Annex 7

Cost benefit analysis for 900MHz spectrum

Introduction

A7.1 This annex sets out in detail our **quantitative** analysis of the costs and benefits of the policy options for the liberalisation of the 900MHz spectrum. Our assessment of options in section 5 necessarily also includes qualitative analysis, and takes into account that some of the quantitative impacts which we have estimated are only illustrative, while it has been possible to estimate others with a higher degree of confidence.

A7.2 The quantitative analysis in this annex covers the following policy options for the liberalisation of 900MHz spectrum. The details of the options are set out in section 5.

- **Liberalisation in the hands of the incumbents.**
- **Regulated access**.
- **Partial spectrum release**:
  - 1 block –one 2 x 5MHz blocks of spectrum being released (2 x 2.5MHz of spectrum for each of Vodafone and O2).
  - 2 blocks - two 2x 5MHz blocks of spectrum being released (2 x 5MHz of spectrum for each of Vodafone and O2).
  - 3 blocks – three 2x 5MHz blocks of spectrum being released (2 x 7.5MHz of spectrum for each of Vodafone and O2).

A7.3 Our analysis of delayed liberalisation (wait and see) and full release is largely qualitative, and can be found in section 5.

A7.4 Our assessment of the options for the liberalisation of the 1800MHz spectrum is set out in section 6.

A7.5 This annex is structured as follows:

- First, we set out the framework for taking account of uncertainty about future outcomes.
- Second, we discuss the significant costs and benefits we have quantified. These are:
  - Benefits of increased competition
  - Efficiency benefits
  - Costs of delay caused by liberalisation

  - Costs of spectrum release
  - Cost of implementing access

- Third, we set out in detail our quantification of the costs and benefits for each policy option under each of the three significance scenarios (as set out in section 5). We present the total welfare impact of each policy option under each of the three significance scenarios (i.e. producer and consumer surplus). In addition, we present the impact on consumer welfare only (i.e. consumer surplus).

Cost Benefit Analysis Framework

A7.6 This section sets out the framework we have developed in order to quantify the key costs and benefits of particular policy options. We have approached the cost benefit analysis with the objective of reflecting the inherent uncertainty about future outcomes of different policy options. In particular:

- uncertainty about the importance of low frequency spectrum i.e. the advantage that operators holding 900MHz spectrum have over operators without 900MHz spectrum; and
- uncertainty about whether the market will achieve wider access to low frequency spectrum if we liberalise the spectrum in the hands of the incumbents, i.e. whether the market would result in wider access to 900MHz spectrum via either a commercial trade or access.

A7.7 In order to take account of uncertainty about future outcomes of the different policy options, we have identified scenarios which we think span the range of plausible eventualities. We have then estimated the costs and benefits of an option for the different outcomes the option may result in under each of these scenarios.

A7.8 The cost benefit analysis draws on many other elements of analysis undertaken as part of this consultation, and reflects a number of different considerations which need to be taken into account when interpreting the results. These are set out in section 5. However, in particular, it is important to note that we have not attempted to quantify every cost and benefit, nor have we sought to capture every possible outcome, for to do so would be too complex. As such, we have had to make a number of simplifying assumptions. Therefore, the cost benefit analysis framework has been designed to be indicative only, and should not be considered as a standalone piece of analysis. Rather, it should be interpreted alongside our qualitative analysis, as set out in section 5.

Availability of 800MHz spectrum and the timeframe of the options assessment

A7.9 As explained in section 5, in assessing the impact of policy options, we have reflected the likely availability of 800MHz spectrum by limiting our net benefits assessment to the interim period between availability of 900MHz spectrum (which we assume to be from around 2011) and the point at which 800MHz spectrum can be fully exploited.

A7.10 There is some uncertainty around the duration of this interim period. Our analysis of timing can be found in annex 12[1]. Based on this analysis, we assume a three year interim period as our base case, and have estimated all our costs and benefits on

[1] In particular, Table 3 and Table 4.

this basis (where they are sensitive to the length of the interim period). We have, however, carried out a sensitivity analysis on the length of this interim period, which can be found toward the end of this annex[2].

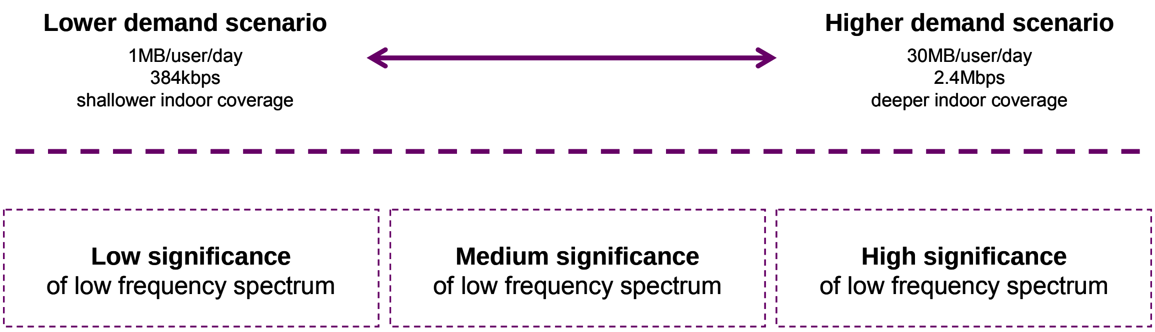
A7.11 In section 5, we include a more qualitative assessment of the potential for longer term impacts if 800MHz spectrum does not allow wider availability of low frequency spectrum in the longer term.

Scenarios and outcomes

A7.12 At the heart of the framework are three different significance scenarios which have been developed to span the uncertainty over the different outcomes which may arise. These scenarios capture the different outcomes relating to the significance of low frequency spectrum (high, medium and low significance).

A7.13 Before setting out the scenarios, we note that these significance scenarios are consistent with and are informed by range of market scenarios developed in annex 11[3].

Figure 1: Relationship between significance scenarios and market scenarios



High significance

A7.14 In this scenario the benefits from liberalisation are very high, and as such, are significantly in excess of the cost of clearing and re-using spectrum so that it would be profitable to rollout high quality mobile broadband networks using 900MHz spectrum. In addition, the services which can be provided with access to liberalised spectrum are such that it is not possible to replicate these using higher frequency spectrum. In this case, wider access to 900MHz spectrum helps to promote competition.

Medium significance

A7.15 In this scenario the benefits from liberalisation are reasonably high, and are higher than the costs of clearing and re-using spectrum so that it would be profitable to rollout high quality mobile broadband networks using 900MHz spectrum. In addition, the services which can be provided with access to liberalised spectrum can plausibly be matched using other higher frequency spectrum.

A7.16 There are two determinants of whether it is possible to match using higher frequency (2100MHz) spectrum:

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[2] See paragraphs A7.383 to A7.395. We use two and four years for the sensitivity on the length of the interim period.

[3] In particular, see Table 2.

7.16.1 Affordability – is it profitable to match using 2100MHz spectrum i.e. do the profits the operator gets as a result of matching exceed the cost of matching using 2100MHz spectrum?

7.16.2 Practicality – is it feasible to match using 2100MHz spectrum i.e. can the operator with 2100MHz physically rollout the number of sites required to provide the same service as the operators with 900MHz spectrum within the same timeframe?

A7.17 In our analysis we have considered the benefits of 900MHz spectrum to single operators with 2100MHz spectrum (hereafter, single 2100MHz operator), and to a pair of RAN-shared operators with 2100MHz spectrum (hereafter, RAN-shared 2100MHz operators or RAN-shared 2100MHz network). We reflect differences between these two categories of operator in the medium significance scenario.

A7.18 While both the single 2100MHz operator and RAN sharing 2100MHz operators are assumed to have the same capability to deploy a network, the RAN sharing 2100MHz operators would be willing to incur higher costs of matching using 2100MHz than the single operator.[4] This is because we assume that their profits are the same as two single operators but their combined costs are less than the cost of two single operators.[5]

A7.19 Because of this, there are two possible outcomes in the medium significance scenario:

7.19.1 Both the single and RAN shared 2100MHz operators can afford to match. In this case, wider access to 900MHz spectrum helps to promote efficiency.

7.19.2 Only the RAN shared operators can afford to match. In this case, wider access to 900MHz spectrum to the RAN shared operators helps to promote efficiency. Wider access to the single operator helps to promote competition.

A7.20 We have calculated costs and benefits under these two outcomes separately (as presented in this annex), but for ease of presentation we combine the two outcomes in our analysis in section 5.

Low significance

A7.21 In this scenario the benefits which are available from liberalisation in the short to medium term turn out to be low relative to the costs of clearing and re-using spectrum. As a result, during this time period it is likely to be optimal for the 900MHz spectrum to remain in its existing use.

[4] A single operator that matches will receive 1/*n* of the total profits from high quality mobile broadband, but will incur cost *z* to match in the interim. A pair of RAN-shared operators that match will receive 2/*n* of the total profits from high quality mobile broadband, but will only incur cost 1.45**z* to match in the interim. *n* is the number of players in the market.

[5] As per our analysis in annex 15 (Table 11), each operator in the RAN share is assumed to have costs 27.5% lower than a single 2100MHz operator. Combined, their costs are therefore 1.45 times the cost of a single operator (or 55% lower than two single operators' costs).

Commercial outcomes (market solutions)

A7.22 As explained in section 5 we consider the costs and benefits of the different policy options relative to the benchmark option of liberalisation in the hands of the incumbents.

A7.23 Under liberalisation in the hands of the incumbents, there is uncertainty over whether the market can achieve wider access when it would be efficient to do so.[6] Therefore, in constructing our counterfactual for assessing the costs and benefits of the policy options relative to liberalisation in the hands of the incumbents, we reflect this uncertainty by considering the following three market solutions (counterfactuals).

Commercial trade occurs (or Market Solution – Trade: MS/T)

A7.24 In this case, one or both of the incumbent 900MHz operators clear an additional block (or blocks) of 900MHz spectrum and trade it commercially with one or more of the operators without 900MHz spectrum.

A7.25 The 2100MHz operator acquiring the traded block of 900MHz spectrum can now deploy a 900MHz network at the same time as the incumbent 900MHz operators. Depending on which significance scenario we are in, this will primarily have an effect on either competition or efficiency (but in the medium scenario it is possible for it to affect both).

A7.26 There are many variants we could have considered for the number of blocks commercially traded, and which 2100MHz operators get the traded block(s). We have not included all variants because the additional complexity that this would introduce. Instead we have:

7.26.1 Assumed that the number of spectrum blocks available via commercial trading mirrors those which are available under the policy option (i.e. partial release of 2 blocks assumes the commercial solution that would have been arrived at would be a 2 block trade). We could have considered other outcome variants when the number of blocks traded varied for each policy option. However, this would have increased the number of outcomes to be considered under each policy option in each scenario, which would have made the results significantly more difficult to interpret.

7.26.2 Made assumptions about which 2100MHz operators get traded or released blocks. For the purposes of this analysis we assume that the RAN shared operators acquired the first block of spectrum traded (and share it). The single operator acquires the second block. The RAN shared operator acquires the third block (giving them two blocks in total). The rationale for this assumption is set out in section 5.

A7.27 For the purposes of this cost benefit analysis, we have also assumed that when the RAN shared operators get only one 2 x 5MHz block of 900MHz spectrum (this is assumed to be the case when less than three blocks are available) there is sufficient capacity to carry both operators' traffic.[7]

[6] A discussion of why the market may not achieve wider access can be found in annex 8.

[7] Even in high demand scenarios, where one 2x5MHz block of 900MHz spectrum may not be sufficient to carry two operators' traffic, our efficiency numbers are calculated on the basis of building a UMTS900 but retaining UMTS2100 equipment. Therefore the additional 2100MHz equipment can carry some of the traffic, making it more likely that half a block for each operator would be sufficient.

Commercial access is granted (Market Solution – Access: MS/A)

A7.28 In this case, one or both of the incumbent 900MHz operators provide some kind of access (for example, roaming or spectrum sharing) to operators without 900MHz spectrum, such that they can compete effectively without the need to deploy a network of their own using higher frequency (2100MHz) spectrum.

A7.29 Like commercial trade, there are many variants of access, and variants over which operators enter into a commercial access agreement. In this analysis we have:

7.29.1 Only considered outcomes where a 'generic' form of commercial access is provided to all 2100MHz operators should they want it. When it is available, we assume that both single and RAN sharing 2100MHz operators prefer access to matching at 2100MHz in the interim period.

7.29.2 Assumed that access is only a short term measure. 2100MHz operators taking up commercial access (and regulated access) will deploy their own low frequency network later (using 800MHz spectrum when it is available).

Neither commercial trade occurs nor commercial access is granted (No Market Solution: NMS)

A7.30 In this case, the incumbent 900MHz operators do not provide commercial access, nor do they commercially trade a block or blocks of spectrum. Absent an alternative policy option, wider access to 900MHz spectrum does not occur.

Mapping outcomes onto the range of cost differences

A7.31 The four significance scenarios (counting the two medium outcomes separately) and the three commercial outcomes (market solution – trade, market solution – access, and no market solution) together give us twelve possible outcomes for which we calculate the costs and benefits for each policy option relative to liberalisation in the hands of the incumbents.

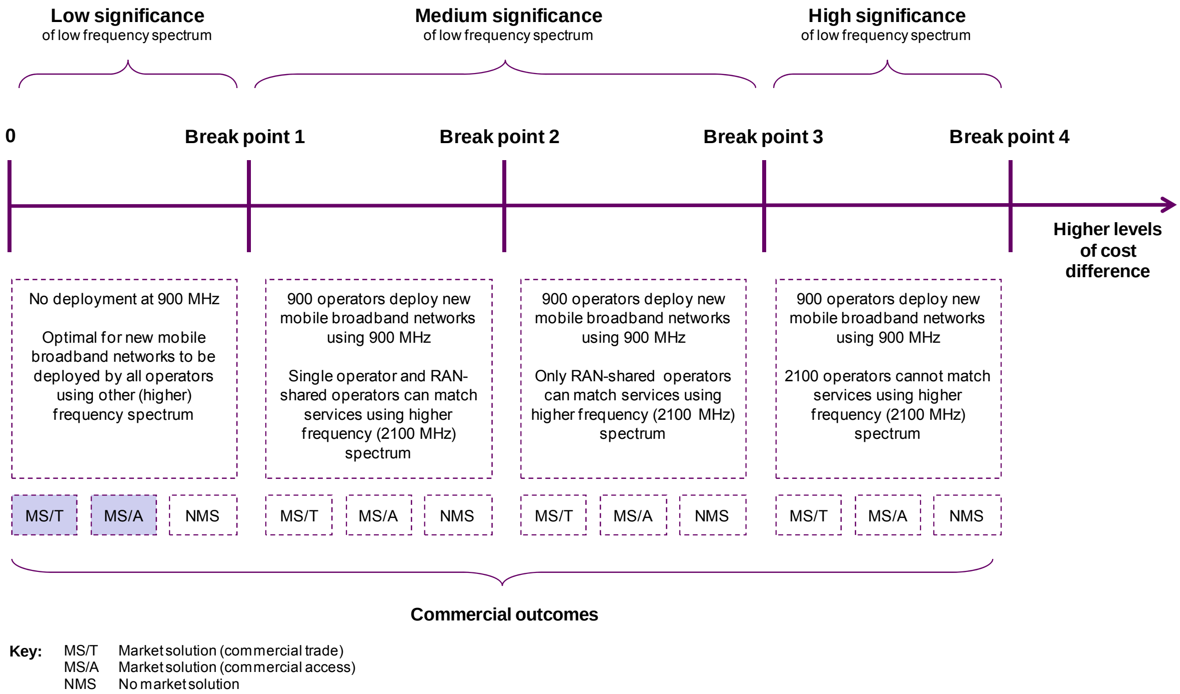
A7.32 A key part of this cost benefit analysis is the estimates of the productive inefficiencies arising under liberalisation in the hands of the incumbents, and hence the productive efficiency benefits that may come about as a result of the alternative policy options. The size of these productive efficiency effects vary depending on which significance scenario we are in. In particular, they are driven by the number of sites needed to deliver the quality of mobile broadband services required to compete in the market.

A7.33 In order to estimate the efficiency effects that apply in a particular outcome, we have mapped the twelve outcomes onto the range of possible cost differences, the cost difference being the additional cost an operator incurs through matching using 2100MHz spectrum, compared to the cost a single 900MHz operator incurs in deploying its 900MHz network. Underlying these cost differences are pairs of target site numbers; the number of 900MHz sites required and the equivalent number of 2100MHz sites needed to provide a given quality of service.

A7.34 This gives us a way of estimating the size of the efficiency effects that apply under a particular significance scenario.

A7.35 In order to achieve this, the range of possible cost differences is separated by certain break points, or thresholds, at which the behaviour of certain operators is assumed to change (as shown in the figure below).[8] These break points provide us with the upper and lower bound estimates of the efficiency effects.

Figure 2: Break points along the range of cost differences, with possible outcomes



Break points

A7.36 We now set out how certain operators' behaviour changes at each of the break points, and how the break points (as a point on the range of cost differences) are calculated. Using the cost differences determined below, we are able to use the site numbers underlying these cost differences to estimate different efficiency effects (discussed later in this annex).

Break point 1

A7.37 Break point 1 is the point on the cost difference (as shown in the figure above) at which the incumbent 900MHz operators would not find it profitable to rollout UMTS900.

7.37.1 The cost difference represents the additional cost of rolling out at 2100MHz, compared to using 900MHz spectrum. Put another way, the cost difference is the cost saving the 900MHz operator gets from rolling out using 900MHz spectrum instead of 2100MHz spectrum.

7.37.2 However, in order to use 900MHz, the 900MHz operator must incur the cost of clearing one block of 900MHz spectrum for that purpose.

7.37.3 If the cost difference is less than the cost of clearing spectrum from its existing use, then it is not profitable to re-use 900MHz spectrum. The 900MHz operator will deploy any improved mobile broadband services using their 2100MHz spectrum. If the cost difference is greater than the

[8] We note that the market solutions in the low significance outcome are assumed not to occur, given it is likely to be optimal for the 900MHz spectrum to remain in its existing use.

cost of clearing, then it is profitable to re-use part of their 900MHz spectrum, and new networks will be deployed using this spectrum.

7.37.4 We assume that the cost difference must be significantly greater than the cost of clearing one block of 900MHz spectrum such that an adequate return on the investment is made by the operator so that it is truly worthwhile to deploy at 900MHz.

A7.38 The cost of commercially clearing a first 2 x 5MHz block of 900MHz spectrum ranges from £40m to £60m[9] per operator.

A7.39 We think it is plausible that when the additional cost of matching in the interim using 2100MHz spectrum (i.e. the cost difference) is less than £150m, the 900MHz operators will not clear 900MHz. Instead they will deploy improved services using 2100MHz spectrum, leaving 900MHz spectrum in its current use.

A7.40 Although this is significantly higher than the high estimate of the cost of clearing one block, we feel that this takes account of the uncertainty over the level of consumer interest in improved mobile broadband networks under the low significance scenario.

Break point 2 and 3

A7.41 Break point 2 is the cost difference above which the single operator will not match. Break point 3 is the cost difference above which the RAN shared operator will not match.

A7.42 Operators may not be able to match either because matching is unaffordable or because it is impractical. Hence, the break points are the lowest cost difference at which either matching is unaffordable or is impractical i.e. whichever is the binding constraint.

A7.43 We calculate both the affordability break points and the practicality break points for both a single operator network and the RAN shared operators. The lowest of these for a single operator network is break point 2, and the lowest of these for a RAN shared network is break point 3.

Affordability break points

A7.44 The affordability break points are the points at which the cost difference becomes large enough that it becomes unprofitable for an operator to match.

A7.45 The affordability constraint for an operator is the point at which the cost difference is likely to comparable to the operator's gross profits from providing improved mobile broadband services.

A7.46 We have modelled the net present value of gross profits over the interim period using the Competition Benefits model discussed in annex 9, using baseline assumptions for the relevant market size. This modelling relies on a number of assumptions, and is illustrative only. However, we believe that it allows us to arrive at break points which appropriately indicate the points at which operators may no longer be able to afford to match using 2100MHz spectrum, and which are generated on a consistent basis with the competition benefits which are included in

[9] Annex 16, Table 1 – Approach 3: half the cost of clearing 2 blocks of spectrum.

our cost benefit analysis. Given that these break points are based on illustrative modelling we have completed sensitivity analysis which shows the impact of varying the assumed break points. This is set out later in this annex, in paragraphs A7.383 to A7.395.

A7.47 The decision of whether or not to match is a commercial decision, so we calculate the gross profiles using a commercial discount rate (11.5%[10]). The result gives us an indicative result for the maximum cost difference the relevant operator would be able to afford in order to match. However, this maximum cost difference is based on a higher discount rate than the discount rate representative of society as whole. As our assessment concerns the costs and benefits to society as a whole, we have converted this cost difference into the equivalent cost difference were a social discount rate (3.5%[11]) used.[12]

A7.48 Single operator's affordability constraint is estimated as follows:

7.48.1 When the single 2100MHz operator can afford to match, there would be five players in the market (as the RAN shared 2100MHz operators would also be able to match).

7.48.2 Assuming symmetry, the gross profit a single 2100MHz operator receives if it matches is equal to the profit of one player in a five player market (i.e. one-fifth of the total profit) over the interim period. This is estimated to be £310m on a commercial discount rate basis, or £470m on a social discount rate basis.

7.48.3 If the cost difference is less than this, then it is profitable for the single 2100MHz operator to match using 2100MHz spectrum in the interim period. The maximum cost difference that a single 2100MHz operator can afford to incur is therefore £470m, using a social discount rate.

A7.49 RAN shared operator's affordability constraint is estimated as follows:

7.49.1 As RAN shared operators will always be able to afford more than a single operator (for reasons outlined above) hence the single operator will not be in the market at the point at which the RAN shared operators reach their affordability constraint. There would be four players in the market when it is "just affordable" for the RAN shared operators to match.

7.49.2 The RAN shared operators are two separate firms downstream and are in direct competition so each RAN sharing operator earns the profits of one firm in a four player market over the interim period (the two RAN shared operators plus the incumbent 900MHz operators). We therefore illustrate the combined profits of the RAN shared operators using the profits of two firms in a four-player market over the interim period.

7.49.3 This combined profit is estimated to be £900m on a commercial discount rate basis, or £1.4bn using a social discount rate.

[10] Annex 15, Table 5.
[11] The Green Book, HM Treasury.
[12] The cost difference modelling described in annex 15 generates results using both the social discount rate and commercial discount rate. A comparison of these results gives us a way of estimating the approximate conversion factor from a cost difference calculated using a commercial discount rate, to one calculated using a social discount rate.

7.49.4 Therefore, the maximum cost difference that the two RAN shared operators can collectively afford to incur is £1.4bn using a social discount rate.

Practicality break points

A7.50 It is assumed that the single 2100MHz operator and the RAN shared 2100MHz network have the same capabilities in terms of network deployment. That is, the maximum network they can rollout using 2100MHz in the interim period is the same for both category of operator.

7.50.1 The practicality break point represents the maximum cost difference at which it is feasible for the 2100MHz operator to match. We estimate this cost difference by capping the site difference with the maximum number of 2100MHz sites that can be deployed.

7.50.2 Assuming a cap of 1,500 new sites every year, and an existing network size of 9,000 UMTS2100 sites by the end of 2010, the maximum 2100MHz network that a 2100MHz operator can deploy by the end of 2013 is 13,500 UMTS2100 sites.[13]

7.50.3 We now need the number of 900MHz sites that could be used to provide an equivalent quality of service. From the technical analysis (set out in annex 13) we know that a ratio of 2100MHz to 900MHz sites of around 3 is plausible[14]. Using this ratio, a 900MHz network with (roughly) 4,500 sites would provide an equivalent quality of service as the 2100MHz network with 13,500 sites.

A7.51 Using these site numbers (4,500 vs. 13,500), we are able to estimate (using the cost difference model) the maximum cost difference which is consistent with this difference in site numbers, and hence the maximum cost difference at which it is practical for the single and RAN-shared operators to match the 900MHz operator.

A7.52 For the single 2100MHz operator, the maximum cost difference at which it is feasible to match is £650m.

7.52.1 For the RAN shared network, the maximum cost difference at which it is feasible to match is £1.3bn. (This is the difference between the combined costs of both RAN shared 2100MHz operators and a single 900MHz operator.)

A7.53 Knowing the affordability and feasibility break points for the single and RAN-shared 2100MHz operators, we can now define the values that break points 2 and 3 should take (i.e. the break point that is binding):

7.53.1 Break point 2 (the cost difference above which the single 2100MHz operator is unable to match) should take the value of the single 2100MHz operator's affordability break point, as this is lower than its feasibility break point (i.e. it becomes unaffordable to match using 2100MHz spectrum before it becomes impractical). Therefore, break point 2 is £470m.

[13] Note that this cap is higher than the "baseline" cap assumed in the cost difference modelling. We assume a higher cap to capture a *maximum* network size that could be deployed. The purpose of this is to ensure that we are not overstating the range of cost differences at which a competition rather than an efficiency effect would arise.

[14] See summary section of annex 13, in particular Table 5.

7.53.2 Break point 3 (the cost difference above which the RAN shared 2100MHz operators are unable to match) should take the value of the RAN shared operators' practicality break point, as this is lower than its affordability break point (i.e. it becomes impractical to match using 2100MHz spectrum before it becomes unaffordable). Therefore, break point 3 is £1.3bn.

Break point 4

A7.54 Break point 4 provides us with an upper limit on the cost difference. It is not a realistic cost difference, because we know that above break point 2 and 3, the single and RAN shared 2100MHz operators will not match using 2100MHz spectrum. To the right of break point 3, we are in the high significance scenario, where operators do not match at 2100MHz spectrum, and so no cost difference would be incurred.

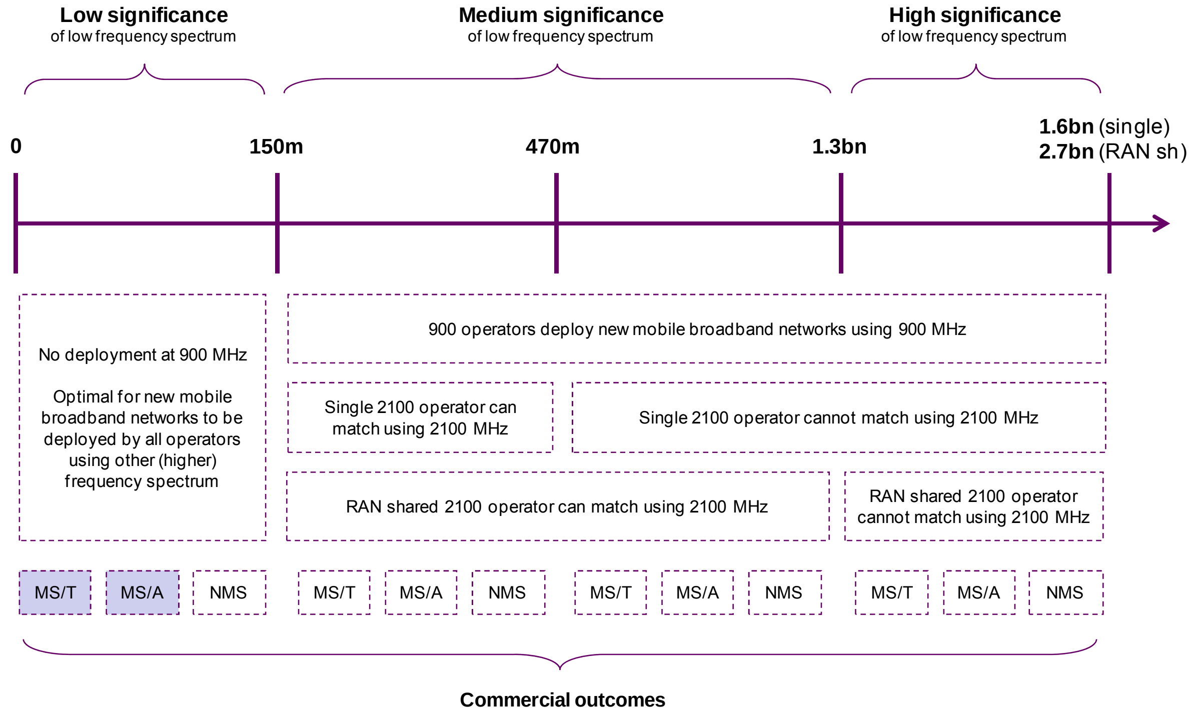
A7.55 It is a theoretical number that shows us what the cost difference would be, were there no affordability or practicality constraints placed on the 2100MHz operators.

A7.56 We need to define break point 4 because there are certain efficiency effects (such as the cost of bringing forward investment) that occur in the high significance scenarios. In order to be able to estimate these, we need a plausible upper limit on the cost difference range.

A7.57 Using a plausible high demand scenario[15], we get a cost difference of £1.6bn for a single operator and £2.7bn for a RAN shared operator. More importantly, the numbers of sites required at this point are 7,300 900MHz sites or 21,000 2100MHz sites.

[15] See annexes 11 (Table 2) and 13 (Table 5) – High demand scenario - 30MB/user/day, 2.4Mbps, deeper indoor coverage. Resulting target site numbers are 7,300 900MHz sites or 21,100 2100MHz sites.

Figure 3: Break point values shown on the range of cost differences



Limitations of the CBA results

A7.58 Some of the limitations of the CBA results are set out below. These are also discussed in section 5, where we explain how these limitations impact upon the interpretation of these results in the wider options assessment.

Simplifying assumptions

A7.59 In our quantitative analysis it has been necessary to make a number of simplifying assumptions. Hence, while the results of this analysis give an useful indication of the welfare impacts resulting from our policy options, they need to be interpreted alongside our qualitative analysis in section 5.

A7.60 In addition to the simplifying assumptions already noted above, we note:

7.60.1 Our quantitative analysis does not consider “partial matching” outcomes, rather, we only quantify the impact when there is a competition effect (i.e. do not match) or an efficiency effect (i.e. match completely). Including partial matching would cause the results to be complex to interpret[16].

7.60.2 Given the uncertainty over the assumptions underlying some of the quantification, we have produced high and low ranges alongside our base case results. The purpose of the high and low ranges is to capture, as far as possible, the plausible range of uncertainty over key input assumptions. Therefore, when looking at the results it is important to consider the high and low ranges as well as the base case results. All of these outcomes are plausible, and it is not necessarily the case that the base case results are any more or less likely than any other point in the range.

[16] See further discussion in annex 8, in particular A8.77 to A8.82.

7.60.3 There are some effects of policy options on which we have no data. Where we think it is sufficiently important to include some illustrative numbers, we have done exactly that, seeking to capture the effect. However, in some cases, particularly when a large number of uncertain assumptions are required to provide even illustrative numbers, we have relied on a qualitative assessment of the effect (these are discussed in section 5). Therefore, the quantitative CBA only tells part of the story.

Disruption of commercial outcomes

A7.61 Our cost benefit analysis captures uncertainty over whether the market will arrive at wider access to lower frequency spectrum by assessing the net benefit of our policy options both when a market solution would have arisen and when it would not have. However, there is also in principle uncertainty over whether or not an intervention will disrupt market solutions that would occur in the counterfactual. For example, if commercial access was to be provided in the counterfactual, would this still occur if we mandated partial release?

A7.62 While we have no significant reason to expect an intervention would disrupt the commercial outcomes, for completeness we have looked at the results for when an intervention does and does not disrupt a market solution. For the disrupt outcomes, we have only considered disruption of a different market solution (e.g. mandatory partial release disrupts commercial access, and regulated access disrupts commercial release). This is because we consider it unlikely that incentives for market solution will be disrupted if we intervene and impose a similar solution, but just a regulated version of it. For example, we assume it is unlikely that regulated access will disrupt the provision of commercial access, but more likely that it would disrupt a commercial trade.

A7.63 In this annex we present first the results for when a market solution is not disrupted, and then present the summary results for the disruption outcomes only where these are significantly different.

7.63.1 For 2 block and 3 block mandatory release, the outcomes under a disruption assumption are virtually the same as for a no disruption assumption. The reason for this is that when two or more blocks of 900MHz spectrum are released, the intervention allows all 2100MHz operators to gain some 900MHz spectrum. As none of them require access any more, there are no operators relying on the market solution (commercial access). Therefore, the result is very similar, whether or not the market solution is disrupted.

Probability of certain outcomes arising

A7.64 As explained earlier, for each option for liberalisation of 900MHz considered we have assessed the net benefit under 12 possible outcomes.

A7.65 It is not appropriate to simply sum the benefits or costs under each outcome to produce a single net benefit figure for each policy option as to do so would implicitly assume that each outcome is equally likely. To produce a single net benefit figure a probability would have to be assigned to each of the 12 outcomes.

A7.66 We have not assigned probabilities to the likelihood of each outcome as we do not think that we could model the probabilities with a reasonable degree of confidence and precision.

A7.67 Instead we have taken a qualitative approach to interpreting the range of costs and benefits which may arise under each outcome. We think is a preferable approach given the significant qualitative factors which we have been unable to quantify.

Total and consumer welfare

A7.68 For each policy option under each of the three significance scenarios we estimate the change in total and consumer welfare. The change in total welfare (i.e. producer and consumer surplus) is the sum of all the costs and benefits associated with the particular policy option and significance scenario. The change in consumer welfare (i.e. consumer surplus) is the sum of the costs and benefits that directly affect consumer surplus. These are the benefits from increased competition and the costs of delay to liberalisation which in turn delays the launch of improve mobile broadband services. In addition, we have included in the consumer surplus estimate a proportion of firms' fixed costs which are assumed to be passed on the consumers. For these purposes, we have assumed 50% of fixed costs are passed on.

Significant costs and benefits

A7.69 We have identified and quantified the key costs and benefits that arise from the policy options for the liberalisation of the 900MHz spectrum.

A7.70 In this section, we set out how these costs and benefits have been quantified, and how they are referred to in our Net Benefits Model. We also present the low, base and high estimates[17], as well as highlighting some of caveats to these numbers.

A7.71 The table below sets out our approach to rounding in this cost benefit analysis.

Table 1: Approach to rounding in this cost benefit analysis

Range	Round to the nearest
≤ 5 million	1 million
> 5 million and ≥ 50 million	5 million
> 50 million and ≥ 250 million	10 million
> 250 million and ≥ 1 billion	25 million
> 1 billion	100 million

Benefit from increased competition

A7.72 Some options for liberalisation may bring about a change in the intensity of competition to differing degrees. Competition effects arise in some of the possible outcomes when more/fewer operators are able to provide competing high quality mobile broadband services.

7.72.1 If wider access is available via a commercial agreement and our policy does not disrupt commercial agreements the effect on competitive intensity of the policy option will be non-negative. A positive effect on competition

[17] In this cost benefit analysis, "low" means low benefits and high costs, and "high" means high benefits and low costs.

only arises if the policy option allows more operators to provide high quality mobile broadband than would be the case under the commercial agreements assumed in the counterfactual. In all other counterfactuals there is no effect on competition.

7.72.2 In the medium and high significance outcomes quality is important to consumers and the ability to use 900MHz spectrum is needed to compete in the market for high quality mobile broadband services. Access to 900MHz spectrum may be through a (regulated or commercial) access agreement, a commercial trade, or mandated release.

7.72.3 In some of the medium and high significance outcomes not all of the 2100MHz operators are able to match the quality of the 900MHz operator and are unable to compete effectively so policy options which result in a wider availability of 900MHz increase competitive intensity, and hence have a positive effect on competition if wider access is not available via a commercial agreement.

7.72.4 However, of our policy *does* disrupt commercial agreements the effect on competition can be positive or negative depending on the number of operators granted access to 900MHz spectrum through commercial agreements (either commercial trade or access) in the counterfactual. For example, suppose 900MHz operators would have granted access through a commercial agreement in the counterfactual, and we impose 1 block release and matching is not practical. In this case, if the policy disrupts the commercial agreement this means that operators who would have been able to compete via the commercial access agreement are no longer able to do so.

A7.73 The effects of changes in intensity of competition were quantified using a calibrated version of the Cournot model of competition, which uses forecasts of mobile subscriber volumes and revenues to produce a baseline development of the demand for mobile broadband services over the period 2008-2027. The Cournot model is then calibrated assuming there are 5 players providing these services over the period. Where competition effects arise the number of players providing these services differs between the factual and counterfactual, which is assumed to change the price charged for the services and as a result, the number of subscribers using these services. The Cournot model is discussed in more detail in annex 9 and the results are summarised in section 4[18].

A7.74 To quantify the potential magnitude of changes in consumer and producer welfare we have assumed that where competitive effects do arise, the ability to use 900MHz spectrum is required to provide competing mobile broadband services. The competition effects resulting from our policy therefore come about from a change in the number of operators who have access to 900MHz spectrum and hence who are able to provide these services.

A7.75 We have allowed for three different sizes of the relevant market to allow us to generate low, base and high estimates of the size of the competition effects. These different market sizes dimension the affected market segment’s revenues to represent 15%, 25% and 35% of the total UK mobile services market, respectively.

[18] See in particular paragraphs 4.34 to 4.42.

A7.76 In order to model the effects of changes in competitive intensity in a tractable way we have made a number of simplifying assumptions which are detailed in annex 9.

A7.77 The table below sets out the full set of competition costs and benefits used in this cost benefit analysis. The costs and benefits differ in terms of the number of operators with access to 900MHz spectrum as a result of the policy option. The mapping of particular costs and benefits to each of the policy options is provided in the assessment of each of the options below.

Table 2: Competition costs and benefits

Input name	Description	High benefit / Low cost	Base case benefit / cost	Low benefit / High cost
		£millions (NPV, calculated over 20 years)		
benefit_competition_2_to_3	An indicative estimate of the impact of a change in competition from 2 to 3 players or vice versa Assumes a 7.0% change in prices as a result of entry/exit	600 Total Welfare 1,500 Consumer Surplus	425 Total Welfare 1,000 Consumer Surplus	250 Total Welfare 625 Consumer Surplus
benefit_competition_2_to_4 and *cost_competition_4_to_2*	An indicative estimate of the impact of a change in competition from 2 to 4 players or vice versa Assumes a 11.2% change in prices as a result of entry/exit	875 Total Welfare 2,400 Consumer Surplus	625 Total Welfare 1,700 Consumer Surplus	375 Total Welfare 1,000 Consumer Surplus
benefit_competition_2_to_5	An indicative estimate of the impact of a change in competition from 2 to 5 players or vice versa Assumes a 14.0% change in prices as a result of entry/exit	1000 Total Welfare 3,100 Consumer Surplus	750 Total Welfare 2,200 Consumer Surplus	450 Total Welfare 1,300 Consumer Surplus
cost_competition_5_to_3	An indicative estimate of the impact of a change in competition from 3 to 5 players or vice versa Assumes a 7.5% change in prices as a result of entry/exit	425 Total Welfare 1,600 Consumer Surplus	300 Total Welfare 1,200 Consumer Surplus	180 Total Welfare 700 Consumer Surplus
benefit_competition_4_to_5 and *cost_competition_5_to_4*	An indicative estimate of the impact of a change in competition from 4 to 5 players or vice versa Assumes a 3.5% change in prices as a result of entry/exit	150 Total Welfare 675 Consumer Surplus	110 Total Welfare 475 Consumer Surplus	70 Total Welfare 300 Consumer Surplus

Note: the assumptions underlying the high, base and low results are set out in the discussion above this table

Efficiency of providing high quality mobile broadband

A7.78 There are a number of possible productivity efficiency effects that we have taken into account in this cost benefit analysis. Our approach to estimating the size of these effects is to compare the cost of deploying in the counterfactual (liberalisation in the hands of the incumbents) and the factual (the alternative policy option).

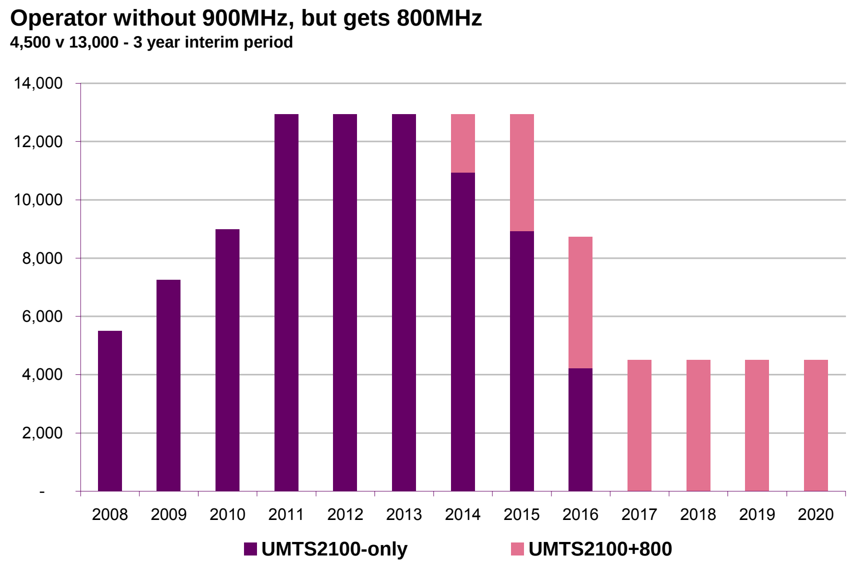
A7.79 We have estimated the costs for single 2100MHz operators and RAN shared 2100MHz operators under three different assumptions about the time at which these operators gain access to low frequency spectrum and whether they match 900MHz deployments in the interim.

A7.80 We begin by setting out the three possible rollout profiles which correspond to these assumptions. The rollout profiles are the same for single 2100MHz operators and for RAN shared 2100MHz operators. However, the cost which will result differs for these two different categories of operator.

Profile A: Matching using 2100MHz spectrum in the interim period

A7.81 This describes the deployment of a 2100MHz network in the interim period (2011-2013) in order to match the service provided by the 900MHz operators. We assume that the operator then acquires 800MHz spectrum in 2014, and deploys an 800MHz network, decommissioning surplus 2100MHz sites.

Figure 4: Rollout profile A (illustrative)

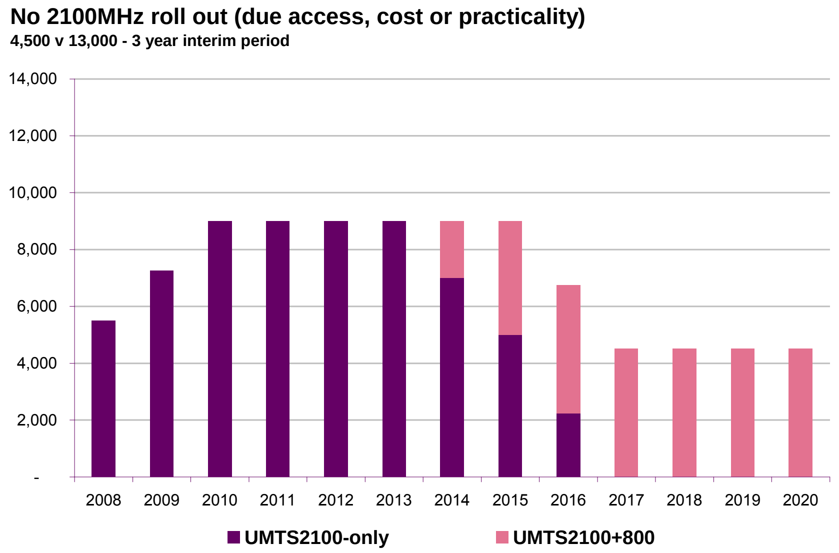


Profile B: No deployment in interim period

A7.82 This describes an operator (or operators) that does not deploy any 2100MHz network in the interim period. This may be because they are unable to match (cannot afford to, or impractical to match), or because they have access to a 900MHz operator's 900MHz network which they can use to compete.

A7.83 Again, we assume that the operator then acquires 800MHz spectrum in 2014, and deploys an 800MHz network.

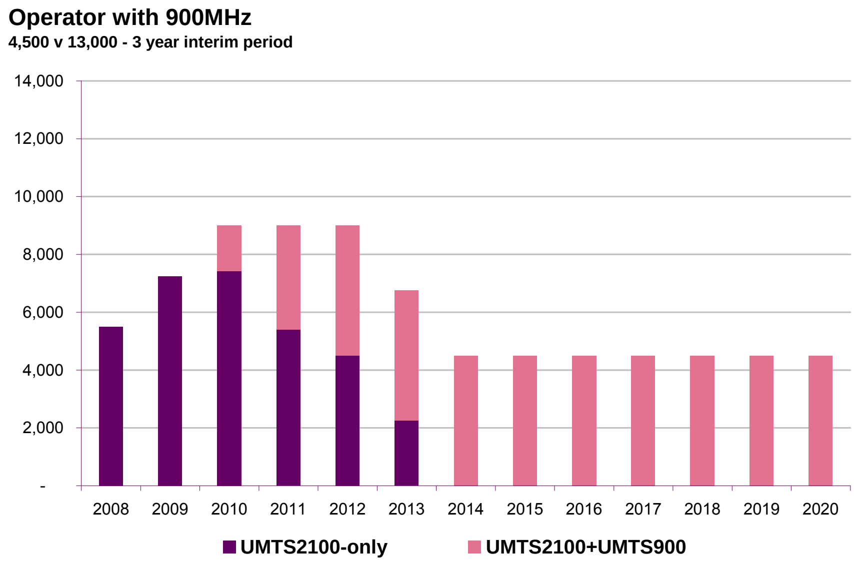
Figure 5: Rollout profile B (illustrative)



Profile C: Deploying a network using liberalised 900MHz spectrum

A7.84 This profile describes the rollout of a 900MHz network as soon as the spectrum is liberalised. The operator(s) could do this as the result of a commercial trade or mandatory release.

Figure 6: Rollout profile C (illustrative)



Costs associated with each rollout profile

A7.85 We have used the “Cost Difference – Costs” model to estimate the costs associated with each of these rollout profiles, for both a single 2100MHz operator and two RAN shared operators. The parameters used to generate these results are set out in more detail below.

A7.86 In order to determine these costs, we need to know the number of sites required to provide the service. Underlying each of the break points is a target number of

900MHz sites, and a target number of 2100MHz sites that will provide an equivalent service. We interpolate between these break points to give us a low, base and high number of sites for each significance scenario. We can then use these site numbers to calculate the low, base and high costs of each of the above rollout profiles, for each significance scenario. The approach used to identify site numbers is discussed in more detail below.

A7.87 The table below summaries the costs of each rollout profile.

Table 3: Cost of each rollout profile for a single and two RAN sharing operators

£million (NPV, calculated over 20 years)		**Rollout Profile A** (deploy 2100MHz, then 800MHz)		**Rollout Profile B** (deploy 800MHz only)		**Rollout Profile C** (deploy 900MHz)	
		Single operator	Two RAN sharing operators	Single operator	Two RAN sharing operators	Single operator	Two RAN sharing operators
Medium significance scenario (when both the single and RAN sharing operators can match)	Low	775	1100	500	750	525	750
	Base	850	1250	500	750	525	750
	High	925	1350	500	750	525	750
Medium significance scenario (when only the RAN sharing operators can match)	Low	1100	1550	525	750	550	800
	Base	1100	1600	525	750	550	800
	High	1100	1650	525	750	550	800
High significance scenario	Low	1400	2000	525	800	575	850
	Base	1800	2600	600	850	625	900
	High	2100	3000	675	1000	675	950

A7.88 The productive efficiency effects arising from an intervention is the difference between the costs associated with the rollout profile in the counterfactual, and the rollout profile in the factual.

A7.89 Annex 15 sets out results for the cost difference in different market scenarios i.e. the difference between a single or RAN-sharing 2100MHz operator's rollout cost, and the cost of a single 900MHz operator's rollout given the market scenario. These cost differences are a theoretical measure of inefficiency. However, in the CBA we have needed to take account of practical effects which could plausibly occur under different significance scenarios. In addition, while these significance scenarios are consistent with the market scenarios, there are some differences. We do not always want to capture the cost difference using the same assumptions as used in annex 15. Hence, while they are based on the same methodology and models the cost difference results used in the CBA annex will differ from those reported in annex 15.

Productive efficiency effects of release

A7.90 The efficiency effects realised when a single 2100MHz operator or two RAN shared 2100MHz operators acquire 900MHz spectrum as a result of a policy option (i.e. under our spectrum release policy options) depend on what they do in the counterfactual, as described by one of the rollout profiles set out above.

Match using 2100MHz spectrum in the interim - rollout profile (A)

A7.91 If they would have matched under liberalisation in the hands of the incumbents, the counterfactual rollout profile is profile A.

A7.92 If the intervention allows the operator(s) access to 900MHz spectrum, they then deploy immediately, as per profile C.

A7.93 The efficiency benefit of release in this case is the difference between the costs associated with profile A and profile C.

A7.94 The productive efficiency benefit comes from no longer deploying so many sites at 2100MHz, because fewer sites are required using 900MHz spectrum There is a small cost of bringing investment in low frequency network forward (from 2014 to 2011), but this is outweighed by the benefit of not deploying the 2100MHz network.

No deployment in the interim - rollout profile (B)

A7.95 If they had commercial access, or were unable to match, in the interim, the counterfactual rollout profile is profile B.

A7.96 If the intervention allows the operator(s) access to 900MHz spectrum, they then deploy immediately, as per profile C.

A7.97 There is an efficiency loss in this case, which is the difference between the costs associated with profile C and profile B.

A7.98 The productive efficiency loss arises because the investment in a low frequency network now occurs earlier (2011, compared to 2014). However, it should be noted that in the case where the operators were unable to match the efficiency loss is offset by a competition benefit.

Deploy 900MHz network in the interim - rollout profile (C)

A7.99 If they acquired 900MHz spectrum as a result of commercial trade in the interim period, then there are no efficiency effects if they were to instead acquire 900MHz spectrum as a result of mandatory release. The counterfactual and factual rollout profile is C.

Productive efficiency effects of access

A7.100 The efficiency effects realised when a single 2100MHz operator or two RAN shared 2100MHz operators gain access to an incumbent’s 900MHz network also depend on what they do in the counterfactual.

Match using 2100MHz spectrum in the interim - rollout profile (A)

A7.101 If they would have matched under liberalisation in the hands of the incumbents, the counterfactual rollout profile is profile A.

A7.102 The intervention gives the operator(s) access to a 900MHz network, which means they now deploy no network in the interim, as per profile B.

A7.103 The efficiency benefit of access in this case is the difference between the costs associated with profile A and profile B.

A7.104 The productive efficiency benefit comes from no longer deploying so many sites at 2100MHz, because fewer sites are required if relying on access to an incumbent's 900MHz network.

No deployment in the interim - rollout profile (B)

A7.105 If they had commercial access, or were unable to match, in the interim, the counterfactual rollout profile is profile B. The intervention results in exactly the same rollout profile (B). As such, there is no efficiency effect in this case.

Deploy 900MHz network in the interim - rollout profile (C)

A7.106 If they acquired 900MHz spectrum as a result of commercial trade in the interim period, then they deploy using 900MHz spectrum as per profile C.

A7.107 If in the factual they now get access to a 900MHz network (i.e. the commercial trade is disrupted), then they now deploy nothing in the interim period, as per Profile B.

A7.108 There is an efficiency benefit in this case, which is the difference between the costs associated with profile B and profile C.

A7.109 The productive efficiency benefit arises because the investment in a low frequency network now occurs later (2014, compared to 2011).

Site numbers along the range of cost differences

A7.110 We know what the cost difference is at the break points, as the cost difference defines the assumed break point. In order to estimate the cost difference in each significance outcome, we have estimated an indicative target number of 900MHz and 2100MHz sites between the break points to estimate the base case cost difference in each outcome. To generate low and high cost differences we identify site differences which lie equally between the mid point and the lower or upper break point respectively. We have not generated low, base and high site numbers by varying the break points, because this would make the results too complex to interpret. However we have carried out sensitivities on the break points (which are set out at the end of this annex[19]).

A7.111 It is important to note that there is no unique answer. Multiple combinations of 900MHz and 2100MHz site numbers can produce the same cost difference. We have therefore selected site numbers (and ratio of 2100MHz to 900MHz site numbers) that appear reasonable and consistent with a particular outcome.

[19] See paragraphs A7.383 to A7.395.

7.111.1 We know the target numbers of 900MHz and 2100MHz sites at the third and fourth break points. (Break point 3 – 4,500 vs. 13,500; Break point 4 – 7,000 vs. 21,000).

7.111.2 As we move to lower cost differences, low frequency spectrum becomes less significant, so it is intuitive that the ratio of 2100MHz to 900MHz site numbers should fall. The number of sites should also fall. Using these two conditions, we are limited to a few combinations of 2100MHz and 900MHz sites numbers that produce the cost differences at break points 1 and 2.

7.111.3 Using this approach we arrive at the following site numbers (900MHz vs. 2100MHz) at each break point:

Break point 1: 4,000 vs. 10,000 (ratio = 2.5)

Break point 2: 4,500 vs. 12,375 (ratio = 2.75)

Break point 3: 4,500 vs. 13,500 (ratio = 3)

Break point 4: 7,000 vs. 12,000 (ratio = 3)

A7.112 Using these site numbers, we have then been able to estimate the number of sites in each significance outcome. As explained above, for our base case, we have taken the mid-point between two break points. For our low case, we have taken the first quartile, and for our high case, we have taken the third quartile.

Table 4: Site numbers required in each significance outcome

		Number of sites required	
		at 800MHz	at 2100MHz
Break point 1		**4,000**	**10,000**
Medium significance scenario (when both the single and RAN sharing operators can match)	Low	4,125	10,594
	Base	4,250	11,188
	High	4,375	11,781
Break point 2		**4,500**	**12,375**
Medium significance scenario (when only the RAN sharing operators can match)	Low	4,500	12,656
	Base	4,500	12,938
	High	4,500	13,219
Break point 3		**4,500**	**13,500**
High significance scenario	Low	5,125	15,375
	Base	5,750	17,250
	High	6,375	19,125
Break point 4		**7,000**	**21,000**

A7.113 These site numbers in turn enable us to estimate the high, base and low efficiency costs and benefits in each significance outcome.

Inputs used in the cost difference model

A7.114 To generate the costs set out above, we have used the following assumptions that are set out in annex 15.

Table 5: Cost inputs used in cost difference model

Input	Table reference in annex 15
Asset lifetime	Table 1
Unit capex at 2008 prices	Table 2
Price trends, in real terms	Table 3
Opex as a percentage of capex	Table 4
Discount rate	Table 5 (Social discount rate)
Number of sites at end of 2010	Table 6
Proportion of existing sites suitable for upgrade	Table 7 (Baseline)
Order of upgrade	Table 8
Reduction in costs for network sharing operators	Table 11 (Baseline)

A7.115 The maximum numbers of sites that the 900MHz operator can deploy per year is assumed to be 1,000 new sites or 2,000 upgrades[20], but we assume the 2100MHz operator matches the quality of service being provided by the 900MHz operators in each year.

A7.116 The timing inputs we have used are consistent with a three year interim period between availability of 900MHz spectrum (which we assume to be from around 2011) and the point at which 800MHz spectrum can be fully exploited (2014). These are set out in the table below.

[20] See annex 12, in particular Table 5.

Table 6: Timing inputs used in cost difference model

Input	Operators with 900MHz	Operators without 900MHz (but who acquire 800MHz)	Reference in annex 12
Dates when operators can begin deploying a low frequency network	2010	2012	
Date when operators no longer need to expand their existing UMTS2100 network	2011	2014	Table 6
Date when operators can decommission part of their UMTS2100 network	2013	2016	Tables 7 and 8

Summary of productive efficiency effects

A7.117 Using the site numbers set out above we generate the following productive efficiency effects.

Table 7: The productive efficiency benefit of rolling out 900MHz instead of 2100MHz and 800MHz (profile A compared to profile C)

Input name	Description	Low benefit / high cost	Base case benefit / cost	High benefit / low cost
	Benefit: cost of profile A – cost of profile C **Cost: cost of profile C – cost of profile A**	£millions (NPV, calculated over 20 years)		
benefit_eff_no_2100_but_ earlier_low_freq_single_medA	For a single operator in the medium significance scenario where both the single and RAN-shared 2100MHz operators can match: an estimate of the change in productive efficiency from deploying 900MHz now, compared to matching at 2100MHz and deploying a low frequency network later (800MHz), or vice versa.	250	325	400
benefit_eff_no_2100_but_ earlier_low_freq_RANsh_medA and *cost_ineff_2100_now_ later_low_freq_RANsh_medA*	For a RAN-shared *network* in the medium significance scenario where both the single and RAN-shared 2100MHz operators can match: an estimate of the change in total productive efficiency of the sharing operators from deploying 900MHz now, compared to matching at 2100MHz and deploying a low frequency network later (800MHz), or vice versa.	350	475	575

Input name	Description	Low benefit / high cost	Base case benefit / cost	High benefit / low cost
benefit_eff_no_2100_but_ earlier_low_freq_RANsh_medB and *cost_ineff_2100_now_ later_low_freq_RANsh_medB*	For a RAN-shared *network* in the medium significance scenario where only the RAN-shared 2100MHz operators can match: an estimate of the change in total productive efficiency of the sharing operators from deploying 900MHz now, compared to matching at 2100MHz and deploying a low frequency network later (800MHz), or vice versa.	750	800	850

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

Table 8: The productive efficiency loss arising from earlier investment in a low frequency network (profile C compared to profile B)

Input name	Description	Low benefit / high cost	Base case benefit / cost	High benefit / low cost
	Benefit: cost of profile C – cost of profile B **Cost: cost of profile B – cost of profile C**	£millions (NPV, calculated over 20 years)		
cost_ineff_earlier_low_freq_ single_medA	For a single operator in the medium significance scenario where both the single and RAN-shared 2100MHz operators can match: the efficiency cost of investing in a low frequency network earlier (i.e. using 900MHz, compared to waiting until 800MHz becomes available).	15	20	20[21]
cost_ineff_earlier_low_freq_ single_medB	For a single operator in the medium significance scenario where only the RAN-shared 2100MHz operators can match: the efficiency cost of investing in a low frequency network earlier (i.e. using 900MHz, compared to waiting until 800MHz becomes available).	25	25	25[22]
cost_ineff_earlier_low_freq_ single_high	For a single operator in the high significance scenario: the efficiency cost of investing in a low frequency network earlier(i.e. using 900MHz, compared to waiting until 800MHz	40	20	-15 [23]

[21] The base and high results are the same due to rounding.
[22] The low, base and high results are the same as the number of low frequency sites required in the medium significance scenario when only the RAN sharing 2100MHz operators are able to match is the same for the low, base and high case. See Table 4.
[23] These costs decrease (and become negative) as you move from “low benefit / high cost” to “high benefit / low cost” because the benefit of decommissioning surplus 2100MHz sites earlier as a result of earlier investment in a low frequency network increases and outweighs the higher cost of deploying the low frequency sites sooner.

Input name	Description	Low benefit / high cost	Base case benefit / cost	High benefit / low cost
	becomes available).			
benefit_eff_later_low_freq_ RANsh_medA and *cost_ineff_earlier_low_freq_ RANsh_medA*	For a RAN-shared *network* in the medium significance scenario where both the single and RAN-shared 2100MHz operators can match: the total efficiency benefit shared between the sharing operators of investing in a low frequency network later (i.e. when 800MHz becomes available, compared to 900MHz), or vice versa.	20	25	30
benefit_eff_later_low_freq_ RANsh_medB and *cost_ineff_earlier_low_freq_ RANsh_medB*	For a RAN-shared *network* in the medium significance scenario where only the RAN-shared 2100MHz operators can match: the total efficiency benefit shared between the sharing operators of investing in a low frequency network later (i.e. when 800MHz becomes available, compared to 900MHz), or vice versa.	35	35	35[24]
benefit_eff_later_low_freq_ RANsh_high and *cost_ineff_earlier_low_freq_ RANsh_high*	For a RAN-shared *network* in the high significance scenario: the total efficiency benefit shared between the sharing operators of investing in a low frequency network later (i.e. when 800MHz becomes available, compared to 900MHz), or vice versa.	60	25	-20[25]

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

[24] The low, base and high results are the same as the number of low frequency sites required in the medium significance scenario when only the RAN sharing 2100MHz operators are able to match is the same for the low, base and high case. See Table 4.

[25] These costs decrease (and become negative) as you move from “low benefit / high cost” to “high benefit / low cost” because the benefit of decommissioning surplus 2100MHz sites earlier as a result of earlier investment in a low frequency network increases and outweighs the higher cost of deploying the low frequency sites sooner.

Table 9: Productive efficiency benefit from no longer deploying so many sites at 2100MHz (profile A compared to profile B)

Input name	Description	Low benefit / high cost	Base case benefit / cost	High benefit / low cost
	Benefit: cost of profile A – cost of profile B **Cost: cost of profile B – cost of profile A**	£millions (NPV, calculated over 20 years)		
benefit_eff_no_2100_single_medA and *cost_ineff_2100_single_medA*	For a single operator in the medium significance scenario where both the single and RAN-shared 2100MHz operators can match: the change in productive efficiency from deploying nothing now and low frequency (800MHz) later, compared to matching at 2100MHz and deploying low frequency (800MHz) later, or vice versa. *benefit_eff_no_2100_single_medA = benefit_eff_no_2100_but_earlier_low_freq_single_medA + benefit_eff_later_low_freq_single_medA* *i.e. cost of profile A – cost of profile B = (cost of profile A – cost of profile C) + (cost of profile C – cost of profile B)* *cost_ineff _2100_single_medA = cost_ineff_2100_now_later_low_freq_single_medA + cost_ineff_earlier_low_freq_single_medA*	275	350	425
benefit_eff_no_2100_RANsh_medA and *cost_ineff_2100_RANsh_medA*	For a RAN-shared *network* in the medium significance scenario where both the single and RAN-shared 2100MHz operators can match: the change in total productive efficiency of the sharing operators from deploying nothing now and low frequency (800MHz) later, compared to matching at 2100MHz and deploying low frequency (800MHz) later, or vice versa. *benefit_eff_no_2100_RANsh_medA = benefit_eff_no_2100_but_earlier_low_freq_RANsh_medA + benefit_eff_later_low_freq_RANsh_medA* *cost_ineff _2100_RANsh_medA = cost_ineff_2100_now_later_low_freq_RANsh_medA + cost_ineff_earlier_low_freq_RANsh_medA*	375	500	600
benefit_eff_no_2100_RANsh_medB and *cost_ineff_2100_RANsh_medB*	For a RAN-shared *network* in the medium significance scenario where only the RAN-shared 2100MHz operators can match: the change in total productive efficiency of the sharing operators from deploying nothing now and low frequency (800MHz) later, compared to matching at 2100MHz and deploying low frequency (800MHz) later, or vice versa. *benefit_eff_no_2100_RANsh_medB = benefit_eff_no_2100_but_earlier_low_freq_RANsh_medB + benefit_eff_later_low_freq_RANsh_medB* *cost_ineff _2100_RANsh_medB = cost_ineff_2100_now_later_low_freq_RANsh_medB + cost_ineff_earlier_low_freq_RANsh_medB*	775	825	875

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

Success of regulated access

A7.118 As discussed in section 5, the degree to which regulated access promotes competition or efficiency will depend on how successful the access agreement is.

We believe that there are significant risks that regulated access would not fully realise the competition or efficiency benefits set out above. As discussed in section 5 the key risks are because of:

7.118.1 Asymmetries of information between the regulator and the parties.

7.118.2 Complexity of the regulatory intervention needed when the incentives of the parties to reach an agreement are not well aligned.

A7.119 In order to reflect these risks in our quantitative analysis, we apply a weighting representing the likelihood that access is not fully effective.

A7.120 These adjustments are illustrative, and there is no evidence on which these can be based. However, we think these adjustment factors reflect the significance of the concerns we have over the effectiveness of regulated access options. As noted in section 5, commercial access agreements are unlikely to be subject to the same risks.

A7.121 Despite the strong assumptions which are needed to arrive at these adjustment factors we think that it is important to include these in the quantitative analysis as without these the value of the cost benefit results would be significantly reduced. However, we note that significant care is required when interpreting these results.

Table 10: Success of regulated access

Input name	Description	Low benefit / High cost	Base case benefit / cost	High benefit / Low cost
probability_regulated_access_ineffective	Probability that regulated access fails to provide the efficiency and competition benefits.	70%	50%	30%

Delay to liberalisation

A7.122 When we impose access or partial release, the date at which 900MHz operators can make use of liberalised 900MHz spectrum may be delayed by anything up to six months (compared to if we were to liberalise in the hands of the incumbents).

A7.123 The cost of this delay depends on whether the 900MHz operators continue to deploy their 2100MHz network, or do not deploy any network, during the period of delay.

A7.124 If it is profitable for a single operator to match using 2100MHz spectrum, then it is likely that the 900MHz operators will continue deploying their 2100MHz network until they can make use of liberalised 900MHz spectrum. In this case, delay imposes a cost through higher network costs for the two 900MHz operators. This is a productive efficiency cost.

A7.125 If it is not profitable for a single operator to match using 2100MHz spectrum, then it is likely that the 900MHz operators will not continue deploying their 2100MHz spectrum, choosing instead just to wait until they can make use of liberalised

900MHz spectrum. And, it is therefore unlikely that any 2100MHz operators will deploy at 2100MHz during this period (even though it may be profitable for the RAN shared 2100MHz operators to do so). In this case, delay imposes a cost through the loss of consumer benefits, as the launch of improved mobile broadband services is delayed.

A7.126 This section explains how we have estimated these costs under these two cases.

900MHz operators continue to rollout at 2100MHz during delay

A7.127 In the medium significance scenario when both the single and RAN shared 2100MHz operators can match, we know that it is profitable for a single operator to deploy high quality mobile broadband services using 2100MHz spectrum.

A7.128 Therefore, we assume that it is also profitable for the 900MHz operators to continue deployment at 2100MHz while they are waiting for liberalised 900MHz (i.e. for an additional 0-6 months).

A7.129 The cost of delay in this case is a productive inefficiency cost. Both 900MHz operators deploy additional 2100MHz sites and equipment for up to six months longer. We note that although they also commence their 900MHz deployment later, this is a very small productive efficiency benefit.

A7.130 This "efficiency cost of delay" has been estimated using the cost difference model (set out in annex 15). For the relevant target site numbers (i.e. medium significance when both single and RAN shared operators can match), we have calculated the cost to the 900MHz operators of additional deployment at 2100MHz, net of any benefits from (slightly) later deployment of 900MHz.

A7.131 The two charts below illustrate a 900MHz operator's rollout profile with no delay, and with a six month delay. Notice the additional UMTS2100 deployment in 2011 when there is a delay, where half of the annual deployment cap is used to determine the number of additional 2100MHz sites deployed.

Figure 7: 900MHz operator rollout profile with no delay to liberalisation

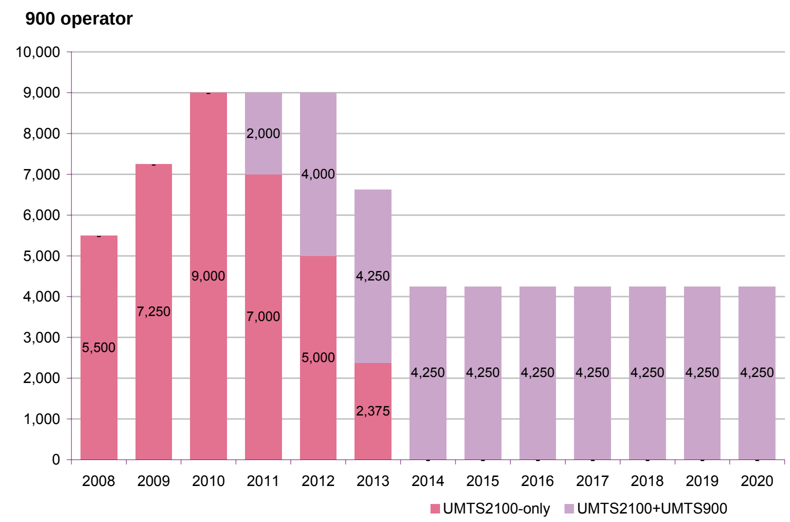
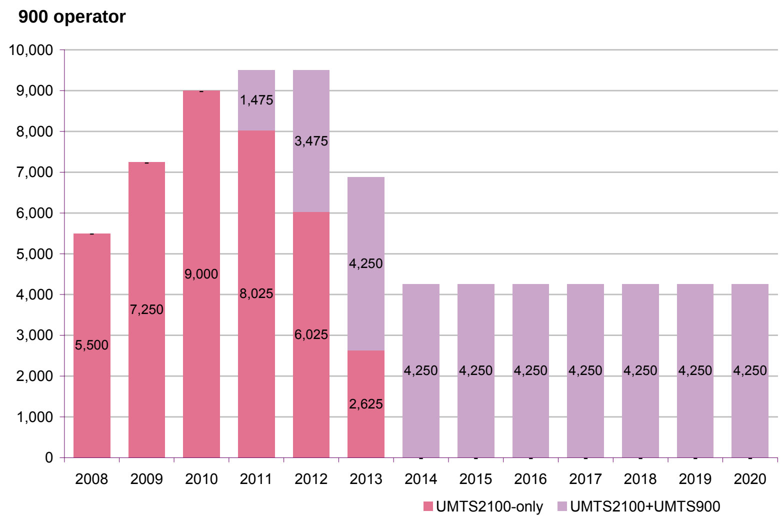


Figure 8: 900MHz operator rollout profile with a six month delay to liberalisation



A7.132 We generate results for low, base and high by assuming a different period of delay. In the low case we assume no delay, in the base case we assume a three month delay, and in the high case we assume a six month delay.

A7.133 Furthermore, when a market solution would have occurred in the counterfactual, we assume that the costs of delay are lower (by a proportion). This is because it is plausible that the policy option will result in a shorter delay if the market was going to reach a solution anyway. For example, it may not take as long to set up regulated access if all parties are willing; or the 900MHz operators will be able to clear spectrum faster if they were planning to clear some spectrum for commercial trade anyway.

A7.134 We summarise these efficiency costs of delay below.

Table 11: Efficiency costs of delay

Input name	Description	High benefit / Low cost	Base case benefit / cost	Low benefit / High cost
	Period of delay	0 months	3 months	6 months
		£millions (NPV, calculated over 20 years)		
cost_efficiency_delay	This is the cost of additional deployment at 2100MHz during the period of delay (net any productive efficiency benefit of delaying 900MHz deployment). Or the benefit of avoiding this cost.	170	90	-
cost_reduction_efficiency_delay	Proportion by which the efficiency cost of delay is reduced (if market would have reached a solution anyway).	100%	50%	0%

Note: The assumptions underlying the high, base and low results are set out in the discussion above this table. To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

900MHz operators do not continue 2100MHz rollout during delay

A7.135 In outcomes where it is not profitable for a single 2100MHz operator to match using 2100MHz (i.e. to the right of break point 2), then we assume that none of the operators deploy new services for the period of delay (up to six months).

A7.136 It is true that there are outcomes in the medium significance scenario where it would be profitable for the RAN shared 2100MHz operators to deploy at 2100MHz. However, we assume that their decision to rollout is determined by whether or not the single 900MHz operators rollout.

A7.137 The cost of delay in this case is the total welfare effect caused by launching the new service by anything up to six months later than would otherwise be the case.

A7.138 50%[26] of this total welfare cost will be lost consumer benefits, and 50% will be lost producer benefits.

A7.139 This cost has been estimated using the cost of delay modelling which has been calibrated using the same set of Analysys Mason forecasts of subscribers and ARPU which are used to calibrate the competition impacts model. The methodology is set out in annex 9. A summary of the costs of benefits of delayed liberalisation when no operator deploys is shown below.

[26] The fact that consumer surplus is exactly 50% of total welfare is not an exogenous assumption. Rather this results from the fact that we are using a symmetric Cournot oligopoly model with 2 players (the 900MHz incumbents) to produce the welfare inputs. The consumer and producer welfare inputs are produced using the competition impacts model using the total UK mobile market as we wish to capture all benefits to consumers and producers from *all* types of mobile service for the purpose of this cost of delay modelling.

A7.140

Table 12: Cost of delay to launch of services

Input name	Description	High benefit / Low cost	Base case benefit / cost	Low benefit / High cost
	Period of delay	0 months	3 months	6 months
		£millions (NPV, calculated over 20 years)		
cost_service_launch_delay	This is the welfare impact of delaying when new services are available. Or the benefit of avoiding this cost.	90	45	-
cost_reduction_service_launch_delay	Proportion by which cost of delay to launch of services is reduced (if market would have reached a solution anyway).	100%	50%	0%

Note: the assumptions underlying the high, base and low results are set out in the discussion above this table.

Costs associated with spectrum release

A7.141 When we mandate spectrum release, we impose costs on the incumbent 900MHz operators. This cost depends on the amount of spectrum we mandate to be released.

Cost of mandatory release

A7.142 The approach to assessing the costs of spectrum release has been set out in detail in annex 16.

A7.143 In this annex we have identified the costs of release as follows.

A7.144 The costs of release are based on the lowest cost approach[27] to clearing the spectrum. The methodology used to estimate this cost is describer in greater detail in annex 16.

A7.145 Under the partial spectrum release options the full cost of mandatory spectrum release is imposed if the 900MHz operators would *not* have offered a commercial trade. If the operators would have offered a commercial trade only the incremental cost of forced release is included (the approach to identifying this is set out below).

[27] Approach 3 in annex 16.

Table 13: Cost of mandatory release

Input name	Description	High benefit / Low cost	Base case benefit / cost	Low benefit / High cost
		£millions (NPV, calculated over 20 years)		
cost _forced_release_1	Cost of forced release for partial release options, depending upon the number of blocks released. This is only incurred if there is no commercial trade in the counterfactual. The results are taken from annex 16 Table 2 Approach 3.	90	80	60
cost _forced_release_2		280	230	180
cost _forced_release_3		690	570	450

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

Incremental cost of mandatory release

A7.146 By mandating release, costs may be higher than they would be if spectrum were released and traded commercially, so there is an incremental cost of forced release.

A7.147 The incremental costs of mandatory release are incurred as the mandatory release may be less flexible than commercial release over the process and timing of release. Therefore, in order to proxy this cost, forced release is assumed to require the operators to release 6 months earlier than they would have if they had released the spectrum for a commercial trade (i.e. at the end of 2011 rather than mid 2012).

A7.148 As the cost of release model produces results for whole year periods this cost is assessed as 50% of the difference between the costs of release in 2011 and the costs of release in 2012.

A7.149 This cost arises in all situations where the operators would release spectrum for a commercial trade but are forced to release instead. The scenarios in which this occurs are illustrated in the table below.

Table 14: Incremental cost of mandatory release

Input name	Description	High benefit / Low cost	Base case benefit / cost	Low benefit / High cost
		£millions (NPV, calculated over 20 years)		
cost_inc_cost_forced_release_1	Cost to incumbent 900MHz operators of incremental cost due to forced clearance. This is proxied by the cost of bringing release forward 6 months Only incurred if there is a commercial trade in the counterfactual. annex 16 Table 50 and Table 54 *cost_inc_cost_forced_release_1 = ((cost _forced_release_1 (in 2012) - cost_forced_release 1 (in 2011)))*0.5*	10	8	5
cost_inc_cost_forced_release_2		30	23	15
cost_inc_cost_forced_release_3		70	60	45

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

Cost of commercial release

A7.150 The costs of commercial release are lower than the costs of forced release for the reasons described above. The cost of commercial release is simply the cost *of forced* release minus the incremental cost of forced release.

A7.151 The costs of commercial release are avoided if a commercial trade was going to take place and we impose access which disrupts the commercial trade. In this case it takes the form of a benefit.

Table 15: Benefit of avoiding commercial release

Input name	Description	High benefit / Low cost	Base case benefit / cost	Low benefit / High cost
		£millions (NPV, calculated over 20 years)		
benefit_avoid_commercial_release_1	Benefit of avoiding costs incurred due to commercial release. These are equal to the benefits of avoiding forced release minus the incremental cost of forced release. Only incurred if there is no commercial trade in the counterfactual. *cost_commercial_release_1 = cost _forced_release_1 - cost_inc_cost_forced_release_1*	80	70	55

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

Cost of clearance when operators do not ultimately clear

A7.152 In the low significance outcome the 900MHz operators were not planning to clear 900MHz spectrum for themselves as the cost of clearing a block for their own use plausibly exceeds the cost saving of deploying UMTS900 over UMTS2100. In this outcome its plausible that the level of interest in the released block(s) will be sufficiently low that the release policy is not fully implemented (i.e. it may be clear once we investigate the level of demand for the released block that the level of demand is not proportionate to the costs of release).

A7.153 In this case we assume that the cost incurred by the 900MHz operators is less than the full cost of releasing the block(s) but is still significant as the 900MHz operators are likely to incur some costs of clearing in advance of the auction, and before it becomes clear that the policy should not be fully implemented.

A7.154 The cost of release if the mandated release policy is aborted due to a low level of demand for the spectrum is proxied by the cost of release incurred in the first year of release. This cost varies with the number of blocks mandated to be released.

A7.155 This cost is incurred in the low significance scenarios where the policy option is mandatory release. It occurs whatever the commercial outcome, as no market solution emerges in this scenario.

Table 16: Cost of clearance when operators do not ultimately clear

Input name	Description	High benefit / Low cost	Base case benefit / cost	Low benefit / High cost
		£millions (NPV, calculated over 20 years)		
cost_release_aborted_1_block	Cost of release incurred if we force release of block(s) but the policy is aborted due to lack of demand for the released block(s). Only incurred in low significance outcomes. Quantified as the costs of release incurred in the first year of release i.e. prior to the auction. *cost_release_aborted_1_block = cost_forced_release_1_block*0.5*	45	40	30
cost_release_aborted_2_block		140	120	90
cost_release_aborted_3_block		350	275	230

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

Increased cost of future clearance

A7.156 Its possible that forced spectrum release will increase the costs of future spectrum clearance, if for example, the 900MHz operators need to clear additional spectrum in the future (e.g. if it were efficient to clear additional 900MHz spectrum for the deployment of extra carriers of UMTS900 or to deploy an alternative technology such as LTE).

A7.157 We estimate the increased cost of future clearance by comparing the costs of clearing 2 blocks in 2015 if the operators have already cleared the following (in total) in 2011:

a. 2 blocks for their own use

b. 3 blocks (2 for their own use and 1 for release)

c. 4 blocks (2 for their own use and 2 for release)

d. 5 blocks (2 for their own use and 3 for release)

A7.158 The increased cost of future clearance is incurred in circumstances in which we force release where there would not have been a commercial trade otherwise.

Table 17: Increased cost of future clearance

Input name	Description	High benefit / Low cost	Base case benefit / cost	Low benefit / High cost
		£millions (NPV, calculated over 20 years)		
benefit_inc_future_clearance_cost_1 or cost_inc_future_clearance_cost_1	Incremental cost of future clearance due to release of blocks. Only incurred in scenarios where a commercial trade would *not* have occurred in the counterfactual. e.g. this cost is captured for 1 block release by comparing the cost to 900MHz operators of clearing 2 blocks (for own use) in 2015 given that they have already cleared 2 blocks for their own use in 2011(see A16.268) with the cost of clearing 2 blocks in 2015 given that they have already cleared 3 blocks (2 blocks for own use, 1 blocks for release) in 2011 (see A16.270). The costs of clearance in 2015 are taken as the costs of clearing 4+n blocks in 2015 minus the cost of clearing 2+n blocks in 2015 where n is the number of blocks released in 2015. See A16.267-A16.272. *cost_inc_future_clearance_cost_3* is calculated as the cost of full clearance in 2015 minus the cost of clearing 5 blocks in 2015, as in this case 4+n=7 i.e. full clearance.	60	45	30
cost_inc_future_clearance_cost_2		180	150	110
cost_inc_future_clearance_cost_3		875	725	575

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

Cost of disruption

A7.159 Spectrum release may also generate disruption costs for the 900MHz operators. This is because forced release requires operators to migrate GSM traffic from 900MHz to 1800MHz and use cell splitting. The approach for modelling these costs is discussed in annex 16.

Table 18: Cost of disruption

Input name	Description	High benefit / Low cost	Base case benefit / cost	Low benefit / High cost
		£millions (NPV, calculated over 20 years)		
cost_disruption_1_block	Cost of disruption due to reduced revenue due to reduced call success rate and increased number of dropped calls. Calculated using Approach 3 for 1,2 and 3 block release. See annex 16 Tables 72, 73 and 74	20	10	2
cost_disruption_2_block		25	15	3
cost_disruption_3_block		30	15	3

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

Costs of implementing access

A7.160 Access, whether commercially negotiated or mandated, has costs associated with it.

A7.161 The main costs of implementing access that we include in the cost benefit analysis are the cost of setting up the access agreement, and the cost of additional infrastructure required to provide sufficient capacity. These are explained below.

A7.162 Access could include roaming or spectrum sharing. We specifically consider roaming here, as there is much more evidence of it being commercially implemented.

Cost of setting up an access agreement

A7.163 The table below shows the illustrative estimates of the cost of setting up a commercial or regulated roaming agreement. We assume that the cost of setting up an access agreement is higher if it is regulated, rather than commercially agreed. These costs are illustrative but have been identified as a reasonable estimate of costs which may be incurred in setting up access agreements such as:

- Non 900 MHz operator establishing a carrier and point of interconnect
- Legal costs for establishing roaming agreement
- Billing systems

A7.164 In the low significance outcomes, if regulated access is imposed then only a proportion of the costs of setting up a regulated access agreement will be incurred, as we assume that ultimately no access agreements will be entered into. The assumed proportions are also shown in the table below.

A7.165

Table 19: Cost of setting up an access agreement

Input name	Description	Low benefit / High cost	Base case benefit / cost	High benefit / Low cost
		£millions (NPV, calculated over 20 years)		
cost_reg_access_agreement	Cost of setting up a regulated access agreement. Benefit of avoiding this cost.	1	5	10
cost_inc_reg_access_agreement_cost	Incremental cost of setting up a regulated access agreement, compared to a commercial access agreement. Benefit of avoiding this cost.	0	1	3
benefit_avoid_comm_access_agreement	Cost of setting up a commercial access agreement. Benefit of avoiding this cost.	1	4	5
cost_access_aborted_proportion	Proportion of costs of setting up a regulated access agreement that are still incurred even if policy aborted.	0%	50%	100%

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

Cost of additional infrastructure required to provide access

A7.166 We assume that one 2 x 5MHz block of 900MHz spectrum is sufficient to carry the traffic of two operators. Therefore, a 900MHz operator can provide access to one other operator without any need for further infrastructure investment.

A7.167 But, if the 900MHz operator provides access to more than one other operator, then we assume that it would need to invest in additional infrastructure (i.e. invest in an additional carrier). We assume that this cost is only incurred when all 3 non-

900MHz operators are relying on access, and that in this case only one of the 900MHz operators will incur this cost.[28]

A7.168 The equipment cost of deploying an additional carrier is estimated to be 15%[29] of the total cost of deploying the existing 900MHz network. As this is dependent on the number of 900MHz sites being built, this cost will vary under each significance outcome (as the number of 900MHz sites required to provide the service varies under each significance outcome).

A7.169 When this cost is incurred we also include the cost of clearing further 900MHz spectrum. This is estimated as being the cost of clearing an additional 2 x 5MHz block of spectrum, which is estimated to be £60m to £90m[30].

A7.170 The costs of additional infrastructure and further spectrum clearance are shown below.

Table 20: Cost of additional infrastructure and further spectrum clearance

Input name	Description	Low benefit / High cost	Base case benefit / cost	High benefit / Low cost
		£millions (NPV, calculated over 20 years)		
cost_additional_infrastructure_medium_A *or* *benefit_avoid_additional_infrastructure_medium_A*	Cost of additional infrastructure including the additional cost of spectrum clearance in medium significance scenario when both single and RAN shared 2100MHz operators can match. Benefit of avoiding this cost.	80 + 60	80 + 75	80 + 90
cost_additional_infrastructure_medium_B *or* *benefit_avoid_additional_infrastructure_medium_B*	Cost of additional infrastructure including the additional cost of spectrum clearance in medium significance scenario when only RAN shared 2100MHz operators can match. Benefit of avoiding this cost.	80 + 60	80 + 75	80 + 90
cost_additional_infrastructure_high *or*	Cost of additional infrastructure including the additional cost of spectrum clearance in high	80 + 60	90 + 75	100 + 90

[28] We are assuming that one block of 900MHz is sufficient to carrier two operators' worth of traffic.
[29] This 15% is a plausible estimate of the proportion of total costs that is equipment only. The reason we use this is because deploying an additional 900MHz carrier will require additional transceivers (i.e. additional equipment) at each site.
[30] This is the cost of clearing a third 2 x 5MHz block of spectrum. The first two blocks are assumed to be cleared by the 900MHz operators for their own use (one each). We estimate the cost of clearance to be the same as that imposed by mandatory 1 block release. Note that this cost only applies if no commercial trade or mandatory release occurs (as if this occurs the RAN shared operator is assumed to acquire 900MHz spectrum, and so only one other operator is relying on access).

benefit_avoid_additional_infrastructure_high	significance scenario. Benefit of avoiding this cost.			

Note: To generate consumer welfare impacts we assume that 50% of these costs are passed through to consumers.

Liberalisation in the hands of the incumbents

A7.171 We now set out what would happen in each of the twelve outcomes if we were to liberalise 900MHz spectrum in the hands of the incumbents. We then assess the other policy options relative to liberalisation in the hands of the incumbents.

A7.172 We do not quantify the outcomes of liberalisation in the hands of the incumbents in absolute terms. Instead, we quantify the difference between the outcomes for other policy options, and the outcomes we describe below for liberalisation in the hands of the incumbents. This is because the decision we need to make is how to liberalise the 900MHz spectrum not whether to liberalise. Hence, it is the relative costs and benefits of the different options which are of interest. However, we note that all options are expected to bring about significant benefits in absolute terms if the liberalisation allows new services to be deployed earlier and/or more efficiently.

High significance

A7.173 In the high significance scenario, it is not possible to replicate the services provided with access to liberalised 900MHz spectrum using higher frequency (2100MHz) spectrum.

A7.174 If the market **does not provide wider access** to 900MHz spectrum via a trade or commercial access:

7.174.1 The two incumbent 900MHz operators provide higher quality mobile broadband services using their liberalised 900MHz spectrum.

7.174.2 Both single and RAN shared 2100MHz operators are unable to compete in the interim period, but deploy low frequency networks later (when 800MHz spectrum becomes available).

A7.175 If the market provides wider access in the form of a **commercial trade**, the effect depends on the number of blocks that are commercially traded.

A7.176 We remind the reader that where a commercial trade takes place, we make the following assumption about how the number of blocks that are commercially traded varies with the policy option we are assessing (see earlier discussion in paragraph A7.26.1).

Table 21: Number of blocks commercially traded in the counterfactual

Policy option being assessed	Number of blocks commercially traded in “market solution – trade” outcome
Regulated access	1 block (2 x 5MHz)
Partial release – 1 block	1 block (2 x 5MHz)
Partial release – 2 blocks	2 blocks (2 x 10MHz)
Partial release – 3 blocks	3 blocks (2 x 15MHz)

<u>If one block commercially traded:</u>

7.176.1 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. They also trade one block of spectrum commercially.

7.176.2 The RAN shared 2100MHz operators acquire a traded block of 900MHz spectrum, and deploy a 900MHz network to provide higher quality mobile broadband services.

7.176.3 The single 2100MHz operator is unable to compete in the interim period, but deploys a low frequency network later (when 800MHz spectrum becomes available).

<u>If two blocks commercially traded:</u>

7.176.4 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. They also trade two blocks of spectrum commercially.

7.176.5 The RAN shared 2100MHz operators acquire a traded block of 900MHz spectrum, and deploy a 900MHz network to provide higher quality mobile broadband services.

7.176.6 The single 2100MHz operator acquires a traded block of 900MHz spectrum, and deploys a 900MHz network to provide higher quality mobile broadband.

<u>If three blocks commercially traded:</u>

7.176.7 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. They also trade three blocks spectrum commercially.

7.176.8 The RAN shared 2100MHz operators acquire two traded blocks of 900MHz spectrum, and deploy a 900MHz network to provide higher quality mobile broadband services.

7.176.9 The single 2100MHz operator also acquires a traded block of 900MHz spectrum, and deploys a 900MHz network to provide higher quality mobile broadband.

A7.177 If the market provides wider access in the form of **commercial access**:

7.177.1 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. One provides access to the single 2100MHz operator; the other provides access to the RAN sharing 2100MHz operators.

7.177.2 Both the single and RAN sharing 2100MHz operators access the incumbent's 900MHz networks in the interim period, and then deploy their own low frequency networks later (when 800MHz spectrum becomes available).

A7.178 When no market solution occurs in the high significance scenario, wider access to 900MHz spectrum through the alternative policy options helps to promote competition.

Medium significance

A7.179 In the medium significance scenario, the services which can be provided with access to liberalised spectrum can plausibly be matched using other higher frequency spectrum. We divide the medium significance scenario into two outcomes:

7.179.1 Both single and RAN sharing 2100MHz operators are able to match using 2100MHz spectrum; and

7.179.2 Only RAN sharing 2100MHz operators are able to match.

<u>If only RAN sharing 2100MHz operators are able to match</u>

A7.180 If the market **does not provide wider access** to 900MHz spectrum via a trade or commercial access:

7.180.1 The two incumbent 900MHz operators provide higher quality mobile broadband.

7.180.2 The RAN shared 2100MHz operators are able to match using 2100MHz spectrum in the interim period. They then deploy a low frequency network later (when 800MHz spectrum becomes available).

7.180.3 The single 2100MHz operator is unable to compete in the interim period, but deploys a low frequency network later (when 800MHz spectrum becomes available).

A7.181 If the market provides wider access in the form of a **commercial trade**:

<u>If one block commercially traded:</u>

7.181.1 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. They also trade one block of spectrum commercially.

7.181.2 The RAN shared 2100MHz operators acquire a traded block of 900MHz spectrum, and deploy a 900MHz network to provide higher quality mobile broadband services.

7.181.3 The single 2100MHz operator is unable to compete in the interim period, but deploys a low frequency network later (when 800MHz spectrum becomes available).

If two blocks commercially traded:

7.181.4 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. They also trade two blocks of spectrum commercially.

7.181.5 The RAN sharing 2100MHz operators acquire a traded block (of 900MHz spectrum), and deploy a 900MHz network to provide higher quality mobile broadband services.

7.181.6 The single 2100MHz operator acquires a traded block of 900MHz spectrum, and deploys a 900MHz network to provide higher quality mobile broadband.

If three blocks commercially traded:

7.181.7 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. They also trade three blocks of spectrum commercially.

7.181.8 The RAN shared 2100MHz operators acquire two traded blocks of 900MHz spectrum, and deploy a 900MHz network to provide higher quality mobile broadband services.

7.181.9 The single 2100MHz operator also acquires a traded block of 900MHz spectrum, and deploys a 900MHz network to provide higher quality mobile broadband.

A7.182 If the market provides wider access in the form of **commercial access**:

7.182.1 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. One provides access to the single 2100MHz operator; the other provides access to the RAN sharing 2100MHz operators.

7.182.2 Both the single and RAN sharing 2100MHz operators access the incumbent's 900MHz networks in the interim period, and then deploy their own low frequency networks later (when 800MHz spectrum becomes available).

A7.183 When no market solution occurs in the medium significance scenario (and only the RAN sharing 2100MHz operators are able to match), wider access to 900MHz spectrum can help to promote both efficiency (i.e. RAN shared operators) and competition (i.e. single 2100MHz operator).

If both the single and RAN shared 2100MHz operators are able to match

A7.184 If the market **does not provide wider access** to 900MHz spectrum via a trade or commercial access:

7.184.1 The two incumbent 900MHz operators provide higher quality mobile broadband.

7.184.2 Both the single and RAN sharing 2100MHz operators are able to match using 2100MHz in the interim period. They then deploy low frequency networks later (when 800MHz spectrum becomes available).

A7.185 If the market provides wider access in the form of a **commercial trade**:

If one block commercially traded:

7.185.1 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. They also trade one block of spectrum commercially.

7.185.2 The RAN shared 2100MHz operators acquire a traded block of 900MHz spectrum, and deploy a 900MHz network to provide higher quality mobile broadband services.

7.185.3 The single 2100MHz operator is able to match using 2100MHz spectrum in the interim period, and deploys a low frequency network later (when 800MHz spectrum becomes available).

If two blocks commercially traded:

7.185.4 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. They also trade two blocks of spectrum commercially.

7.185.5 The RAN shared 2100MHz operators acquire a traded block of 900MHz spectrum, and deploy a 900MHz network to provide higher quality mobile broadband services.

7.185.6 The single 2100MHz operator acquires a traded block of 900MHz spectrum, and deploys a 900MHz network to provide higher quality mobile broadband.

If three blocks commercially traded:

7.185.7 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. They also trade three blocks of spectrum commercially.

7.185.8 The RAN shared 2100MHz operators acquire two traded blocks of 900MHz spectrum, and deploy a 900MHz network to provide higher quality mobile broadband services.

7.185.9 The single 2100MHz operator acquires a traded block of 900MHz spectrum, and deploys a 900MHz network to provide higher quality mobile broadband.

A7.186 If the market provides wider access in the form of **commercial access**:

7.186.1 The two incumbent 900MHz operators provide higher quality mobile broadband using 900MHz spectrum. One provides access to the single

2100MHz operator; the other provides access to the RAN sharing 2100MHz operators.

7.186.2 Both the single and RAN shared 2100MHz operators access the incumbent's 900MHz networks in the interim period, and then deploy their own low frequency networks later (when 800MHz spectrum becomes available).

A7.187 When no market solution occurs in the medium significance scenario (and both the single and RAN shared 2100MHz operators are able to match), wider access to 900MHz spectrum through alternative policy options helps to promote efficiency (by reducing the costs of providing high quality mobile broadband).

Low significance

A7.188 In the low significance scenario, we assume that it is optimal for the 900MHz spectrum to remain in its existing use, and for improved mobile broadband services to be deployed using higher frequency (2100MHz) spectrum.

A7.189 As a result, the market solution outcomes (commercial trade or commercial access) are assumed not to occur in this scenario. Firstly, there is no incentive on the part of the incumbent 900MHz operators to clear 900MHz spectrum to trade as the 2100MHz operators' willingness to pay will not be sufficient to cover the clearance costs, as they can deploy using 2100MHz at a lower total cost. Secondly, there is no high quality mobile broadband 900MHz network on which to provide access, because it is not cost effective for the incumbent operators to use this spectrum for this purpose.

A7.190 Given that the market solution outcomes do not occur, there is a single outcome in the low significance scenario:

7.190.1 The two incumbent operators do not deploy a higher quality mobile broadband network using 900MHz spectrum, choosing instead to deploy using 2100MHz spectrum.

7.190.2 Both the single and RAN sharing 2100MHz operators deploy networks using 2100MHz spectrum.

A7.191 In the low significance scenario, wider access to 900MHz spectrum through alternative policy options does not have any efficiency or competition benefits.

Summary tables

A7.192 The following tables summarise what the operators do in each of the twelve outcomes if we were to liberalise 900MHz spectrum in the hands of the incumbents. We then use similar tables to describe the effects of the different policy options relative to liberalisation in the hands of the incumbents.

A7.193 For presentational clarity, we have used the following terms in the tables throughout the rest of this annex:

7.193.1 Market solution – trade (MS/T): a commercial trade takes place in the counterfactual.

7.193.2 Market solution – access (MS/A): commercial access is granted in the counterfactual.

7.193.3 No market solution (NMS): the market does not achieve wider access to 900MHz spectrum without intervention.

7.193.4 Number of operators: this is the number of operators providing higher quality mobile broadband during the interim period.

Table 22: Liberalisation in the hands of the incumbents: high significance scenario

	Market solution – trade (MS/T)	Market solution – access (MS/A)	No market solution (NMS)
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade **X** blocks of 900MHz spectrum between them.	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks.
RAN sharing 2100MHz operators	If **X** ≤ 2, acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network. (Acquires two blocks if **X** > 2).	Access to an incumbent 900MHz operator's 900MHz network for interim period. Deploy a low frequency network later (when 800MHz becomes available).	Unable to compete in the interim period, but deploy a low frequency network later (when 800MHz becomes available).
Single 2100MHz operator	If **X** > 1, acquires commercially traded block of 900MHz spectrum, and deploys a UMTS900 network. If **X** = 1, does not match in interim, but deploys a low frequency network later (when 800MHz becomes available).	Access to an incumbent 900MHz operator's 900MHz network for interim period. Deploys a low frequency network later (when 800MHz becomes available).	Unable to compete in the interim period, but deploys a low frequency network later (when 800MHz becomes available).
Number of operators	If **X** = 1, then 4 If **X** > 1, then 5	5	2

Table 23: Liberalisation in the hands of the incumbents: medium significance scenario (when only the RAN shared 2100MHz operators are able to match)

	Market solution – trade (MS/T)	Market solution – access (MS/A)	No market solution (NMS)
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade **X** blocks of 900MHz spectrum between them.	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks.
RAN sharing 2100MHz operators	If **X** ≤ 2, acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network. (Acquires two blocks if **X** > 2).	Access to an incumbent 900MHz operator's 900MHz network for interim period. Deploy a low frequency network later (when 800MHz becomes available).	Able to match using 2100MHz spectrum in the interim period, and then deploy a low frequency network later (when 800MHz becomes available).
Single 2100MHz operator	If **X** > 1, acquires commercially traded block of 900MHz spectrum, and deploys a UMTS900 network. If **X** = 1, does not match in interim, but deploys a low frequency network later (when 800MHz becomes available).	Access to an incumbent 900MHz operator's 900MHz network for interim period. Deploys a low frequency network later (when 800MHz becomes available).	Unable to compete in the interim period, but deploys a low frequency network later (when 800MHz becomes available).
Number of operators	If **X** = 1, then 4 If **X** > 1, then 5	5	4

Table 24: Liberalisation in the hands of the incumbents: medium significance scenario (when both the single and RAN shared 2100MHz operators are able to match)

	Market solution – trade (MS/T)	Market solution – access (MS/A)	No market solution (NMS)
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade **X** blocks of 900MHz spectrum between them.	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks.
RAN sharing 2100MHz operators	If **X** ≤ 2, acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network. (Acquires two blocks if **X** > 2).	Access to an incumbent 900MHz operator's 900MHz network for interim period. Deploy a low frequency network later (when 800MHz becomes available).	Able to match using 2100MHz spectrum in the interim period, and then deploy a low frequency network later (when 800MHz becomes available).
Single 2100MHz operator	If **X** > 1, acquires commercially traded block of 900MHz spectrum, and deploys a UMTS900 network. If **X** = 1, able to match using 2100MHz in the interim period, and then deploy a low	Access to an incumbent 900MHz operator's 900MHz network for interim period. Deploys a low frequency network later (when 800MHz becomes available).	Able to match using 2100MHz spectrum in the interim period, and then deploy a low frequency network later (when 800MHz becomes available).

	frequency network later (when 800MHz becomes available).		
Number of operators	5	5	5

Table 25: Liberalisation in the hands of the incumbents: low significance scenario

	Market solution – trade (MS/T)	Market solution – access (MS/A)	No market solution (NMS)
Incumbent 900MHz operators	Do not deploy a 900MHz network. Improved services deployed using 2100MHz spectrum. Commercial trade does not occur.	Do not deploy a 900MHz network. Improved services deployed using 2100MHz spectrum. Commercial access does not occur.	Do not deploy a 900MHz network. Improved services deployed using 2100MHz spectrum.
RAN sharing 2100MHz operators	Improved services deployed using 2100MHz spectrum.	Improved services deployed using 2100MHz spectrum.	Improved services deployed using 2100MHz spectrum.
Single 2100MHz operator	Improved services deployed using 2100MHz spectrum.	Improved services deployed using 2100MHz spectrum.	Improved services deployed using 2100MHz spectrum.
Number of operators	5	5	5

Option assessment - introduction

A7.194 We now assess each of the other policy options relative to the option of liberalisation in the hands of the incumbents. The assessment for each option is structured as follows:

7.194.1 We describe what happens under each of the twelve outcomes, relative to the counterfactual described above.

7.194.2 We set out which of the costs and benefits set out earlier in this annex apply under each outcome, providing intuition where necessary.

7.194.3 We present our estimates of the relevant costs and benefits for each outcome.

A7.195 We also summarise the net benefits for each policy option under each outcome. However, in order to make the net benefits estimates easier to present and interpret, we have:

7.195.1 Combined the two versions of the medium significance scenario (when both the single and RAN shared 2100MHz operators can match, and when only the RAN shared 2100MHz operator can match). This is done using a simple average[31].

7.195.2 Combined the results for the two types of market solution – commercial trade and commercial access – again, using a simple average.[32]

A7.196 This allows us to present summary results for six net benefit outcomes for each policy option, rather than the full 12 set out in the detailed discussion. This reduction in the number of outcomes makes the results significantly easier to interpret, and we do not believe that this simplification impacts upon the conclusions which are reached.

A7.197 The summary results are also presented in the form of a diagram showing the range of net benefits for the different policy options both in the case where the market would not have achieved wider access (highlighted by a red box), and where the market would have achieved wider access (highlighted by a blue box). In the diagram, we show our base case and high and low net benefit assessments.

A7.198 As discussed earlier, we generate high and low ranges as these help us to reflect the significant uncertainty over the outcomes which may arise, and the illustrative nature of the quantification of some impacts which rest on uncertain assumptions.

A7.199 Therefore, the base case results should not be interpreted to mean our assessment of the most likely net benefit result. The high, base and low results are all plausible outcomes.

A7.200 As noted above – we focus on the cases where the intervention does not disrupt the market solution (if there is one), but highlight where the disruption of the commercial outcome would result in significantly different results.

A7.201 As well as presenting the net benefits in total welfare terms, we present summarised results for our consumer surplus analysis.

A7.202 As explained earlier, all of these quantitative results also need to be considered alongside the qualitative analysis in section 5.

[31] In the absence of any significant evidence to suggest that either of the two medium significance outcomes is more or less likely than the other we have combined these outcomes using a simple average.

[32] As with the two medium significance outcomes, in the absence of any significant evidence to suggest that either the trade or commercial access outcomes is more or less likely than the other we have combined these outcomes using a simple average.

Regulated Access

A7.203 Regulated access would require the 900MHz operators to offer access to any 2100MHz operator that requests it. The costs and benefits of access under each of the different outcomes are set out below (relative to the counterfactual, liberalisation in the hands of the incumbents).

A7.204 We note that there are significant risks that regulated access does not realise its potential benefits. This is largely because of asymmetries of information between the regulator and the parties and the complexity of the regulatory intervention needed when the incentives of the parties to reach an agreement are not well aligned. As noted earlier, we have used a probability that regulated access is not effective to capture this risk in this quantitative analysis.

A7.205 As we are assuming that our intervention does not disrupt any commercial outcomes, if regulated access fails then we just revert to the counterfactual outcome (but incurring some additional costs).

High significance

A7.206 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 26: Regulated access: high significance scenario (no market solution: NMS)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. One operator provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.
RAN sharing 2100MHz operators	Unable to compete in the interim period, but deploy a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Single 2100MHz operator	Unable to compete in the interim period, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Number of operators	2	5

A7.207 If the market provides wider access in the form of a commercial trade:

Table 27: Regulated access: high significance scenario (market solution – trade: MS/T)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 1 block of 900MHz spectrum between them.	Deploy own UMTS900 networks. Trade 1 block of 900MHz spectrum commercially. One operator is required to provide access to the single 2100MHz operator.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Does not match in interim, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Intervention gives operator access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	4	5

A7.208 If the market provides wider access in the form of commercial access:

Table 28: Regulated access: high significance scenario (market solution – access: MS/A)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One operator provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. One operator provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Single 2100MHz operator	Access to a 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

A7.209 In the high significance scenario, regulated access results in an increase in the number of players from four to five in the outcome where a block is commercially traded. The single operator can now provide a service via regulated access, while the RAN shared operator already has 900MHz spectrum via the market solution. In the no market solution outcome, regulated access results in an increase in the number of players from two to five, as access enables the RAN-shared operators and the single operator to provide higher quality mobile broadband services. There are no productive efficiency benefits arising from regulated access in the high significance outcomes, because no operators deploy 2100MHz spectrum in the counterfactual. In this scenario, the benefit of the regulated access is a pure competition benefit.

A7.210 We discount the benefits of regulated access by the probability that this policy is ineffective. If regulated access is ineffective then we revert to the counterfactual (liberalisation in the hands of the incumbents) as the market solution (if any) is not disrupted. As such, there is no reduction in competition as a result of regulated access being ineffective if there is a market solution. However, where there is no market solution there is a significant reduction in competition benefits when access is ineffective.

A7.211 The cost of setting up a regulated access agreement applies in all three outcomes. However, if commercial access is granted, then much of this cost is incurred anyway. In this case we only include the incremental cost of a regulated access agreement, over the cost of setting up a commercial access agreement.

A7.212 The cost of additional infrastructure for roaming traffic only applies when an incumbent 900MHz operator provides access to more than one operator. Therefore, when access is provided to the RAN-sharing operators, this cost is incurred. Relative to the counterfactual of liberalising in the hands of the incumbents, we only incur the cost of additional infrastructure – as an additional cost – when there is no market solution.

A7.213 By imposing access, spectrum liberalisation may be delayed by up to 6 months (as we would want the access agreement in place before liberalising the spectrum). In these outcomes, it is not profitable for a single operator to provide high quality mobile broadband using 2100MHz spectrum. Therefore, in the event of a delay, high quality mobile broadband is delayed. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.214 The tables below show the costs and benefits that arise from imposing regulated access in the high significance scenario.

7.214.1 The first table sets out the names of the costs and benefits which apply under each commercial outcome, as they appear in the Net Benefits model.

7.214.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each commercial outcome.

Table 29: Regulated Access – description of costs and benefits in the high significance scenario

Regulated access - High significance			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition	benefit_competition_4_to_5* (1-probability_regulated_access_ineffective)		benefit_competition_2_to_5* (1-probability_regulated_access_ineffective)
Productive efficiency of provision of service			
Cost of bringing forward low freq. network investment			
Incremental cost of future clearance			
Cost of release			
Incremental cost of forced release (vs comm. release)			
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay
Cost of setting up access agreement	cost_reg_access_agreement	cost_inc_reg_access_agreement	cost_reg_access_agreement
Additional infrastructure for roaming traffic			cost_additional_infrastructure_high
Cost of disruption			

Table 30: Regulated Access – costs and benefits in the high significance scenario

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition	20		140	60		375	110		700
Productive efficiency of provision of service									
Cost of bringing forward low freq. network investment									
Incremental cost of future clearance									
Cost of release									
Incremental cost of forced release (vs comm. release)									
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services	-90	-90	-90	-25	-25	-45	0	0	0
Cost of setting up access agreement	-10	-3	-10	-5	-1	-5	-1	0	-1
Additional infrastructure for roaming traffic			-190			-170			-140
Cost of disruption									
Net benefit / cost	-80	-90	-150	30	-25	160	100	0	550

Medium significance

If only the RAN shared 2100MHz operators are able to match

A7.215 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 31: Regulated access: medium significance scenario (no market solution: NMS) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. One operator provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.
RAN sharing 2100MHz operators	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Single 2100MHz operator	Unable to compete in the interim period, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Number of operators	4	5

A7.216 If the market provides wider access in the form of a commercial trade:

Table 32: Regulated access: medium significance scenario (market solution – trade: MS/T) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 1 block of 900MHz spectrum between them.	Deploy own UMTS900 networks. Trade 1 block of 900MHz spectrum commercially. One operator is required to provide access to the single 2100MHz operator.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Does not match in interim, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Intervention gives operator access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	4	5

A7.217 If the market provides wider access in the form of commercial access:

Table 33: Regulated access: medium significance scenario (market solution – access: MS/A) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. One operator provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

A7.218 In the medium significance scenario, where only the RAN sharing 2100MHz operators are able to match, mandating access increases the number of players in the market compared to the counterfactual where either one block is commercially traded, or there is no market solution. In these outcomes, the single 2100MHz operator that cannot match in the counterfactual (liberalisation in the hands of the incumbents) now provides a higher quality mobile broadband service via regulated access to an incumbent's UMTS900 network. There are productive efficiency benefits arising from regulated access if there is not a market solution, as the RAN shared operator no longer rolls out at 2100MHz compared to liberalising in the hands of the incumbents. When a 2100MHz operator who would not have matched now gets access to a 900MHz network, there is no efficiency benefit; in this case it is a pure competition benefit.

A7.219 We discount the benefits of intervention by the probability that regulated access is ineffective. If regulated access is ineffective then we revert to the counterfactual (liberalisation in the hands of the incumbents) as the market solution (if any) is not disrupted. As such, there is no productive inefficiency or reduction in competition as a result of regulated access being ineffective if there is an appropriate market solution. But there is a significant loss if no market solution occurs.

A7.220 The cost of setting up a regulated access agreement applies in all three outcomes. However, if commercial access is granted, then much of this cost is incurred anyway. We only include the incremental cost of a regulated access agreement, over the cost of setting up a commercial access agreement.

A7.221 The cost of additional infrastructure for roaming traffic only applies when an incumbent 900MHz operator provides access to more than one operator. Therefore, when access is provided to the RAN-sharing operators, this cost is incurred. Relative to the counterfactual of liberalising in the hands of the incumbents, we only incur the cost of additional infrastructure – as an additional cost – when there is no market solution.

A7.222 By imposing access, spectrum liberalisation may be delayed by up to 6 months (as we would want the access agreement in place before liberalising the spectrum). In these outcomes, it is not profitable for a single operator to provide high quality mobile broadband using 2100MHz. Therefore, in the event of a delay, high quality mobile broadband is delayed.[33] In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.223 The tables below show the costs and benefits that arise from imposing regulated access in the medium significance scenario when only the RAN shared network can match.

7.223.1 The first table sets out the names of the costs and benefits which apply under each commercial outcome, as they appear in the Net Benefits model.

7.223.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each commercial outcome.

[33] We note that this excludes the possibility of a partial rollout, as our analysis is stylised to consider the extreme outcomes, for reasons outlined in section 5.

Table 34: Regulated Access – costs and benefits in the medium significance scenario when only the RAN shared network can match

Regulated access - Medium significance (when only RAN-shared 2100 operators can match)			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition	benefit_competition_4_to_5* (1-probability_regulated_access_ineffective)		benefit_competition_4_to_5* (1-probability_regulated_access_ineffective)
Productive efficiency of provision of service			(benefit_eff_no_2100_RANsh_medB)* (1-probability_regulated_access_ineffective)
Cost of bringing forward low freq. network investment			
Incremental cost of future clearance			
Cost of release			
Incremental cost of forced release (vs comm. release)			
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay
Cost of setting up access agreement	cost_reg_access_agreement	cost_inc_reg_access_agreement	cost_reg_access_agreement
Additional infrastructure for roaming traffic			cost_additional_infrastructure_medium_B
Cost of disruption			

Table 35: Regulated Access – costs and benefits in the medium significance scenario when only the RAN shared network can match

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition	20		20	60		60	110		110
Productive efficiency of provision of service			240			425			625
Cost of bringing forward low freq. network investment									
Incremental cost of future clearance									
Cost of release									
Incremental cost of forced release (vs comm. release)									
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services	-90	-90	-90	-25	-25	-45	0	0	0
Cost of setting up access agreement	-10	-3	-10	-5	-1	-5	-1	0	-1
Additional infrastructure for roaming traffic			-170			-160			-140
Cost of disruption									
Net benefit / cost	-80	-90	-10	30	-25	275	100	0	575

If both the single and RAN shared 2100MHz operators are able to match

A7.224 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 36: Regulated access: medium significance scenario (no market solution: NMS) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.
RAN sharing 2100MHz operators	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Single 2100MHz operator	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

A7.225 If the market provides wider access in the form of a commercial trade:

Table 37: Regulated access: medium significance scenario (market solution – trade: MS/T) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 1 blocks of 900MHz spectrum between them.	Deploy own UMTS900 networks. Trade 1 block of 900MHz commercially. One is required to provide access to the single 2100MHz operator.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Policy gives operator access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

A7.226 If the market provides wider access in the form of commercial access:

Table 38: Regulated access: medium significance scenario (market solution – access: MS/A) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

A7.227 In the medium significance scenario, where all 2100MHz operators are able to match, mandating access does not increase the number of players in the market, as all are already able to compete using 2100MHz. There are productive efficiency benefits arising from regulated access; in the cases where 2100MHz operators would have matched using 2100MHz spectrum, they now get access to the incumbents' 900MHz networks.

A7.228 We discount the benefits of intervention by the probability that regulated access is ineffective. If regulated access is ineffective then we revert to the counterfactual (liberalisation in the hands of the incumbents) as the market solution (if any) is not disrupted. As such, there is no productive inefficiency as a result of regulated access being ineffective if there is an appropriate market solution.

A7.229 The cost of setting up a regulated access agreement applies in all three outcomes. However, if commercial access is granted, then much of this cost is incurred anyway. We only include the incremental cost of a regulated access agreement, over the cost of setting up a commercial access agreement.

A7.230 The cost of additional infrastructure for roaming traffic only applies when an incumbent 900MHz operator provides access to more than one operator. Therefore, when access is provided to the RAN-sharing operators, this cost is incurred. Relative to the counterfactual of liberalising in the hands of the incumbents, we only incur the cost of additional infrastructure – as an additional cost – when there is no market solution.

A7.231 By imposing access, spectrum liberalisation may be delayed by up to 6 months (as we would want the access agreement in place before liberalising the spectrum). In these outcomes, it is profitable for a single operator to provide higher quality mobile broadband using 2100MHz spectrum. Therefore, in the event of a delay, the 900MHz operators will continue their deployment at 2100MHz for longer, deploying 900MHz spectrum slightly later. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted.

A7.232 The tables below show the costs and benefits that arise from imposing access in the medium significance scenario when all 2100MHz operators can match.

7.232.1 The first table sets out the names of the costs and benefits which apply under each commercial outcome, as they appear in the Net Benefits model.

7.232.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each commercial outcome.

Table 39: Regulated Access – description of costs and benefits in the medium significance scenario (when both the single operator and RAN shared network can match)

Regulated access - Medium significance (when both single and RAN-shared 2100 operators can match)			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			
Productive efficiency of provision of service	benefit_eff_no_2100_single_medA* (1-probability_regulated_access_ineffective)		(benefit_eff_no_2100_single_medA+ benefit_eff_no_2100_RANsh_medA)* (1-probability_regulated_access_ineffective)
Cost of bringing forward low freq. network investment			
Incremental cost of future clearance			
Cost of release			
Incremental cost of forced release (vs comm. release)			
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency	cost_efficiency_delay* (1-cost_reduction_efficiency_delay)	cost_efficiency_delay* (1-cost_reduction_efficiency_delay)	cost_efficiency_delay
Delay to liberalisation - launch of services			
Cost of setting up access agreement	cost_reg_access_agreement	cost_inc_reg_access_agreement	cost_reg_access_agreement
Additional infrastructure for roaming traffic			cost_additional_infrastructure_medium_A
Cost of disruption			

Table 40: Regulated Access – costs and benefits in the medium significance scenario (when both the single operator and RAN shared network can match)

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition									
Productive efficiency of provision of service	80		190	170		425	300		725
Cost of bringing forward low freq. network investment									
Incremental cost of future clearance									
Cost of release									
Incremental cost of forced release (vs comm. release)									
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency	-170	-170	-170	-45	-45	-90	0	0	0
Delay to liberalisation - launch of services									
Cost of setting up access agreement	-10	-3	-10	-5	-1	-5	-1	0	-1
Additional infrastructure for roaming traffic			-170			-160			-140
Cost of disruption									
Net benefit / cost	-100	-170	-160	120	-45	170	300	0	575

Low significance

A7.233 In the low significance scenario, it is optimal for the 900MHz spectrum to remain in its existing use, and for any improved mobile broadband services to be deployed using higher frequency (2100MHz) spectrum. As a result, the market solution outcomes are assumed not to occur. The analysis for the different commercial outcomes (commercial trade, commercial access, no market solution) is therefore the same in the low significance scenario.

A7.234 As with all our options for intervention, it is not clear what the true market outcome will be at the time of deciding on our preferred policy option. Whilst it is clear that regulated access would not ultimately take place in the low significance scenario, a proportion of some of the costs of regulated access would still be incurred prior to it becoming clear that 900MHz spectrum is not important, and the intervention being aborted.

A7.235 If we impose access, we would need to set up an access agreement. This process would commence prior to it becoming clear that we are in the low significance scenario, so a proportion of the costs of setting up an agreement would be incurred before we abort the intervention. No other costs or benefits would be incurred relative to liberalising the spectrum in the hands of the incumbent operators.

A7.236 The tables below show the costs and benefits that arise from imposing access in the low significance scenario.

7.236.1 The first table sets out the names of the costs and benefits which apply under each commercial outcome, as they appear in the Net Benefits model.

7.236.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each commercial outcome.

Table 41: Regulated Access – description of costs and benefits in the low significance scenario

Regulated access - Low significance			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			
Productive efficiency of provision of service			
Cost of bringing forward low freq. network investment			
Incremental cost of future clearance			
Cost of release			
Incremental cost of forced release (vs comm. release)			
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services			
Cost of setting up access agreement	cost_reg_access_agreement* cost_access_aborted_proportion	cost_reg_access_agreement* cost_access_aborted_proportion	cost_reg_access_agreement* cost_access_aborted_proportion
Additional infrastructure for roaming traffic			
Cost of disruption			

Table 42: Regulated Access – costs and benefits in the low significance scenario

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition									
Productive efficiency of provision of service									
Cost of bringing forward low freq. network investment									
Incremental cost of future clearance									
Cost of release									
Incremental cost of forced release (vs comm. release)									
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services									
Cost of setting up access agreement	-10	-10	-10	-3	-3	-3	0	0	0
Additional infrastructure for roaming traffic									
Cost of disruption									
Net benefit / cost	-10	-10	-10	-3	-3	-3	0	0	0

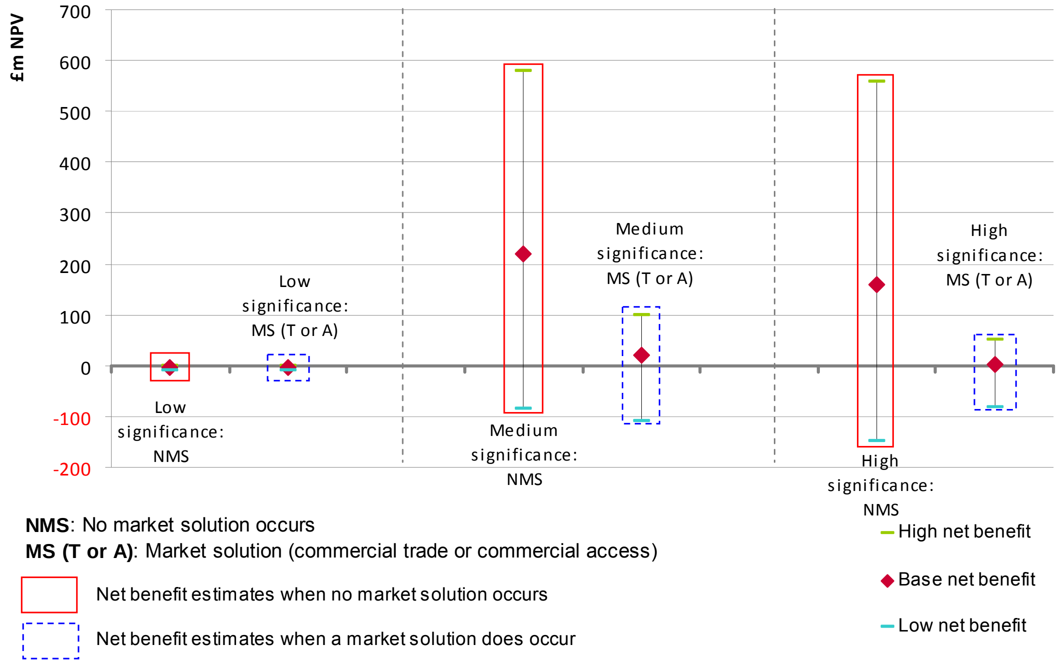
Summary of net benefits under each outcome

A7.237 The table and diagram below present the summary results for regulated access, on a total welfare basis.

Table 43: Regulated Access – summary of net benefits under each outcome

Significance scenario:	**Low significance**		**Medium significance**		**High significance**	
Commercial outcome:	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**
Low net benefit	-10	-10	-80	-110	-150	-80
Base net benefit	-3	-3	220	20	160	2
High net benefit	0	0	575	100	550	50

Figure 9: Regulated Access – summary of net benefits under each outcome



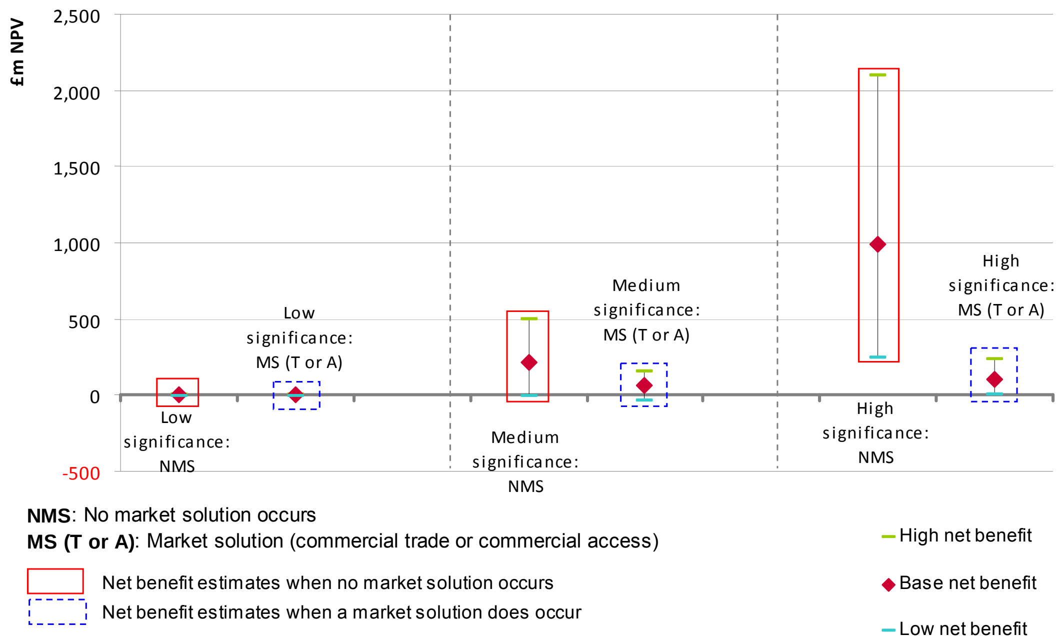
Summary of net benefits under each outcome (consumer surplus only)

A7.238 The table and diagram below present the summary results for regulated access, on a consumer surplus basis.

Table 44: Regulated Access – summary of net benefits under each outcome (consumer surplus only)

Significance scenario:	Low significance		Medium significance		High significance	
Commercial outcome:	No market solution	Market solution (trade or access)	No market solution	Market solution (trade or access)	No market solution	Market solution (trade or access)
Low net benefit	-5	-5	-2	-35	250	-1
Base net benefit	-1	-1	220	60	1,000	110
High net benefit	0	0	500	150	2,100	240

Figure 10: Regulated Access – summary of net benefits under each outcome (consumer surplus only)



Disruption of commercial outcomes

A7.239 We have also considered the costs and benefits where our intervention disrupts any commercial outcomes that would occur under liberalisation in the hands of the incumbents.

7.239.1 We only consider cases where an intervention disrupts a different commercial outcome (e.g. regulated access disrupts a commercial trade, or forced release disrupts commercial access). We do not think it is plausible that regulated access will disrupt a commercial access agreement.

7.239.2 Therefore, in the outcomes where commercial access is granted, or no market solution emerges, the analysis is the same. It is only where a block is commercially traded that we need to consider what happens when our intervention – in this case, regulated access – disrupts the market solution.

A7.240 As we assume that regulated access disrupts (i.e. prevents) a commercial trade, we need to explicitly consider the effects of our intervention when access is not effective. When we considered the costs and benefits in the ‘non-disrupt’ case, we applied a probability to the benefits to reflect the risk of regulatory failure. But now, in the ‘does disrupt’ case, the market solution (trade) no longer exists, so we could be in a situation of being worse off than before the intervention in some outcomes.

A7.241 The main differences compared to the non-disrupt analysis are:

7.241.1 900MHz operators no longer incur the costs of clearing a block of 900MHz spectrum for the commercial trade.

7.241.2 The RAN shared operators, which would have acquired commercially traded block now competes via access to an incumbent's 900MHz network, delaying their own investment in a low frequency network until 800MHz spectrum is available.

7.241.3 One of the 900MHz operators must invest in additional infrastructure in order to carry the RAN sharing operators' traffic in addition to its own.

7.241.4 When access fails in the non-disruption case, we revert to the counterfactual (as the market solution still occurs), and therefore there was no cost associated with failure (just a discount on the benefits). Now, we disrupt the commercial outcome so if access were to fail, the result could be less competition, increased productive inefficiency, or both, compared to the counterfactual.

Table 45: Regulated access: high significance scenario (MS/T) (commercial outcome disrupted by intervention)

	Counterfactual	Factual – regulated access is successful	Factual – regulated access fails
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 1 block of 900MHz spectrum between them.	Deploy own UMTS900 networks. Trade disrupted. One is required to provide access to the single 2100MHz operator; the other required to provide access to the RAN-sharing operators.	Deploy own UMTS900 networks. Trade disrupted. One is required to provide access to the single 2100MHz operator; the other required to provide access to the RAN-sharing operators.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Intervention gives operator access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Unable to compete via access. Does not match in interim. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Single 2100MHz operator	Does not match in interim, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Intervention gives operator access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Unable to compete via access. Does not match in interim. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	4	5	2

Table 46: Regulated access: medium significance scenario (MS/T) (when only the RAN shared 2100MHz operators are able to match) (commercial outcome disrupted by intervention)

	Counterfactual	Factual – regulated access is successful	Factual – regulated access fails
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 1 block of 900MHz spectrum between them.	Deploy own UMTS900 networks. Trade disrupted. One is required to provide access to the single 2100MHz operator; the other required to provide access to the RAN-sharing operators.	Deploy own UMTS900 networks. Trade disrupted. One is required to provide access to the single 2100MHz operator; the other required to provide access to the RAN-sharing operators.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Intervention gives operator access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Unable to compete via access. Matches using UMTS2100. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Single 2100MHz operator	Does not match in interim, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Intervention gives operator access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Unable to compete via access. Does not match in interim. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	4	5	4

Table 47: Regulated access: medium significance scenario (MS/T) (when both the single and RAN shared 2100MHz operators are able to match) (commercial outcome disrupted by intervention)

	Counterfactual	Factual – regulated access is successful	Factual – regulated access fails
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 1 block of 900MHz spectrum between them.	Deploy own UMTS900 networks. Trade disrupted. One is required to provide access to the single 2100MHz operator; the other required to provide access to the RAN-sharing operators.	Deploy own UMTS900 networks. Trade disrupted. One is required to provide access to the single 2100MHz operator; the other required to provide access to the RAN-sharing operators.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Intervention gives operator access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Unable to compete via access. Matches using UMTS2100. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Single 2100MHz operator	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Intervention gives operator access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Unable to compete via access. Matches using UMTS2100. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5	5

Low significance (MS/T)

A7.242 As the commercial trade never actually takes place, and as we abort our intervention, the cost and benefits do not change under a disruption assumption.

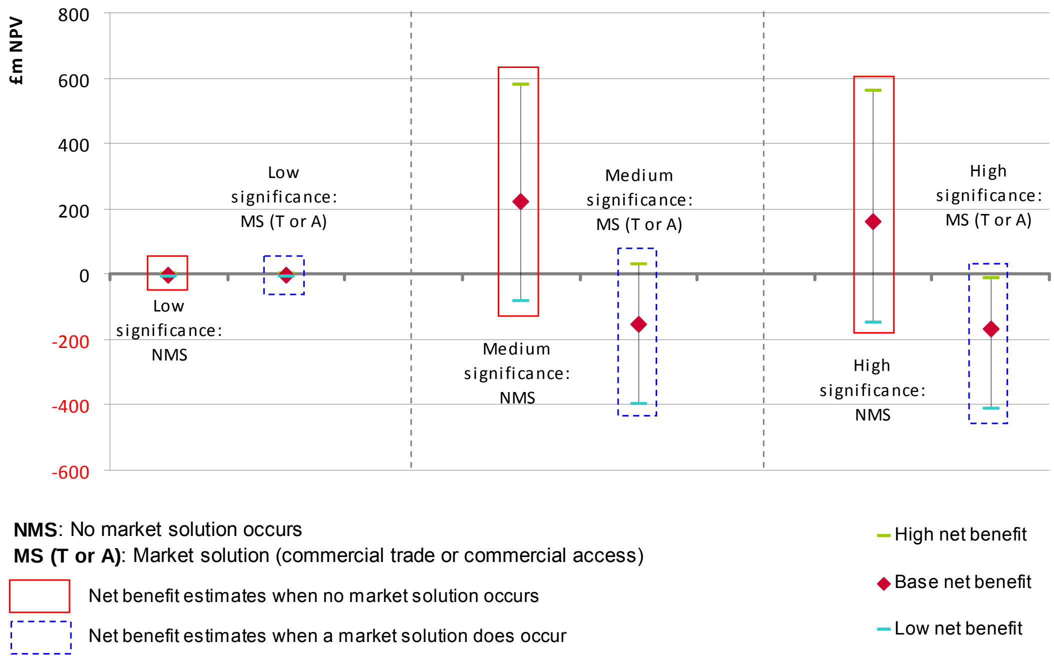
Summary of costs and benefits under each outcome

A7.243 The table and diagram below present the summary results for regulated access when the market solution is disrupted, on a total welfare basis.

Table 48: Regulated Access – summary of net benefits under each outcome when intervention disrupts market solution

Significance scenario:	**Low significance**		**Medium significance**		**High significance**	
Commercial outcome:	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**
Low net benefit	-10	-10	-80	-400	-150	-400
Base net benefit	-3	-3	220	-150	160	-170
High net benefit	0	0	575	30	550	-15

Figure 11: Regulated Access – summary of net benefits under each outcome when intervention disrupts market solution



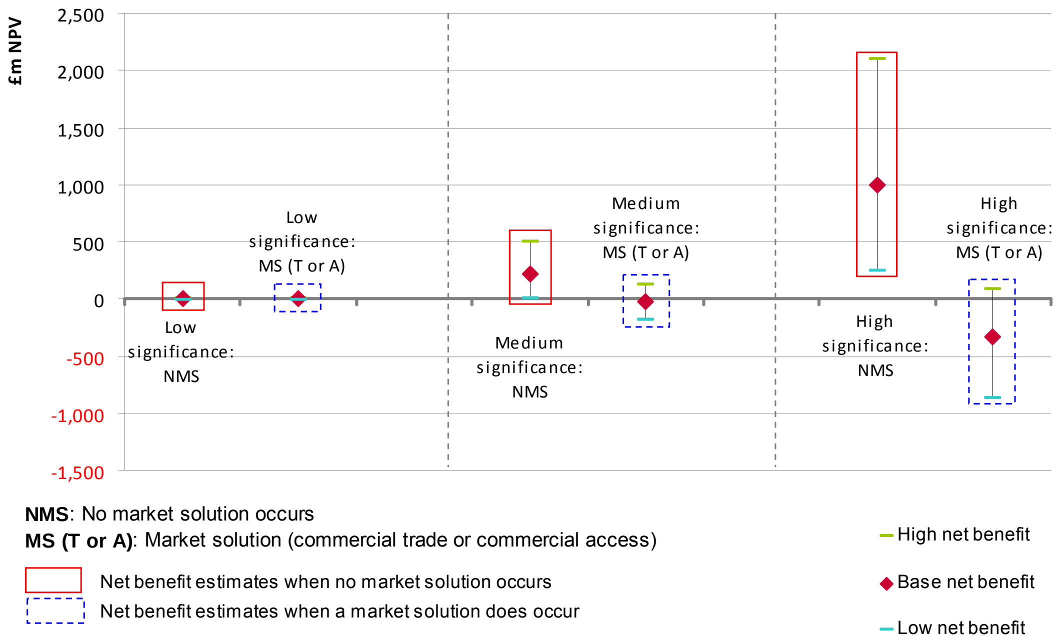
Summary of net benefits under each outcome when intervention disrupts the market solution (consumer surplus only)

A7.244 The table and diagram below present the summary results for regulated access when the market solution is disrupted, on a consumer surplus basis.

Table 49: Regulated Access – summary of net benefits under each outcome when intervention disrupts the market solution (consumer surplus only)

Significance scenario:	Low significance		Medium significance		High significance	
Commercial outcome:	No market solution	Market solution (trade or access)	No market solution	Market solution (trade or access)	No market solution	Market solution (trade or access)
Low net benefit	-5	-5	-2	-180	250	-850
Base net benefit	-1	-1	220	-25	1,000	-325
High net benefit	0	0	500	120	2,100	80

Figure 12: Regulated Access – summary of net benefits under each outcome when intervention disrupts the market solution (consumer surplus only)



Partial spectrum release – 1 block

A7.245 One block release requires 2x5MHz of spectrum to be released alongside liberalisation of the remainder of the 900MHz spectrum. The released spectrum would be liberalised and re-awarded, and the existing holders of 900MHz would not be able to reacquire this spectrum.

A7.246 In order to assess the costs and benefits of this policy we need to make assumptions about whether the released block of 900MHz spectrum is acquired by a single 2100MHz operator or RAN sharing operators . As discussed in section 5, in order to be consistent with the results from our quantitative analysis, we have assumed that the first released block is acquired by RAN sharing operators. While we think this is a plausible outcome, the use of this assumption does not imply that we think sharing is the most likely outcome, merely that it is the appropriate assumption for us to use in our quantitative net benefits analysis.

A7.247 We now detail the factual and counterfactuals used for each of the outcomes to evaluate the costs and benefits of 1 block release relative to liberalisation in the hands of the incumbents.

High significance

A7.248 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 50: Partial release – 1 block: high significance scenario (no market solution: NMS)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. Forced release of 1 block of 900MHz spectrum.
RAN sharing 2100MHz operators	Unable to compete in the interim period, but deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Does not match in interim, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Does not match. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	2	4

A7.249 If the market provides wider access in the form of a commercial trade:

Table 51: Partial release – 1 block: high significance scenario (market solution – trade: MS/T)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 1 block of 900MHz spectrum between them.	Deploy own UMTS900 networks. Forced release of 1 block of 900MHz spectrum.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Does not match in interim, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Does not match in interim. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	4	4

A7.250 If the market provides wider access in the form of commercial access:

Table 52: Partial release – 1 block: high significance scenario (market solution – access: MS/A)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Forced release of 1 block of 900MHz. Access is provided to remaining 2100MHz operators.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

A7.251 In the high significance scenario, 1 block release results in an increase in the number of market players in the outcome where there is no market solution. The RAN sharing 2100MHz operators obtain the block and use it to provide higher quality mobile broadband. As the RAN sharing 2100MHz operators are two separate competing retail operators the level of competition is assumed to increase from two to four players during the interim period.

A7.252 Where commercial access or no market solution takes place, mandating 1 block release results in a productive inefficiency as the RAN sharing

2100MHz operators now deploy a low frequency network earlier (using 900MHz instead of 800MHz).

A7.253 In the outcomes where commercial access or no market solution occurs in the counterfactual, the full costs of forced release (1 block) are imposed on the 900MHz operators, as well as the incremental cost of future clearance.

A7.254 Where a commercial trade occurs in the counterfactual, only the incremental costs of forced release (1 block), relative to commercial release, are imposed by the intervention. The incremental costs of future clearance are incurred in the counterfactual.

A7.255 Mandating the release of 1 block also results in a delay to when the 900MHz operators can make use of liberalised spectrum (up to 6 months). In the high significance scenario, it is not profitable for these operators to continue deploying 2100MHz during this period. Therefore, in the event of delay, high quality mobile broadband is delayed. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.256 In the outcome where commercial access would have been offered in the counterfactual, the RAN sharing 2100MHz operators would have used this to compete, imposing additional infrastructure costs on the 900MHz operator carrying their traffic. As a result of 1 block release, only the single 2100MHz operator relies on commercial access as the RAN sharing 2100MHz operators acquire the released block of 900MHz. Hence, the additional infrastructure costs are avoided.

A7.257 The tables below show the costs and benefits that arise from mandating release of 1 block in the high significance scenario.

7.257.1 The first table sets out the names of the costs and benefits which apply under each commercial outcome, as they appear in the Net Benefits model.

7.257.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each commercial outcome.

Table 53: Partial release – 1 block – description of costs and benefits in the high significance scenario

1 block release - High significance			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			benefit_competition_2_to_4
Productive efficiency of provision of service			
Cost of bringing forward low freq. network investment		cost_ineff_earlier_low_freq_RANsh_high	cost_ineff_earlier_low_freq_RANsh_high
Incremental cost of future clearance		cost_inc_future_clearance_cost_1	cost_inc_future_clearance_cost_1
Cost of release		cost_forced_release_1	cost_forced_release_1
Incremental cost of forced release (vs comm. release)	cost_inc_cost_forced_release_1		
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay
Cost of setting up access agreement			
Additional infrastructure for roaming traffic		benefit_avoid_additional_infrastructure_high	
Cost of disruption			

Table 54: Partial release – 1 block – costs and benefits in the high significance scenario

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition			375			625			875
Productive efficiency of provision of service									
Cost of bringing forward low freq. network investment		20	20		-25	-25		-60	-60
Incremental cost of future clearance		-60	-60		-45	-45		-30	-30
Cost of release		-90	-90		-80	-80		-60	-60
Incremental cost of forced release (vs comm. release)	-10			-10			-5		
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services	-90	-90	-90	-25	-25	-45	0	0	0
Cost of setting up access agreement									
Additional infrastructure for roaming traffic		140			170			190	
Cost of disruption									
Net benefit / cost	-100	-80	160	-30	-10	425	-5	40	725

Medium significance

<u>If only the RAN shared 2100MHz operators are able to match</u>

A7.258 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 55: Partial release – 1 block: medium significance scenario (no market solution: NMS) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. Forced release of 1 block of 900MHz spectrum.
RAN sharing 2100MHz operators	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Does not match in interim, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Does not match. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	4	4

A7.259 If the market provides wider access in the form of a commercial trade:

Table 56: Partial release – 1 block: medium significance scenario (market solution – trade: MS/T) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 1 block of 900MHz spectrum between them.	Deploy own UMTS900 networks. Forced release of 1 block of 900MHz spectrum.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Does not match in interim, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Does not match in interim. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	4	4

A7.260 If the market provides wider access in the form of commercial access:

Table 57: Partial release – 1 block: medium significance scenario (market solution – access: MS/A) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Forced release of 1 block of 900MHz spectrum. Access is provided to remaining 2100MHz operators.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

A7.261 In the three outcomes above, there are no changes in the number of players in the market, and hence there are no competition effects as a result of imposing 1 block release in the medium significance scenario when only the RAN sharing 2100MHz operators are able to match.

A7.262 If no market solution occurs, a productive efficiency benefit arises from mandating 1 block release as the RAN sharing 2100MHz operators would have matched in the interim using 2100MHz spectrum in the counterfactual, but now acquire the released block and deploy a 900MHz network.

A7.263 If spectrum is traded commercially in the counterfactual, then there are no productive efficiency benefits as there is no change in the way the RAN sharing 2100MHz operators provide high quality mobile broadband services.

A7.264 If commercial access is granted, mandating 1 block release results in a productive efficiency loss as the RAN sharing 2100MHz operators now deploy a low frequency network earlier (using 900MHz spectrum instead of relying on access in the interim and then deploying using 800MHz spectrum).

A7.265 In the outcomes where commercial access or no market solution occurs in the counterfactual, the full costs of forced release (1 block) are imposed on the 900MHz operators, as well as the incremental cost of future clearance.

A7.266 Where a commercial trade occurs in the counterfactual, only the incremental costs of forced release (1 block), relative to commercial release, are imposed by the intervention. The incremental costs of future clearance are incurred in the counterfactual.

A7.267 Mandating the release of 1 block also results in a delay to when the 900MHz operators can make use of liberalised spectrum (up to 6 months). In these outcomes, it is not profitable for these operators to continue deploying

2100MHz during this period. Therefore, in the event of delay, high quality mobile broadband is delayed. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.268 In the outcome where commercial access would have been offered in the counterfactual, the RAN sharing 2100MHz operators would have used this to compete, imposing additional infrastructure costs on the 900MHz operator carrying their traffic. As a result of 1 block release, only the single 2100MHz operator relies on commercial access as the RAN sharing 2100MHz operators acquire the released block of 900MHz. Hence, the additional infrastructure costs are avoided.

A7.269 The tables below show the costs and benefits that arise from mandating 1 block release in the medium significance scenario (when only the RAN shared 2100MHz operators are able to match):

7.269.1 The first table sets out the names of the costs and benefits which apply under each outcome, as they appear in the Net Benefits model.

7.269.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each commercial outcome.

Table 58: Partial release – 1 block – description of costs and benefits in the medium significance scenario (when only the RAN shared 2100MHz operators are able to match)

1 block release - Medium significance (when only RAN-shared 2100 operators can match)

Cost / Benefit	Market solution - trade	Market solution - access	No market solution
Level of competition			
Productive efficiency of provision of service			benefit_eff_no_2100_but_earlier_low_freq_RANsh_medB
Cost of bringing forward low freq. network investment		cost_ineff_earlier_low_freq_RANsh_medB	
Incremental cost of future clearance		cost_inc_future_clearance_cost_1	cost_inc_future_clearance_cost_1
Cost of release		cost_forced_release_1	cost_forced_release_1
Incremental cost of forced release (vs comm. release)	cost_inc_cost_forced_release_1		
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay
Cost of setting up access agreement			
Additional infrastructure for roaming traffic		benefit_avoid_additional_infrastructure_medium_B	
Cost of disruption			

Table 59: Partial release – 1 block – costs and benefits in the medium significance scenario (when only the RAN shared 2100MHz operators are able to match)

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition									
Productive efficiency of provision of service			750			800			850
Cost of bringing forward low freq. network investment		-35			-35			-35	
Incremental cost of future clearance		-60	-60		-45	-45		-30	-30
Cost of release		-90	-90		-80	-80		-60	-60
Incremental cost of forced release (vs comm. release)	-10			-10			-5		
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services	-90	-90	-90	-25	-25	-45	0	0	0
Cost of setting up access agreement									
Additional infrastructure for roaming traffic		140			160			170	
Cost of disruption									
Net benefit / cost	-100	-130	525	-30	-30	625	-5	45	750

<u>If both the single and RAN shared 2100MHz operators are able to match</u>

A7.270 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 60: Partial release – 1 block: medium significance scenario (no market solution: NMS) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. Forced release of 1 block of 900MHz.
RAN sharing 2100MHz operators	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

A7.271 If the market provides wider access in the form of a commercial trade:

Table 61: Partial release – 1 block: medium significance scenario (market solution – trade: MS/T) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 1 block of 900MHz spectrum between them.	Deploy own UMTS900 networks. Forced release of 1 block of 900MHz spectrum.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

A7.272 If the market provides wider access in the form of commercial access:

Table 62: Partial release – 1 block: medium significance scenario (market solution – access: MS/A) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Forced release of 1 block of 900MHz spectrum. Access is provided to remaining 2100MHz operators.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Access to 900MHz network for interim period. Deploys low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

A7.273 In each of the three outcomes above, there is no change in the number of players in the market, and hence there are no competition effects as a result of imposing 1 block release in the medium significance scenario when both the single and RAN sharing 2100MHz operators are able to match.

A7.274 If no market solution occurs, a productive efficiency benefit arises from mandating 1 block release as the RAN sharing 2100MHz operators would have matched in the interim using 2100MHz spectrum in the counterfactual, but now acquire the released block and deploy a 900MHz network.

A7.275 If spectrum is traded commercially in the counterfactual, then there are no productive efficiency benefits as there is no change in the way the 2100MHz operators provide high quality mobile broadband services.

A7.276 If commercial access is granted, mandating 1 block release results in a productive efficiency loss as the RAN sharing 2100MHz operators now deploy a low frequency network earlier (using 900MHz spectrum instead of relying on access in the interim and then deploying using 800MHz spectrum).

A7.277 In the outcomes where commercial access or no market solution occurs in the counterfactual, the full costs of forced release (1 block) are imposed on the 900MHz operators, as well as the incremental cost of future clearance.

A7.278 Where a commercial trade occurs in the counterfactual, only the incremental costs of forced release (1 block), relative to commercial release, are imposed by the intervention. The incremental costs of future clearance are incurred in the counterfactual.

A7.279 Mandating the release of 1 block also results in a delay to when the 900MHz operators can make use of liberalised spectrum (up to 6 months). In these outcomes, it is profitable for these operators to continue deploying 2100MHz during this period. Therefore, in the event of delay, the 900MHz operators will continue their deployment at 2100MHz for longer, deploying 900MHz slightly later. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.280 In the outcome where commercial access would have been offered in the counterfactual, the RAN sharing 2100MHz operators would have used this to compete, imposing additional infrastructure costs on the 900MHz operator carrying their traffic. As a result of 1 block release, only the single 2100MHz operator relies on commercial access as the RAN sharing 2100MHz operators acquire the released block of 900MHz. Hence, the additional infrastructure costs are avoided.

A7.281 The tables below show the costs and benefits that arise from mandating partial release of 1 block in the medium significance scenario (when both the single and RAN shared 2100MHz operators are able to match):

7.281.1 The first table sets out the names of the costs and benefits which apply under each commercial outcome, as they appear in the Net Benefits model.

7.281.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each commercial outcome.

Table 63: Partial release – 1 block – description of costs and benefits in the medium significance scenario (when both the single and RAN shared 2100MHz operators are able to match)

1 block release - Medium significance (when both single and RAN-shared 2100 operators can match)			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			
Productive efficiency of provision of service			benefit_eff_no_2100_but_earlier_low_freq_RANsh_medA
Cost of bringing forward low freq. network investment		cost_ineff_earlier_low_freq_RANsh_medA	
Incremental cost of future clearance		cost_inc_future_clearance_cost_1	cost_inc_future_clearance_cost_1
Cost of release		cost_forced_release_1	cost_forced_release_1
Incremental cost of forced release (vs comm. release)	cost_inc_cost_forced_release_1		
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency	cost_efficiency_delay* (1-cost_reduction_efficiency_delay)	cost_efficiency_delay* (1-cost_reduction_efficiency_delay)	cost_efficiency_delay
Delay to liberalisation - launch of services			
Cost of setting up access agreement			
Additional infrastructure for roaming traffic		benefit_avoid_additional_infrastructure_medium_A	
Cost of disruption			

Table 64: Partial release – 1 block – costs and benefits in the medium significance scenario (when both the single and RAN shared 2100MHz operators are able to match)

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition									
Productive efficiency of provision of service			350			475			575
Cost of bringing forward low freq. network investment		-30			-25			-20	
Incremental cost of future clearance		-60	-60		-45	-45		-30	-30
Cost of release		-90	-90		-80	-80		-60	-60
Incremental cost of forced release (vs comm. release)	-10			-10			-5		
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency	-170	-170	-170	-45	-45	-90	0	0	0
Delay to liberalisation - launch of services									
Cost of setting up access agreement									
Additional infrastructure for roaming traffic		140			160			170	
Cost of disruption									
Net benefit / cost	-180	-210	30	-50	-40	250	-5	60	475

Low significance

A7.282 In the low significance scenario, it is optimal for the 900MHz spectrum to remain in its existing use, and for any improved mobile broadband services to be deployed using higher frequency (2100MHz) spectrum. As a result, the market solution outcomes are assumed not to occur. The analysis of the different commercial outcomes (commercial trade, commercial access, no market solution) is therefore the same in the low significance scenario.

A7.283 As with all our options for intervention, it is not clear what the true market outcome will be at the time of deciding on our preferred policy option. While it is unlikely to be efficient for forced release to take place in the low significance scenario, this will not be known until after a proportion of some of the costs of clearing spectrum have been incurred. Hence, if we impose 1 block release the operators will have to begin preparing to allow the block to be cleared and released. However, as explained in the discussion of the costs earlier in this annex, we assume that once it becomes clear that release is not efficient the policy is aborted and hence the full costs of release are not incurred.

A7.284 The tables below show the costs and benefits that arise from mandating 1 block release in the low significance scenario.

7.284.1 The first table sets out the names of the costs and benefits which apply under each commercial outcome, as they appear in the Net Benefits model.

7.284.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each commercial outcome.

Table 65: Partial release – 1 block – description of costs and benefits in the low significance scenario

1 block release - Low significance			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			
Productive efficiency of provision of service			
Cost of bringing forward low freq. network investment			
Incremental cost of future clearance			
Cost of release			
Incremental cost of forced release (vs comm. release)			
Cost of clearance when operators do not ultimately clear	cost_release_aborted_1_block	cost_release_aborted_1_block	cost_release_aborted_1_block
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services			
Cost of setting up access agreement			
Additional infrastructure for roaming traffic			
Cost of disruption			

Table 66: Partial release – 1 block – costs and benefits in the low significance scenario

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition									
Productive efficiency of provision of service									
Cost of bringing forward low freq. network investment									
Incremental cost of future clearance									
Cost of release									
Incremental cost of forced release (vs comm. release)									
Cost of clearance when operators do not ultimately clear	-45	-45	-45	-40	-40	-40	-30	-30	-30
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services									
Cost of setting up access agreement									
Additional infrastructure for roaming traffic									
Cost of disruption									
Net benefit / cost	-45	-45	-45	-40	-40	-40	-30	-30	-30

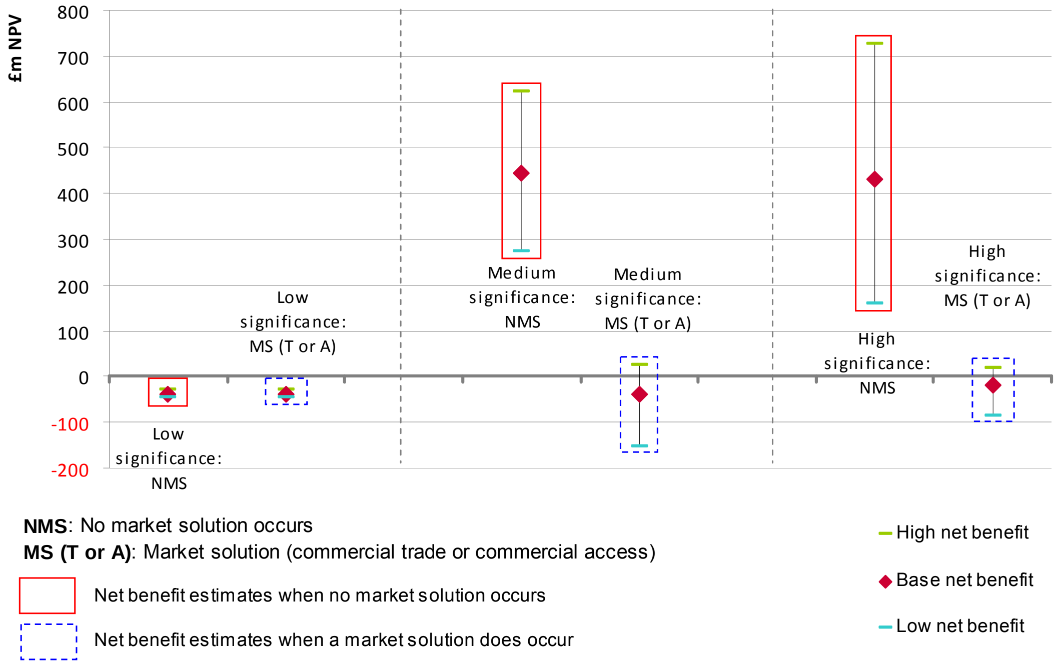
Summary of costs and benefits under each outcome

A7.285 The table and diagram below present the summary results for the mandatory release of 1 block, on a total welfare basis

Table 67: Partial release – 1 block – summary of net benefits under each outcome

Significance scenario:	**Low significance**		**Medium significance**		**High significance**	
Commercial outcome:	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**
Low net benefit	-45	-45	275	-150	160	-90
Base net benefit	-40	-40	450	-40	425	-20
High net benefit	-30	-30	625	25	725	20

Figure 13: Partial release – 1 block – summary of net benefits under each outcome



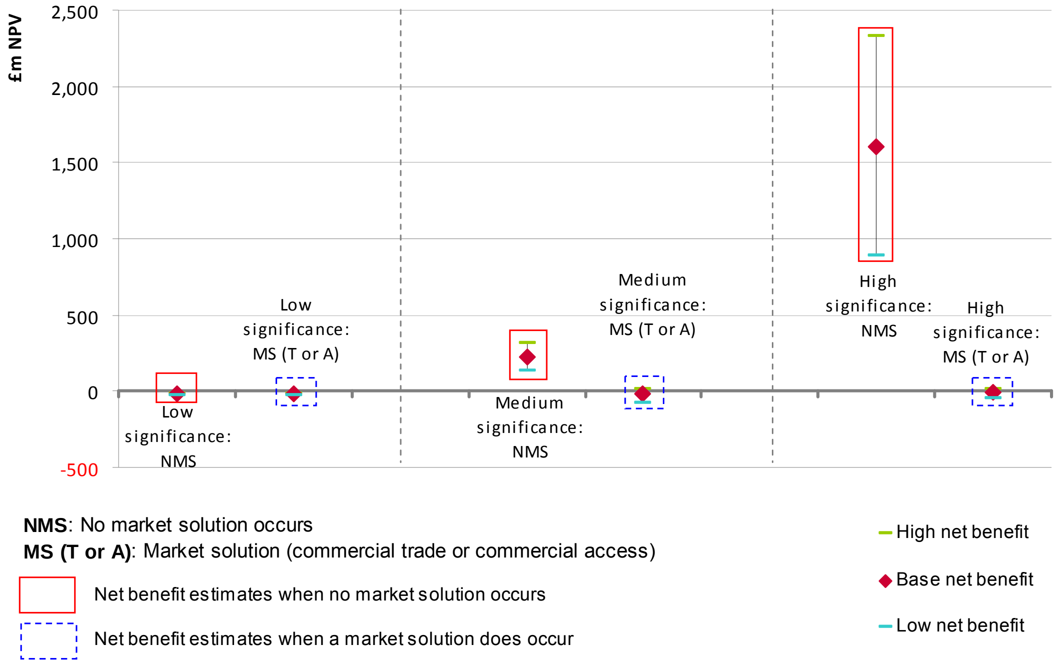
Summary of net benefits under each outcome (consumer surplus only)

Table 68: Partial release – 1 block – summary of net benefits under each outcome (consumer surplus only)

A7.286 The table and diagram below present the summary results for the mandatory release of 1 block, on a consumer surplus basis

Significance scenario:	Low significance		Medium significance		High significance	
Commercial outcome:	No market solution	Market solution (trade or access)	No market solution	Market solution (trade or access)	No market solution	Market solution (trade or access)
Low net benefit	-25	-25	140	-80	900	-45
Base net benefit	-20	-20	220	-20	1,600	-10
High net benefit	-15	-15	300	10	2,300	10

Figure 14: Partial release – 1 block – summary of net benefits under each outcome (consumer surplus only)



Disruption of commercial outcomes

A7.287 We have also considered the costs and benefits where our intervention disrupts any commercial outcomes that would occur under liberalisation in the hands of the incumbents. As with our analysis of regulated access, we only consider cases where an intervention disrupts a different commercial outcome (e.g. regulated access disrupts a commercial trade, or forced release disrupts commercial access).

A7.288 Therefore, in the outcomes where a commercial trade is agreed, or no market solution emerges, the analysis is the same. It is only where commercial access is provided that we need to consider what happens when our intervention – in this case, 1 block release – disrupts the market solution.

A7.289 The main differences compared to the non-disruption analysis are:

7.289.1 If both the single and RAN sharing 2100MHz operators can match using 2100MHz, then disruption results in an efficiency cost, as the single 2100MHz operator now deploys using 2100MHz spectrum in the interim period rather than relying on the commercial access agreement.

7.289.2 If only the RAN sharing 2100MHz operators can match then there is a reduction in competition as a result of disruption. This is because the single 2100MHz operator can no longer gain commercial access to a 900MHz operator's network, and cannot rollout and compete during the interim period.

7.289.3 In the high significance outcome the disruption outcome is the same as the medium significance outcome when only the RAN sharing 2100MHz operators can match.

7.289.4 In the low significance outcome, as commercial access never actually takes place, and as we abort our intervention, the cost and benefits do not change under a disruption assumption.

Table 69: Partial release – 1 block: high significance scenario (MS/A) (commercial outcome disrupted by intervention)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Forced release of 1 block 900MHz spectrum. No access is provided to remaining 2100MHz operators.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Does not match in interim. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	4

Table 70: Partial release – 1 block: medium significance scenario (MS/A) (when only the RAN shared 2100MHz operators are able to match) (commercial outcome disrupted by intervention)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Forced release of 1 block 900MHz spectrum. No access is provided to remaining 2100MHz operators.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Does not match in interim. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	4

Table 71: Partial release – 1 block: medium significance scenario (MS/A) (when both the single and RAN shared 2100MHz operators are able to match) (commercial outcome disrupted by intervention)

	Counterfactual	
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Forced release of 1 block 900MHz spectrum. No access is provided to remaining 2100MHz operators.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Matches using UMTS2100. Deploys a low frequency network later (when 800MHz spectrum becomes available).
Number of operators	5	5

Low significance (MS/A)

A7.290 As commercial access never actually takes place, and as we abort our intervention, the cost and benefits do not change under a disruption assumption.

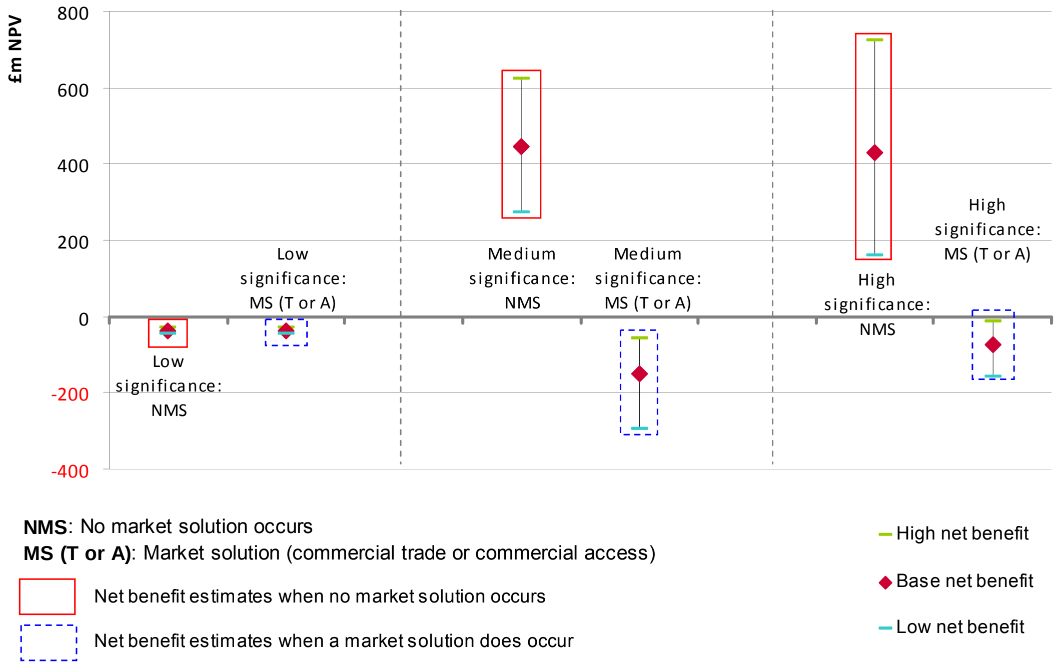
Summary of costs and benefits under each outcome

A7.291 The table and diagram below present the summary results for the mandatory release of 1 block when the market solution is disrupted, on a total welfare basis.

Table 72: Partial release – 1 block – summary of net benefits under each outcome when intervention disrupts market solution

Significance scenario:	**Low significance**		**Medium significance**		**High significance**	
Commercial outcome:	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**
Low net benefit	-45	-45	275	-300	160	-160
Base net benefit	-40	-40	450	-150	425	-70
High net benefit	-30	-30	625	-60	725	-15

Figure 15: Partial release – 1 block – summary of net benefits under each outcome when intervention disrupts market solution



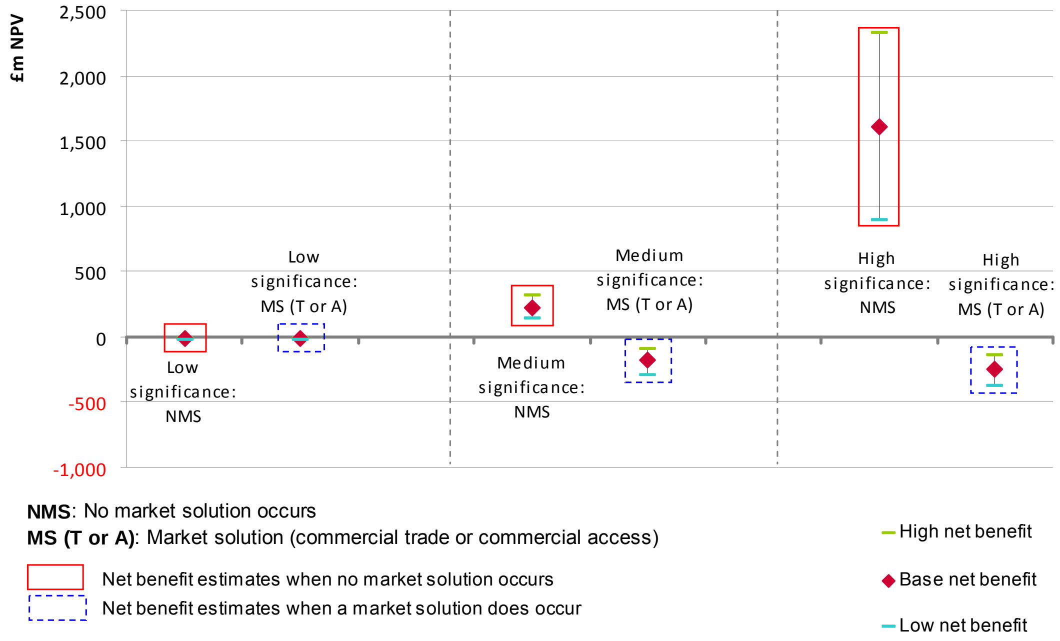
Summary of net benefits under each outcome when intervention disrupts the market solution (consumer surplus only)

A7.292 The table and diagram below present the summary results for the mandatory release of 1 block when the market solution is disrupted, on a consumer surplus basis.

Table 73: Partial release – 1 block – summary of net benefits under each outcome when intervention disrupts the market solution (consumer surplus only)

Significance scenario:	Low significance		Medium significance		High significance	
Commercial outcome:	No market solution	Market solution (trade or access)	No market solution	Market solution (trade or access)	No market solution	Market solution (trade or access)
Low net benefit	-25	-25	140	-300	900	-375
Base net benefit	-20	-20	220	-180	1,600	-250
High net benefit	-15	-15	300	-100	2,300	-140

Figure 16: Partial release – 1 block – summary of net benefits under each outcome when intervention disrupts the market solution (consumer surplus only)



Partial spectrum release – 2 blocks

A7.293 Two block release requires two blocks of spectrum to be released alongside liberalisation of the remainder of the 900MHz spectrum. The released spectrum would be liberalised and re-awarded, and the existing holders of 900MHz would not be able to reacquire this spectrum.

A7.294 The costs and benefits resulting from the release of 2 blocks of 900MHz spectrum depend on which of the 2100MHz operators acquire the released spectrum.

A7.295 As stated previously, we assume that the RAN sharing operators acquire one block (to deploy a shared network, but still operator as two separate retail operators), and a single 2100MHz operator acquires the other block. Also as explained previously, we assume that in the counterfactuals where a commercial trade takes place, two blocks are commercially traded.

A7.296 We now detail the factual and counterfactuals used for each of the outcomes to evaluate the costs and benefits of 2 block release relative to liberalisation in the hands of the incumbents.

High significance

A7.297 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 74: Partial release – 2 blocks: high significance scenario (no market solution: NMS)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Unable to compete in the interim period, but deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Unable to compete in the interim period, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	2	5

A7.298 If the market provides wider access in the form of a commercial trade:

Table 75: Partial release – 2 blocks: high significance scenario (market solution – trade: MS/T)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 2 blocks of 900MHz spectrum between them.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Acquires commercially traded block of 900MHz spectrum, and deploys a UMTS900 network.	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.299 If the market provides wider access in the form of commercial access:

Table 76: Partial release – 2 blocks: high significance scenario (market solution – access: MS/A)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.300 In the high significance scenario, mandating the release of two blocks only results in a competition benefit if there is no market solution in the counterfactual. In this outcome, the intervention increases the number of market players from two to five, as both the single and RAN sharing 2100MHz operators acquire 900MHz spectrum for themselves.

A7.301 If there is no market solution or commercial access is provided in the counterfactual, the 2100MHz operators do not deploy their own networks in the interim period, but do deploy using 800MHz spectrum later. The mandatory release of 2 blocks of 900MHz spectrum results in a cost of bringing forward investment in low frequency networks for both single and RAN shared 2100MHz operators.

A7.302 In the outcomes where commercial access or no market solution occurs in the counterfactual, the full costs of forced release (2 blocks) are imposed on the 900MHz operators, as well as the incremental cost of future clearance.

A7.303 Where a commercial trade occurs in the counterfactual, only the incremental costs of forced release (2 blocks), relative to commercial release, are imposed by the intervention. The incremental costs of future clearance are incurred in the counterfactual.

A7.304 Mandating the release of 2 blocks also results in a delay to when the 900MHz operators can make use of liberalised spectrum (up to 6 months). In these outcomes, it is not profitable for these operators to continue deploying 2100MHz during this period. Therefore, in the event of delay, high quality mobile broadband is delayed. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.305 In the outcome where commercial access would have been offered in the counterfactual, the 2100MHz operators would have used this to compete, imposing additional infrastructure costs on the 900MHz operator carrying their traffic. As a result of 2 block release, none of the 2100MHz operators rely on commercial access, so the additional infrastructure costs are avoided.

A7.306 The tables below show the costs and benefits that arise from mandating the release of 2 blocks in the high significance scenario.

7.306.1 The first table sets out the names of the costs and benefits which apply under each outcome, as they appear in the Net Benefits model.

7.306.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each outcome.

Table 77: Partial release – 2 blocks – description of costs and benefits in the high significance scenario

2 block release - High significance			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			benefit_competition_2_to_5
Productive efficiency of provision of service			
Cost of bringing forward low freq. network investment		cost_ineff_earlier_low_freq_single_high+ cost_ineff_earlier_low_freq_RANsh_high	cost_ineff_earlier_low_freq_single_high+ cost_ineff_earlier_low_freq_RANsh_high
Incremental cost of future clearance		cost_inc_future_clearance_cost_2	cost_inc_future_clearance_cost_2
Cost of release		cost_forced_release_2	cost_forced_release_2
Incremental cost of forced release (vs comm. release)	cost_inc_cost_forced_release_2		
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay
Cost of setting up access agreement			
Additional infrastructure for roaming traffic		benefit_avoid_additional_infrastructure_high	
Cost of disruption	cost_disruption_2_block	cost_disruption_2_block	cost_disruption_2_block

Table 78: Partial release – 2 blocks – costs and benefits in the high significance scenario

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition			450			750			1,000
Productive efficiency of provision of service									
Cost of bringing forward low freq. network investment		35	35		-45	-45		-100	-100
Incremental cost of future clearance		-180	-180		-150	-150		-110	-110
Cost of release		-275	-275		-230	-230		-180	-180
Incremental cost of forced release (vs comm. release)	-30			-25			-15		
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services	-90	-90	-90	-25	-25	-45	0	0	0
Cost of setting up access agreement									
Additional infrastructure for roaming traffic		140			170			190	
Cost of disruption	-25	-25	-25	-15	-15	-15	-3	-3	-3
Net benefit / cost	-140	-400	-80	-60	-300	275	-20	-200	600

Medium significance

If only the RAN shared 2100MHz operators are able to match

A7.307 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 79: Partial release – 2 blocks: medium significance scenario (no market solution: NMS) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Able to match using 2100MHz spectrum in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Unable to compete in the interim period, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	4	5

A7.308 If the market provides wider access in the form of a commercial trade:

Table 80: Partial release – 2 blocks: medium significance scenario (market solution – trade: MS/T) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 2 blocks of 900MHz spectrum between them.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Acquires commercially traded block of 900MHz spectrum, and deploys a UMTS900 network.	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.309 If the market provides wider access in the form of commercial access:

Table 81: Partial release – 2 blocks: medium significance scenario (market solution – access: MS/A) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.310 In the medium significance scenario when only the RAN shared 2100MHz operators are able to match, 2 block mandatory release results in a competition benefit where no market solution emerges. This is because the single 2100MHz operator cannot match using 2100MHz in the counterfactual but can now acquire a block of 900MHz spectrum. In the outcomes where there is a market solution, there are no competition benefits from mandating 2 block release.

A7.311 When no market solution emerges, there is an efficiency benefit as the RAN shared operators – which would have matched using 2100MHz spectrum – now deploy using 900MHz spectrum. This is partially offset, however, by the efficiency cost of the single operator bringing forward the deployment of its low frequency network. It would have deployed 800MHz later, but now deploys 900MHz in 2011/12.

A7.312 In the case where the market would have provided commercial access, there is an efficiency cost of bringing forward investment for both single and RAN sharing 2100MHz operators.

A7.313 In the outcomes where commercial access or no market solution occurs in the counterfactual, the full costs of forced release (2 blocks) are imposed on the 900MHz operators, as well as the incremental cost of future clearance.

A7.314 Where a commercial trade occurs in the counterfactual, only the incremental costs of forced release (2 blocks), relative to commercial release, are imposed by the intervention. The incremental costs of future clearance are incurred in the counterfactual.

A7.315 Mandating the release of 2 blocks also results in a delay to when the 900MHz operators can make use of liberalised spectrum (up to 6 months). In these outcomes, it is not profitable for these operators to continue deploying 2100MHz during this period. Therefore, in the event of delay, high quality mobile broadband is delayed. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.316 In the outcome where commercial access would have been offered in the counterfactual, the 2100MHz operators would have used this to compete, imposing additional infrastructure costs on the 900MHz operator carrying their traffic. As a result of 2 block release, none of the 2100MHz operators rely on commercial access, so the additional infrastructure costs are avoided.

A7.317 The tables below show the costs and benefits that arise from mandating the release of 2 blocks in the medium significance scenario (when only the RAN shared operators can match):

7.317.1 The first table sets out the names of the costs and benefits which apply under each outcome, as they appear in the Net Benefits model.

7.317.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each outcome.

Table 82: Partial release – 2 blocks – description of costs and benefits in the medium significance scenario (when only the RAN shared operators can match)

2 block release - Medium significance (when only RAN-shared 2100 operators can match)			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			benefit_competition_4_to_5
Productive efficiency of provision of service			benefit_eff_no_2100_but_earlier_low_freq_RANsh_medB
Cost of bringing forward low freq. network investment		cost_ineff_earlier_low_freq_single_medB + cost_ineff_earlier_low_freq_RANsh_medB	cost_ineff_earlier_low_freq_single_medB
Incremental cost of future clearance		cost_inc_future_clearance_cost_2	cost_inc_future_clearance_cost_2
Cost of release		cost_forced_release_2	cost_forced_release_2
Incremental cost of forced release (vs comm. release)	cost_inc_cost_forced_release_2		
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay
Cost of setting up access agreement			
Additional infrastructure for roaming traffic		benefit_avoid_additional_infrastructure_medium_B	
Cost of disruption	cost_disruption_2_block	cost_disruption_2_block	cost_disruption_2_block

Table 83: Partial release – 2 blocks – costs and benefits in the medium significance scenario (when only the RAN shared operators can match)

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition			70			110			150
Productive efficiency of provision of service			750			800			850
Cost of bringing forward low freq. network investment		-60	-25		-60	-25		-60	-25
Incremental cost of future clearance		-180	-180		-150	-150		-110	-110
Cost of release		-275	-275		-230	-230		-180	-180
Incremental cost of forced release (vs comm. release)	-30			-25			-15		
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services	-90	-90	-90	-25	-25	-45	0	0	0
Cost of setting up access agreement									
Additional infrastructure for roaming traffic		140			160			170	
Cost of disruption	-25	-25	-25	-15	-15	-15	-3	-3	-3
Net benefit / cost	-140	-500	220	-60	-325	450	-20	-180	675

<u>If both the single and RAN shared 2100MHz operators are able to match</u>

A7.318 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 84: Partial release – 2 blocks: medium significance scenario (no market solution: NMS) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Able to match using 2100MHz spectrum in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Able to match using 2100MHz spectrum in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.319 If the market provides wider access in the form of a commercial trade:

Table 85: Partial release – 2 blocks: medium significance scenario (market solution – trade: MS/T) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 2 blocks of 900MHz spectrum between them.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Acquire commercially traded block of 900MHz spectrum, and deploy a UMTS900 network.	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Acquires commercially traded block of 900MHz spectrum, and deploys a UMTS900 network.	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.320 If the market provides wider access in the form of commercial access:

Table 86: Partial release – 2 blocks: medium significance scenario (market solution – access: MS/A) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.321 In the medium significance scenario when both the single and RAN shared 2100MHz operators are able to match, mandating the release of 2 blocks brings about no competition benefits in these outcomes, because all the 2100MHz operators are able to match (using 2100MHz spectrum or by acquiring commercially traded 900MHz spectrum).

A7.322 There is an efficiency benefit when no market solution emerges, as both the single and RAN shared 2100MHz operators no longer need to match using 2100MHz spectrum. They deploy networks using 900MHz spectrum instead.

A7.323 Where commercial access would have been granted, mandating 2 block release results in an efficiency cost of bringing forward investment for both single and RAN shared 2100MHz operators. In the counterfactual, they would have deployed using 800MHz spectrum later (relying on access in the interim period), but now deploy using 900MHz spectrum in 2011/12.

A7.324 In the outcomes where commercial access or no market solution occurs in the counterfactual, the full costs of forced release (2 blocks) are imposed on the 900MHz operators, as well as the incremental cost of future clearance.

A7.325 Where a commercial trade occurs in the counterfactual, only the incremental costs of forced release (2 blocks), relative to commercial release, are imposed by the intervention. The incremental costs of future clearance are incurred in the counterfactual.

A7.326 Mandating the release of 2 blocks also results in a delay to when the 900MHz operators can make use of liberalised spectrum (up to 6 months). In these outcomes, it is profitable for these operators to continue deploying 2100MHz during this period. Therefore, in the event of delay, the 900MHz operators will continue their deployment at 2100MHz for longer, deploying 900MHz slightly later. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.327 In the outcome where commercial access would have been offered in the counterfactual, the 2100MHz operators would have used this to compete, imposing additional infrastructure costs on the 900MHz operator carrying their traffic. As a result of 2 block release, none of the 2100MHz operators rely on commercial access, so the additional infrastructure costs are avoided.

A7.328 The tables below show the costs and benefits that arise from mandating release of 2 blocks in the medium significance scenario (when both the single and RAN shared operators can match):

7.328.1 The first table sets out the names of the costs and benefits which apply under each outcome, as they appear in the Net Benefits model.

7.328.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each outcome.

Table 87: Partial release – 2 blocks – description of costs and benefits in the medium significance scenario (when both the single and RAN shared operators can match)

2 block release - Medium significance (when both single and RAN-shared 2100 operators can match)			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			
Productive efficiency of provision of service			benefit_eff_no_2100_but_earlier_low_freq_single_medA+ benefit_eff_no_2100_but_earlier_low_freq_RANsh_medA
Cost of bringing forward low freq. network investment		cost_ineff_earlier_low_freq_single_medA + cost_ineff_earlier_low_freq_RANsh_medA	
Incremental cost of future clearance		cost_inc_future_clearance_cost_2	cost_inc_future_clearance_cost_2
Cost of release		cost_forced_release_2	cost_forced_release_2
Incremental cost of forced release (vs comm. release)	cost_inc_cost_forced_release_2		
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency	cost_efficiency_delay* (1-cost_reduction_efficiency_delay)	cost_efficiency_delay* (1-cost_reduction_efficiency_delay)	cost_efficiency_delay
Delay to liberalisation - launch of services			
Cost of setting up access agreement			
Additional infrastructure for roaming traffic		benefit_avoid_additional_infrastructure_medium_A	
Cost of disruption	cost_disruption_2_block	cost_disruption_2_block	cost_disruption_2_block

Table 88: Partial release – 2 blocks –costs and benefits in the medium significance scenario (when both the single and RAN shared operators can match)

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition									
Productive efficiency of provision of service			600			800			975
Cost of bringing forward low freq. network investment		-50			-45			-35	
Incremental cost of future clearance		-180	-180		-150	-150		-110	-110
Cost of release		-275	-275		-230	-230		-180	-180
Incremental cost of forced release (vs comm. release)	-30			-25			-15		
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency	-170	-170	-170	-45	-45	-90	0	0	0
Delay to liberalisation - launch of services									
Cost of setting up access agreement									
Additional infrastructure for roaming traffic		140			160			170	
Cost of disruption	-25	-25	-25	-15	-15	-15	-3	-3	-3
Net benefit / cost	-220	-575	-50	-80	-325	325	-20	-160	675

Low significance

A7.329 In the low significance scenario, we assume it is optimal for the 900MHz spectrum to remain in its existing use, and for improved mobile broadband services to be deployed using higher frequency (2100MHz) spectrum. As a result, the market solution outcomes are assumed not to occur. The analysis for the different commercial outcomes (commercial trade, commercial access, no market solution) is therefore the same in the low significance scenario.

A7.330 As with all our options for intervention, it is not clear what the true market outcome will be at the time of deciding on our preferred policy option. While it is unlikely to be efficient for forced release to take place in the low significance scenario, this will not be known until after a proportion of the costs of clearing spectrum have been incurred. Hence, if we impose 2 block release the operators will have to begin preparing to allow the spectrum to be cleared and released.. However, as explained in the discussion of the costs earlier in this annex, we assume that once it becomes clear that release is not efficient the policy is aborted and hence the full costs of release are not incurred.

A7.331 The tables below show the costs and benefits that arise from mandating partial release of 2 blocks in the low significance scenario.

7.331.1 The first table sets out the names of the costs and benefits which apply under each commercial outcome, as they appear in the Net Benefits model.

7.331.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each commercial outcome.

Table 89: Partial release – 2 blocks – description of costs and benefits in the low significance scenario

2 block release - Low significance

Cost / Benefit	Market solution - trade	Market solution - access	No market solution
Level of competition			
Productive efficiency of provision of service			
Cost of bringing forward low freq. network investment			
Incremental cost of future clearance			
Cost of release			
Incremental cost of forced release (vs comm. release)			
Cost of clearance when operators do not ultimately clear	cost_release_aborted_2_block	cost_release_aborted_2_block	cost_release_aborted_2_block
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services			
Cost of setting up access agreement			
Additional infrastructure for roaming traffic			
Cost of disruption			

Table 90: Partial release – 2 blocks – costs and benefits in the low significance scenario

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition									
Productive efficiency of provision of service									
Cost of bringing forward low freq. network investment									
Incremental cost of future clearance									
Cost of release									
Incremental cost of forced release (vs comm. release)									
Cost of clearance when operators do not ultimately clear	-140	-140	-140	-120	-120	-120	-90	-90	-90
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services									
Cost of setting up access agreement									
Additional infrastructure for roaming traffic									
Cost of disruption									
Net benefit / cost	-140	-140	-140	-120	-120	-120	-90	-90	-90

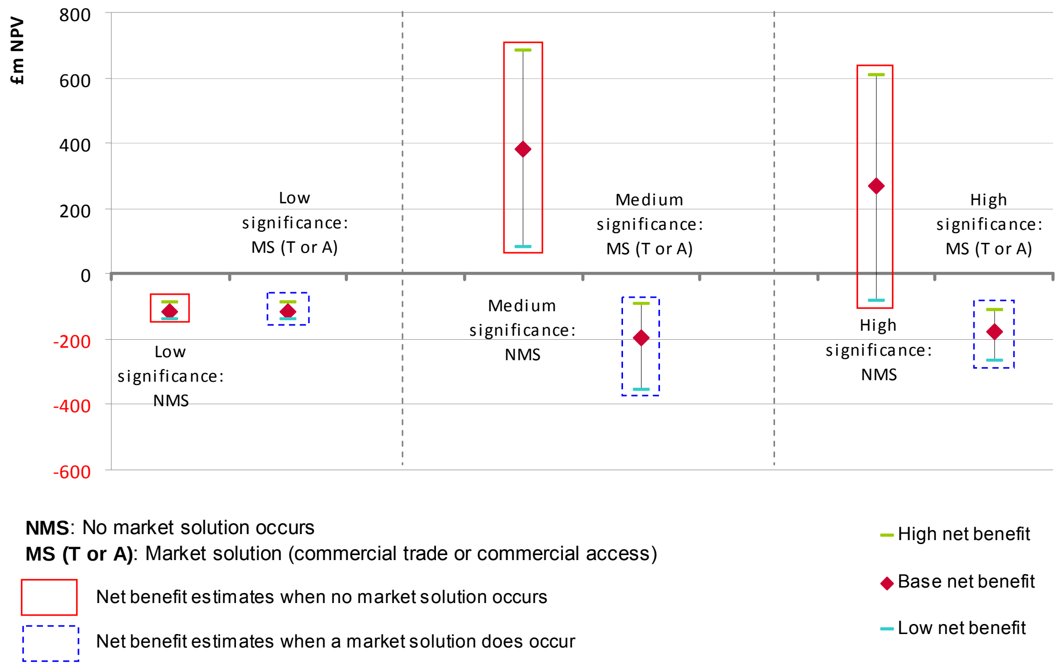
Summary of costs and benefits under each outcome:

A7.332 The table and diagram below present the summary results for the mandatory release of 2 blocks, on a total welfare basis.

Table 91: Partial release – 2 blocks – summary of net benefits under each outcome

Significance scenario:	**Low significance**		**Medium significance**		**High significance**	
Commercial outcome:	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**
Low net benefit	-140	-140	80	-350	-80	-275
Base net benefit	-120	-120	375	-200	275	-180
High net benefit	-90	-90	675	-90	600	-110

Figure 17: Partial release – 2 blocks – summary of net benefits under each outcome



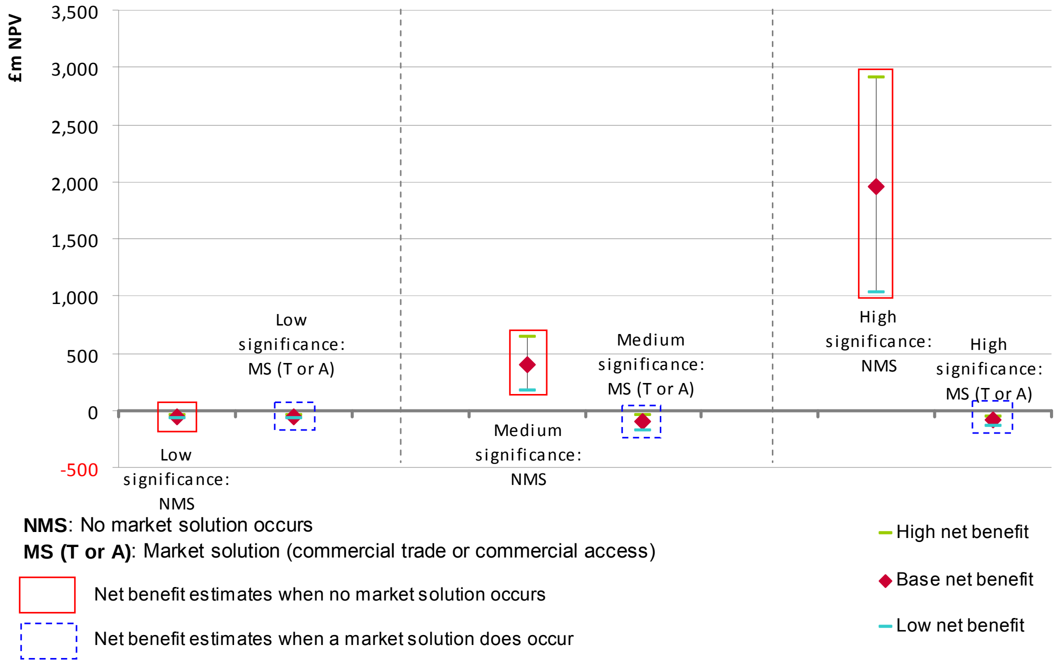
Summary of net benefits under each outcome (consumer surplus only)

A7.333 The table and diagram below present the summary results for the mandatory release of 2 blocks, on a consumer surplus basis.

Table 92: Partial release – 2 blocks – summary of net benefits under each outcome (consumer surplus only):

Significance scenario:	Low significance		Medium significance		High significance	
Commercial outcome:	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**
Low net benefit	-70	-70	180	-180	1,000	-130
Base net benefit	-60	-60	400	-100	2,000	-90
High net benefit	-45	-45	650	-45	2,900	-60

Figure 18: Partial release – 2 blocks – summary of net benefits under each outcome (consumer surplus only)



Disruption of commercial outcomes

A7.334 When we mandate the release of two blocks, our results are very similar both in the disruption and non-disruption cases.

A7.335 We only consider disruption of commercial access for the mandatory release options. When we mandate the release of two blocks, none of the 2100MHz operators are reliant on commercial access. Both the single and RAN shared 2100MHz operators have their own 900MHz spectrum. As such, it does not matter whether commercial access is disrupted.

A7.336 The only difference is that if our intervention does disrupt commercial access, then the costs of setting up a commercial access agreement are no longer incurred. As this cost is less that £10m, we do not present these results here.

Partial spectrum release – 3 blocks

A7.337 Three block release requires three blocks of spectrum to be released alongside liberalisation of the remainder of the 900MHz spectrum. The released spectrum would be liberalised and re-awarded, and the existing 900MHz licensees would not be able to reacquire this spectrum.

A7.338 The costs and benefits resulting from the release 3 blocks of spectrum depend on which of the 2100MHz operators acquire the released spectrum.

A7.339 As stated earlier in this annex, we assume that the RAN shared network acquires two blocks (to share between the two retail operators downstream), and the single 2100MHz operator acquires the third block. We also assume that in the counterfactual where a commercial trade takes place, three blocks are commercially released.

A7.340 We now detail the factual and counterfactuals used for each of the outcomes to evaluate the costs and benefits of 3 block release relative to liberalisation in the hands of the incumbents.

High significance

A7.341 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 93: Partial release – 3 blocks: high significance scenario (no market solution: NMS)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. Release 3 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Unable to compete in the interim period, but deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire two released blocks of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Unable to compete in the interim period, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	2	5

A7.342 If the market provides wider access in the form of a commercial trade:

Table 94: Partial release – 3 blocks: high significance scenario (market solution – trade: MS/T)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 3 blocks of 900MHz spectrum between them.	Deploy own UMTS900 networks. Release 3 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Acquire two commercially traded blocks of 900MHz spectrum, and deploy a UMTS900 network.	Acquire two released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Acquires commercially traded block of 900MHz spectrum, and deploys a UMTS900 network.	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.343 If the market provides wider access in the form of commercial access:

Table 95: Partial release – 3 blocks: high significance scenario (market solution – access: MS/A)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Release 3 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire two released block of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.344 Mandating the release of 3 blocks only results in greater competition if there is no market solution in the counterfactual. In this case, the number of players in the market increases from two to five, as the 2100MHz operators now deploy using the 900MHz spectrum they have acquired.

A7.345 If there is no market solution or commercial access is provided in the counterfactual, the 2100MHz operators do not deploy their own networks in the interim period, but do deploy using 800MHz spectrum later. The mandatory release of 3 blocks of 900MHz spectrum results in a cost of bringing forward investment in low frequency networks for both single and RAN shared 2100MHz operators.

A7.346 In the outcomes where commercial access or no market solution occurs in the counterfactual, the full costs of forced release (3 blocks) are imposed on the 900MHz operators, as well as the incremental cost of future clearance.

A7.347 Where a commercial trade occurs in the counterfactual, only the incremental costs of forced release (3 blocks), relative to commercial release, are imposed by the intervention. The incremental costs of future clearance are incurred in the counterfactual.

A7.348 Mandating the release of 3 blocks also results in a delay to when the 900MHz operators can make use of liberalised spectrum (up to 6 months). In these outcomes, it is not profitable for these operators to continue deploying 2100MHz during this period. Therefore, in the event of delay, high quality mobile broadband is delayed. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.349 In the outcome where commercial access would have been offered in the counterfactual, the 2100MHz operators would have used this to compete, imposing additional infrastructure costs on the 900MHz operator carrying their traffic. As a result of 3 block release, none of the 2100MHz operators rely on commercial access, so the additional infrastructure costs are avoided.

A7.350 The tables below show the costs and benefits that arise from mandating release of 3 blocks in the high significance scenario.

7.350.1 The first table sets out the names of the costs and benefits which apply under each outcome, as they appear in the Net Benefits model.

7.350.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each outcome.

Table 96: Partial release – 3 blocks – description of costs and benefits in the high significance scenario

3 block release - High significance			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			benefit_competition_2_to_5
Productive efficiency of provision of service			
Cost of bringing forward low freq. network investment		cost_ineff_earlier_low_freq_single_high+ cost_ineff_earlier_low_freq_RANsh_high	cost_ineff_earlier_low_freq_single_high+ cost_ineff_earlier_low_freq_RANsh_high
Incremental cost of future clearance		cost_inc_future_clearance_cost_3	cost_inc_future_clearance_cost_3
Cost of release		cost_forced_release_3	cost_forced_release_3
Incremental cost of forced release (vs comm. release)	cost_inc_cost_forced_release_3		
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay
Cost of setting up access agreement			
Additional infrastructure for roaming traffic		benefit_avoid_additional_infrastructure_high	
Cost of disruption	cost_disruption_3_block	cost_disruption_3_block	cost_disruption_3_block

Table 97: Partial release – 3 blocks – costs and benefits in the high significance scenario

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition			450			750			1,000
Productive efficiency of provision of service									
Cost of bringing forward low freq. network investment		35	35		-45	-45		-100	-100
Incremental cost of future clearance		-850	-850		-725	-725		-575	-575
Cost of release		-700	-700		-575	-575		-450	-450
Incremental cost of forced release (vs comm. release)	-70			-60			-45		
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services	-90	-90	-90	-25	-25	-45	0	0	0
Cost of setting up access agreement									
Additional infrastructure for roaming traffic		140			170			190	
Cost of disruption	-30	-30	-30	-15	-15	-15	-3	-3	-3
Net benefit / cost	-180	-1,500	-1,200	-100	-1,200	-650	-50	-925	-120

Medium significance

<u>If only the RAN shared 2100MHz operators are able to match</u>

A7.351 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 98: Partial release – 3 blocks: medium significance scenario (no market solution: NMS) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. Release 3 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Able to match using 2100MHz in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire two released blocks of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Unable to compete in the interim period, but deploys a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	4	5

A7.352 If the market provides wider access in the form of a commercial trade:

Table 99: Partial release – 3 blocks: medium significance scenario (market solution – trade: MS/T) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 3 blocks of 900MHz spectrum between them.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Acquire two commercially traded blocks of 900MHz spectrum, and deploy a UMTS900 network.	Acquire two released blocks of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Acquires commercially traded block of 900MHz spectrum, and deploys a UMTS900 network.	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.353 If the market provides wider access in the form of commercial access:

Table 100: Partial release – 3 blocks: medium significance scenario (market solution – access: MS/A) (when only the RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire two released blocks of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.354 In the medium significance scenario when only the RAN shared 2100MHz operators are able to match, 3 block mandatory release results in a competition benefit where no market solution emerges. This is because the single 2100MHz operator cannot match using 2100MHz in the counterfactual but can now acquire a block of 900MHz spectrum. In the outcomes where there is a market solution, there are no competition benefits from mandating 3 block release.

A7.355 When no market solution emerges, there is an efficiency benefit as the RAN shared operators – which would have matched using 2100MHz spectrum – now deploy using 900MHz spectrum. This is partially offset, however, by the efficiency cost of the single operator bringing forward the deployment of its low frequency network. It would have deployed 800MHz later, but now deploys 900MHz in 2011/12.

A7.356 In the case where the market would have provided commercial access, there is an efficiency cost of bringing forward investment for both single and RAN sharing 2100MHz operators.

A7.357 In the outcomes where commercial access or no market solution occurs in the counterfactual, the full costs of forced release (3 blocks) are imposed on the 900MHz operators, as well as the incremental cost of future clearance.

A7.358 Where a commercial trade occurs in the counterfactual, only the incremental costs of forced release (3 blocks), relative to commercial release, are imposed by the intervention. The incremental costs of future clearance are incurred in the counterfactual.

A7.359 Mandating the release of 1 block also results in a delay to when the 900MHz operators can make use of liberalised spectrum (up to 6 months). In these outcomes, it is not profitable for these operators to continue deploying 2100MHz during this period. Therefore, in the event of delay, high quality mobile broadband is delayed. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.360 In the outcome where commercial access would have been offered in the counterfactual, the 2100MHz operators would have used this to compete, imposing additional infrastructure costs on the 900MHz operator carrying their traffic. As a result of 3 block release, none of the 2100MHz operators rely on commercial access, so the additional infrastructure costs are avoided.

A7.361 The tables below show the costs and benefits that arise from mandating the release of 3 blocks in the medium significance scenario (when only the RAN shared operators can match):

7.361.1 The first table sets out the names of the costs and benefits which apply under each outcome, as they appear in the Net Benefits model.

7.361.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each outcome.

Table 101: Partial release – 3 blocks – description of costs and benefits in the medium significance scenario (when only the RAN shared operators can match)

3 block release - Medium significance (when only RAN-shared 2100 operators can match)			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			benefit_competition_4_to_5
Productive efficiency of provision of service			benefit_eff_no_2100_but_earlier_low_freq_RANsh_medB
Cost of bringing forward low freq. network investment		cost_ineff_earlier_low_freq_single_medB + cost_ineff_earlier_low_freq_RANsh_medB	cost_ineff_earlier_low_freq_single_medB
Incremental cost of future clearance		cost_inc_future_clearance_cost_3	cost_inc_future_clearance_cost_3
Cost of release		cost_forced_release_3	cost_forced_release_3
Incremental cost of forced release (vs comm. release)	cost_inc_cost_forced_release_3		
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay* (1-cost_reduction_service_launch_delay)	cost_service_launch_delay
Cost of setting up access agreement			
Additional infrastructure for roaming traffic		benefit_avoid_additional_infrastructure_medium_B	
Cost of disruption	cost_disruption_3_block	cost_disruption_3_block	cost_disruption_3_block

Table 102: Partial release – 3 blocks – costs and benefits in the medium significance scenario (when only the RAN shared operators can match)

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition			70			110			150
Productive efficiency of provision of service			750			800			850
Cost of bringing forward low freq. network investment		-60	-25		-60	-25		-60	-25
Incremental cost of future clearance		-850	-850		-725	-725		-575	-575
Cost of release		-700	-700		-575	-575		-450	-450
Incremental cost of forced release (vs comm. release)	-70			-60			-45		
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services	-90	-90	-90	-25	-25	-45	0	0	0
Cost of setting up access agreement									
Additional infrastructure for roaming traffic		140			160			170	
Cost of disruption	-30	-30	-30	-15	-15	-15	-3	-3	-3
Net benefit / cost	-180	-1,600	-875	-100	-1,200	-475	-50	-925	-50

<u>If both the single and RAN shared 2100MHz operators are able to match</u>

A7.362 If the market does not provide wider access to 900MHz spectrum via a trade or commercial access:

Table 103: Partial release – 3 blocks: medium significance scenario (no market solution: NMS) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks.	Deploy own UMTS900 networks. Release 3 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Able to match using 2100MHz spectrum in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire two released blocks of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Able to match using 2100MHz spectrum in the interim period, and then deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.363 If the market provides wider access in the form of a commercial trade:

Table 104: Partial release – 3 blocks: medium significance scenario (market solution – trade: MS/T) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. Trade 3 blocks of 900MHz spectrum between them.	Deploy own UMTS900 networks. Release 2 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Acquire two commercially traded blocks of 900MHz spectrum, and deploy a UMTS900 network.	Acquire two released blocks of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Acquires commercially traded block of 900MHz spectrum, and deploys a UMTS900 network.	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.364 If the market provides wider access in the form of commercial access:

Table 105: Partial release – 3 blocks: medium significance scenario (market solution – access: MS/A) (when both the single and RAN shared 2100MHz operators are able to match)

	Counterfactual	Factual
Incumbent 900MHz operators	Deploy own UMTS900 networks. One provides access to the single 2100MHz operator; the other provides access to the RAN-sharing operators.	Deploy own UMTS900 networks. Release 3 blocks of 900MHz spectrum.
RAN sharing 2100MHz operators	Access to 900MHz network for interim period. Deploy a low frequency network later (when 800MHz spectrum becomes available).	Acquire two released blocks of 900MHz spectrum, and deploy a UMTS900 network.
Single 2100MHz operator	Access to 900MHz network for interim period. Deploys a low frequency network later (when 800MHz spectrum becomes available).	Acquire a released block of 900MHz spectrum, and deploy a UMTS900 network.
Number of operators	5	5

A7.365 In the medium significance scenario when both the single and RAN shared 2100MHz operators are able to match, mandating the release of 3 blocks brings about no competition benefits in these outcomes, because all the 2100MHz operators are able to match (using 2100MHz spectrum or by acquiring commercially traded 900MHz spectrum).

A7.366 There is an efficiency benefit when no market solution emerges, as both the single and RAN shared 2100MHz operators no longer need to match using 2100MHz spectrum in the interim. They deploy networks using 900MHz spectrum instead.

A7.367 Where commercial access would have been granted, mandating 3 block release results in an efficiency cost of bringing forward investment for both single and RAN shared 2100MHz operators. In the counterfactual, they would have deployed using 800MHz spectrum later (relying on access in the interim period), but now deploy using 900MHz spectrum in 2011/12.

A7.368 In the outcomes where commercial access or no market solution occurs in the counterfactual, the full costs of forced release (3 blocks) are imposed on the 900MHz operators, as well as the incremental cost of future clearance.

A7.369 Where a commercial trade occurs in the counterfactual, only the incremental costs of forced release (3 blocks), relative to commercial release, are imposed by the intervention. The incremental costs of future clearance are incurred in the counterfactual.

A7.370 Mandating the release of 3 blocks also results in a delay to when the 900MHz operators can make use of liberalised spectrum (up to 6 months). In these outcomes, it is profitable for these operators to continue deploying 2100MHz during this period. Therefore, in the event of delay, the 900MHz operators will continue their deployment at 2100MHz for longer, deploying 900MHz slightly later. In the outcomes where a market solution (trade or access) occurs, the cost of delay is discounted by a proportion.

A7.371 In the outcome where commercial access would have been offered in the counterfactual, the 2100MHz operators would have used this to compete, imposing additional infrastructure costs on the 900MHz operator carrying their traffic. As a result of 3 block release, none of the 2100MHz operators rely on commercial access, so the additional infrastructure costs are avoided.

A7.372 The tables below show the costs and benefits that arise from mandating release of 3 blocks in the medium significance scenario (when both the single and RAN shared operators can match):

7.372.1 The first table sets out the names of the costs and benefits which apply under each outcome, as they appear in the Net Benefits model.

7.372.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each outcome.

Table 106: Partial release – 3 blocks – description of costs and benefits in the medium significance scenario (when both the single and RAN shared operators can match)

3 block release - Medium significance (when both single and RAN-shared 2100 operators can match)

Cost / Benefit	Market solution - trade	Market solution - access	No market solution
Level of competition			
Productive efficiency of provision of service			benefit_eff_no_2100_but_earlier_low_freq_single_medA+ benefit_eff_no_2100_but_earlier_low_freq_RANsh_medA
Cost of bringing forward low freq. network investment		cost_ineff_earlier_low_freq_single_medA + cost_ineff_earlier_low_freq_RANsh_medA	
Incremental cost of future clearance		cost_inc_future_clearance_cost_3	cost_inc_future_clearance_cost_3
Cost of release		cost_forced_release_3	cost_forced_release_3
Incremental cost of forced release (vs comm. release)	cost_inc_cost_forced_release_3		
Cost of clearance when operators do not ultimately clear			
Delay to liberalisation - efficiency	cost_efficiency_delay* (1-cost_reduction_efficiency_delay)	cost_efficiency_delay* (1-cost_reduction_efficiency_delay)	cost_efficiency_delay
Delay to liberalisation - launch of services			
Cost of setting up access agreement			
Additional infrastructure for roaming traffic		benefit_avoid_additional_infrastructure_medium_A	
Cost of disruption	cost_disruption_3_block	cost_disruption_3_block	cost_disruption_3_block

Table 107: Partial release – 3 blocks –costs and benefits in the medium significance scenario (when both the single and RAN shared operators can match)

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition									
Productive efficiency of provision of service			600			800			975
Cost of bringing forward low freq. network investment		-50			-45			-35	
Incremental cost of future clearance		-850	-850		-725	-725		-575	-575
Cost of release		-700	-700		-575	-575		-450	-450
Incremental cost of forced release (vs comm. release)	-70			-60			-45		
Cost of clearance when operators do not ultimately clear									
Delay to liberalisation - efficiency	-170	-170	-170	-45	-45	-90	0	0	0
Delay to liberalisation - launch of services									
Cost of setting up access agreement									
Additional infrastructure for roaming traffic		140			160			170	
Cost of disruption	-30	-30	-30	-15	-15	-15	-3	-3	-3
Net benefit / cost	-275	-1,700	-1,100	-120	-1,200	-600	-50	-900	-50

Low significance

A7.373 In the low significance scenario, we assume that it is optimal for the 900MHz spectrum to remain in its existing use, and for improved mobile broadband services to be deployed using higher frequency (2100MHz) spectrum. As a result, the market solution outcomes do not actually occur. The analysis for the different commercial outcomes (commercial trade, commercial access, no market solution) is therefore the same in the low significance scenario.

A7.374 As with all our options for intervention, it is not clear what the true market outcome will be at the time of deciding on our preferred policy option. While it is unlikely to be efficient for forced release to take place in the low significance scenario, this will not be known until after a proportion of the costs of clearing spectrum have been incurred. Hence, if we impose 3 block release the operators will have to begin preparing to allow the spectrum to be cleared and released. However, as explained in the discussion of the costs earlier in this annex, we assume that once it becomes clear that release is not efficient the policy is aborted and hence the full costs of release are not incurred.

A7.375 The tables below show the costs and benefits that arise from mandating partial release of 3 blocks in the low significance scenario.

7.375.1 The first table sets out the names of the costs and benefits which apply under each commercial outcome, as they appear in the Net Benefits model.

7.375.2 The second table sets out the actual costs and benefits, as well as the net cost / benefit under each commercial outcome.

Table 108: Partial release – 3 blocks – description of costs and benefits in the low significance scenario

3 block release - Low significance			
Cost / Benefit	**Market solution - trade**	**Market solution - access**	**No market solution**
Level of competition			
Productive efficiency of provision of service			
Cost of bringing forward low freq. network investment			
Incremental cost of future clearance			
Cost of release			
Incremental cost of forced release (vs comm. release)			
Cost of clearance when operators do not ultimately clear	cost_release_aborted_3_block	cost_release_aborted_3_block	cost_release_aborted_3_block
Delay to liberalisation - efficiency			
Delay to liberalisation - launch of services			
Cost of setting up access agreement			
Additional infrastructure for roaming traffic			
Cost of disruption			

Table 109: Partial release – 3 blocks – costs and benefits in the low significance scenario

£million (NPV)	Low			Base			High		
Cost / Benefit	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**	**MS/T**	**MS/A**	**NMS**
Level of competition									
Productive efficiency of provision of service									
Cost of bringing forward low freq. network investment									
Incremental cost of future clearance									
Cost of release									
Incremental cost of forced release (vs comm. release)									
Cost of clearance when operators do not ultimately clear	-350	-350	-350	-275	-275	-275	-230	-230	-230
Delay to liberalisation - efficiency									
Delay to liberalisation - launch of services									
Cost of setting up access agreement									
Additional infrastructure for roaming traffic									
Cost of disruption									
Net benefit / cost	-350	-350	-350	-275	-275	-275	-230	-230	-230

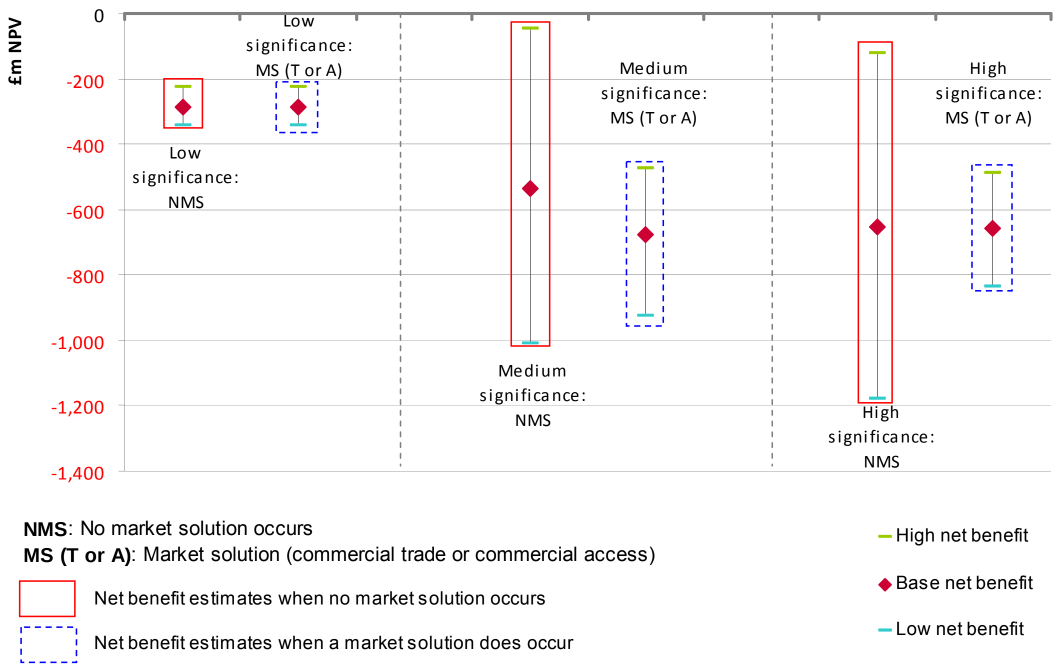
Summary of costs and benefits under each outcome:

A7.376 The table and diagram below present the summary results for the mandatory release of 3 blocks, on a total welfare basis.

Table 110: Partial release – 3 blocks – summary of net benefits under each outcome

Significance scenario:	Low significance		Medium significance		High significance	
Commercial outcome:	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**	**No market solution**	**Market solution (trade or access)**
Low net benefit	-350	-350	-1,000	-925	-1,200	-825
Base net benefit	-275	-275	-525	-675	-650	-650
High net benefit	-230	-230	-50	-475	-120	-500

Figure 19: Partial release – 3 blocks – summary of net benefits under each outcome



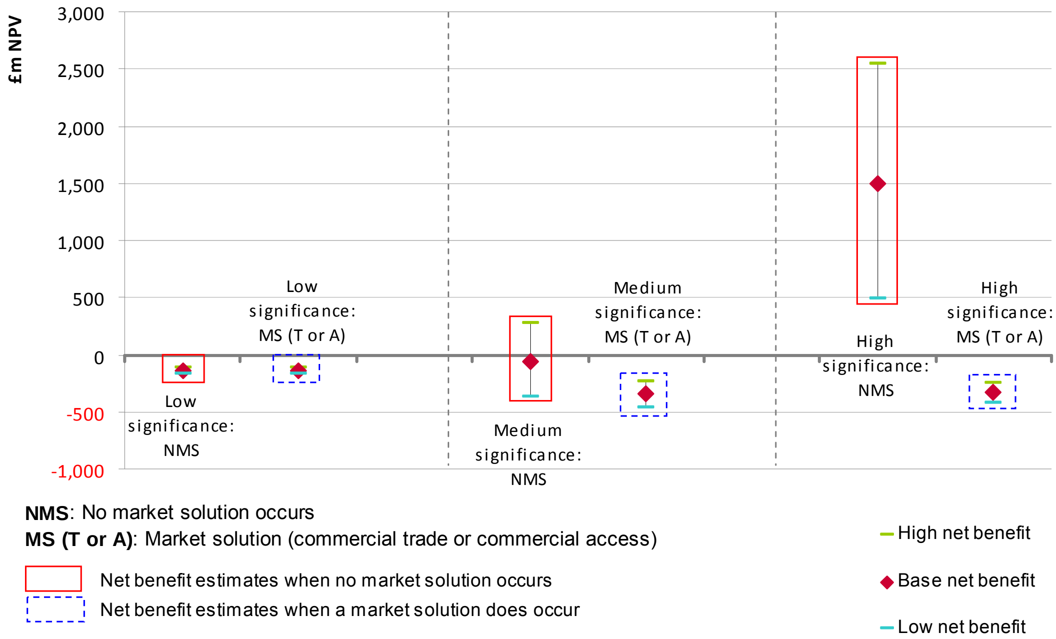
Summary of net benefits under each outcome (consumer surplus only)

A7.377 The table and diagram below present the summary results for the mandatory release of 3 blocks, on a consumer surplus basis.

Table 111: Partial release – 3 blocks – summary of net benefits under each outcome (consumer surplus only)

Significance scenario:	Low significance		Medium significance		High significance	
Commercial outcome:	No market solution	Market solution (trade or access)	No market solution	Market solution (trade or access)	No market solution	Market solution (trade or access)
Low net benefit	-170	-170	-375	-450	475	-425
Base net benefit	-140	-140	-60	-350	1,500	-325
High net benefit	-110	-110	275	-240	2,500	-250

Figure 20: Partial release – 3 blocks – summary of net benefits under each outcome (consumer surplus only)



Disruption of commercial outcomes

A7.378 When we mandate the release of three blocks, our results are very similar both in the disruption and non-disruption cases.

A7.379 We only consider disruption of commercial access for the mandatory release options. When we mandate the release of three blocks, none of the 2100MHz operators are reliant on commercial access. Both the single and RAN shared 2100MHz operators have their own 900MHz spectrum. As such, it does not matter whether commercial access is disrupted.

A7.380 The only difference is that if our intervention does disrupt commercial access, then the costs of setting up a commercial access agreement are no longer incurred. As this cost is less that £10m, we do not present these results here.

Summary of net benefits

Total welfare

A7.381 The table below summarises the low, base, and high net benefits under each option, for each significance outcome, and for whether a market solution arises or not.

Table 112: Summary of net benefits under each option, for each outcome (total welfare)

Significance scenario:	Low significance			Medium significance			High significance		
Net benefits:	Low	Base	High	Low	Base	High	Low	Base	High
Regulated access: NMS	-10	-3	0	-80	220	575	-150	160	550
Regulated access: MS (T or A)	-10	-3	0	-110	20	100	-80	2	50
1 block release: NMS	-45	-40	-30	275	450	625	160	425	725
1 block release: MS (T or A)	-45	-40	-30	-150	-40	25	-90	-20	20
2 block release: NMS	-140	-120	-90	80	375	675	-80	275	600
2 block release: MS (Tor A)	-140	-120	-90	-350	-200	-90	-275	-180	-110
3 block release: NMS	-350	-275	-230	-1,000	-525	-50	-1,200	-650	-120
3 block release: MS (T or A)	-350	-275	-230	-925	-675	-475	-825	-650	-500

A7.382 Below, we present these results in diagrams. Section 5 sets out our interpretation of these results.

Figure 21: Summary of net benefits under each option, for each outcome in the high significance scenario (total welfare)

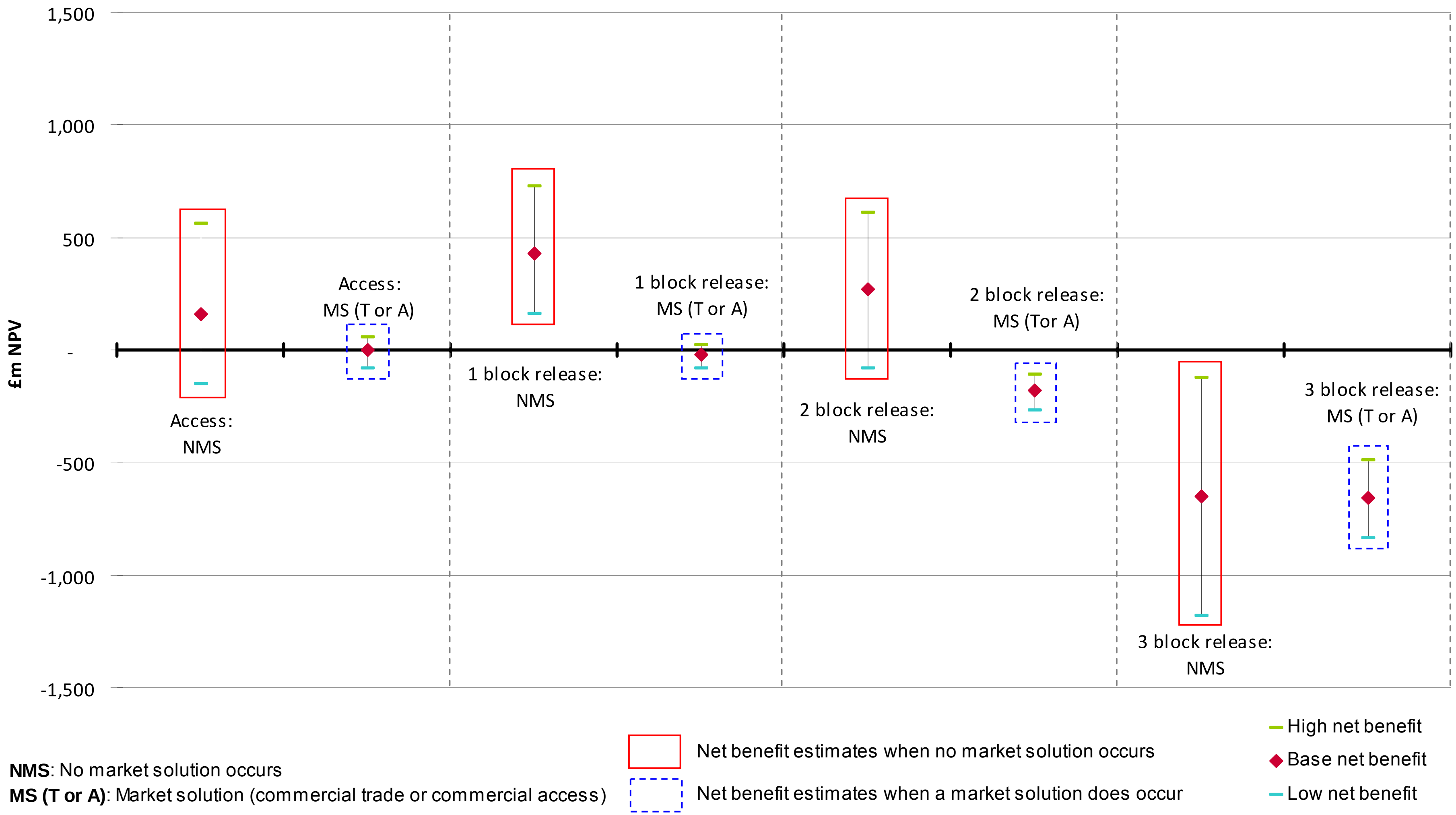
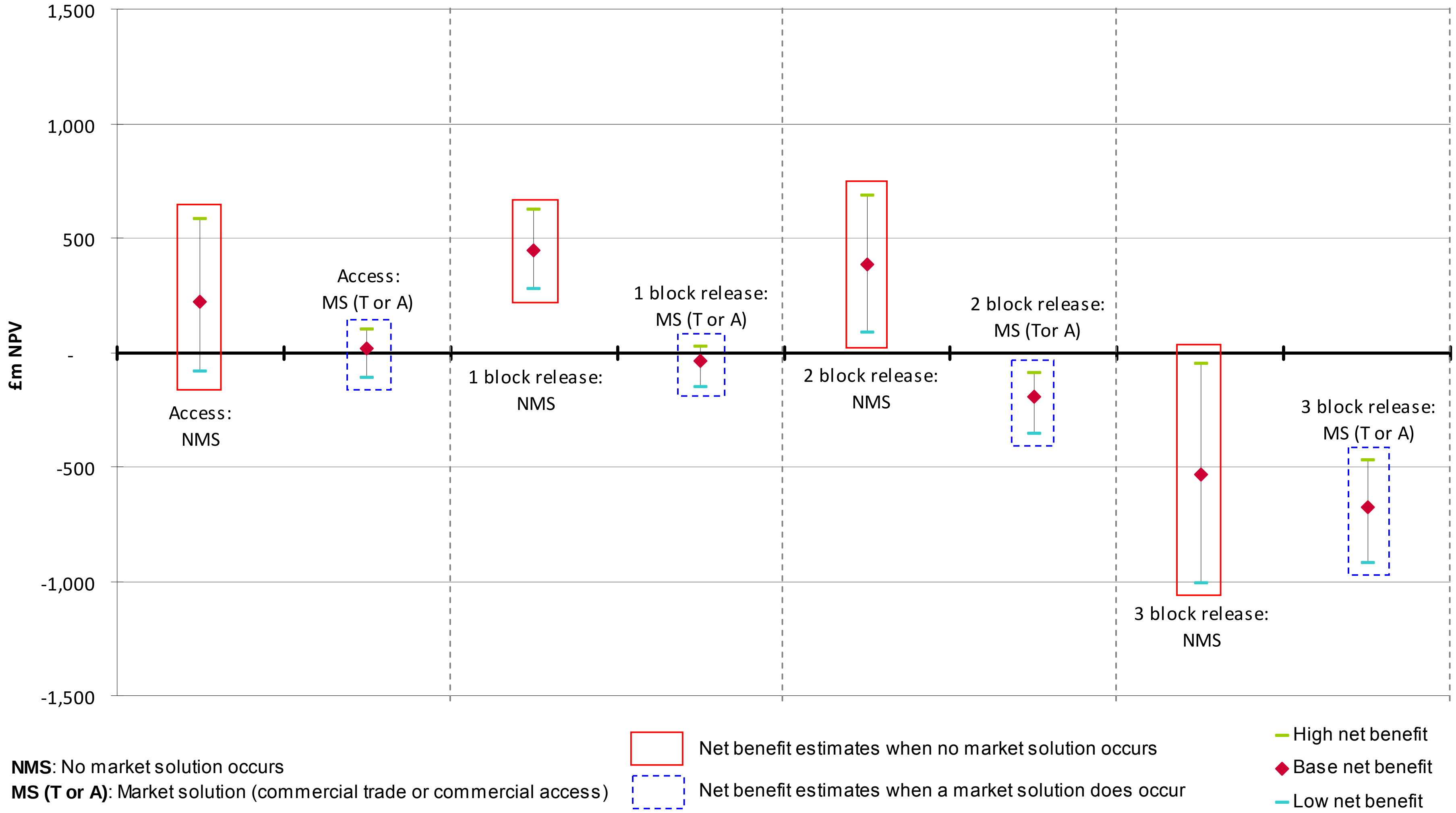
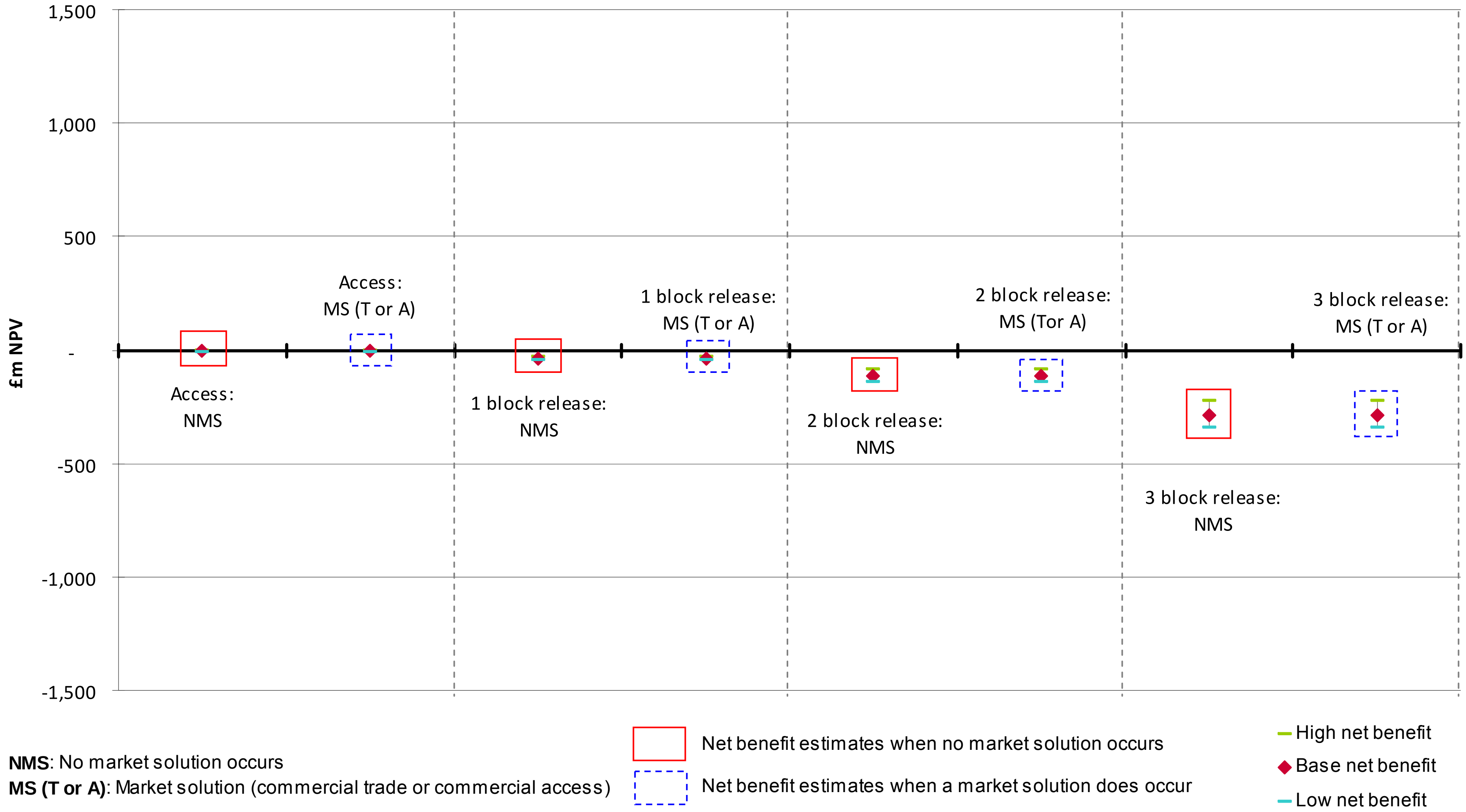


Figure 22: Summary of net benefits under each option, for each outcome in the medium significance scenario (total welfare)



NMS: No market solution occurs
MS (T or A): Market solution (commercial trade or commercial access)

Figure 23: Summary of net benefits under each option, for each outcome in the low significance scenario (total welfare)



Consumer surplus only

A7.383 The table below summarises the low, base, and high net benefits to consumers under each option, for each significance outcome, and for whether a market solution arises or not.

Table 113: Summary of net benefits under each option, for each outcome (consumer surplus)

Significance scenario:	Low significance			Medium significance			High significance		
Net benefits:	**Low**	**Base**	**High**	**Low**	**Base**	**High**	**Low**	**Base**	**High**
Regulated access: NMS	-5	-1	0	-2	220	500	250	1,000	2,100
Regulated access: MS (T or A)	-5	-1	0	-35	60	150	-1	110	240
1 block release: NMS	-25	-20	-15	140	220	300	900	1,600	2,300
1 block release: MS (T or A)	-25	-20	-15	-80	-20	10	-45	-10	10
2 block release: NMS	-70	-60	-45	180	400	650	1,000	2,000	2,900
2 block release: MS (Tor A)	-70	-60	-45	-180	-100	-45	-130	-90	-60
3 block release: NMS	-170	-140	-110	-375	-60	275	475	1,500	2,500
3 block release: MS (T or A)	-170	-140	-110	-450	-350	-240	-425	-325	-250

A7.384 Below, we present these results in diagrams. Section 5 sets out our interpretation of these results.

Figure 24: Summary of net benefits under each option, for each outcome in the high significance scenario (consumer surplus)

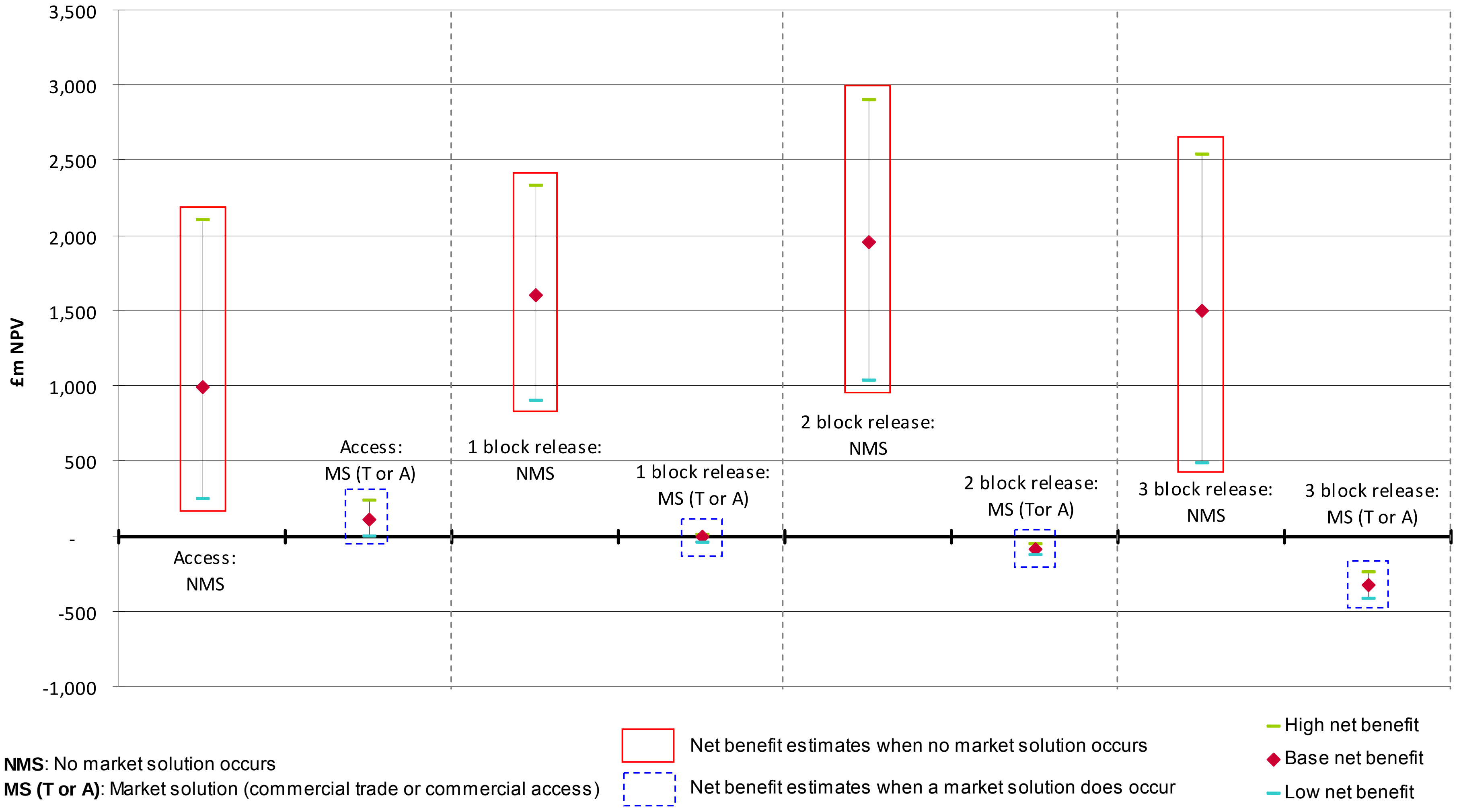
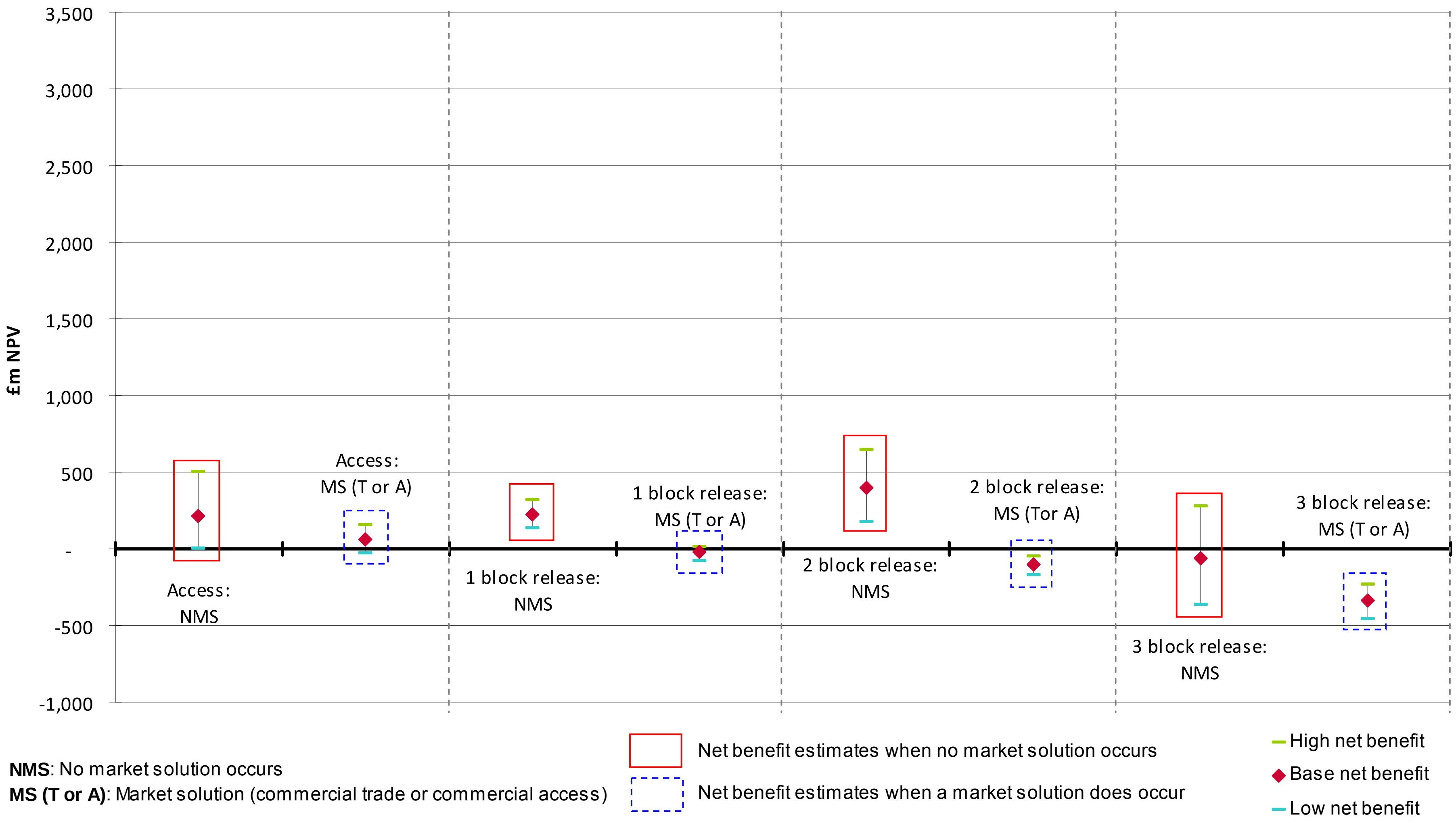
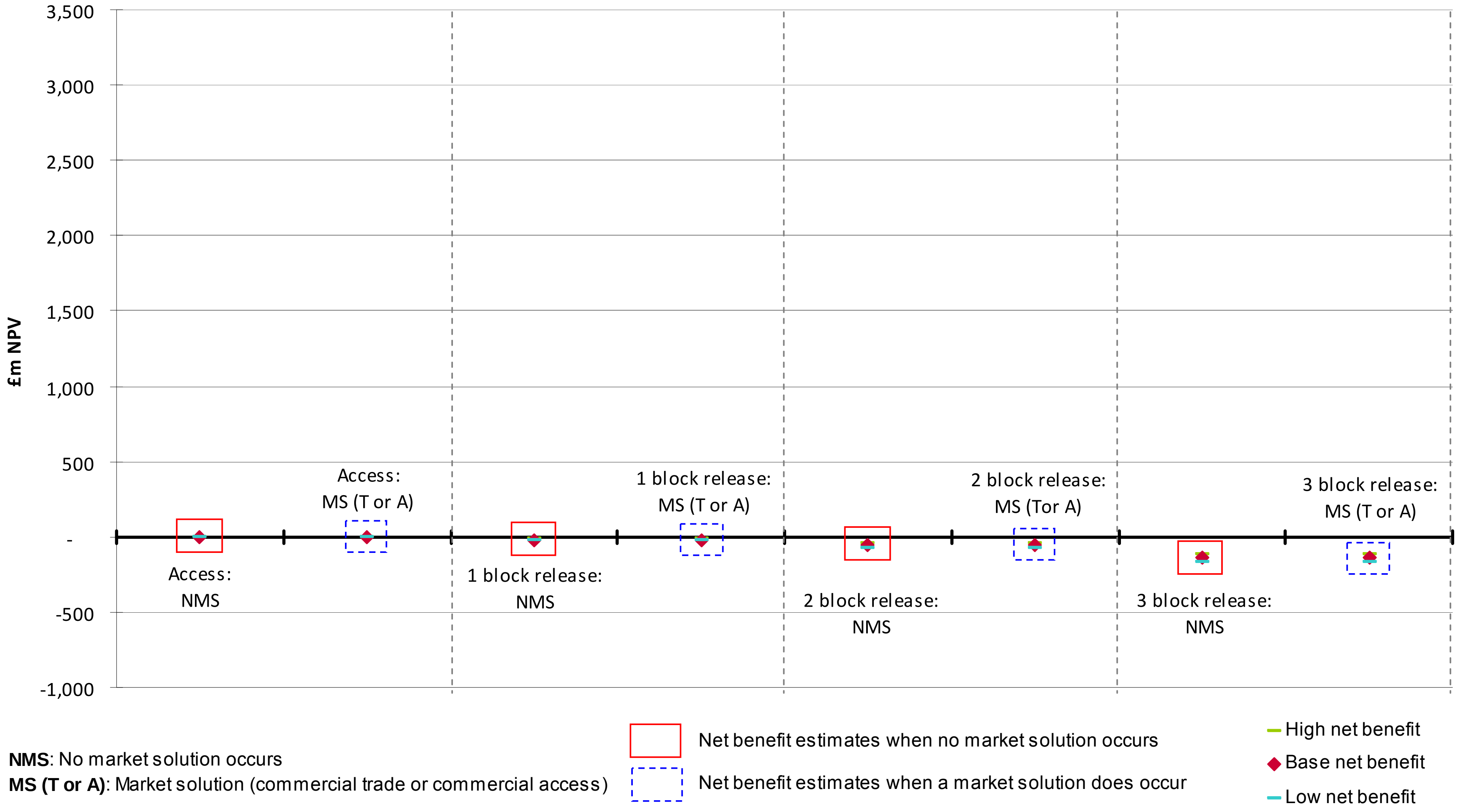


Figure 25: Summary of net benefits under each option, for each outcome in the medium significance scenario (consumer surplus)



NMS: No market solution occurs
MS (T or A): Market solution (commercial trade or commercial access)

Figure 26: Summary of net benefits under each option, for each outcome in the low significance scenario (consumer surplus)



Sensitivity analysis

A7.385 We have considered a range of lengths of the interim period, based on the reasoning set out in annex 12.

A7.386 The base case is an interim period of 3 years, the low case is an interim period of 2 years and the high case is an interim period of 4 years.

A7.387 The timing assumptions affect the following inputs into the CBA.

- Break points 2 and 3, which are the points at which a single 2100 operator is able to match, and a RAN shared 2100 operator is able to match, respectively.
    - Break point 2 is calculated as the single operator's affordability break point, i.e. the gross profits a single player in a 5-player market over the interim period. A longer interim period will give higher gross profits so the value of break point 2 is £330 million in the low case (2 years), £470million in the base case (3 years), and £660 million in the high case (4 years).
    - Break point 3 is the RAN shared operator's practicability break point is calculated as the cost difference given that the 2100MHz operator rolls out to match the quality of the 900 operator, and given the cap on the number of sites which can be rolled out per year. This cost difference increases with the length of the interim period, so the value of break point 3 is £1billion in the low case (2 years), £1.3billion in the base case (3 years) and £1.5billion in the high case (4 years).
- The size of the competition effects depend on the length of the interim period. A longer period will yield larger welfare effects so a 2 to 3 player competition effect using the base market size is £300 million using a 2 year period, £425 million using a 3 year period, and £575million using a 4 year period.
- The size of the efficiency effects also depend on the length of the interim period. A longer interim period will result in larger efficiency effects, so the efficiency cost for a single operator in the medium significance outcome where only RAN sharing operators can match is £475 million using a 2 year period, £550 million using a 3 year period, and £775million using a 4 year period.
- All the other costs and benefits in the net benefits model do not vary according to the length of the interim period.

A7.388 We present the net benefit results for each option given a 2 year interim period, then the results given a 4 year interim period below. The summary of the results given a 3 year interim period are the base case presented above.

A7.389 A summary of the results given a 2 year interim period is below.

Table 114: Summary of net benefits - sensitivity (2 year interim period)

Significance scenario:	Low significance			Medium significance			High significance		
Net benefits:	Low	Base	High	Low	Base	High	Low	Base	High
Regulated access: NMS	-10	-3	0	-100	180	500	-200	35	350
Regulated access: MS (T or A)	-10	-3	0	-110	15	80	-90	-5	35
1 block release: NMS	-45	-40	-30	210	350	525	45	200	450
1 block release: MS (T or A)	-45	-40	-30	-170	-50	15	-80	-35	15
2 block release: NMS	-140	-120	-90	4	250	525	-210	-40	275
2 block release: MS (Tor A)	-140	-120	-90	-375	-210	-110	-250	-200	-120
3 block release: NMS	-350	-275	-230	-1,100	-650	-200	-1,300	-950	-450
3 block release: MS (T or A)	-350	-275	-230	-950	-700	-500	-825	-675	-500

A7.390 The effect of using a shorter interim period of two years, is that the net benefits of all liberalisation options, relative to liberalisation in the hands of the incumbents, in the summary tables are reduced in the medium and high significance scenarios. The net benefit is reduced as the competition and efficiency losses in the counterfactuals in particular, where the market would not have achieved wider access, are smaller if the interim period is shorter.

A7.391 In the counterfactuals where the competition and/or efficiency effects would have been particularly large the sensitivity of the net benefit results to the interim period assumption is greater. The net benefits of liberalisation options in the low significance scenario are unaffected by the break point sensitivities as the competition and efficiency effects do not arise here.

Figure 27: Summary of net benefits in the high significance scenario - sensitivity (2 year interim period)

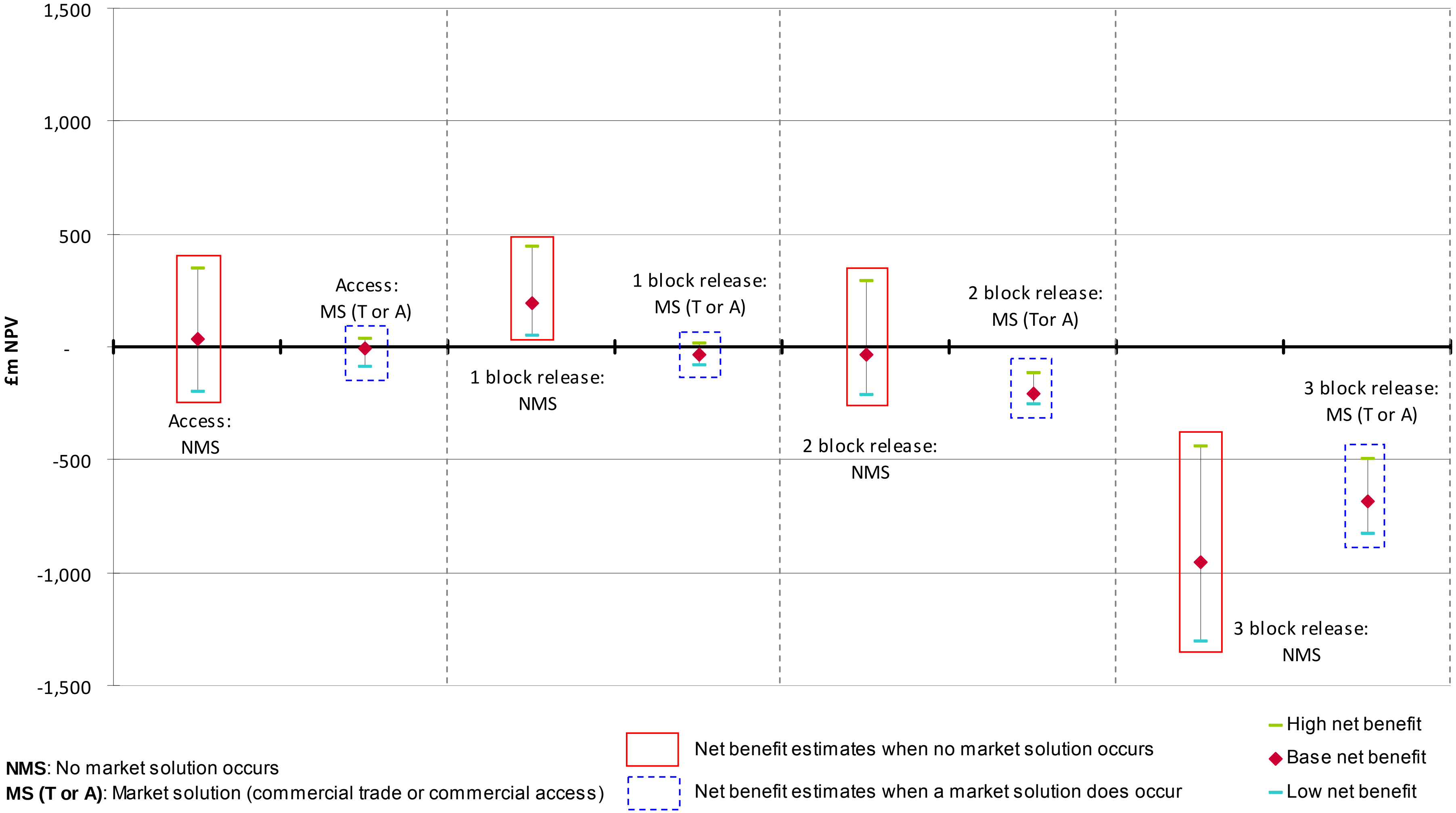


Figure 28: Summary of net benefits in the medium significance scenario - sensitivity (2 year interim period)

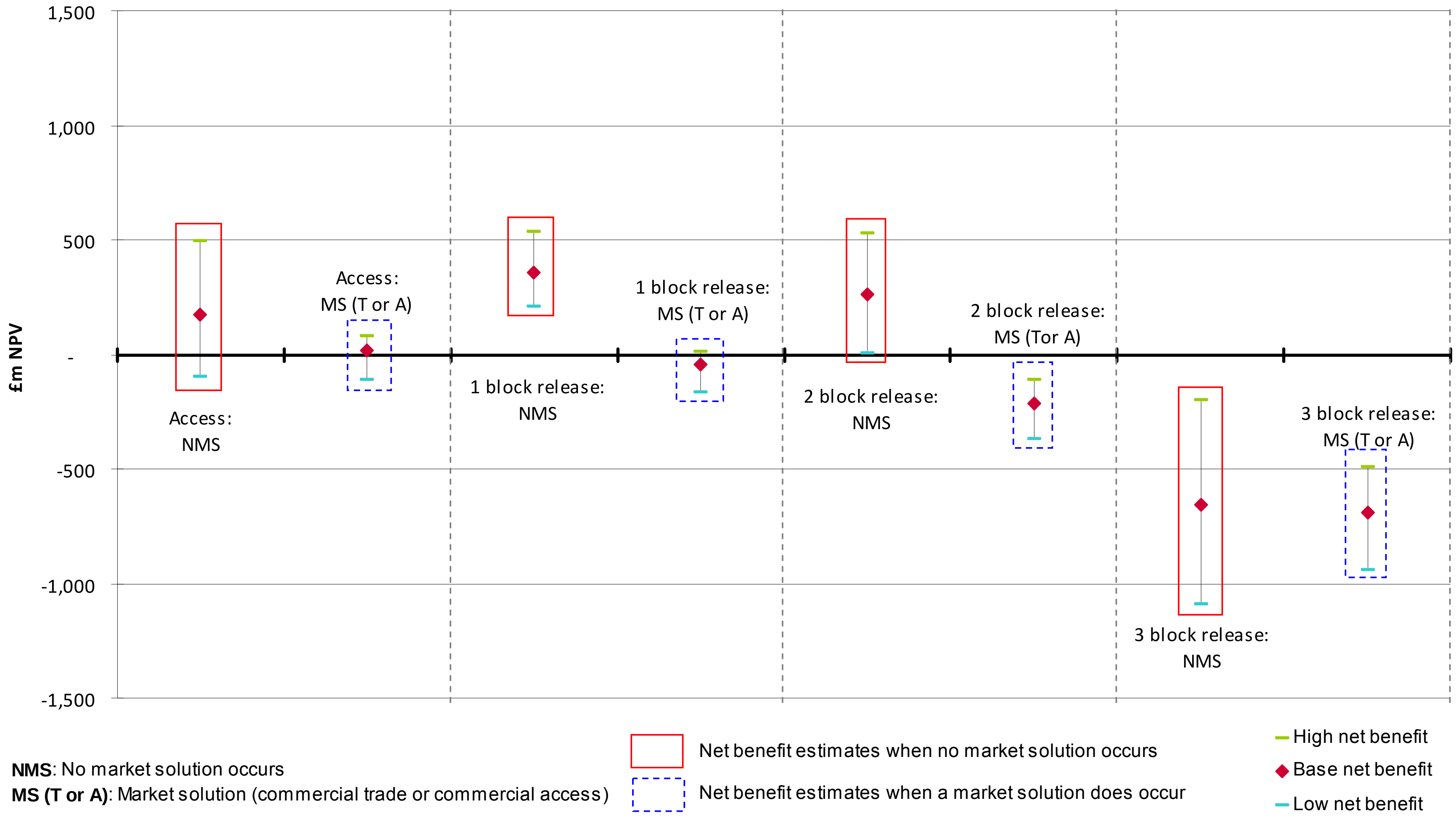
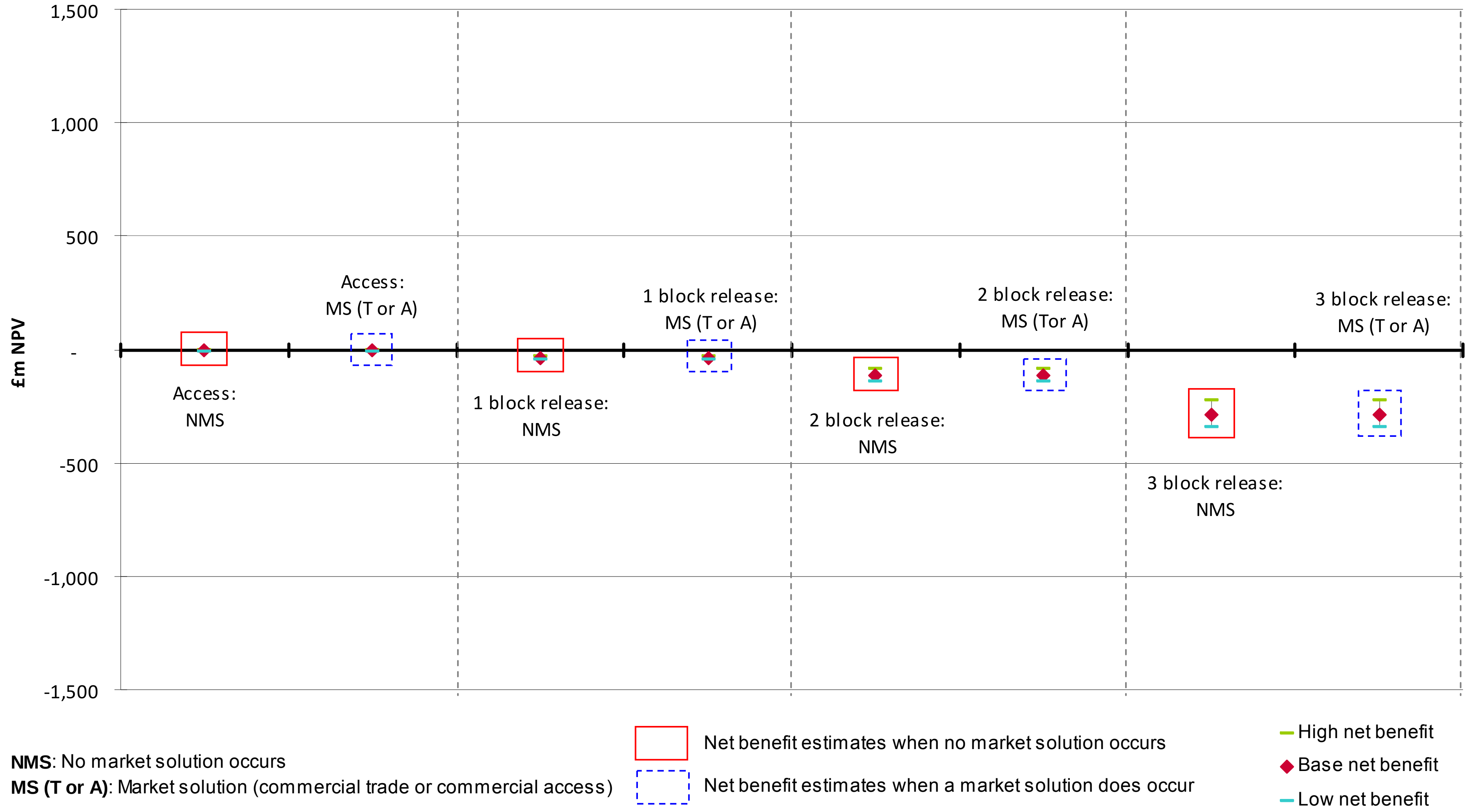


Figure 29: Summary of net benefits in the low significance scenario - sensitivity (2 year interim period)



A7.392 A summary of the results given a 4 year interim period is below.

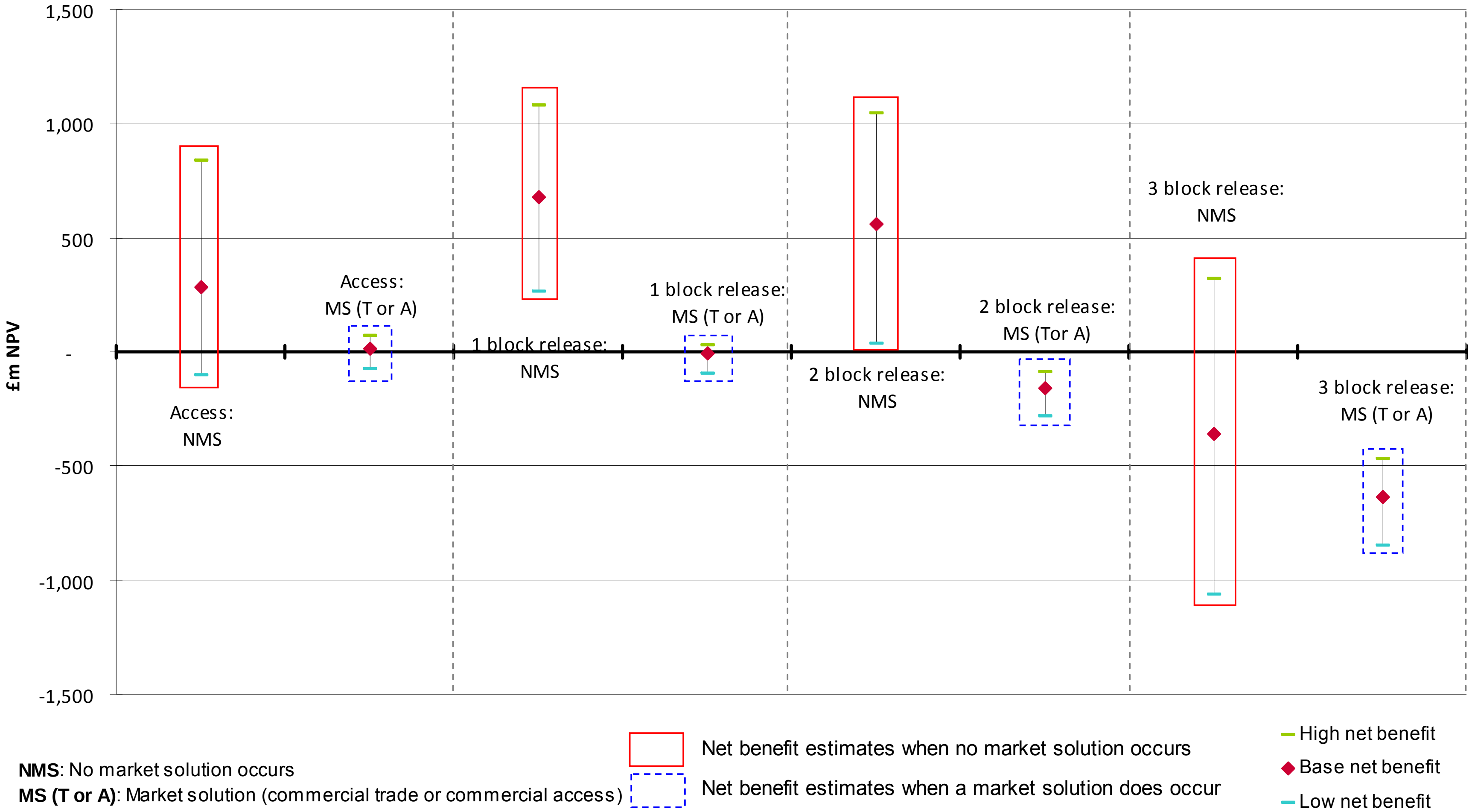
Table 115: Summary of net benefits - sensitivity (4 year interim period)

Significance scenario:	Low significance			Medium significance			High significance		
Net benefits:	**Low**	**Base**	**High**	**Low**	**Base**	**High**	**Low**	**Base**	**High**
Regulated access: NMS	-10	-3	0	-25	375	850	-110	275	850
Regulated access: MS (T or A)	-10	-3	0	-100	35	130	-80	10	70
1 block release: NMS	-45	-40	-30	450	675	900	275	675	1,100
1 block release: MS (T or A)	-45	-40	-30	-150	-35	30	-90	-5	30
2 block release: NMS	-140	-120	-90	300	675	1,100	35	550	1,000
2 block release: MS (Tor A)	-140	-120	-90	-350	-190	-90	-275	-160	-90
3 block release: NMS	-350	-275	-230	-800	-240	350	-1,100	-350	325
3 block release: MS (T or A)	-350	-275	-230	-925	-675	-475	-850	-625	-475

A7.393 The effect of using a longer interim period of four years, is that the net benefits of all liberalisation options, relative to liberalisation in the hands of the incumbents, in the summary tables are increased in the medium and high significance scenarios. The net benefit is increased as the competition and efficiency losses in the counterfactual in particular, where the market would not have achieved wider access, are larger if the interim period is larger.

A7.394 In the counterfactuals where the competition and/or efficiency effects would have been particularly large the sensitivity of the net benefit results to the interim period assumption is greatest. The net benefits of liberalisation options in the low significance scenario are unaffected by the break point sensitivities as the competition and efficiency effects do not arise here.

Figure 30: Summary of net benefits in the high significance scenario - sensitivity (4 year interim period)



NMS: No market solution occurs
MS (T or A): Market solution (commercial trade or commercial access)

Figure 31: Summary of net benefits in the medium significance scenario - sensitivity (4 year interim period)

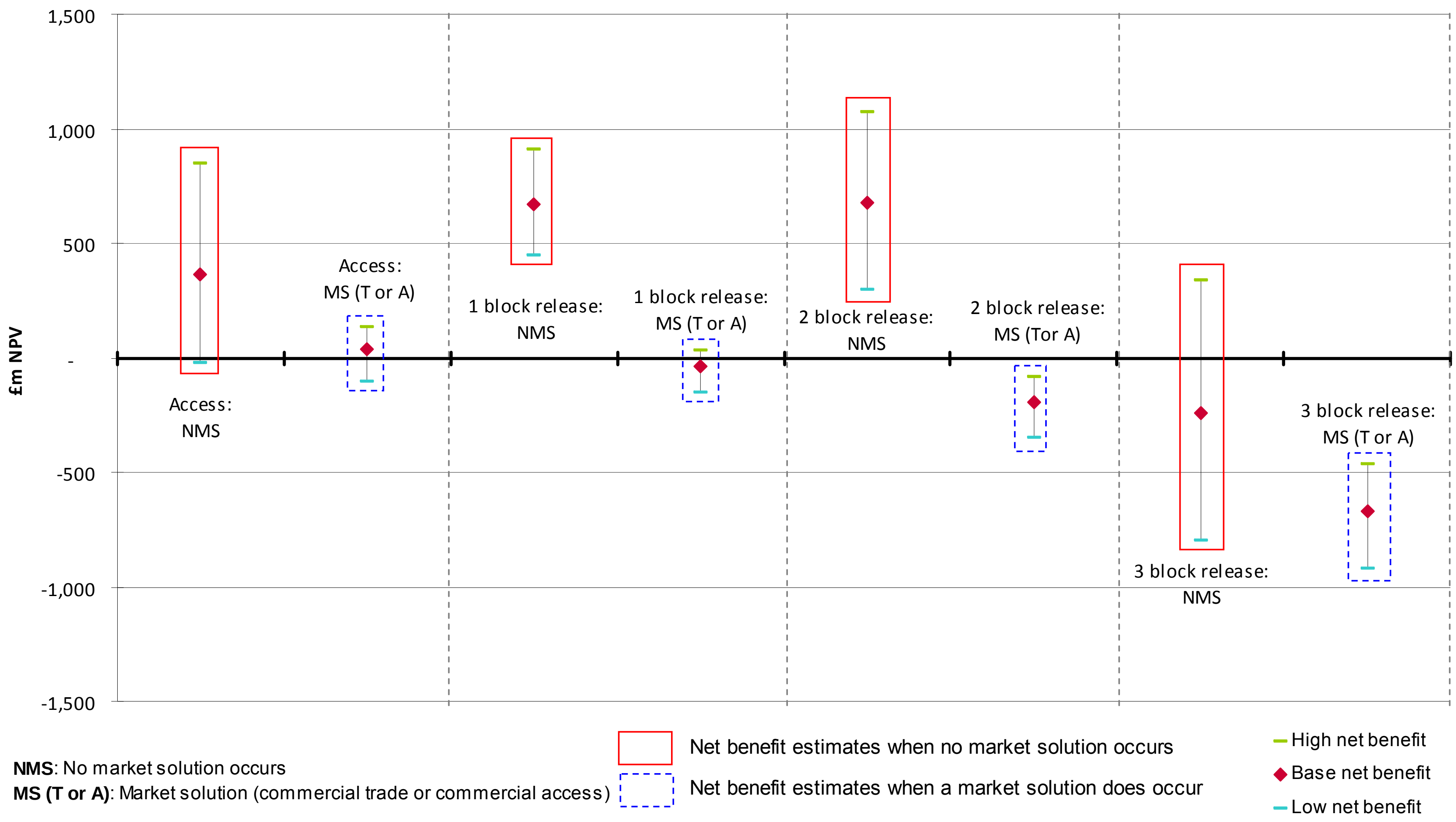
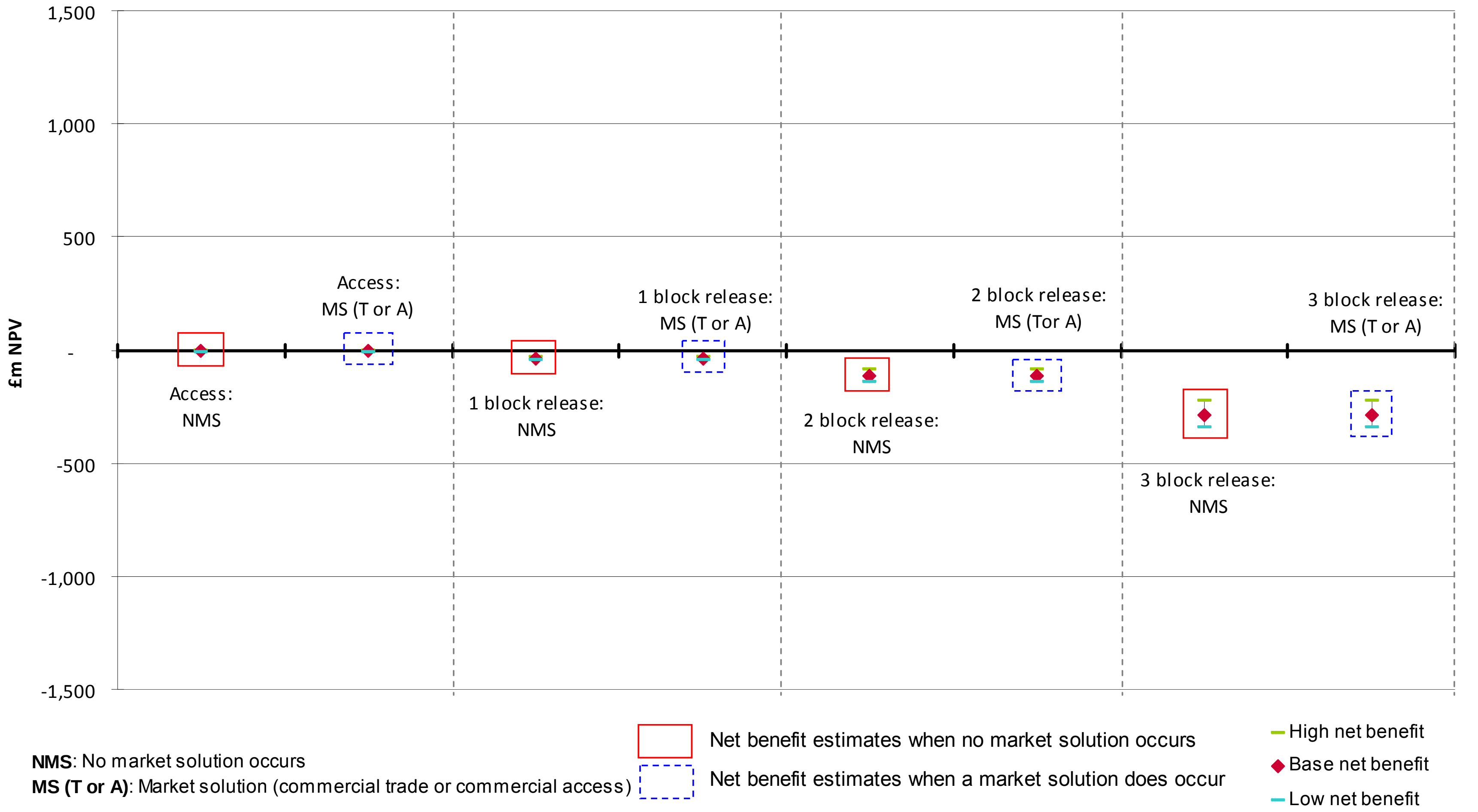


Figure 32: Summary of net benefits in the low significance scenario - sensitivity (4 year interim period)



A7.395 The length of the interim period determines the value of the break points and therefore may affect the likelihood of a particular significance scenario occurring.

A7.396 If 900MHz spectrum is of low significance then the net benefit results are insensitive to the length of the interim period. If 900MHz is of medium or high significance then a longer interim period will mean that the net benefits of other policy options, such as mandating partial release of spectrum or regulated access, are increased.

A7.397 The impact on the net benefits of other policy options of changes in the interim period is greatest if 900MHz spectrum is of medium or high significance and the market does not find a solution through commercial roaming or trade.

Stakeholder comments

A7.398 Following our September 2007 consultation we received comments from stakeholders in relation to our cost benefit analysis. This section addresses those comments that have not already been dealt with.

A7.399 Several respondents felt that the risks associated with regulated access were much less than we had suggested. The main points put forward to support these arguments were as follows:

- Vodafone suggested that regulated roaming could actually result in faster and wider network deployment, because it could encourage competition to provide roaming services. As such, it was not necessarily detrimental to competitive intensity and innovation. Moreover, the potential to gain revenues from roaming could enable incumbents to rollout in areas where there would otherwise be no competition at all. Vodafone also noted that roaming and sharing could also reduce the cost of mobile broadband rollout, and so should be considered as a viable alternative to release. Vodafone observed that Ofcom had stated in a 2004 consultation on 2G national roaming that it could quickly intervene to determine access agreements in the event of a dispute, whereas in this instance it was concerned that it would not get the roaming agreement 'right' if it intervened.

- Orange suggested that regulated roaming (with a sunset clause) was a reasonable temporary solution. They envisaged this being combined with a commitment to grant them access to 800MHz spectrum.

- Tesco Mobile suggested that H3G’s roaming arrangement shows that regulated roaming can be successful. They also noted that there is a difference between imposing roaming obligations on an existing network, and imposing roaming obligations on a network that is yet to be built.

A7.400 In response to Vodafone’s comments, we agree that it is possible that regulated roaming could bring some benefits, such as those described by Vodafone. However, we think that the benefits set out by Vodafone are more likely under a commercial access agreement than under one imposed by regulation. We have also taken elements of Orange’s suggestion on board, in that we are comparing all the options in the short term, up to when 800MHz may be fully available. However, as set out in section 5, we think that even if there is a sunset clause, it may be difficult to remove regulated access in a timely fashion.

A7.401 The effectiveness of regulated roaming clearly depends on the impact it has on the 900MHz incumbents’ behaviour, both in terms of their willingness to deploy UMTS 900 networks and their willingness to negotiate or agree roaming agreements that are fully pro-competitive.

A7.402 For the reasons set out in section 5, we still consider that regulated roaming carries some material risks, as we outlined in the September 2007 consultation. These risks affect our assessment of the likelihood that roaming will achieve the full the benefits which it could deliver.

A7.403 We note Vodafone's comment in relation to the position we took in relation to our 2G national roaming consultation in 2004. However, that consultation was in the context of 2G voice services. These are much better understood and the networks on which roaming is provided were already built and in operation. This is not the case for the use of liberalised 900MHz spectrum for improved mobile broadband services.

A7.404 We also received the following comments which we provide responses to.

- O2 suggested that it was unlikely to be commercially viable for five UMTS900 networks to be deployed given their estimates of the incremental costs and revenues relating to deploying UMTS900 networks.
  - We do not accept O2's estimate of the number of UMTS900 networks that the market could commercially support. We estimate that the costs of deploying UMTS900 sites would range from £250 million to £450 million (in NPV terms over 20 years using the commercial discount rate). We note that network or spectrum sharing agreements could result in fewer than five UMTS900 networks being deployed. However, even if five networks were deployed, our modelling shows that the profit which each operator could gain from mobile broadband is between £960million and £2.1billion. Hence it does not seem likely that each of the MNOs could not afford to roll out a UMTS 900 network for mobile broadband.
- Vodafone argued that we should consider what the impact on competition would be if the 900MHz operators have to release some of their spectrum. Vodafone identifies a number of dimensions of competition that would be affected, such as higher costs of supply and poorer service quality (coverage, dropped calls, speech quality).
  - We have considered the potential for spectrum release to cause disruption to Vodafone's and O2's network. We conclude that this disruption would not be significant and hence we do not expect that this would have a competition impact[34].
- Vodafone argued that the benefits of 900MHz spectrum were not sufficient to disrupt competition for mobile broadband.
  - This is not consistent with our analysis. We think that there are plausible scenarios in which the benefits of 900MHz are such that operators without access to this spectrum can not practically match the quality of services provided by those with this resource, and that this quality difference could be such that it matters to consumers. Hence, there are plausible scenarios in which the benefits of 900MHz spectrum could result in a disruption of competition if wider access to 900MHz is not available. Our analysis on these issues is set out sections 4 and 5.
- An individual was concerned that since his car phone used 900MHz spectrum only he did not want to buy a new car so that he could have a working car phone.

[34] See annex 16, in particular paragraphs A16.303 onwards.

- Consumer 2G equipment that uses 900MHz spectrum only will continue to work under our proposals. It is therefore not a relevant cost to take into account in the analysis.