial access agreements, are viable alternatives with similar implications. Some operators, such as O2, suggest that commercial roaming is more likely than trading, for example because this would allow the incumbent licensee to avoid the cost of clearing the spectrum.

Costs of wider access

- A8.17 The most obvious cost of providing access is the cost of clearing and releasing the spectrum for use. Our analysis in annex 16 sets out our calculations of these costs.

- A8.18 We must also consider the loss of option value suffered by the incumbent licensee. This is the value the licensee derives from the options it has available for using the spectrum it holds. For example, following liberalisation a 900MHz licensee could use this spectrum for GSM, UMTS, HSDPA, or for providing entirely different services altogether.
- A8.19 On the other hand, the new user will experience a gain in option value from now having more spectrum available. The option values of the new and incumbent users are likely to be similar. However, sometimes one party's option value may be higher e.g. the current 900MHz licensee's option value will include any impact of a trade on the future options for how they use the remainder of their 900MHz spectrum. This option would not be available to a new licensee. Therefore, option value may either be a net cost or a net benefit of access, depending on whether the option value of the incumbent user is greater or less than that of a new user.
- A8.20 This difference in option values is only a true cost to society, to be taken into account in the welfare assessment, to the extent that it reflects efficiency considerations. Other sources of option value, such as the ability to gain an unmatched competitive advantage in the future, should not be included as a cost to society in this context. It would, however, be taken into account by the incumbent licensee when determining their willingness to accept a bid for 900MHz, which is discussed in paragraphs A8.32-A8.34.

Benefits of wider access

- A8.21 The benefits of wider access include any increase in efficiency that new users could achieve through using this as opposed to substitute spectrum to provide the same quality of service. We estimate the effect on efficiency by comparing the number of base stations a 2100MHz operator would need to rollout compared to those required by a 900MHz operator to provide the same quality of service. We then translate this into the difference in cost between the two operators. This analysis is summarised in annex 10 and set out in detail in annexes 11-15.
- A8.22 Another benefit would be any increase in welfare that arises from greater competitive intensity where new users are better able to compete with incumbents by providing services of equal quality, which they would be unable to do without access to 900MHz spectrum. We estimate the effect of increased competition by comparing welfare between two situations, one with more competition and the other with less competition. In this simplified setting, the degree of competition is captured in the number of competitors assumed in high quality mobile broadband. This represents a stylised approach, as we expect the reality to be substantially more complicated. A detailed description of this analysis is set out in annex 9.
- A8.23 In addition, in their response to the September 2007 consultation, O2 suggested that network effects from trades or commercial roaming agreements may provide benefits for the incumbent licensees. The extent to which customers use 3G services depends in part upon the total number of users in the market. For example, if more people use 3G services, third parties such as broadcasters will provide more 3G content. Individual users are then likely to use 3G services more, as there are more services available. The take-up of 3G services is influenced in part by the actions of operators, such as their pricing structures. If a greater number of operators having access to 900MHz spectrum stimulated greater adoption of 3G services, the profits of the incumbents may increase by encouraging their existing customers to use these services more extensively. However, demand for mobile

broadband services is already growing rapidly¹. This suggests network effects are not necessary for stimulating greater adoption. In addition, this effect will be mitigated by (and may be less than) the loss in profit to the incumbent from the greater competitive intensity in the market, which is discussed below in paragraph A8.33.

- A8.24 There are a number of other benefits and costs of access, which are fully set out in our cost benefit analysis in annex 7, and our welfare analysis is further examined in our analysis of the available options in section 5.

What incentives exist in the market?

- A8.25 For market incentives to be aligned to deliver the best outcome, the action which is privately profitable must lead to the outcome which is socially desirable.
- A8.26 The profitability of a transaction depends upon the willingness of a 2100MHz operator to pay for 900MHz spectrum compared to the willingness of a 900MHz operator to accept an offer for some of their spectrum. All other things being equal, when the willingness to pay of a 2100MHz operator exceeds the minimum a 900MHz operator would be willing to accept, a trade should occur and the 2100MHz operator should gain access to 900MHz spectrum.
- A8.27 If incentives are correctly aligned, then willingness to pay will exceed willingness to accept when the benefits society derives from wider access to 900MHz spectrum exceed the costs of providing this access.

Willingness to pay

- A8.28 Willingness to pay is the maximum that a potential new user would offer in order to gain access to 900MHz spectrum. This depends upon the value this user could derive from the spectrum, including any gain in option value. This in turn depends on the strategy they would adopt with and without access.
- A8.29 If a user would provide a service of equal quality to that of 900MHz licensees even without access to 900MHz spectrum, the maximum it would be willing to pay would be the cost savings it would achieve by using 900MHz spectrum to provide this service more cheaply.
- A8.30 If it would not match the quality of a 900MHz operator's output, then the maximum it would be willing to pay would be the profits it could earn by obtaining 900MHz spectrum and matching the quality of the 900MHz licensee's output.
- A8.31 Willingness to pay may also be affected where we required some portion of 900 MHz spectrum to be released to the market. In this situation a current 900MHz operator's willingness to pay could be higher than that of other operators. This is because if a current 900 MHz licensee were to win the auction it would in effect retain the spectrum and the possibility to benefit from any higher profit that might result from being one of only two firms in the affected market segment. This contrasts with the situation of a non 900 MHz spectrum owner, whose willingness to pay would be based on an outcome where there are three or more firms in the affected market segment. (A more detailed explanation of differences in profits implied by different numbers of players is given in annex 9²). Hence the willingness

¹ See annex 11, in particular A11.15-A11.16 and figure 1

² See annex 9, in particular A1.40-A1.44 and figure 3

to pay of the current licensee could be distorted by the chance to earn better profits as a result of the less competitive structure of this sector of the market.

Willingness to accept

- A8.32 The willingness to accept is the minimum that the current licensee would consider to be sufficient remuneration for providing access to part of their 900MHz spectrum holdings. This partly depends upon the cost of clearing the spectrum, including any loss of option value.
- A8.33 In addition, if a 2100MHz operator would not match the quality of service offering provided by a 900MHz operator, it is likely to be at a competitive disadvantage, as we explain in paragraph A8.63.3. Therefore, if the 2100MHz operator then gained access to 900MHz spectrum, it could increase the quality of its service and so compete more effectively. This would increase the competitive pressure on the 900MHz operator, which would reduce its profits. This reduction in profits would be counted as a cost by the 900MHz operator and so would be factored into the minimum it would be willing to accept for access to 900MHz spectrum.
- A8.34 In their response to the September 2007 consultation, O2 suggest that the seller's willingness to accept will be influenced by the desire to avoid paying AIP for 900MHz spectrum in the future. However, the buyer would take into account the fact that they will have to pay AIP when determining how much they would be willing to pay for the spectrum. The overall effect of AIP on the likelihood of trade should therefore be neutral.

Factors affecting the development of the market

- A8.35 There are many factors which affect how the market for a service will develop. In the case of mobile broadband, we have identified three major influences on whether the market will develop such that 900MHz spectrum is important in delivering these services. These factors are:
- the level of demand for mobile broadband services and the importance of quality to consumers of those services
 - the number of operators with similar spectrum and the availability of substitutes
 - the scale of differences between 900MHz spectrum and other frequencies
- A8.36 We explain the significance of each of these factors, how stakeholders responded to each in the September 2007 consultation and how this has affected our position.
- A8.37 In addition, the current financial situation is likely to have a major effect on most sectors of the economy. We therefore also discuss the possible impact this could have on the development of the market.

Level of demand for mobile broadband services and the importance of quality to consumers of those services

- A8.38 If mobile broadband services were only a small part of the mobile market, as they were when we launched our September 2007 consultation, the scale of the advantage of using lower frequency spectrum would be relatively small as meeting this demand may require little or no expansion of the 3G networks.

- A8.39 If quality is not important for consumers of mobile broadband services, the ability of providers with low frequency spectrum to provide higher quality coverage is unlikely to be a significant advantage.
- A8.40 In the September 2007 consultation, we developed three market demand scenarios which reflected both of these features. We considered each to be equally plausible, given the uncertainty over how the market would develop.
- A8.41 However, various stakeholder responses to the consultation questioned whether this was the case. Vodafone stated that we had presented little evidence to support either the level of demand or the assumed importance of quality in our high scenario. O2 suggested only the low adoption and low market demand scenarios were supported by our evidence.
- A8.42 O2 put forward the view that other evidence suggested that demand for mobile broadband could be higher than our high scenario and so capacity rather than coverage or quality is likely to be the key constraint on networks. T-Mobile and H3G also suggested that our scenarios were conservative.
- A8.43 It is clear that since the September 2007 consultation, use of mobile broadband has expanded rapidly³. In light of the responses we received, we carried out additional research and analysis and constructed new demand scenarios which we use in our analysis in this document. Annex 11 presents our research findings and the new demand scenarios we are considering.
- A8.44 The degree of competitive impact resulting from quality differences is uncertain at this stage. We commissioned focus group research⁴, the results of which suggest that although consumers are currently satisfied with relatively low speeds it is the ability to access the service (i.e. the coverage) that is most important at present. As discussed in annex 11, experience in the fixed broadband and mobile voice markets suggests that, as consumer expectations grow, quality differences are likely to become important to at least some consumers. Early evidence for mobile broadband tends to support this, with operators actively marketing their speed and coverage credentials, and signs that some consumers are becoming dissatisfied with the level of service provided⁵.
- A8.45 The competitive impact will also depend on the quality of information available to consumers regarding the speed and coverage for mobile broadband and barriers to switching providers. These are both areas where we expect to see improvement over time, so that consumers can make well informed decisions when choosing a mobile broadband provider and, if already using mobile broadband, can switch provider.

Conclusions on demand and the importance of quality

- A8.46 It is now clearer than at the time of our previous consultation that there is significant and growing demand for mobile broadband. If 900MHz spectrum is important for meeting demand, this trend will increase the willingness to pay of 2100MHz operators, but will also increase what the 900MHz operators are willing to accept.

³ See annex 11, in particular A11.15-A11.16 and figure 1

⁴ The findings of the consumer research are discussed at greater length in annex 11, in particular A11.8-A11.9. In addition, the full research report commissioned for this consultation can be found at <http://www.ofcom.org.uk/consult/condocs/spectrumlib/mobilebb.pdf>

⁵ See annex 11, in particular A11.25-A11.26 and A11.30-A11.31

- A8.47 We consider that providing high quality mobile broadband coverage, particularly the ability to reliably provide high data rates indoors, is likely to be important to at least some consumers. However, it is still too early to determine how large a proportion of the market these consumers will comprise. This will increase the willingness to pay of 2100MHz operators for 900MHz spectrum if low frequency spectrum has a significant advantage in providing better quality services. However, it will also increase the 900MHz licensee's minimum willingness to accept.

The number of operators with similar spectrum and the availability of substitutes

- A8.48 In order for a wider distribution of 900MHz spectrum to be optimal, this spectrum and any close substitutes for it must currently not be widely available.
- A8.49 In the September 2007 consultation, our provisional conclusion was that there were limited substitutes available for 900MHz spectrum, particularly given the major uncertainties over the use of 800MHz spectrum for this purpose. This, together with the fact that 900MHz spectrum is currently held by only two operators, suggests that a wider distribution of 900MHz spectrum may be optimal.
- A8.50 Orange and Vodafone, however, suggested that 800MHz spectrum was likely to be a good substitute for 900MHz spectrum. Vodafone also suggested that we should take a longer term view of the market and the use of UMTS and LTE, in which case the timeframe over which 800MHz spectrum would become available would not limit its substitutability with 900MHz spectrum.
- A8.51 Orange also suggested that, should a timely decision on 2G liberalisation not be reached, then operators without access to 900MHz spectrum should be allocated the DDR spectrum. Vodafone, however, suggested that we should postpone a decision on 900MHz until the uncertainty around the DDR is resolved.
- A8.52 On the other hand, T-Mobile took a more pessimistic view of the substitutability of 800MHz spectrum and the time it might take to achieve European harmonisation of the band.
- A8.53 Since the time of the previous consultation, it has become more likely that the 800MHz band may become available for use for mobile broadband⁶. While it is true that the award of 800MHz spectrum has the potential to resolve any concerns over wider access to 900MHz spectrum by creating an opportunity for wider availability of sub 1GHz spectrum, this is not certain for a number of reasons:

A8.53.1 The 800MHz spectrum is part of the DDR cleared award, which will be awarded in a technology-neutral auction. While it is likely this spectrum will be bought for mobile use, this is not a certainty. This approach to the assignment of the spectrum also means that it would be inappropriate to allocate this spectrum to any particular operator, as per Orange's suggestion.

A8.53.2 The precise volume of 800MHz spectrum that will be available for award and when it will be available is presently unclear, since the exact design of the DDR cleared award is still being developed. In our considerations of the appropriate award design, we will take into account and act in the best interests of all our stakeholders. We have set out our next steps on the DDR in the recent consultation on clearing the 800MHz band.

⁶ See section 3, in particular 3.34-3.36

A8.53.3 It is unclear if or how much contiguous spectrum might be needed to provide competitive mobile broadband services using NGM networks (such as LTE). If for example bandwidths of 2x10MHz or more are required to provide an adequate data rate, sub 1GHz spectrum for mobile use will remain a scarce resource.

A8.54 We consider that we should take into account the potential role of 800MHz spectrum in the mobile broadband market once it is available, as it is increasingly likely that this spectrum may be suitable for mobile use and the availability of this spectrum would significantly increase the amount of sub 1GHz spectrum available for such use.

A8.55 However, we must also take into account the uncertainties surrounding 800MHz spectrum. One approach would be to delay our decision on the appropriate way to approach liberalising 900MHz spectrum until the uncertainties are resolved, as suggested by Vodafone. The disadvantage of this is that delay could have real costs, given that consumer demand is growing rapidly and that it is unclear when the uncertainty will be resolved. We examine this in more detail in section 5⁷.

A8.56 An alternative approach is to assess the options for liberalisation in relation to the interim period between the liberalisation of 900MHz spectrum and the time when operators can fully exploit 800MHz spectrum which they might have purchased. We assume that time will be needed to rollout services following DSO and so we assume the end of this interim period will be no later than 2015. A full explanation of our timing analysis is set out in annex 12. On balance, we think that this approach is the appropriate way to take account of the role 800MHz spectrum may play.

Conclusions on the number of operators with similar spectrum and the availability of substitutes

A8.57 We now consider that 800MHz spectrum is more likely to be a substitute for 900MHz spectrum in the longer term. We set out in our June 2008 consultation paper⁸ on the cleared award how longer term competition issues encompassing both bands might arise in the context of mobile broadband provision and we consulted on our analysis and possible approaches. Here, we propose to consider the situation in the interim period before services using this spectrum are fully available (i.e. up to 2015).

A8.58 In the interim period, there are limited substitutes for 900MHz spectrum available, and only two operators will have access to 900MHz spectrum, absent any trade. This suggests that the willingness of a 2100MHz operator to pay for 900MHz spectrum will be influenced mainly by the advantage it can derive from it in the interim as opposed to waiting for 800MHz spectrum to be fully available in 2015. The willingness of a 900MHz operator to accept an offer may also be influenced by the potential fall in value which will occur after 2015 when it is no longer a unique resource.

The scale of differences between 900MHz spectrum and other frequencies

A8.59 Differences between bands have to be significant – in terms of differentiating the provider's service offerings from those of its competitors in the eyes of consumers – for the wider availability of 900MHz spectrum to provide greater benefits for society.

⁷ See section 5, in particular 5.42-5.47

⁸ <http://www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf>

- A8.60 If these differences are significant, operators without access to 900MHz spectrum may find it economically or practically infeasible to match the coverage quality, capacity and/or speed of service of 900MHz operators, or will need to incur large resource costs to do so. This will affect their willingness to pay for 900MHz.
- A8.61 Our modelling in the September 2007 consultation demonstrated that access to 900MHz spectrum was likely to give a substantial cost advantage to an operator providing good quality in-building coverage.
- A8.62 In their responses to the consultation, stakeholders raised a variety of issues relating to our approach, ranging from technical assumptions, cost assumptions and demand. These are considered in detail in annexes 13, 14 and 15⁹ and a summary of our refined analysis is presented in annex 10.
- A8.63 Our refined assessment considers the differences between an operator with 900MHz spectrum and one with 2100MHz spectrum in terms of both the number of sites needed to provide high quality mobile broadband coverage and the costs incurred. Although we followed the same approach as in the September 2007 consultation, we did so in light of stakeholder comments, carrying out sensitivity analysis to assess their impact where necessary. We have also considered the impact on quality if an MNO without 900MHz spectrum does not match the level of quality that we expect a 900MHz operator to offer.
- A8.63.1 Our results¹⁰ suggest that a 900MHz operator would need to rollout between 2,900 and 7,300 sites to cover densely populated areas (i.e. the 80% population area), while a 2100MHz operator would need to rollout between 8,600 and 21,100 sites to provide the same quality coverage over the same area. This translates into a cost difference of between £50m and £1.6bn¹¹ where 2100MHz operators are assumed to be able to begin to benefit from the availability of 800MHz spectrum from 2013.
- A8.63.2 We have considered the feasibility of the 2100MHz operators matching the quality of the 900MHz operators. At the lower end of the range of significance, a 2100MHz operator is likely to be able to match quality in the interim period, given that they are likely to have 9,000 sites by 2010. However, at the upper end of our range matching quality may not be practically feasible. This is because the 2100MHz operator would need to install roughly 4,000 sites a year between 2011 and 2013 (when the incumbents can fully exploit 900MHz spectrum) to increase the site count from 9,000 to 21,100. This compares with a maximum of around 2,000 new sites a year that has been achieved in the past.
- A8.63.3 We also considered the impact of a 2100MHz operator not matching quality. If an operator does not match quality, it is effectively excluded from the segment of the market which is highly sensitive to quality. The magnitude of this disadvantage partly depends upon what proportion of consumers is very sensitive to quality – the greater the proportion of quality-sensitive consumers, the harder the operator will find it to compete. In addition, the proportion of spend on mobile services that a customer switches in order to gain quality may have an effect. For example, a

⁹ See annex 13, in particular A13.105-A13.114 and table 7, annex 14, in particular A14.22-A14.49 and annex 15, in particular A15.34-A15.56

¹⁰ See annex 10, in particular tables 4 and 5

¹¹ 20 year NPV at 3.5%

subscriber may choose to switch only their mobile broadband service, or they may decide to move their entire mobile communications package to a different provider. The price the 2100MHz operator can charge for its services compared to a 900MHz operator to attract consumers may also have an effect. Therefore, there is a material risk that an MNO not matching quality could be at a competitive disadvantage to a 900MHz operator.

Conclusions on the scale of differences between 900MHz spectrum and other frequencies

- A8.64 900MHz spectrum is likely to bring substantial cost advantages in providing access to mobile broadband services in the interim period before 800MHz spectrum is widely available.
- A8.65 Offering a lower quality service may reduce an operator's ability to compete. Therefore, if access to 900MHz spectrum means a 2100MHz operator would be able to compete more effectively, the effect of increased competition on the incumbents' profits would increase the amount they are willing to accept as discussed in paragraph A8.33.
- A8.66 Both of the points made here would make it more important for a 2100MHz operator to gain access to 900MHz spectrum and so would increase its willingness to pay for it.

The impact of the financial crisis and economic slowdown

- A8.67 Since the September 2007 consultation, the financial sector has been subject to a severe shock which has in general reduced liquidity and made it harder and more expensive to raise capital. The UK economy as a whole has now also entered a slowdown. These changes could in principle affect both demand for high quality mobile broadband services and MNOs' incentives and ability to deploy infrastructure to provide such services. Therefore it is necessary to assess whether these changes are likely to materially affect how we believe the market is likely to develop.
- A8.68 In principle, an economic slowdown could seriously weaken demand for mobile broadband services in the short term. Mobile broadband demand may subsequently catch up to where it would have been in the medium term. However it is also possible that demand will be permanently affected.
- A8.69 Consumer research in this area is limited and conflicting. While some research¹² suggests that fixed broadband and mobile services in general are resilient to economic downturn, the same survey also suggested that, for mobile data services specifically, consumers are more likely to cut back their spending. As a result we consider that the economic slowdown makes it more uncertain whether mobile broadband will grow strongly in the short term. However, we believe that our range of demand scenarios is wide enough to cover this uncertainty.
- A8.70 The survey also reports that consumers may delay upgrading their handsets, at least for the duration of the slowdown, which has two potential implications for liberalisation:

¹² Execution Research, European Mobile Survey, 28th October 2008

A8.70.1 The costs of spectrum clearance may be higher if the rate of migration to 3G slows in the short term. Handset subsidies may need to be higher to induce users to upgrade.

A8.70.2 The cost of deploying new spectrum may also rise if it costs more to induce users to upgrade their terminals. This may reduce the attractiveness of deploying new spectrum or slow the rate of deployment. However, the effect may be limited if mobile broadband is driven more by dongle usage than handheld devices

A8.71 These two points suggest that operators may be less willing to deploy new infrastructure using both 900MHz spectrum and 2100MHz spectrum. In addition, operators may also be less able to deploy new infrastructure. It has clearly become more difficult for businesses to obtain finance over the past year. The financial crisis means that capital markets have become more constrained. As a result some investments which would otherwise have been funded may now not proceed and MNOs may be less able to afford new infrastructure deployments. This could

A8.71.1 Limit the extent to which 900MHz incumbents can increase mobile broadband quality in the interim period, and/or delay their rollout of UMTS 900.

A8.71.2 Affect whether 2100MHz MNOs will be able to match the quality offered by the 900MHz incumbents.

A8.72 Since it is likely to be more costly for 2100MHz MNOs to provide high quality mobile broadband services, they are likely to be more constrained than the 900MHz incumbents by the financial crisis, all other things being equal. Of course, if demand were significantly affected, then, as discussed above, the 900MHz operators might deploy fewer sites than they otherwise would have, making it less expensive for 2100MHz MNOs to provide competing services.

Conclusions on the likely impact of the financial crisis

A8.73 The financial crisis is likely to have conflicting effects on the ability of 2100MHz operators to match the quality of 900MHz operators and on the willingness of 900MHz operators to accept bids for their spectrum.

A8.74 On one hand, 2100MHz operators may be less able to raise capital either to deploy more sites using 2100MHz spectrum or to buy 900MHz spectrum. This suggests that operators without access to 900MHz spectrum may be less able to match quality. Moreover, if 900MHz MNOs believe that 2100MHz operators will be less likely to match quality, according to the analysis in paragraph A8.33 this will increase the minimum they are likely to be willing to accept.

A8.75 However, if demand is significantly weakened due to the constraints on consumers' disposable incomes, the strategic benefit of holding 900MHz spectrum may be lower and so the minimum a licensee will be willing to accept should fall. In addition, if the current state of the capital market limits the increase in quality of the 900MHz operators' services, 2100MHz operators may still be able to match quality.

A8.76 It is therefore unclear what the overall influence of the current financial situation will be.

Partial matching

- A8.77 As stated in paragraph A8.15, in much of our analysis we refer to 2100MHz operators either matching or not matching the quality of the services provided by 900MHz licensees. In reality, the quality choice of non-900MHz operators is not an 'either/or' decision. Rather than fully matching the quality of a 900MHz operator, the 2100MHz operator may choose to provide a service which is of a higher quality than that which it currently provides, but not of equal quality to that of a 900MHz operator. This would allow it to be in a more competitive position than if it did not make any attempt at matching (as its service offering is closer to that of the 900MHz licensee). However it may still face a competitive disadvantage, even if it is a smaller one, by failing to fully match quality. Similarly, the operator would still have a cost disadvantage, albeit a smaller one than if it fully matched.
- A8.78 We accept that it is likely that some operators will follow a partial matching strategy. Such a strategy would mean that the 2100MHz operator would be more competitive than a non-matching operator but with higher costs, and would be less competitive than a matching operator but with lower costs. Therefore by partially matching, the 2100MHz operator would be at both a cost and competitive disadvantage.
- A8.79 In order to model the possible effects of partial matching on 2100MHz operators and social welfare, it would be necessary to observe how the cost and competition effects change as quality changes. The Cournot model we use in our analysis of competition effects does not allow for differences in quality, but rather is a stylised model which allows only for operators either to match or to exit the market¹³. Even if we were to use a different model which allowed for product differentiation, it would still be necessary to specify the extent of differentiation and the competitive dynamics and to combine it with a model of cost differences to give the overall impact on welfare.
- A8.80 We consider that the trade off between cost and competition disadvantages for a 2100MHz operator will be significantly complex. It depends upon the sensitivity of consumers to quality changes and the costs of creating these changes at the margin. The uncertainty of the exact nature of this trade off, together with the fact that there are many possible variations in quality a 2100MHz operator could choose, mean that we consider that including partial matching as one of the possible strategies of an operator would significantly complicate our analysis.
- A8.81 As the analysis in paragraphs A8.85-A8.96 shows, in the absence of partial matching, in the high significance scenario the key source of potential welfare gains from a more intrusive policy option (such as partial spectrum release) is the competition benefits arising from increased competition in high quality mobile broadband. In the medium significance scenario the key source of potential welfare gains is the productive efficiency benefits arising from network build using lower cost, low frequency spectrum see paragraphs A8.99-A8.101). Allowing for partial matching, the source of potential welfare gains in each of the high and medium significance scenarios would become a combination of competition and productive efficiency benefits. It is uncertain whether in each scenario this combination would result in higher or lower overall benefits and we are not aware of compelling reasons for taking a clear view on the direction of this effect.

¹³ Our analysis of the Cournot model is set out in annex 9, in particular see A9.13-A9.16 for the justification for using this model.

A8.82 As a result of this, we cannot be certain exactly how a partial matching strategy would affect the position of a 2100MHz operator and the resulting analysis of benefits of policy options. Given also the very significant additional complexities of attempting to incorporate this effect into the modelling, we have excluded partial matching from our quantified analysis.

Assessment of likely outcomes

A8.83 It is not yet clear how the above factors will evolve and so how the market will develop is still uncertain. Therefore, we have developed three scenarios which capture the range of possible ways in which the market may develop in terms of the significance of low frequency spectrum. We will now examine the likely outcomes in each of these three different significance scenarios. As already stated, the likely outcomes depend upon both the costs and benefits to society of wider access, and also the economic incentives of the operators involved. These incentives are characterised in our analysis as the willingness of 2100MHz operators to pay for 900MHz spectrum and the willingness of incumbent licensees to accept an offer for 900MHz spectrum in the interim period before alternative spectrum is available.

A8.84 The aim of this analysis is not to prove definitively that wider access to 900MHz spectrum will or will not be achieved. Rather, it is designed to demonstrate that it is plausible that wider access may be beneficial to society, even where this does not necessarily fit with the incentives of individual players. As such, the figures given below are intended only to illustrate this. Assumptions underlying these figures are set out in annex 7 unless otherwise stated.

High significance of low frequency spectrum

A8.85 In the high significance scenario, the benefits of liberalisation are significantly in excess of the costs of clearance. This corresponds to a situation where

- Demand is high and grows very strongly, and consumers are highly sensitive to differences in quality; and/or
- Differences between 900MHz spectrum and other spectrum are such that the service provided using 900MHz spectrum cannot be replicated using higher frequencies.

A8.86 Our analysis of the circumstances of the market set out above suggests that it is possible (though far from certain) that these circumstances may arise, particularly in the interim period. We consider that demand is significant and growing, although the pace of growth may change¹⁴. In addition, our cost analysis summarised in annex 10¹⁵ suggests that differences between the relevant spectrum bands are likely to be material.

Would wider access be beneficial?

A8.87 We estimate in annex 16 that the cost of clearing a block of 900MHz spectrum (assuming the operator has already cleared one for their own use) is in the region of £60-90m¹⁶.

¹⁴ See annex 11, in particular A11.15-A11.23

¹⁵ See annex 10, for example figure 4 and table 3

¹⁶ Figure for 2011 with NPV at 3.5%. See annex 16, in particular table 50

- A8.88 The above description of the difference between frequencies comes from the fact that, although in theory a 2100MHz operator could match the quality of service provided by 900MHz licensees, in reality this would require them to roll out an unfeasibly large number of base stations (as described in paragraph A8.63.2). Even if they could rollout this many sites, doing so would leave them at a considerable cost disadvantage, since the 900MHz operators would need to roll out significantly fewer sites. We estimate that the difference in cost between a 900MHz and a 2100MHz network providing the same quality of service could be in the region of £1.5 - £2.4bn¹⁷.
- A8.89 These cost differences suggest that it is highly unlikely that operators without access to 900MHz spectrum will be able to match the quality of those with 900MHz spectrum. Given this, for the reasons set out in paragraph A8.63.3, operators without access will be at a competitive disadvantage. This disadvantage may be significant in this scenario, as consumers are assumed to be highly sensitive to quality differences. Our calculations of the competition effects of widening access show that benefits could potentially be in the range of £400-900m¹⁸. Thus, wider access to 900MHz spectrum is likely to be highly beneficial.

What incentives exist in the market?

- A8.90 As explained in paragraph A8.30, since it is unlikely that 2100MHz operators would match the quality of service offered by 900MHz operators, the value they place on 900MHz spectrum reflects the profits they can earn by matching this quality now rather than waiting for 800MHz spectrum to become available.
- A8.91 However, as set out in paragraph A8.33, when assessing the cost of allowing access, the 900MHz operator will factor in the loss of profit from the increase in competition in the market.
- A8.92 The loss of profit to one incumbent 900MHz operator will depend in part on the decision by the other incumbent whether or not to trade. If, for example, Vodafone traded a block of 900MHz spectrum but O2 did not, O2 would lose profit due to the increased competition without gaining any offsetting profit from a trade. So, if O2 knew that Vodafone was going to engage in a trade (or vice versa), it would be more likely to engage in a trade itself. This is because refusing to trade would not prevent the increase in competitive position of a 2100MHz operator (who would be purchasing 900MHz spectrum from Vodafone), but would forego the profits from the trade. However, in our September 2007 consultation, we suggested that it was plausible for a situation to arise where 900MHz spectrum was not traded due to the strategic interactions between the incumbent operators (such as the lack of certainty that the other incumbent would engage in a trade). In such circumstances, by refusing to trade, Vodafone and O2 would avoid the loss in profit from more competitive provision of high quality mobile broadband, even where wider access would be beneficial to society.
- A8.93 Economic theory provides conflicting evidence on whether the gain in profit to the new licensee – affecting willingness to pay - is greater than the loss of profit for the current licensee – affecting willingness to accept. Some models of oligopoly competition predict one result, while others predict the opposite.

¹⁷ This is based on the difference in cost between a 2100MHz RAN sharing network and a single 900MHz network. See annex 7, in particular table 3

¹⁸ This arises where a RAN sharing operator purchases a block of 900MHz spectrum and so access widens from 2 to 4 players. See annex 7, in particular table 2

- A8.94 However, it is clear that the incumbent licensee would also bear the cost of clearing and releasing the spectrum. In addition, there may be differences in the option value of the new and current licensee, as explained in paragraph A8.19. In this situation, the incumbent may also have additional options such as the ability to capture an unmatched competitive position (as mentioned in paragraph A8.20). This will further increase the minimum they will be willing to accept.
- A8.95 In a situation where we required some 900MHz spectrum to be released to the market, the willingness to pay of the current 900MHz licensee may be distorted, as described in paragraph A8.31. If this were to be the case, it is reasonable to suppose that the current licensee would reacquire the spectrum. This means that, all other things being equal, the incentives present in the market may still not be aligned towards securing the efficient level of access to 900MHz spectrum.
- A8.96 Hence, it is likely that the incentives in the market may not be aligned to provide wider access.

Medium significance of low frequency spectrum

- A8.97 In the medium significance scenario, the benefits of liberalisation are reasonably high relative to the costs of release. This corresponds to a situation where
- Demand is reasonably high and growing in line with current trends. Some consumers have a preference for a high quality service, although this is not true of all consumers; and/or
 - There are differences between 900MHz spectrum and other spectrum, but it is still plausible to match the services provided with 900MHz spectrum using higher frequencies.
- A8.98 Our analysis of the circumstances of the market set out above suggests that these circumstances may occur. We consider that demand side characteristics similar to those described under this scenario could plausibly develop. Our cost analysis suggests that differences between the relevant spectrum bands are likely to be material. However, it is unclear exactly how both of these factors will be affected by the financial crisis, as explained in paragraphs A8.67-A8.76.

Would wider access be beneficial?

- A8.99 This scenario suggests that there are some significant differences between frequencies. Depending on exactly how these differences affect the number of sites needed at 2100MHz to match the quality of service provided with 900MHz spectrum, this could imply a significant cost difference between 900MHz spectrum and alternative spectrum. Our cost estimates suggest this cost difference could be anywhere between £600m-£1.1bn¹⁹. Since demand is reasonably high in this scenario, 900MHz operators are likely to rollout a mobile broadband network using this spectrum.
- A8.100 It is still possible for some operators to match the quality of service of 900MHz operators using higher frequency spectrum. However, as the cost differences get

¹⁹ This is based on the difference in cost between a 2100MHz RAN sharing network and a single 900MHz network. See annex 7, in particular table 3

higher i.e. as more base stations are needed at the higher frequency to compete, it may only be possible to compete as a RAN sharing operator²⁰.

A8.101 Thus, since there is an advantage to be derived from access to 900MHz spectrum, wider access is likely to be beneficial to some extent. The benefits of wider access are larger the bigger the cost difference between using 900MHz spectrum and higher frequencies.

What incentives exist in the market?

A8.102 As explained in paragraph A8.29, since the 2100MHz operator would match without access to 900MHz spectrum, its willingness to pay is the cost saving of using 900MHz spectrum instead of 2100MHz spectrum. In theory, since the cost of clearance is likely to be significantly less than this value to 2100MHz operators, and since we do not expect there to be a significant difference between the option values of the current and new licensee, a trade should occur. However, it is possible that other factors could distort the incumbent's decision making:

A8.102.1 Firstly, 900MHz licensees may take a strategic view about the importance of holding low frequency spectrum in the long term, which may affect their option value but not a potential acquirer's. In particular, they may believe there is a chance that retaining 900MHz spectrum may provide them a competitive advantage in the longer term, even if other operators provide a competitive service using 2100MHz spectrum in the interim. This is because sub 1GHz spectrum is likely to continue to be particularly valuable and scarce. We are seeking to ensure that access to sub 1GHz spectrum promotes competition as effectively as possible in the future. But the 900MHz licensees may still consider there is some potential to realise a competitive advantage in the future through retaining 900MHz spectrum. For example, they may consider there are some risks to the effectiveness of competition remedies (such as access requirements) or that the scarcity of sub 1GHz spectrum will inevitably limit the level of competition.

A8.102.2 Secondly, the incumbent may not have full information about the intentions of the 2100MHz operator. If the incumbent believed that the 2100MHz operator would not provide the same quality of service without 900MHz spectrum, they would expect a trade to increase the competitive intensity of the market. This would increase the minimum they would be willing to accept, regardless of what the 2100MHz operator would actually have done.

A8.103 Therefore, it is possible that the incentives of the incumbents may discourage efficient trades. This would require significant asymmetries. For example, for the first point to hold there would need to be a significant difference between the value 900MHz operators place on 900MHz spectrum in the future and the value 2100MHz operators believe it will have. This might arise because of differences in holdings of sub 1GHz spectrum. But the effect is limited to the extent that incumbents expect future access to sub 1 GHz spectrum to promote competition, such as through future regulatory policy. If differences between sub 1GHz and other spectrum are larger (i.e. if we are at the higher end of the cost difference range), then this effect is likely to be greater as access to sub 1GHz spectrum is more important for effective competition.

²⁰ See annex 7, in particular A7.15-A7.20 for a discussion

- A8.104 Asymmetries of information are relevant to the second point. It is plausible that the 900MHz operators will not know exactly what the 2100MHz operators plan to do (and different operators may have different views). To some extent we might expect a degree of consensus within bounds between operators about the relative cost and profit gain of using different spectrum to provide services. This is because these costs and gains are driven by technical and market conditions common to operators. However, the potential for asymmetries is likely to be greater where cost differences are higher as there may be more uncertainty over how different operators will react. Overall we expect some uncertainty will remain.
- A8.105 Therefore, while it is possible that market incentives may lead to a suboptimal outcome for society, we think it is plausible that wider access to 900MHz spectrum may be achieved through the market, especially towards the lower end of the range of cost differences covered by this scenario. However, if cost differences are at the higher end of the range, it becomes more likely that private incentives would not be aligned with a social welfare maximising outcome.
- A8.106 The reasons set out above also suggest that, if cost differences are at the higher end of the range, the current 900MHz licensee may be willing to pay more than a potential new user if we required part of the 900MHz spectrum to be released. However, there is more uncertainty over how far this is the case than in the high scenario, as here the relative willingness to pay of the current and new users will depend upon the extent to which the asymmetries described above distort incentives. This could mean that incentives may still not be aligned towards providing wider access.

Are there any other concerns over the market mechanism?

- A8.107 One issue which we believe is more likely to arise in the medium significance scenario than the other scenarios is the possibility of an asymmetric profit shock arising as a result of liberalisation. In this context, an asymmetric profit shock would be a change in the relative profits of the MNOs that could arise if there were significant cost differences between 900MHz spectrum and other spectrum, and firms without 900MHz spectrum matched the quality of 900MHz operators and incurred a higher cost. For example, a 2100MHz operator may suffer a profit shock as its profits would be substantially lower (all other things being equal) relative to those of the 900MHz incumbents as a result of liberalisation.
- A8.108 It is not, however, inevitable that asymmetric profit shocks will affect the outcome in the market. For example, if capital markets operate efficiently, in the sense that all profitable investments are able to attract funding, investment decisions would be unaffected. On the other hand, if capital markets have inefficiencies, the negative effect on the 2100MHz operator's profit could mean that the operator would not be able to afford to invest as much in its networks as 900MHz licensees, which would put it at an even greater disadvantage. In the limit, in principle this could result in the exit of a competitor from the market.
- A8.109 In the September 2007 consultation, we considered it unlikely that asymmetric profit shocks would have a detrimental impact on competition. Firstly, we considered it unlikely that, in a sector with large, well-resourced multinational companies, capital markets would be so inefficient that profit shocks would be allowed to affect competition. Secondly, we did not consider that profit shocks would be sufficiently large to force firms to exit the market. However, we recognised that it is generally good regulatory practice to avoid large, asymmetric profit shocks wherever possible, as they could be disruptive and contribute to perceptions of a less certain

regulatory framework. This could potentially adversely affect incentives to invest in the sector more generally.

- A8.110 O2 and H3G disagreed with our analysis in their responses to the consultation. They suggested that capital markets would not be able to both fund profit shocks and provide funds for necessary investment. In addition, H3G pointed out that cost disadvantages would not be a one-off profit shock affecting fixed costs, but would also mean that operating costs would be higher, and so the disadvantage would persist.
- A8.111 We have refined our analysis of cost differences between frequency bands. We now have greater certainty that cost differences and therefore asymmetric profit shocks are likely to be material.
- A8.112 In addition, the financial crisis (discussed in paragraphs A8.67-A8.76) has created significant uncertainty in the financial markets such that it is now more plausible that operators would be unable to attract funding for sufficiently sound long term investments. However, we expect this effect to reduce as the financial system recovers, so this should only be a significant problem in the short run. The earliest that the operators would be likely to start major deployments of liberalised 900MHz spectrum would be 2011²¹, by which time these problems may have been alleviated.
- A8.113 We still consider that it is unlikely that asymmetric profit shocks will have a direct, material effect on competition. However, we continue to acknowledge that large asymmetric profits shocks of this type resulting from regulatory policy could have an impact on investment incentives in the sector in general. Therefore, some form of intervention may be justified to prevent this.
- A8.114 We consider that correctly applying AIP could substantially reduce asymmetric profit shocks since AIP should reflect the value of the spectrum. This approach is also neutral with regard to the promotion of competition, since whoever owns the 900MHz spectrum pays the relevant AIP charge.

Low significance of low frequency spectrum

- A8.115 In this scenario, the benefits of liberalisation are low relative to the costs of clearing spectrum. This corresponds to a situation where
- Demand is so low there is little need to expand the network to provide extra capacity, and consumers are insensitive to differences in quality so an operator cannot gain a significant competitive advantage from providing a high quality service; and/or
 - The differences between 900MHz spectrum and other spectrum are insignificant.
- A8.116 Our analysis of the circumstances of the market set out above suggests that there is slightly less certainty over the likelihood of this scenario. We consider that there is some evidence that demand is growing rapidly enough to require new investment in 3G provision. However, the financial crisis will affect how far this is true in the immediate future. As explained in paragraphs A8.44-A8.45, it is possible that consumer sensitivity to quality may become more significant in the future. In

²¹ See annex 12, in particular Gantt charts A-F and table 3

addition, we consider that differences between 900MHz spectrum and other available spectrum are likely to be significant, although the extent of this significance will be influenced by the demand situation. Therefore, while it is possible that this outcome could occur, given what we know or can predict about the market, we consider that it is less likely that this scenario will arise than it is that the medium or high scenario in aggregate will occur.

Would wider access be beneficial?

A8.117 In the low significance scenario, the cost advantage of 900MHz spectrum compared to 2100MHz spectrum is likely to be quite low as there is by definition little difference between the frequencies. We estimate that the cost advantage may range from £0-150m²². This compares to an estimated cost of release which may be in the region of £90m-140m. In addition, if mobile broadband is taken up only slowly, then 2G services may remain popular for longer, which could increase the cost of clearance further²³. Therefore, it is possible that 900MHz operators may not use this spectrum for mobile broadband if cost differences were at the lower end of this range, and so 2100MHz operators would be at no disadvantage.

A8.118 Even if 900MHz operators do rollout a service using 900MHz spectrum, 2100MHz operators are likely to be able to match the quality of this service without rolling out more sites than are already planned, and so will not need access to 900MHz spectrum to provide a service of equal quality.

A8.119 Thus, wider access to 900MHz spectrum may not be beneficial.

What incentives exist in the market?

A8.120 Given that 900MHz spectrum is not expected to provide a significant advantage in this scenario, 2100MHz operators are likely to have only a limited willingness to pay for it. The willingness to accept of the 900MHz operator will reflect the cost of release, which we expect to be similar to or greater than the 2100MHz operator's willingness to pay. Therefore, we consider that a no trade outcome is more likely to be optimal in this scenario than the other scenarios.

A8.121 This of course ignores the possibility of further costs and benefits to operators, such as option value. However, it is unlikely in this situation that 900MHz spectrum will give an operator many advantages which could not be obtained with other frequency spectrum, and so the market could reasonably be expected to induce and achieve all mutually beneficial trades.

Stakeholder responses

A8.122 We received a number of comments from stakeholders following our September 2007 consultation, some of which were relevant to the analysis we have presented in this annex. We have attempted to integrate these comments and our responses to them throughout our analysis. The following responses relate to the issues presented here as a whole.

²² This is set out as break point 1 in the cost benefit analysis. See annex 7, in particular A7.37-A7.40

²³ We have taken into account that 2G traffic may continue to increase up to 2011. See annex 16, in particular A16.108-A16.117

Analysis of stakeholder responses on the desirability of wider access

- A8.123 We received responses to our September 2007 consultation relating to whether wider access to 900MHz spectrum would be desirable. The responses were mixed as to whether wider access would be considered to be beneficial.
- A8.124 A number of responses related to the importance of competition in mobile broadband, and how wider access is necessary to achieve this. For example, H3G stated that spectrum allocations could have a material effect on competition, and that Ofcom should intervene to enable five strong competitors to remain in order to promote mobile broadband and broadband Britain. T-Mobile commented that a competitive market was needed to accelerate the removal of barriers to adoption of mobile data services, such as ease of use and reliability of service
- A8.125 In contrast to this, Vodafone suggested that we should take a longer term view of competition. Vodafone suggested that there may only be enough sub 2GHz spectrum to support 3-4 LTE based mobile competitors.
- A8.126 Vodafone also suggested that we had provided no evidence that widening access to 900MHz spectrum and so increasing the number of players in the market would have a large effect on competitive intensity, and that any future competition problems we identified were speculative.
- A8.127 In addition, we received comments on the likelihood of non-900MHz operators matching the quality of service provided by 900MHz operators. T-Mobile argued that operators without 900MHz spectrum would not match the quality and/or cost of the 900MHz operators as this would trigger a 'customer value proposition' war which the non-900MHz operator could not win.
- A8.128 One MNO also provided evidence which suggested that operators need to minimise quality disadvantages or face a large loss of customers over time. This respondent estimated that it could lose 50% of its customers by the end of 2009 if it does not provide a competitive 3G network.

Our response

- A8.129 We agree that competition is at the heart of securing the best outcome for citizens and consumers and we are committed to ensuring that a competitive outcome is reached. We do not, however, have a duty to determine or fix the number of competitors. Intense competition may be achieved with more or indeed fewer competitors, depending on market circumstances.
- A8.130 We address Vodafone's view on wider access, including that an increase in the number of players would not necessarily increase competitive intensity, in annex 9²⁴.

Analysis of stakeholder comments on market incentives to provide wider access

- A8.131 Our September 2007 Consultation concluded that it was likely that market incentives would not be aligned to provide wider access, even where it would be beneficial for this to occur.

²⁴ See annex 9, in particular A1.15

- A8.132 Orange and T-Mobile agreed with our analysis. T-Mobile stated that it had in the past been unsuccessful in trying to acquire 900MHz spectrum from the current holders.
- A8.133 Vodafone and O2 both disagreed with our analysis. Each sought to show that it could be possible for either spectrum trading or commercial roaming to be offered. They claimed that the conditions for access to be restricted were unlikely and that we could not demonstrate that there was sufficient risk of this occurring to justify intervention. We discuss below the comments of both operators in more detail.
- A8.134 Vodafone stated that if the costs savings from use of 900MHz spectrum were small, then a no trading outcome might be efficient, because the benefits to potential buyers of the spectrum might not exceed the costs of releasing the spectrum.
- A8.135 Vodafone also noted that for our analysis of the dynamic interactions between two holders of liberalised 900MHz spectrum to affect the outcome of their decision whether or not to trade, the following had to be true:
- it had to be credible that one incumbent would retaliate, if the other agreed to a trade
 - the threat of retaliation would have to be effective (i.e. after retaliation, the other incumbent would be worse off)
- A8.136 Vodafone put forward scenarios based around these criteria to illustrate that spectrum trades could occur and suggested that these scenarios were more realistic than scenarios in which trading would not occur. For example, if the increase in competition from a trade were unlikely to have a great impact on incumbents' profits, the threat of retaliation would be ineffective (even if cost differences were significant). Vodafone also stated that we had judged the market to be effectively competitive in the past. It concluded that it was unclear, as a result, why a change in competitive intensity would significantly affect incumbent profits.
- A8.137 O2 claimed that the conditions for the 900MHz operators to foreclose access to their spectrum are not present, on the basis that:
- 900MHz spectrum is homogeneous
 - it is uncertain if MNOs without 900MHz would be considerably disadvantaged
 - the downstream market is competitive
- A8.138 O2 (and their consultants Oxera) also presented a model which showed that it was possible for trading or commercial roaming to occur if certain critical assumptions, which are interlinked in their model, were met:
- MNOs without 900MHz could compete in the same market as those with 900MHz spectrum;
 - Cost differences were low (i.e. the ratio of a 2100MHz only MNO's costs to a 900MHz incumbent's costs was below a certain threshold); and
 - Consumers were relatively insensitive to changes in prices

A8.139 O2 also disputed our use of a prisoner's dilemma analysis for the 'one off' trade, since the trade decision would be made sequentially rather than simultaneously. Therefore, each 900MHz operator could observe the other's decision.

A8.140 In addition, O2 suggested that our views in the September 2007 Consultation were inconsistent with the view we set out in our Statement on Mobile Call Termination in March 2007, that trading would remove small cost differences between GSM900 and 1800.

A8.141 Moreover O2 argued that we could always intervene at a later stage if there were a market failure and that the threat of future intervention by Ofcom would give the incumbents incentives to trade or offer commercial roaming.

Our response

A8.142 We consider that the main differences between our analysis and those of Vodafone and O2 are:

- the likelihood that there are significant cost differences between operators with and without 900MHz spectrum; and
- whether increases in competitive intensity as a result of a wider distribution of 900MHz spectrum would have a significant impact on the profits of the 900MHz operators.

A8.143 We have reflected the possibility that low cost savings could create a situation where a no trade outcome is efficient in our low scenario. However, our analysis of cost differences between operators (see above and in annexes 13-15) shows that, in some scenarios, there could be considerable differences between operators with and without 900MHz spectrum. We consider, therefore, that it is clearly plausible that cost differences could be significant.

A8.144 We would make two points in response to the comment that we have judged the mobile market as effectively competitive. First, this assessment related to the structure of the mobile market in 2003. The issue we are considering is how the structure of the market may be affected by liberalisation and the resultant impact of this on competitive intensity. Especially in the high significance scenario we consider it unlikely that operators without low frequency spectrum will be able to completely match the service provided using 900MHz spectrum and hence provide services which can compete fully.

A8.145 Second, we do not agree that there is no scope for the mobile market to become more competitive. We addressed this issue in our Statement on the award of 2.6GHz (April 2008) and our view is unchanged. We noted that our Statement on Mobile Call Termination²⁵ set out our view that, although no single or joint dominance was found when mobile access and origination were last reviewed by Oftel in 2003, there still remained scope for an increase in competitiveness in the mobile market. In other words, the concept of dominance is a threshold whereas the competitiveness of a market is a continuum, and it is possible for the degree of competitiveness to increase even in the absence of dominance. We therefore consider that it is likely that competition would increase as a result of entry into the mobile market.

²⁵ Ofcom, Statement on Mobile Call Termination, 27th March 2007

- A8.146 We note that the threat and the credibility of retaliation depend on the size of cost differences between operators and the impact on competition of more operators having access to 900MHz spectrum. The analysis above suggests that cost differences may be significant, as could the effect of wider access to 900MHz spectrum on competition. Therefore, we disagree with Vodafone and consider that there is a clear risk that the necessary conditions for retaliation to be credible and the threat of retaliation to be effective will exist.
- A8.147 We also note that in the scenario Vodafone describes where the threat of retaliation is not credible, the outcome is still that one operator does not trade. So, although the impact on consumers would be less than if no one traded, there is still potential for a better outcome to be achieved.
- A8.148 Our response to O2's analysis is as follows. We disagree with O2's arguments on the ability and incentives for 900MHz operators to foreclose. We accept that blocks of 900MHz spectrum are homogeneous inputs. However, this input is in short supply and is held by only two operators. We consider that the real issue is whether blocks of spectrum at different frequencies are homogeneous, which our analysis (summarised in annex 10) suggests may not be the case²⁶. Our analysis as set out above in paragraphs A8.63.1-A8.63.3 also suggests that, in some circumstances, operators without access to 900MHz may be at a significant cost or competitive disadvantage. Finally, as we state in our response to Vodafone in paragraphs A8.144-A8.145 above, we consider that there is scope for the downstream market to become more competitive through entry by further players. Therefore, we consider it plausible that 900MHz operators may not grant access to 900MHz spectrum in all situations where it would be beneficial to society for this to occur.
- A8.149 We would make two points on the analysis based on O2's modelling. First, it is not at all clear that O2's assumption that MNOs without liberalised 900MHz spectrum would be competing in the same market as those with liberalised 900MHz spectrum is correct. If 900MHz spectrum gives a significant cost advantage, and other MNOs are unable to provide the same level of quality, it could well affect their ability to compete in the market, as suggested by our analysis of the high significance scenario. At the very least they would not be able to compete for the segment of the market which was sensitive to quality differences. If this is the case, Oxera's own analysis suggests that trades would not occur.
- A8.150 Second, if operators are all assumed to compete in the same market regardless of whether they hold 900MHz spectrum or not, Oxera's analysis rests critically on another set of assumptions which neither Oxera nor O2 analyse in any detail. Oxera show how, given a set of "critical" assumptions relating to elasticity of demand, their model predicts that trades (or commercial roaming) are likely to occur. However, there is no discussion of how likely this set of critical assumptions is to be met. Moreover, the larger cost differences are, the more limiting a constraint these critical assumptions or thresholds would become. In other words, the more unlikely it would be that market conditions are above the critical thresholds in the Oxera model for trading to occur.
- A8.151 We accept O2's criticism of our analysis of a 'one off' trade. However, this observation does not undermine our analysis of the repeated game, which is of more significance.

²⁶ See annex 10, for example figure 4

- A8.152 We disagree with O2's suggestion that our views in the September 2007 Consultation are inconsistent with our view set out in the Statement on Mobile Call Termination. In the Statement we state "spectrum trading... (ii) may result in changes to the opportunity cost of different blocks of spectrum (regardless of whether or not trades actually occur, since the opportunity to trade is still present)...²⁷" This clearly makes the point that it is not trading but the *opportunity to trade* which will eliminate cost differences between GSM900 and 1800 by allowing for changes in the opportunity cost of the different spectrum bands.
- A8.153 This is not true of the situation created by liberalisation of 900MHz spectrum. As demonstrated earlier in this annex, it is possible that, under certain circumstances, the opportunity cost of not trading may not be great enough to fully align the incentives of incumbent licensees such that a welfare maximising outcome will be achieved.
- A8.154 We consider the option of intervening at a later stage in our assessment of the options available to us in section 5²⁸.

Conclusion

- A8.155 This analysis suggests that, in the low significance scenario, wider access may not be beneficial, but in the medium and high scenarios, it is plausible that it will be.
- A8.156 Our assessment of the factors which will create the market scenarios suggests that, while there is considerable uncertainty over how the market will develop, it is more likely that we will be in one of either the high or medium significance scenarios than we are to be in the low significance scenario.
- A8.157 Given the uncertainty surrounding how the market will develop, it is difficult to say whether the medium or high significance scenario is more likely. In the absence of clear evidence to the contrary, our working assumption is that both are equally likely.
- A8.158 In the high scenario, we consider there to be a significant possibility that the incentives of incumbents may not be aligned to provide wider access, even where this could bring extremely large benefits to society.
- A8.159 In the medium scenario, we believe that the risk that the private incentives of operators will not facilitate wider access is smaller than under the high significance scenario, but that this is still a possible outcome, particularly when cost differences are higher. Large asymmetric profit shocks resulting from regulatory policy may not be desirable in general for investment incentives in the sector, but any adverse effect should be ameliorated by the correct application of AIP.
- A8.160 Overall, we consider that there is a plausible risk that the market may not bring about wider access in all situations where it would be beneficial for this to occur. This is reflected in our assessment of the options.

²⁷ Ofcom, Statement on Mobile Call Termination, 27th March 2007, p.157

²⁸ See section 5, in particular 5.72