Digital Dividend Review

A statement on our approach
to awarding the digital dividend

Annexes

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Annex 2

Detailed application of the total value framework: service by service

Introduction

A2.1 This annex sets out in more detail the application of our analytical approach to each of the likely licensed uses of the digital dividend (local television, digital terrestrial television (DTT), mobile broadband, and programme making and special events (PMSE) services). This section builds on the analysis set out in sections 5 and 7 of the statement in order to provide a comprehensive account of our analysis in relation to all of the market failures considered.

A2.2 Two of the potential uses are not considered in the annex. Mobile television is not addressed here because no significant market failure concerns were identified either in or since the digital dividend review (DDR) consultation document. Applications which are suitable for licence exemption are also not discussed in this annex since we have addressed this issue in sufficient detail in section 6 of the statement.

A2.3 The structure of this annex is as follows. We start with further discussion of background issues which are relevant to our assessment. This background section covers:

- the possible reasons for market failure, this is aimed at complementing the general discussion of these matters in section 5;
- our analysis of the opportunity cost of intervention and how this relates to each of the different uses; and
- the advantages and disadvantages of the intervention options which can be employed to resolve each of the key market failures.

A2.4 After setting out this general background information we proceed to apply our total value framework to each of local television, DTT, mobile broadband and PMSE. In doing so we use the following approach:

- we firstly set out new developments, evidence and responses;
- we then reassess each of the relevant market failure arguments to reach a conclusion on whether there is likely to be a significant market failure risk;
- for issues where there is a significant market failure risk, we go on to consider whether intervention might be appropriate. This involves assessment of the opportunity cost of interventions, and the risk of regulatory failures in relation to the different intervention options. In addition where there is a risk that the scale of market failure could change over time, or where other agencies may wish to consider intervention on behalf of uses with wider social goals, we go on to consider how intervention to resolve these issues can be achieved under a market led approach; and
- we finally conclude on whether there is a reason to intervene in relation to each of the uses, and if so, what form of intervention we propose to apply.
A2.5 Our analysis of the application of the total value framework to PMSE is split over this annex and the following annex. In this annex we focus predominantly on the argument for there being a market failure in relation to this use. In the next annex we set out the work we have completed to identify which intervention option can best resolve the market failures faced by PMSE users.

**Background**

**Sources of market failure**

A2.6 We identify in the statement the two most likely causes of market failure in the DDR, these being:

- transaction costs; and
- externalities caused by the presence of broader social value (BSV).

A2.7 The services considered in this annex between them all contain examples of these types of market failure. As these two forms of market failure are discussed in section 5 we do not provide an introduction to them in this section.

A2.8 In addition to these two market failures, we also identified in the DDR consultation document two further sources of market failure which are relevant to some of the potential uses of the digital dividend. These are firstly, potential capital market failures affecting the BBC and Channel 4, and secondly, the possibility of an advertiser funded business model giving rise to a market failure. Since these market failures were not discussed in section 5 we provide here a background discussion of these issues and how we propose to assess if they are significant.

A2.9 In this section we also provide a more detailed description of the types of BSV market failures we have considered. This complements the general discussion of this form of market failure in section 5. We identify and explain the three main categories of BSV argument and how for each of these arguments we identify the incremental BSV associated with use of the digital dividend. We also explain further how we go about assessing whether the presence of BSV could be expected to result in a market failure in the award of this spectrum.

**Capital market failures**

A2.10 When identifying capital market failures it is important to distinguish between two cases. The first is where organisations seeking to provide a particular use face difficulties accessing capital because of potential weaknesses in the viability of their business case. Generally, this is the capital market working effectively and is not a source of market failure. The second situation is where particular institutions face difficulties which result in them finding it hard to access capital despite their proposals being likely to generate significant value. When this is the case there is a capital market failure.

A2.11 In the context of the DDR consultation, we identified that there was one situation in which capital market failures may occur. This is where the BBC and Channel 4 are bidding for spectrum. These two organisations face borrowing constraints which may limit their ability to source capital as efficiently as their privately funded competitors. This may mean that these organisations are unable to fully reflect their willingness to pay for spectrum in an auction process.
A2.12 In order to understand how significant this type of problem might be we need to consider whether this is likely to prevent these organisations from gaining access to spectrum entirely and if so what the impact of this may be. For example, if the BBC and Channel 4 wish to acquire additional multiplex capacity, whilst their ability to acquire this through bidding for spectrum directly may be constrained, their ability to acquire additional multiplex capacity may not be significantly affected if there are other bidders who are willing and able to bid in the auction as multiplex operators.

Advertiser funded business model

A2.13 We noted in the DDR consultation document the potential implications of the use of an advertiser funded model for local television, further standard definition (SD) channels and high definition (HD) channels in terms of potential market failure.

A2.14 The commercial (COM) public service broadcasters (PSBs) have traditionally used such a model. One of the reasons for this on the DTT platform is the historical position of this platform. However, added to this is the technical difficulty and high cost of providing a subscription service for a subset of the services, when compared with the low marginal cost of delivering a free-to-view service.

A2.15 The argument that an advertiser funded business model might result in a market failure essentially rests on the proposition that the producer value generated under such a model is less well correlated with consumer value than other business models for uses of spectrum. Consequently, it is argued, that the advertiser funded model will, all other things being equal, result in other uses obtaining spectrum even where consumer value may be lower and so result in market failure.

A2.16 In order to assess whether this proposition is valid we take the following approach:

- first we consider whether there are any a priori reasons to expect the relative incremental producer and consumer value for a subscription television service to be significantly different to the relevant values of other subscription services which could use the digital dividend;

- second, we assess whether there are a priori reasons to expect the producer value of free-to-view advertiser funded television likely to underestimate consumer value relative to a subscription television service; and

- finally, we consider whether there are any reasons to expect that this relationship would not hold for the use of the digital dividend. In particular, given the proposition that free-to-view models are systematically disadvantaged, we consider whether there are reasons to expect a lower ratio of producer to consumer value from the use of the digital dividend by a free-to-view broadcaster.

A2.17 If the relativities in each of these cases are plausibly the same, then we can conclude that there is no compelling case why the use of a free-to-view advertiser funding model by some uses would not be expected to result in a market failure in the award of the digital dividend.

A2.18 We address the first two points of our approach in this background discussion. We then consider the final point in relation to each of the services affected (local television, and SD and HD services on DTT) in the relevant service by service discussions.
A2.19 There are a number of factors which can influence the ratio of consumer to producer value generated by a subscription funded use of the digital dividend. For example, the degree of competition in downstream markets and the presence of consumer externalities (i.e. network effects). However, we do not have evidence to suggest that these sorts of differences will systematically affect only a subset of the uses. Hence, while it is not the case that the ratio of producer to consumer value will always be the same across all subscription services, we do not believe that there is evidence to suggest that a subscription television service would systematically generate different levels of consumer value relative to producer value than other subscription based services, such as mobile broadband.

A2.20 In order to understand whether a subscription based model for television services would generate a significantly different ratio to that of a free-to-view advertiser funded service, we need to consider the reasons why these two models are used. The use of a subscription business model will generally be preferred where audiences are interested in and prepared to pay for niche or special interest content, viewing reach and share is generally low, and non subscribers can be excluded. Conversely, broadcasting to a large audience where reach and viewing is relatively high, demand is relatively sensitive to the price of viewing, and costs of transmission and content are relatively low, will tend to favour a free-to-view model and will be one in which many advertisers are interested.

A2.21 In some cases a free-to-view advertiser funded business model will be best able to translate consumer value into revenue and result in a good business case for a broadcaster and in others a subscription model will be more profitable. While it is not the case that for the same type of content that two models will generate the same ratio of producer and consumer value, where they are each being used appropriately (i.e. where they are the most efficient business model for the delivery of the content in question) it is not clear that the ratio of consumer value to producer value will differ significantly.

Identification and consideration of BSV externalities

A2.22 As we explained in section 5, market failure can occur when differences in external value between uses are large enough to distort the ranking of willingness to pay for spectrum relative to total value. Hence the existence of significant BSV generated by a service which uses spectrum could result in market failure. In order to identify whether the presence of BSV is likely to result in a market failure we need to consider first how significant the BSV is likely to be and secondly whether this is sufficient to result in a distortion in the ranking of the service if it is not factored into willingness to pay for spectrum. Our approach to answering these two questions is discussed below.

Approach to assessing incremental BSV

A2.23 In order to understand whether a use generates significant BSV we have assessed the extent to which BSV generated by the use in aggregate may differ from the incremental BSV generated by its use of the digital dividend. Many of the uses of this spectrum clearly generate significant BSV in aggregate but the relevant question for our assessment here is does use of the digital dividend significantly increase this value. In order to help answer this question we identified three categories of BSV arguments:

- those which relate to BSV generated by the provision of universal access to socially valuable services. This argument is particularly relevant to our assessment of HD (the provision of PSB content in this format) and mobile broadband;
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- those which relate to BSV generated by services, the content of which is socially valuable. This argument is particularly relevant to our assessment of local television and additional SD channels; and

- those which relate to knock-on effects on the BSV generated by other services. The key example of this is an argument that a failure to acquire additional spectrum for HD could reduce the amount of BSV generated by the DTT platform.

A2.24 In our assessment of incremental BSV we consider qualitatively whether there are likely to be other options for delivering this value, given its drivers (e.g. whether it the content or its universal availability which drives BSV). It is possible and likely that some services that generate BSV can be delivered in a number of ways. For example, local television can potentially be delivered over the Internet or through the use of personal video recorders, rather than over the digital dividend. When this is the case the incremental BSV associated with this spectrum, and the positive externalities from its use may be lower, and hence the risk of market failure resulting from the award of the digital dividend is reduced. However, if the magnitude of the BSV generated is very dependent on access to the digital dividend then market failure arguments may be more significant.

A2.25 In relation to local television this could be the case if the delivery of content over the digital dividend is likely to be significantly more attractive to viewers. It is sometimes argued that this is the case as viewers find it easier to access services if they are available via their television set. However, given the rapid development of internet delivery of content and likely increases in the opportunity to access this via a television set, the validity of this argument is reduced.

A2.26 Regarding the DTT platform, it is quite possible that BSV is associated with providing further SD channels or HD including the universal availability of PSB content in this format. If it is the case that such further services can only be provided through using the digital dividend to increase the capacity of the platform, the incremental BSV associated with this spectrum might be significant. On the other hand, the incremental BSV would be lower to the extent that such additional services can be delivered using existing spectrum capacity. Our work in relation to the future of DTT consultation document¹ has shown how the use of new technologies can allow new services, including HD, to be delivered using the spectrum already reserved for DTT.

A2.27 Universal access to broadband is another service that might generate significant BSV. To the extent that this could only be achieved through this spectrum again there might be potentially significant incremental BSV associated with this. However, it is important to bear in mind that alternative delivery routes could exist for universal access to broadband which would tend to reduce the incremental BSV associated with the digital dividend per se. These include alternative spectrum bands (such as the 900 MHz spectrum) and alternative wired delivery mechanisms.

A2.28 Taken together, the points made above all suggest that whilst many of the potential uses of the digital dividend may generate significant BSV in aggregate, there is reason to believe that the incremental BSV generated by their use of this spectrum is significantly lower.

Approach to assessing whether BSV may result in a market failure

A2.29 The assessment of the potential for BSV externalities to result in a market failure involves two elements. Firstly, we consider the BSV generated by the different uses and assess whether this differs across the uses. Secondly, we consider whether any differences in BSV are significant enough to result in a market failure in the award of the digital dividend.

A2.30 Many of the potential uses of the DDR generate significant BSV. Further SD channels on the DTT platform, local television and universal access to broadband services for example all directly generate BSV. However, as discussed above, the question we need to answer in the DDR is whether access to the digital dividend will generate extra (or incremental) BSV from these uses.

A2.31 Our modelling work in annex 8, and the market research results the modelling is based on, allows an indicative estimate of the incremental consumer and producer value of the digital dividend and of the BSV which may be generated by these uses. Broadly speaking, we find that most potential uses of this spectrum have a relatively high value to consumers and producers and some degree of BSV. The estimates can only be indicative, and are subject to a large degree of uncertainty. The estimates, which are summarised in table A39 in annex 8, indicate that the BSV generated ranges from around 5-15% of the producer and consumer value. Whilst in some cases this may overstate the incremental BSV given limitations on the nature of questions which can be answered using market research, this overall picture of relatively low incremental BSV is consistent with our qualitative assessment of the incremental BSV generated by the use of the digital dividend.

Illustrative comparison

A2.32 We illustrate here the broad implications of this modelling work and the estimates in table A39 in annex 8 in terms of the effect of BSV on potential rankings of services and hence any question of market failure resulting from BSV.

A2.33 The indicative ranges of BSV for each use, as a percentage of value to consumers and producers, are not very different from each other and overlap significantly. There are two consequences of this for the assessment of market failure. First, where two uses have similar private value, this suggests that their total values will not differ significantly. Second, where private values do differ significantly, this is likely to be a good indicator of their relative ranking in terms of total value.

A2.34 Figure A1 illustrates this in principle. We consider four potential uses of spectrum, A, B, C, D, each with some level of private value (PV) and BSV, and ranked here by the sum of these (i.e. by total value). Their private values correspond broadly with the upper ranges derived from our modelling. Total value for uses A, B, and D include 15% BSV, and use C includes 5% BSV (uplift from private value). Clearly the ranking by total value is not distorted by the inclusion of BSV, when compared to ranking by private value alone. This is because the differences in BSV are relatively small compared to the differences in private value.
A2.35 The one situation in which relatively small differences in BSV can distort overall rankings is where two uses have similar private values but slightly different BSV. However, even where this results in a change in the ranking of the services, the overall impact on total value of this change not being reflected in willingness to pay for spectrum would be relatively low. This is because the amount of total value lost will be limited to the small difference in the BSVs.

**Opportunity costs**

A2.36 Any intervention will have a cost to society because it will displace resources from one use to another. In the case of spectrum, which has many alternatives uses, setting aside spectrum for one use or user will impose a cost on society by denying access to other uses or users. This is what is known as the opportunity cost, where the cost is equal to the value of the opportunity that is being denied.

A2.37 We have modelled the values of different services and derived generic estimates of the opportunity cost of intervention (see annex 8). We summarise here the broad implications for opportunity cost for each of the services. All opportunity cost figures shown here are the producers and consumers surplus which would be lost by denying access to spectrum as alternative use expressed as a net present value (NPV) over 20 years.

A2.38 For local television we assume that this would most likely be broadcast using the interleaved spectrum. An intervention to give local television a preferred use of this spectrum on one channel (with the actual channel used varying across the UK in order to allow local television broadcast) could, depending on assumptions, give opportunity costs of up to £400m.

A2.39 Displacing channels in the cleared spectrum, in order for example for the DTT platform to secure an additional multiplex to broadcast further SD channels or HD, or to provide mobile broadband services, could give opportunity costs in the range £1bn-2.5bn in total (based on intervention for six channels).
A2.40 In relation to PMSE use of spectrum, the economic modelling provides a first very rough estimate of the opportunity cost of this use. That modelling work looked into the range of economic values generated by the most probable alternative users of the interleaved spectrum. On the assumption that some of these uses of the interleaved spectrum will be allowed, for example, by our proposal to auction some packages of interleaved spectrum which are suitable but not reserved for local television, the opportunity cost of allocating spectrum to the PMSE sector will be linked to the least valuable remaining uses which are displaced by PMSE.

A2.41 Our modelling suggests that the cost of displacing alternative uses from the first few channels allocated to PMSE could be as high as £50m per channel lost. However, the cost per channel is likely to decline rapidly as the number of channels allocated to the PMSE sector increases because progressively fewer alternative uses are denied spectrum. Therefore, although an intervention in favour of the PMSE sector may involve a significant number of interleaved channels being allocated to this use (in some locations the number of channels available for PMSE may be relatively low, i.e. 5 or fewer, whereas in others it could be relatively high i.e. 20 or more) we think it is plausible that the opportunity costs of the PMSE use is no greater than £250 million.

A2.42 Please note that the opportunity cost figures show here represent the lost value to consumers and producers from what is in most cases a significant reduction in the amount of spectrum available. These are not indicative of the administered incentive pricing (AIP) that may be charged for access to any spectrum provided via an administrative process. AIP is generally based on more marginal changes in spectrum availability, and is also based on the impact of this on other spectrum users (i.e. producers) and hence does not include any impact on consumer value.

A2.43 The opportunity cost estimates are helpful in order to set any market failure in context; that is, where opportunity costs of intervention are significant, the corresponding market failure will also need to be at least as significant in order for an intervention in the first instance to be justified (not taking account of the risk and significance of any regulatory failure). Furthermore, to the extent that expected opportunity costs are relatively high, we would also be particularly concerned about any risk and significance of regulatory failure associated with any intervention, which may increase the costs of the intervention.

**Intervention options**

A2.44 We have considered a wide range of options for resolving market failures. Some are consistent with a market led approach, while others involve increasingly significant departure from a market, and hence are interventionist approaches to resolving market failures. The type of intervention required will depend upon the cause of the market failure and the circumstances of the market in which it occurs.

A2.45 In this section we discuss the following intervention options: direct funding, match winning bids, phased payments, bidder credits, auction design and packaging, and administrative allocation. The first five are intervention options which can be consistent with a market led approach. The final intervention generally involves increasing restrictions on the use of spectrum hence is likely to be interventionist in approach.

A2.46 In the following paragraphs and figures A2 to A7 we describe each of the intervention options mentioned above. We then conclude by providing a summary assessment of the advantages and disadvantages of the intervention options which are likely to be effective at resolving each of the market failure arguments we have considered.
Direct funding

A2.47 Figure A2 provides an example of how the direct funding option might work. This intervention is particularly relevant to BSV externalities. The idea is that potential bidders who might be expected to deliver BSV through the use of spectrum would approach funding bodies in order to be given funding that would allow them to reflect this BSV in bids for spectrum. This might for example apply to broadcasters who could be expected to provide wider benefits to society by providing content which meets PSB purposes. The funding body would normally be expected to place some form of contractual or regulatory obligation on the bidder to ensure delivery of the anticipated BSV.

A2.48 This approach has a clear advantage in that it allows spectrum to be valued in a market manner while reflecting BSV attached to particular uses. Furthermore funding decisions can be retained by those responsible and best able to make decisions concerning the provision of the service and the inputs, including spectrum, necessary for it. Nevertheless there are a number of drawbacks of this approach. Direct funding can in principle distort competition between spectrum uses. More generally it might be argued that public funding (direct or indirect) for a service in a particular market can have impacts—positive or negative—on other firms or entities in the same or related markets. For example, BBC activities may have effects on competition and markets for broadcasting and media (amongst others), including potential ‘crowding out’ of other market parties. Furthermore, the approach implies some oversight issues and costs in that any direct funding of a spectrum user by a provider should in principle be matched by obligations put in place on the provider by the funding body.

A2.49 In their responses, some respondents questioned the suitability of direct funding for resolving BSV externalities. Some suggested that a number of issues might impede either the provision or use of direct funding. We have therefore given thought to reasons why direct funding may not work in practice. We have identified the following possibilities:

- processes for acquiring public funding may be open, revealing bidders’ valuations prior to auction. This could result in strategic behaviour by other bidders as they will know how much they can bid the price up before those financed through public funding drop out;

- public bodies may be subject to different capital funding constraints than the private sector. These are a result of the current funding mechanisms which are generally designed for shorter term funding requirements (i.e. 3 to 5 year spending reviews) rather than for acquiring long lived assets such as spectrum licences; and

- compared to the private sector, public funding bodies may currently lack experience in spectrum procurement. This may be resolved in the future but is likely to be an issue during the transition to the situation in which publicly funded organisations acquire spectrum via the market.

A2.50 We have carefully considered these issues and have identified that there may be some interventions which we can combine with direct funding in order to facilitate this process. These options are allowing some organisations to match winning bids or to phase their payments. However, these further interventions are not costless, and

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2 For this reason where such activities are publicly funded the BBC must carry out a Market Impact Assessment in order to ensure that there are no such adverse effects.
therefore their potential disadvantages need to be considered carefully. Additionally, there may be alternative mechanisms by which these problems can be addressed, such as changing the institutional funding arrangements which result in these barriers. Indeed, it is likely that these changes would be required long term as publicly funded organisations are increasingly required to acquire spectrum through market mechanisms.

**Figure A2. Direct Funding**

<table>
<thead>
<tr>
<th>Service provider engages with funding bodies</th>
<th>Service providers approach funding bodies with (contingent) request for funding to acquire DDR spectrum, or alternative delivery capacity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Funding bodies set requirements for service</td>
<td>In return for providing additional funding, funding bodies place some form of contractual or regulatory obligations on service providers to ensure delivery of the anticipated BSV.</td>
</tr>
<tr>
<td>Service provider bids in spectrum auction</td>
<td>We then hold a spectrum auction – service providers are able to reflect total value of service provision in bids (equally, able to decide not to use DDR spectrum and deliver service through other routes).</td>
</tr>
</tbody>
</table>

**Match winning bid**

A2.51 Giving market parties an opportunity to match a winning bid for spectrum in an auction would be a way of facilitating funding and participation in auction. Figure A3 provides an example of how this intervention might work. The idea is that we would set criteria for a particular use of spectrum, reflecting BSV associated with it. Parties willing to provide services using these criteria would be eligible to match the winning bid at the end of the auction process. Where a bidder matches the winning bid, they are awarded spectrum. This would give them the opportunity to find funding once there is better information available on the amount of funding they require. This approach is similar in concept to the ‘Waverley Rules’ under which museums may match winning bids for certain works of art in order to keep them in the UK.

A2.52 Such an approach could help to address market failures associated with BSV, because a potential bidder providing BSV might find it easier to access funds when the outcome of the auction is known. As such the approach facilitates direct funding. It also allows an auction process to reveal the value of spectrum for alternative uses. Furthermore any contractual or other conditions regarding provision of the service remain with the appropriate responsible and capable funding bodies. However, this approach might be disadvantageous since care is needed when designing the process in order to avoid any inappropriate or perverse incentives on market participants to become eligible. Additionally, there is a risk that this option could result in an inefficient allocation of spectrum. This is firstly because it might reduce the level of participation in the auction as those who are not able to match winning bids may be less willing to participate on this basis. Also, there is a risk that when a bidder matches a winning bid they are not actually the bidder with the highest valuation. This is because the winning bid is generally the amount that the second highest bidder would have been willing to pay.
**Figure A3. Match winning bid**

- **Consult on BSV**
  - We consult on potential BSV involved in provision of particular use of spectrum.

- **Define requirements for right to MWB**
  - Based on responses, we set out requirements and criteria to be met in order for bidders to secure the right to match winning bid. Criteria might include: the provision of certain socially valuable applications.

- **Bidders apply to qualify for MWB**
  - Bidders submit proposals to be considered for the right to match winning bids. Those bidders who qualify are identified and will be given the opportunity to exercise this right at the end of the auction.

- **Hold spectrum auction**
  - We then hold a spectrum auction – note, that the option to match winning bids may reduce the level of competition in the process.

- **Bidders seek funding to MWB**
  - Once auction completed, bidders who can demonstrate that they will meet our requirements have a period of time over which they can to match the winning bid. Bidder approaches funding providers with non-contingent, clearly defined funding requests. Funding providers place some form of contractual or regulatory obligations on bidder to ensure delivery of the anticipated BSV.

- **Qualified bidders awarded spectrum if able to MWB**
  - If they can match winning bids, qualified bidders are able to exercise this right and will be awarded the spectrum. May need process for determining winner if more than one qualified bidder seeks to exercise this right.

**Phased payments**

A2.53 Allowing certain or all parties to phase their payments instead of making an upfront payment if they win an auction is a further way of facilitating direct funding, but is also an intervention which could be used to solve other forms of market failure such as capital market failures. Figure A4 provides an example of how this intervention might work. Here, all bidders are allowed to submit bids in the form of a profile of phased payments. The auction is held and the bidder with the highest NPV of phased payments would win.

A2.54 The approach is advantageous in that it retains a clear auction process and allows full competition between competing uses. It is also compatible with direct funding and supports rather than replaces it. It is relatively simple to implement and may not require the setting of criteria for eligibility or ex post enforcement if all bidders are given the opportunity to phase payments. Nevertheless, this approach carries potentially significant risks. First there is a credit risk for us because of the risk of payment default by a bidder that has committed to a payment stream. Second there is a risk that spectrum is returned to us, where the business case of the winning bidder does not prove to be profitable and the payment stream cannot be maintained. In such a case the return of spectrum to us for resale or reallocation would not be straightforward given the administrative requirements which we need to meet when awarding spectrum.
Bidder credit

A2.55 Awarding particular bidders a ‘bidder credit’ in any auction is a direct way of allowing the user to reflect a BSV. Figure A5 provides an example of how this intervention might work. Again under this approach it would be necessary for us to set out criteria and assess bidders’ eligibility for a bidder credit, likely based on potential BSV. The auction would be held, with any bidders holding a bidder credit able to use this as part of their bid. Where the bidder is successful, we would impose and oversee spectrum licence conditions in relation to the delivery of the BSV. The bidder may be able to trade the spectrum subject to repaying the bidder credit.

A2.56 This approach risks reducing flexibility in spectrum use, and may encourage those eligible for bidder credit to be less efficient in terms of choosing between spectrum and non spectrum inputs needed to deliver a use. This approach also involves our setting the level of the credit and implies the need for a large and accurate information bank across all uses to set this; hence it risks excluding other spectrum bidders where the level is set too high, or insufficiently representing BSV interests if it is set too low. The setting of and enforcement of conditions relating to BSV are also relatively complex and potentially costly. Nevertheless the approach has the advantage that it retains market testing of uses of spectrum against each other.

Figure A5. Bidder credit

<table>
<thead>
<tr>
<th>Consult on BSV</th>
<th>Define requirements for right to bidder credit</th>
<th>Bidders submit applications</th>
<th>Hold spectrum auction</th>
<th>Licence requirements on “bidder credit” winners</th>
<th>Ofcom has ongoing regulatory role in relation to service</th>
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<tbody>
<tr>
<td>We consult on BSV involved with particular service use of spectrum.</td>
<td>Based on responses, we set out: • requirements to be met in order for bidders to secure a bidder credit (e.g. broadcast X hours per day of relevant content) • value of bidder credit for those that meet the requirements</td>
<td>Bidders notify us of willingness to accept spectrum licence obligations, which are designed to ensue that the requirements are met. Those that accept requirements become eligible for bidder credit.</td>
<td>Normal spectrum auction held, with parties holding bidder credits being able to put those credits towards their auction bids – though note this will distort their incentives to consider alternate delivery mechanisms.</td>
<td>If bidder qualifying for credit is successful in the award, we include spectrum licence obligations in relation to delivery of BSV (though may not be explicitly linked to use of spectrum). Licence obligations require that, if spectrum is sold on he bidder credit is repaid</td>
<td>Through licence conditions we exercise ongoing oversight in relation to adequate delivery of service for which the bidder credit has been received.</td>
</tr>
</tbody>
</table>
Auction design and packaging

A2.57 The final intervention option which is consistent with a market led approach, involves the spectrum auction being amended or tailored in some way to reflect market structures or other difficulties, in order that auction participation and expression of value is as full as possible. Such auction design and packaging could for example involve creating packages of local rather than UK wide spectrum in order to address coordination difficulties of geographically diverse local broadcasters. An auction would then be held as normal, with bids made for the spectrum packaged in this manner. Winning bids would not be obliged to use the spectrum for the use for which it had been packaged. Figure A6 provides an example of how this intervention might work.

A2.58 This approach is helpful in that it can directly address the market failure, particularly coordination failures. However it carries risks that overly tailored products are unsuitable for and so exclude bids from other uses or bidders for spectrum, who potentially value it more highly.

Figure A6: Auction design and packaging

| Assess need to adjust auction design and packaging | Assess extent to which some form of market failure (e.g. coordination failure or transaction costs) exists which can be resolve through auction design and packaging. |
| Amend auction or packaging | Tailor spectrum product in way that addresses the issue. For example, package spectrum locally rather than UK-wide, whilst still ensuring that the packaging is suitable for other, potentially higher value, uses. |
| Hold spectrum auction | Normal spectrum auction held. All parties and potential uses of spectrum are eligible to participate. |
| Assess winning bids | Highest bid wins. This may or may not be the original use for which the spectrum packaging was amended. |

Administrative allocation

A2.59 The last intervention option we consider is a non market based approach. It involves the regulator in determining directly which uses or services some parts of the spectrum should be allocated to. It may be possible following such an allocation to hold an auction or other comparative selection process, such as a beauty contest, to determine which providers should obtain use of the relevant reserved part of spectrum. Such an administrative allocation approach in principle enables the regulator to address perceived market failures, including coordination issues. It clearly has a disadvantage that it requires the regulator to make decisions on use of spectrum and so implies that the regulator is better informed about current and future potential uses and values of spectrum. The approach therefore risks excluding higher value uses of spectrum. Figure A7 provides an example of how this intervention might work.
A2.60 We now explain which of these intervention options are likely to be most effective at resolving the main market failure risks considered in this annex. These are coordination problems, capital market failures, and BSV. We have excluded the issue of advertiser funded business model on the basis that our reassessment later in this annex has not identified this issue as of sufficient significance to pursue this further here.

A2.61 Coordination problems can cause market failure where a disparate group of market participants need to coordinate in order to enter the spectrum market. Where coordination or transaction costs are large, it may impede their participation and so result in a market failure, even where the group’s aggregate valuation of spectrum is high.

A2.62 The intervention options which are most likely to be effective at resolving coordination failures are: auction design and packaging and administrative allocation. We set out below the advantages and disadvantages.

### Table A1. Forms of intervention to address coordination problems

<table>
<thead>
<tr>
<th>Auction design and packaging</th>
<th>Administrative allocation</th>
</tr>
</thead>
<tbody>
<tr>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>• Can remove need to coordinate</td>
<td>• Ensures that the coordination problem does not result in the use failing to acquire spectrum</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>• Could result in other types of bidders being disadvantages</td>
<td>• Distorts incentives for efficient spectrum use through: a) its impact on the auction outcome, and hence on the perceived opportunity cost of spectrum, and b) the potential for restrictions imposed during the prequalification phase to reduce the flexibility of spectrum use in the future</td>
</tr>
<tr>
<td></td>
<td>• Risk of inefficiently excluding other uses which are higher value</td>
</tr>
</tbody>
</table>

A2.63 Capital market failures can arise where a market participant faces particular difficulties in accessing finance. Such difficulties can impede participation in spectrum markets, again with potential for market failure.

A2.64 The intervention options which are most likely to be effective at resolving capital market failures are: removing institutional barriers, phased payments, and bidder credits. We set out below the advantages and disadvantages.
Table A2. Forms of intervention to address problems with capital market failures

<table>
<thead>
<tr>
<th>Removing institutional barriers</th>
</tr>
</thead>
</table>
| + • Auction process reveals opportunity cost of different spectrum uses  
  • Supports direct funding                                             |
| - • Could have unexpected effects if the institutional barriers are justified in some situations |

<table>
<thead>
<tr>
<th>Phased payments</th>
</tr>
</thead>
</table>
| + • Auction process reveals opportunity cost of different spectrum uses  
  • Supports rather than replaces direct funding                       |
| - • We take credit risk                                               
  • If the bidder defaults, spectrum returns to us and is unused until we award it again |

<table>
<thead>
<tr>
<th>Bidder credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ • Auction process reveals opportunity cost of different spectrum uses</td>
</tr>
</tbody>
</table>
| - • Distorts incentives for efficient spectrum use                    
  • High information requirement for us in setting the credit—may need to set the credit very high if the capital market failure is significant |

A2.65 The existence of BSV for a particular service can, as explained above, result in the ranking of total value differing from the ranking by private value of all uses of spectrum, perhaps resulting in market failure.

A2.66 The intervention options which are most likely to be effective at resolving market failures associated with BSV are: direct funding, direct funding combined with phased payments or match winning bids, and bidder credits. We set out below the advantages and disadvantages.

Table A3. Forms of intervention to address problems with BSV

<table>
<thead>
<tr>
<th>Direct funding</th>
</tr>
</thead>
</table>
| + • Ensures spectrum users have appropriate signals to use spectrum efficiently (by ensuring they pay the full opportunity cost for spectrum and by allowing them to trade off between different inputs)  
  • Provides socially valuable spectrum users with access to a flexible spectrum licence which allows them to respond quickly to changes in the nature of the service they are providing  
  • By tying the provision of funding to the socially desirable output it allows greater flexibility in the delivery of the socially valuable output (i.e. can use funding to deliver the desired output using non spectrum delivery mechanisms)  
  • Auction process reveals opportunity cost of different spectrum uses |
| - • Need to set the funding at the correct level. But this assessment would be required with any form of intervention to secure access to spectrum for socially valuable uses  
  • Significant public funding can create market distortions. But once again, distortions would be created with any form of intervention to secure access to spectrum for socially valuable uses |

<table>
<thead>
<tr>
<th>Direct funding combined with phased payments</th>
</tr>
</thead>
</table>
| + • We take credit risk, if bidders default on the future payments we will need to instigate proceedings to reclaim the spectrum  
  • Can provide spectrum users with incentives to bid for spectrum speculatively—if their service does not turn out to be commercially attractive they can return the spectrum to us  
  • If the bidder defaults (or decided to return their spectrum), spectrum returns to us and is unused until we award it again, this may take a considerable period  
  • If only a subset of bidders are allowed to phase payments this may result in difficulties in assessing which is the winning bid (when comparing phased payments with upfront bids)  
  • Need to identify a suitable criteria by which to judge who should be allowed to phase payments |
| - • Supports rather than replaces direct funding                     |
**Direct funding combined with matched winning bids**

<table>
<thead>
<tr>
<th>+</th>
<th>• Supports rather than replaces direct funding</th>
</tr>
</thead>
</table>
| - | • Care needed in choosing the right types of bidder to receive the rights to match winning bids and the prices they will pay  
  • Can result in an inefficient outcome if the price matched does not reflect the full valuation of the current highest bidder at the end of the auction  
  • May significantly affect extent of competition in the auction—at its most extreme other bidders may decide not to bid at all (given that taking part in the auction can involve costs)  
  • Can result in strategic behaviour in the auction  
  • May resolve the difficulties caused by funding decisions prior to the auction being open, but there may be other options to resolving this. For example, by restricting the availability of information on funding decisions until after the award is complete |

**Bidder credits**

<table>
<thead>
<tr>
<th>+</th>
<th>• Auction process reveals opportunity cost of different spectrum uses</th>
</tr>
</thead>
</table>
| - | • Distorts incentives for efficient spectrum use by adjusting the price paid for spectrum  
  • High information requirement when setting the credit (but this holds for other forms of intervention such as direct funding)  
  • Requires acceptance by bidder of licence conditions, relating to generating BSV, in return for access to bidder credit. These may be complex or time consuming to enforce, or modify, as circumstances change  
  • The imposition of conditions in licences ties the delivery of the desirable output to spectrum which does not allow those delivering socially valuable outputs to trade off different delivery mechanisms  
  • Imposing conditions in licences may reduce the future flexibility of the licence which can have knock-on effects on innovation and future spectrum efficiency |

**Conclusions**

A2.67 We have set out here the main elements of our analytical framework for assessing total value and the intervention options that might be available for addressing any market failures. In particular we have further discussed possible sources of market failure, including capital market failure, the advertiser funded business model, and BSV externalities. In the last case we have explained how the existence of BSV might or might not produce market failure owing to its overall effect on total value. We explained how any intervention to address market failure must be seen in the context of its opportunity cost, and went on to describe what intervention options were available for particular causes of market failure and what advantages and disadvantages these might have.

**Application of the framework**

A2.68 We set out here our application of the total value framework to the services local television, the DTT platform, mobile broadband, and PMSE services.

A2.69 In doing so we also use a number of sources of evidence, as the statement noted:

- market research;
- economic modelling;
- secondary research and sources;
- technical analysis; and
- consultation responses.
A2.70 The statement provides further details on the relevance of these forms of evidence. We note here in particular the need to recognize that no one piece of evidence in isolation can give a full picture. The market research for example reflects only opinions at the time they are taken. It is therefore important in assessing the evidence to weigh up and balance the sources against each other.

**Local television**

A2.71 We made an initial identification and assessment in the DDR consultation document of the factors and arguments that might point to local television not being able to reflect the total value to society of this use of spectrum in their bids for spectrum, and hence where a market based approach for spectrum award might result in a market failure. We assessed in the DDR consultation document three possible sources of market failure, these being:

- coordination failure: demand for spectrum for local television services is likely to be geographically diverse, with a number of different operators across the UK. Where spectrum is awarded on a UK wide basis, potential coordination and transaction issues arise in particular for disparate local television operators who might wish to obtain geographically specific tranches of spectrum;

- BSV: local television may generate BSV, hence we need to consider whether this may alter rankings of total value of spectrum uses; and

- advertiser funded business model: local television operators typically use advertiser funded business models that result in advertising revenue, hence producer value and willingness to pay for spectrum under represent total value to society.

A2.72 We concluded in the DDR consultation document that the first issue was significant enough to justify intervention, through packaging interleaved spectrum in a way suitable for use by local television operators. We concluded that the second two issues were not sufficiently significant to warrant direct intervention, but noted that direct funding could be used to allow the expression and valuation of any BSV through use of the digital dividend for local television if public funding bodies identify that the value generated warrants this level of support.

A2.73 Responses to the DDR consultation document and discussion with stakeholders during 2007 have not led us to believe that there are further market failure arguments to consider.

A2.74 The remainder of this section provides a summary for the new evidence and then incorporates this into our updated assessment of the three arguments.

**New developments, evidence and responses**

A2.75 Since the publication of the DDR consultation document there have been a number of developments concerning the provision of local television services, including new information and data that relate to the assessment of the case for market failure and intervention. Respondents to the consultation made a variety of views known and some have put forward further information or data illustrating their arguments. We also commissioned further market research and undertook further modelling work designed to understand the latest position with respect to, for example, the societal value that is placed on local television and content. The 2007 quantitative market research includes booster samples of viewers who have experience local television, and the deliberative research also included participants who had seen local television.
A2.76 During the year we also had separate discussions with a number of existing local television and content providers in order to understand their issues further. In particular some expressed concerns regarding their existing licences to broadcast analogue signals and how any transition to digital broadcasting might best be managed.

Responses

A2.77 Views concerning the application of the total value framework to this potential use of spectrum came mainly from the public service or large broadcasters, the local television community, and organisations or individuals concerned with public or community welfare or policy. The public sector or large broadcasters mainly favoured our proposed approach to offer packages of interleaved spectrum suitable for, but not reserved to, local television services. The local television community expressed concerns about the ability of the interleaved spectrum to deliver local television and so some favoured more work on the add/drop option\(^3\). Many respondents argued that local television delivers significant BSV to local communities, and expressed concern about the consequences of a market led approach for the ability of local television to deliver such value. Consequently some respondents argued for measures to ensure that spectrum was available for local television.

A2.78 Paragraph 7.110 of the statement reprises our view on the add/drop option. Our appraisal of market failures below addresses the BSV argument.

Market Research

A2.79 The consultation document summarised the research that we had undertaken at that point concerning views about the provision and worth of local television on the DTT platform. The research suggested that many viewers do attach personal value to local television on DTT, with the primary benefit coming from local news and travel updates. Viewers also see local television as offering benefits to society, with its social value ranking second in importance compared with other uses. There were some concerns over the extent to which sufficient local television content might be available and viewed, and the extent to which communities of interest as well as locality might also be a source of BSV.

A2.80 The 2007 market research again indicates both consumer value and BSV from the provision of local television. However valuation has decreased a little in overall terms. In addition, some ambiguity remains concerning the extent to which viewers might watch broadcast local television content. For example the deliberative market research found that some participants ‘did not want to watch it themselves’.

Economic modelling including assessment of BSV

A2.81 Our modelling work for the DDR consultation document suggested that there was considerable uncertainty over the consumer value of local television, but noted that there might be sufficient consumer demand, particularly, in the larger, metropolitan areas for such services to be commercially viable.

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\(^3\) Add/drop denotes an approach in which a national multiplex operator would add local content in a particular region at the expense of a channel which could be used to provide national services.
A2.82 We have updated and refined our modelling work during 2007, in order to reflect stakeholder comments, update the input data and reflect the most recent market research results. We continue to find that delivery of local television using the DTT platform may be a plausible, but challenging, business model particularly in larger metropolitan areas. However our modelling also suggests that alternative delivery mechanisms (such as the Internet) might be more commercially viable. Our modelling work involves a range of scenarios for the likely value of the digital dividend for the delivery of local television. Our high value scenario assumes that this spectrum boosts the value which local television providers can generate. However, scenarios at the lower end of the range of value assume that the boost gained from using the digital dividend is lower.

A2.83 This is because an advertiser funded business model for local television on DTT might be relatively weak. This is in part because viewers seem to be unlikely to watch local television for significant periods of time, hence the overall audience share of these services may be low, meaning that advertiser demand for airtime may be lower than for other services. In part this is also because costs of producing and delivering high quality content are significant. These factors combined with the costs of delivering content via the DTT platform (which in turn reflect the scarcity and value of this spectrum) suggest that the business model for delivering local content in this way is likely to face difficulties. We note in addition that other local media will in general offer strong competition to local television broadcast. These challenges may be less severe on alternative platforms, such as the Internet, as one of the key costs faced when broadcasting on the DTT platform, namely the cost of DTT capacity and/or spectrum, would be avoided.

A2.84 The evidence of the suitability of alternative platforms, such as the Internet, for delivering local television has increased over this period. Digital Local identified the enormous potential of broadband Internet to meet local public service purposes, including through interactivity. This finding looks increasingly strong, given that the attractiveness of the delivery of content over this platform is growing, and looks likely to continue to increase rapidly in the future. More and more providers are now using the Internet to provide local news and information, including in video form. These providers include newspapers, local authorities, community groups and some commercial Internet television operators. Additionally, the development of next generation broadband access, with improved technical performance, is likely to make broadband television both more accessible and more watchable in the home. ITV Local has already launched a fully interactive television type service throughout England and Wales, using linear and on-demand services side by side and building on the broadcaster's regional news services for ITV1. The BBC, ITV, and Channel 4 have also announced that they are launching a web based platform for many of their programmes.

A2.85 Given the increasing availability and attractiveness of the delivery of content over the Internet, to both viewers and advertisers, it seems increasingly likely that the delivery of local content via these means could be successful in the near future.

A2.86 Our modelling suggests that the BSV generated by local television could be high, but that on an incremental basis, this may not be disproportionately greater than the BSV generated by other uses of the digital dividend. This is because:
• it is not clear whether the BSV is specifically linked to the DTT platform and hence the digital dividend. Other platforms exist which could and currently do deliver local television, such as broadband, digital satellite and cable. The greater the extent that these platforms can deliver local television, the less concern we might have that the BSV associated with it is not delivered;

• the extent to which viewers will in fact choose to watch local television is not clear. Our market research highlighted that viewers value quality of content. In a competitive broadcasting market this will particularly be an issue for local providers on the DTT platform who are likely to face a more challenging business model than their counterparts using alternative platforms such as the Internet, and hence are likely to have less money to spend on the production of high quality content; and

• other kinds of interest or faith based communities not tied to geographic scope might equally offer benefits to groups of viewers and might in time emerge. This might reduce the demand for local television.

Hence, our modelling analysis supports the view that local television is most likely to find commercial viability in the larger metropolitan areas, and that the commercial challenges it faces may be lower on alternative platforms, such as the Internet. And that these alternative platforms might in the future be equally as good at delivering the BSV associated with local content, as viewers become increasingly interested in accessing content via the Internet, as this becomes easier to access.

Further developments during 2007

In November 2007, the House of Commons Select Committee for Culture, Media and Sport’s report on Public Service Content was published. Among other things, it considered the value which might be generated by provision of local content, and the need to support this use to allow it to be provided on the DTT platform. The Committee concluded that:

We note the enthusiasm of some witnesses for the potential for local television and the view that the Government needs to take action to support the provision of local content. However, while we do see some value in local content, we are not convinced of the need to intervene to support local television, particularly by giving away spectrum for broadcasting on digital terrestrial television. If providers want to offer local television services, we believe that more targeted delivery platforms, such as broadband, are more appropriate.

In the following sections we reassess the case for intervention against each of the identified market failure risks, which are coordination problems, the presence of BSV and the use of an advertiser funded business model.

Potential coordination problem

Recap from DDR consultation document

We noted that diverse local operators may face difficulties coordinating bids for spectrum if it is only awarded as a right to broadcast over the whole of the UK. The fragmented nature of local television broadcasting, in terms of geography, number of broadcasters, and business models, could result in significant coordination and transaction costs in participating in a spectrum award. As a result it may be that these providers do not acquire spectrum even where it represents the best value use.
Responses and evidence

A2.91 Responses to the consultation document and subsequent discussions with local television operators and broadcasters raised a number of issues connected with the ability of local television operators to coordinate in order to participate fully in any UK wide auction of interleaved spectrum, as well as illustrating some transaction costs, transitional and timing issues. Some respondents for example considered that local uses for spectrum, such as local television, would consist of many small initiatives which would face significant difficulties and transaction costs were they to attempt to coordinate to bid at a national level. Moreover some respondents argued that should interleaved spectrum be packaged with the potential to form a national multiplex, this might favour a national bidder over disparate local television bidders, as a national bidder could outbid local television bidders given the economies of scale available when providing content nationally. However, we also note that some local operators may want to acquire semi or wholly UK type licences in order to benefit from economies of scale (where these are available).

Reassessment

A2.92 Responses to our DDR consultation document have tended to confirm our initial view that coordination issues are a particular issue for the procurement of spectrum for local television provision. We have not received views or seen evidence that argue strongly against this view.

A2.93 Absent other measures, coordination issues and transaction costs of coordinating bids are likely to be very significant for the disparate group of existing and local television broadcasters if they are to bid for a UK wide package of the digital dividend. This would tend to result in the willingness to pay for spectrum being less than it might have been, absent these coordination problems, and so potentially lead to a misallocation of spectrum under a market led award.

A2.94 We note in this context that the opportunity cost of local television could be relatively high (i.e. as explained in the background section this could reach £400m NPV over 20 years). This level of opportunity cost is plausibly of a comparable order of magnitude to the potential benefits generated by the provision of local television. When this is the case we need to have strong evidence of market failure to intervene, as the evidence on whether the benefit of intervening outweighs the cost is not clear cut.

A2.95 After taking this into account, we conclude that the evidence of coordination difficulties is sufficiently strong to suggest that we should consider whether there are interventions which can resolve this issues.

BSV of local television may be high and not factored into willingness to pay

Recap from DDR consultation document

A2.96 The DDR consultation document noted that local television and content could deliver significant BSV. In terms of our total value framework these benefits include but are not limited to: a sense of access and inclusion; educated citizens; informed democracy; cultural understanding; and belonging to a community. We recall in this context that our Digital Local report identified and discussed a number of these factors.

4 www.ofcom.org.uk/tv/psb_review/digital_local.
A2.97 Our 2006 market research tended to confirm that some BSV was associated with local television. We nevertheless concluded that the evidence did not justify any intervention on the grounds of market failure, for three reasons:

- we cannot identify the best use of spectrum, now or for the future;
- giving local television privileged access to spectrum risks undermining incentives to use spectrum efficiently; and
- we risked getting things wrong, both in terms of the assessment of any BSV associated with local television and the costs of inappropriate intervention (i.e. regulatory failure).

Responses and evidence

A2.98 Many respondents representing the local television community and organisations or individuals concerned with public or community welfare or policy expressed the view that local television is a significant source of BSV, which needs to be properly reflected in our assessment of market failure. For example our Advisory Committee for Older and Disabled people suggested that local television could be particularly important to older and disabled people, while the Gaelic Media Service noted that broadcast television targeted at Scotland could provide access to education and information, improve quality of life and encourage cultural understanding and community cohesion. Some respondents argued that we had underestimated the extent of BSV associated with local television, with some explicitly mentioning some benefits that they feel we have missed such as the power to connect communities. Some respondents, including the Community TV Trust and the Community Media Association said that they did not find our economic and modelling arguments compelling since it is difficult to quantify BSV. Consequently many respondents favoured further work concerning BSV, and the reservation of part of the digital dividend for local television. Consumer bodies called for BSV generated by local television to be factored into the auction process.

A2.99 Conversely other respondents were sceptical about the level of likely demand from consumers or the ability of local television to deliver BSV. The importance of the approach to local television not precluding spectrum for other uses was raised by a number of respondents, while others including the BBC and the UMTS Forum noted that local television services can be delivered over a number of alternative platforms such as broadband.

A2.100 Our 2007 market research further illustrated that local television services are valued both personally and for society. In the deliberative research, just under half of those asked ranked local television in first or second place from the perspective of value to society, while in an exercise where participants were asked to take on our role and allocate chips to services, local television received 22% of chips, behind ‘better mobile services’ (which received 30.5% of chips) and ‘extra channels on DTT’ (which received 24% of chips). The deliberative research demonstrated that some saw local television having benefits such as creating or fostering a sense of community.

A2.101 However the valuation for local television has fallen compared to the 2006 market research. In addition, the new research illustrated some scepticism about the potential quality of a full time local television channel, and the views of those participants who had experience of local television as to its worth were mixed. Some urban dwellers said that they considered regional programming to be an acceptable alternative to more local programming. Overall the perceived BSV of local television is similar to that for more channels on the DTT platform.
Additionally, as described in the results of our modelling work above, there is increasing evidence of the suitability of alternative platforms, such as the Internet for delivering content, including local television.

Reassessment

Overall, information and views gathered since December 2006 have produced a more mixed and less robust view in general about the overall significance of BSV associated with local television and in particular about the incremental BSV of using the digital dividend for local television, given the availability of alternative delivery platforms.

There is some evidence to suggest that consumers and citizens attach a high BSV to local television and responses to the consultation have highlighted a number of benefits of local television and content provision for the wider society which are unlikely to be factored into willingness to pay for using the digital dividend. However, the available evidence does not suggest that the BSV generated by local television is disproportionately greater than the value generated by other potential uses of the DDR (such as extra channels on DTT or mobile broadband).

Additionally, there are a number of factors which suggest that the incremental BSV generated by the delivery of local television using the digital dividend may not be as large as expected, or could be realised through other means:

- in order to deliver BSV, local content must be accessed. Our market research suggests that the quality of the content available is important in determining how much content is viewed. However, our modelling suggests that the quality of content which could be offered over the DTT platform may be limited (when compared to what may be possible over other platforms). This is because broadcasting on this platform is costly (hence reducing the available funds for content); and

- the nature of demand for local content (short bursts of content rather than watching for long periods) suggest that linear broadcast of content over a platform such as DTT might not be the most efficient way of delivering this value. As indicated by the House of Commons Select Committee for Culture, Media and Sport, the Internet might be a more appropriate delivery mechanism for this type of content. Moreover, since the BSV is likely to be generated by the local content itself we would expect the delivery of local content via the Internet (rather than the DTT platform) to result in comparable levels of BSV. This is because the growing popularity of accessing content via the Internet and the developments in relation to accessing Internet content via the television both suggest that in the future the accessibility of content delivered in this way will be comparable to content delivered via the DTT platform.

We recall in this context estimates of the opportunity costs associated with potential spectrum intervention on behalf of local television given in annex 8 and discussed in the background section of this annex. These are in the order of £400m at the high end. Therefore, given the magnitude of this and the assessment above, we do not think the evidence of market failure in relation to BSV is sufficient to warrant intervention in the DDR award.
However, given that the broadcasting market is developing quickly and that there is relatively little experience of local television provision either through broadcast or other means, uncertainty over the magnitude of the BSV generated by local television is likely to remain for a period.

Therefore, whilst we conclude that there is insufficient evidence to suggest that BSV generated by local television could result in a market failure in the DDR award, we consider below whether retaining a market led approach would be future proof to changes to this conclusion. If the Government were to decide that local television content on DTT generated sufficient BSV to warrant its provision, would this still be achievable via a market led approach?

**Advertiser funded business model may result in producer value (and hence willingness to pay) under representing total value to society**

Recap from DDR consultation document

We noted in the DDR consultation document that if local television services are offered free-to-view using an advertiser funded business model, the advertiser revenue associated with it may not directly or adequately reflect the consumer value that the service produces. If this were the case, the willingness to pay for spectrum to provide the local television service may be too low compared with bids from other spectrum uses, resulting in market failure.

Responses and evidence

A small number of respondents representing the local television community argued that the business model for local television broadcast relies on advertising revenue that may for particular reasons fail to reflect consumer value and hence willingness to pay for spectrum in any market led award. The Guardian Media Group for example argued that advertising revenue for local television suffers from a lack of a standardised audience measurement system, and so advertising revenue will be reduced.

Reassessment

As discussed in the background section, we have not found general evidence of systematic differences in the ratio of consumer to producer value across the free-to-view and subscription based models which could be employed by the potential uses of the digital dividend.

We now consider whether there are any particular characteristics of use of the digital dividend for free-to-view local television which might cause it to deviate from this general rule.

We start by considering the situation where alternative delivery platforms such as the Internet are viable substitutes for local television provided over the DTT platform. In this case, the incremental producer value of the digital dividend (i.e. the extra value a free-to-view local television broadcaster gains from being on DTT as well as other platforms) would be relatively low. However, in this situation we would also expect the incremental consumer value to be relatively low, as consumers would be able to access local content on alternative platforms if it is not available on DTT.
A2.114 Now consider the situation where alternative delivery platforms are not viable. In this case the incremental producer value would be higher, as would be the incremental consumer value. If the content provided by local television broadcasters is suitable for a free-to-view model (i.e. viewing figures are sufficiently high) then the ratio of consumer to producer value would also be expected to be relatively high. There are some cases where this might not hold, but there are reasons why this is not due to a fundamental failure in the free-to-view model:

- the ratio may be low if the content offered is more suited to a subscription rather than advertiser funded model. If the content is niche (i.e. viewing figures are relatively low) but when consumers' access the content they value it highly, this would generally suggest that a subscription model would be the most efficient funding option; and

- the ratio may be low if the fixed costs of delivering this content over the DTT platform (which reflect the value and scarcity of the spectrum this platform uses) mean that the incremental consumer value is insufficient to warrant the use of this resource. For example, when broadcasting on the DTT platform the costs incurred are for an always on linear broadcast. Therefore, in order to justify this (given that this resource is in demand by others), consumer demand for the content needs to be sufficiently high throughout the day. It is possible that consumer demand for local content (i.e. short bursts of content) is not sufficient to warrant the use of this resource.

A2.115 Therefore whilst it is not always going to be the case that the ratio of the producer to consumer value for free-to-view local television on DTT is relatively high, we do not believe that this is due to a market failure in the free-to-view model.

Summary of market failure assessment

A2.116 We remain of the view that coordination and transaction cost issues are a significant issue for local television and could, absent measures, result in local television broadcasters and providers being unable to bid for the digital dividend in a way which, in aggregate, properly represents their worth.

A2.117 The evidence for BSV is insufficient to suggest that we should intervene in the award of the DDR, particularly given that the opportunity costs attached to intervention are relatively high at up to £400m. Nevertheless we think that there is merit in considering whether there would be options for intervening to secure BSV generated by local television in the future if we are to adopt a market led approach to the award of the spectrum. This is to ensure that our proposals are future proof to either changes in the magnitude of BSV generated by local television in the future, and/or decisions that its worth (in aggregate) warrants the provision of funding to support this service.

A2.118 Table A4 summarises our reassessment of the market failure arguments for local television.
Table A4. Summary reassessment

<table>
<thead>
<tr>
<th>Argument</th>
<th>Coordination</th>
<th>BSV</th>
<th>Advertiser funded business model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Potential coordination problem could result in local television operators not being able to acquire spectrum even if they have the highest aggregate value</td>
<td>BSV of local television may be high and are not factored into willingness to pay for spectrum</td>
<td>Advertiser funded business model may result in producer value (and hence willingness to pay for spectrum) under representing total value to society</td>
</tr>
</tbody>
</table>

| Relevant new evidence | Respondents confirmed this as an issue | No strong evidence that BSV of local television is disproportionately higher than the BSV of some of the other uses of the DDR. Hence, the addition of this would not be expected to result in the rankings of the services being significantly different when assessed on total value rather than private value. Additionally, evidence that incremental BSV of local television on DTT may be less than expected. This may be more effectively delivered via alternative platforms such as the Internet | Respondents argued that this continues to be an issue and potentially significant market failure |

| Reassessment | Confirms view that coordination issues represent a potentially significant market failure | Confirms view that evidence of market failure is insufficient to warrant intervention in the DDR award given the magnitude of the opportunity cost | Confirms view that, although there are difficulties associated with advertiser funded model, these are addressable by market parties and do not constitute a market failure |

| Conclusion | Consider intervention options | No significant market failure—no intervention in the DDR award Given future uncertainty, consider whether this conclusion in future proof, by assessing whether options for intervention may be available in the future if a market led approach is adopted | No significant market failure—no intervention in DDR award |

Intervention: Remedies and risks

A2.119 For local television services, we consider here the set of remedies that may effectively address potential market failures stemming from coordination failure. We also assess the risks of regulatory failure associated with these remedies.

A2.120 In order to assess whether our proposals are future proof, we also consider what remedies for BSV externalities would still be available under our market led approach.

A2.121 We note in addition that the opportunity costs of intervention for local television could be reasonably significant, at up to something like £400m. We will need to bear this in mind in the assessment of the risks and significance of any regulatory failure, which could compound the overall costs of any intervention.
Coordination

A2.122 We firstly consider what interventions would address the problem of the inability to coordinate a bid for spectrum. This is based on the assumption that, in the absence of intervention, local television operators would find it difficult or costly to coordinate in order to secure spectrum that would be available on a UK wide basis rather than being able to purchase only the spectrum that is required to offer a local service.

A2.123 We set out in paragraph A2.63 the intervention options that might best address market failures resulting from coordination failure. We therefore consider the following:

- administrative allocation—this could involve either setting aside capacity on a new UK wide DTT multiplex in the cleared spectrum, enabling local services to be launched in every area covered by that multiplex, or setting aside frequencies in the interleaved spectrum. Providers would then be able to bid for this and if these bids are not financial (i.e. if a beauty contest is used) spectrum would be subject to AIP; and

- auction design and packaging—in the case of the award of the digital dividend this would suggest that the packaging of interleaved spectrum should include packages that are suitable for possible local television operators, hence minimising the impact of transaction costs on the ability of local television operators to bid for spectrum. A normal auction process would be carried out.

A2.124 We note that the inability to coordinate to secure spectrum for the provision of local television on DTT is not solely associated with the digital dividend. The inability to coordinate also impacts on the ability of local television providers to obtain access to multiplex capacity on the existing DTT platform. This is because there is generally a requirement to purchase UK wide, rather than local, coverage on the DTT platform. A number of responses to the consultation document raised this issue and suggested that more work be undertaken to facilitate ‘add/drop’ technology on existing DTT multiplexes such that local rather than national or UK coverage can be obtained. Paragraph 7.110 of the statement sets out our position on ‘add/drop’ and we do not pursue it here.

A2.125 We now assess the intervention options in terms of their efficacy of addressing a market failure and the risk that such an intervention will result in some form of regulatory failure (see table A5).

Table A5. Local television: assessment of effectiveness and regulatory risks of intervention options for resolving coordination failures

<table>
<thead>
<tr>
<th>Option</th>
<th>Coordination failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Directness/ achieves</td>
</tr>
<tr>
<td></td>
<td>outcome</td>
</tr>
<tr>
<td>Auction design and spectrum packaging</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Administrative allocation</td>
<td>✓ ✓</td>
</tr>
</tbody>
</table>
A2.126 The assessment suggests that, for coordination failures, auction design and packaging is an effective and efficient solution. Packaging removes the coordination problem by enabling local operators to bid for the spectrum they require but also retains the auction mechanism such that other potential uses can also bid for the spectrum (that is, allows trade-offs to occur between uses, which is particularly important when the opportunity cost is high). This approach has the added advantage of being less prone to unintended consequences, as it retains a market based approach and does not preclude other uses of the spectrum, either now or in the future.

A2.127 It is, however, worth noting that packaging can still be subject to regulatory failure. For example, it is possible that the packaging decisions could in principle raise (aggregation) costs or makes the spectrum unsuitable for those other uses. The overall cost of such an intervention will therefore depend on the whether the packaging required to resolve the coordination problems of local television bidders could have these adverse effects on others. However, if these risks arise, it may be possible to mitigate them through the use of an appropriate auction design.

A2.128 We have also considered whether intervention via packaging could have unintended effects on the delivery of local television via other platforms (for example, the Internet). Other platforms, such as the Internet, do not typically have the same coordination problems since local television providers do not share capacity (for example, websites). As such, spectrum intervention via packaging is unlikely to distort downstream competition by favouring one platform over another. Indeed, it may make the choice between platforms more equal than would otherwise be the case.

A2.129 Therefore, the overall risk of regulatory failure in relation to this type of intervention appears to be low to medium. Therefore, we think that the regulatory failure risk in relation to this intervention is unlikely to be significant and careful management can be expected to reduce this further.

A2.130 Administrative allocation is also a directly effective solution since it can remove the need for coordination by directly allocating spectrum in some manner. This option is however a complete departure from a market mechanism, which means that it does not allow the opportunity cost of spectrum to be traded off against the benefits (i.e. it removes the ability of potentially higher value uses to compete for the spectrum). Administrative allocation also reduces future flexibility of use, both in so far as it allocates the spectrum to a specific use, and the potential loss of accurate pricing information could have severe implications on future incentives for reallocation of spectrum between uses. Administrative allocation requires a great deal of knowledge and a reasonable degree of certainty concerning the value associated with the provision of a specific use using the digital dividend (relative to other uses, other spectrum bands and other forms of provision), which mean it could be associated with a significant risk of regulatory failure.

A2.131 Therefore, we consider that an administrative allocation approach has significant potential for regulatory failure. There is a strong possibility of regulatory failure since the regulator does not hold the information necessary to trade off different uses of the spectrum, and because of the adverse effects this form of intervention can have on the efficient use of spectrum both now and in the future.

A2.132 Table A6 summarises our regulatory failures assessment.
Table A6. Coordination: assessment of significance of regulatory failure

<table>
<thead>
<tr>
<th>Coordination: significance of regulatory failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auction design and packaging</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Administrative allocation</td>
</tr>
<tr>
<td></td>
</tr>
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<td></td>
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</tbody>
</table>

BSV

A2.133 In terms of the BSV associated with local television, we consider the options which would be open for delivering this under a market led approach if, in the future, the assessment of the BSV generated by this use were to change and/or there were decisions that its worth (in aggregate) warrants the provision of funding to support this service. Our analysis identified that the BSV generated by this use is insufficient to warrant intervention in the award of the digital dividend. However, this analysis does not rule out the need for other forms of intervention to recognise the value this service generates in aggregate (as compared to through its use of this spectrum) either now or in the future.

A2.134 As discussed in paragraphs 2.47-2.50 above, this implies the requirement for additional funding that reflects BSV (in order for the total value of local content services to be realised) or an intervention in the market led award process to proxy for this funding. Hence appropriate intervention options include direct funding, which could be augmented through the use of matching winning bids, phased payments and/or bidder credits. Administrative allocation is not an alternative as here we consider what options would be available in the future once a market led approach has been adopted.

A2.135 For the reasons set out in paragraphs 2.57-2.58 above, auction design and packaging can be particularly aimed at coordination failures and are less likely to be generally effective in addressing market failures associated with BSV.

A2.136 We now assess the available intervention options in terms of their efficacy and the risk that such an intervention will result in some form of regulatory failure.

A2.137 Table A7 sets out our high level assessment of these items.

Table A7. Local television: assessment of effectiveness and regulatory risks of intervention options for resolving BSV under a market led approach

<table>
<thead>
<tr>
<th>Option</th>
<th>Directness/ achieves outcome</th>
<th>Is efficient/no or few unintended consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct funding</td>
<td>✅✅</td>
<td>✅</td>
</tr>
<tr>
<td>Direct funding + match winning bids</td>
<td>✅✅</td>
<td>✗?</td>
</tr>
<tr>
<td>Direct funding + phased payments</td>
<td>✅✅</td>
<td>✗?</td>
</tr>
<tr>
<td>Bidder credit</td>
<td>✅</td>
<td>✗</td>
</tr>
</tbody>
</table>
A2.138 Direct funding is an effective option since it allows interested parties to make their own assessment of the valuation of spectrum bearing in mind their objectives and alternative delivery mechanisms. It is also likely to minimise the risk of regulatory failures since it provides strong incentives for efficient use of the spectrum. Nevertheless there are risks associated with setting the right level of funding such that it reflects the total value of the service and, as with any form of public funding (either implicit or explicit), it is possible for this to have an impact upon other firms in the same or related markets.

A2.139 We also consider here options for combining direct funding with matching winning bids and phased payments. These are both intervention options which may help to facilitate the provision of direct funding.

A2.140 Matching winning bids effectively provides more time for local television bidders to access funding following completion of an auction process. This could allow them to either consider diverting funds from alternative activities or to access funding from alternative sources once the amount required is known. The success of this intervention option is dependent on the nature of the funding mechanisms available to local television bidders, and whether this provision of additional time makes funding decisions easier.

A2.141 There are a number of regulatory failure risks associated with this type of intervention. There is a risk that it could result in an inefficient allocation of spectrum in the auction; this is because it might discourage bidders from taking part (hence distorting the outcome of the auction) and, depending upon the price the local television bidders are asked to match, it may result in them gaining spectrum when they are not the highest value use. Additionally, this form of intervention could have unintended consequences, since it may make spectrum appear to be a relatively more attractive option compared to other platforms.

A2.142 Phased payments, since they enable bidders to submit bids based on a stream of future payments rather than single upfront bids, may enable bidders to match their spectrum payments to their funding cycles. However, there are risks associated with this form of intervention. Phased payments can result in a risk that spectrum is acquired and then returned to us if outturn demand for services is not as high as expected. This can encourage speculative bidding, and has significant costs for consumers and citizens, as when spectrum is handed back to us this will tend to result in it being unused for a potentially significant period, given the administrative requirements we need to meet when awarding spectrum.

A2.143 A bidder credit is a direct form of intervention, in that it expressly considers the size of the BSV associated with a use relative to a bidder’s willingness to pay for spectrum. A bidder credit does not preclude any uses or bidders from participating in an auction and obligations attached to the credit ensure delivery of the socially valuable service. However, there is a high level of uncertainty regarding the ability to set the ‘right’ level of credit and errors have the potential to exclude other more valuable services from competing for the spectrum. Additionally, this form of intervention can result in other regulatory failure risks as it distorts incentives to use spectrum relative to other platforms (i.e. if the credit is available if you deliver local television via the digital dividend but not if you deliver local television over the internet this will distort choices). Also, as it ties the obligation to deliver BSV to the spectrum licence it can have adverse effects on the future flexibility of the resource, and imposes an ongoing regulatory burden on us.
A2.144 We set out here our assessment of the extent to which the possibilities for regulatory failure identified above might be significant (see table A8).

**Table A8. Coordination and BSV: assessment of significance of regulatory failure**

<table>
<thead>
<tr>
<th></th>
<th>BSV: Significance of regulatory failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct funding</td>
<td>• Purchasing body chooses how best to purchase inputs including spectrum</td>
</tr>
<tr>
<td></td>
<td>• Significance of regulatory failure relatively low(^5)</td>
</tr>
<tr>
<td>Matching winning bids</td>
<td>• Facilitates publicly funded bodies participation by revealing likely levels of bids</td>
</tr>
<tr>
<td></td>
<td>• Risks of distorting behaviour—prequalification may reduce liquidity in initial auction</td>
</tr>
<tr>
<td></td>
<td>• Overall risk of regulatory failure medium</td>
</tr>
<tr>
<td>Phased payments</td>
<td>• May fit better with public funding cycles, tends to help market based outcome</td>
</tr>
<tr>
<td></td>
<td>• Risk that spectrum is returned to us if bidder defaults—so spectrum use is suboptimal</td>
</tr>
<tr>
<td></td>
<td>• Overall risk of regulatory failure medium</td>
</tr>
<tr>
<td>Bidder credit</td>
<td>• Requires assessment of size of bidder credit, in turn implying regulator holds adequate information and foresight</td>
</tr>
<tr>
<td></td>
<td>• Ties credit to the use of spectrum hence distorts choices between inputs</td>
</tr>
<tr>
<td></td>
<td>• Method could distort behaviour in terms of seeking bidder credit</td>
</tr>
<tr>
<td></td>
<td>• May reduce future flexibility of the spectrum by tying the obligation to deliver BSV to the spectrum licence</td>
</tr>
<tr>
<td></td>
<td>• Overall risk of regulatory failure is relatively high</td>
</tr>
</tbody>
</table>

A2.145 To summarise, it is clear that possible regulatory failures associated with bidder credit could be significant. Possible regulatory failures associated with phased payments, matched winning bids are of medium significance. Direct funding is an option where the significance of regulatory failure is likely to be relatively low.

**Is intervention justified given the risks and opportunity costs?**

A2.146 The views and evidence put forward since publication of the DDR consultation document have lent support to our first view expressed in the consultation document that coordination failure and transaction costs could, absent other measures, result in significant market failure in the award of the digital dividend.

A2.147 The evidence in relation to BSV suggests that there is insufficient evidence to suggest that intervention in the DDR award is justified. This does not mean that local television is of low value, or that it does not generate BSV, rather that our assessment of the significance of this value when compared to other potential uses which also generate BSV does not suggest that the presence of this value is likely to result in a market failure in the award of the digital dividend. The relatively significant opportunity costs of such an intervention, at around £400m, lend weight to this assessment, as this suggests that strong evidence of market failure is required to justify intervention in the DDR award.

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\(^{5}\) Regulatory failures which result from intervention to support socially valuable outputs having adverse effects on other firms’ competition in the market are not factored into this conclusion, as these would be present whether the support is provided explicitly through direct funding, or implicitly through adjusting the spectrum award.
A2.148 However, we acknowledge that whilst there is no justification for intervention in the award of the DDR this does not preclude other forms of intervention, either now and in the future, in response to the BSV generated by this use (in aggregate). Therefore we have considered whether a market led approach would be future proof to others assessing that this service warrants the provision of public funding.

A2.149 The option of packaging spectrum in a way which allows individual local television operators and broadcasters to express their willingness to pay while simultaneously allowing in principle bids from competing uses appears to be the best intervention option for resolving the coordination failure. With careful management such an option can be designed in order to minimise the likelihood of regulatory failure, the significance of any regulatory failure, and any opportunity cost. Overall we see this option as representing a justifiable approach to resolving coordination failures in relation to use of the interleaved spectrum by local television. We also note that this remedy is consistent with our market led approach to the award, and hence does not involve us moving to take an interventionist approach.

A2.150 In relation to whether a market led approach would be future proof to a changing assessment of the BSV generated by local television, we believe that this would be. This is because the best intervention option in this situation would be to provide direct funding which local television operators can use to purchase either access to the digital dividend or access to DTT multiplex capacity, or to fund the provision of services over the Internet (if these was deemed by these operators to be the most efficient approach). This intervention option remains under our market led approach. Hence, if funding bodies were to decide to support local television operators in this way, this option would still remain open.

DTT

A2.151 Our DDR consultation document made a first identification of a number of factors and arguments that could in principle result in DTT providers not being able to reflect the total value to society of additional capacity in their bids for additional spectrum for either SD or HD use, where a market based approach for spectrum award is used. We set out six basic market failure arguments, these being:

- coordination failure: the challenges of coordinating a bid for spectrum may be more complex for DTT providers than for other potential bidders and hence may result in significant transaction costs;

- capital market failure: DTT providers’ access to capital may be more constrained than other providers, for example owing to capital market imperfections, and therefore they may have difficulty raising funds to make investments in spectrum;

- BSV: additional free-to-view DTT services in either HD or SD (these are services in addition to those which can realistically be provided using existing capacity) may provide BSV that would result in a positive externality that may not be fully reflected in the willingness to pay for spectrum of potential bidders;

- advertiser funded business model: the use of advertiser funded business models may result in free-to-view broadcasters being less able to extract the consumer value of their services to consumers than subscription service providers. If there is evidence to suggest this is the case, this structural difference between these funding models and those used for subscription services could result in free-to-view broadcasters being less able to afford additional capacity even if their services represent a high value use of the available spectrum;
• weakening of DTT platform: the DTT platform may be weakened as a competitor to cable and satellite if it does not secure more capacity to allow additional SD services or HD, resulting in detriment to consumers and citizens—a negative externality—that is not reflected in bidders’ willingness to pay for spectrum; and

• availability of PSB content in HD: if the digital dividend is required to make PSB content available in HD, the BSV generated by this and its impact on the DTT platform more widely, may not be fully reflected in the willingness to pay for spectrum of potential bidders. This as another example of a potential negative effect owing to the weakening of the DTT platform.

A2.152 We concluded in the DDR consultation document that we did not judge these market failures as significant enough to justify intervention, but that it might be helpful to package spectrum in a way that enables potential DTT users to acquire spectrum.

A2.153 Responses to the consultation document and discussions with stakeholders during 2007 have not identified further market failure arguments to consider. However, respondents provided views and evidence on their analysis supporting our conclusions on the significance of the potential market failures considered.

A2.154 We first set out the new market research and other relevant developments, and then, in the light of these, reassess the five arguments above concerning the significance of market failure and any reasons for intervention.

A2.155 As noted above, the importance of universally available PSB content in HD is an example of a negative externality which might weaken the DTT platform. Hence, in this assessment the potential for a market failure to arise owing to the availability of PSB content in HD is considered under the heading of a market failure resulting form a weakening of the DTT platform.

New developments, evidence and responses

Responses

A2.156 Many respondents commented on SD and HD use of spectrum and the implications of this for market failure and intervention. Of the respondents commenting on these issues, the majority were concerned with HD and the implications of the spectrum award for its future availability.

A2.157 Concerning the provision of more SD channels on the DTT platform, the respondents that mentioned it, particularly those representing public bodies or community groups, argued that some additional channels could deliver significant BSV where such channels have a community or social element. They argued further that in this case danger of market failure existed since the total value of such services was unlikely to be delivered under a market led approach, partly because bodies providing such services are less well resourced than other competing bidders for spectrum. These respondents generally favoured some form of intervention or ring fencing of spectrum such that some of these uses can be realised.
Concerning HD, two broad groups of view arose. Firstly, a number of PSBs, equipment manufacturers and retailers (including HDforAll) comprised a group that argued that it was necessary to recognise investment already made in and expectations of HD broadcasting by both viewers and providers. Broadly speaking this group said that additional spectrum is required in order to broadcast HD on the DTT platform and expressed concerns over whether a market led award would sufficiently deliver this. They put forward between them the following arguments for this:

- HD would be the new broadcasting standard and so a minimum critical mass of five PSB HD channels should be available on the DTT platform in order both to deliver PSB and maintain the viability of the DTT platform;
- the digital switch off is based around the DTT platform and so we (or the Government by direction) must act to protect the platform;
- it would be difficult for publicly funded bodies to acquire funds to bid for the necessary spectrum, and that any incremental revenue from DTT services in HD would be insufficient; and
- that there is significant BSV for HD television, which we have underestimated.

We readdress these arguments in paragraphs A2.222 –A2.226 and A2.244–A2.251. The question of funding framework is addressed in paragraphs A2.204 and A2.214.

A number of the respondents representing broadcasters and the interests of HD were particularly vocal concerning our identification of potential market failures and the assessment of the significance of these. A number presented evidence and studies seeking to refute our conclusions regarding the likelihood for market failure in relation to HD services on the Freeview platform. Paragraphs A2.238-A.2.251 below summarise these views and set out our assessment and response.

Secondly, other respondents expressed strong support for our proposals in the consultation document to package cleared spectrum in a way that would be suitable for but not reserved for DTT. This group of respondents argued between them that intervention could distort competition and incur significant opportunity costs.

Other responses received commented on the role of our statutory duties in terms of our approach to the DDR. That is, some respondents questioned how the market led approach might deliver BSV and meet our statutory duties in relation to broadcasting. We respond to this issue in section 5 of the statement.

Our use of market research to inform our view of possible private and social values of different spectrum uses was remarked upon and criticised by some respondents. The extent to which the 2006 research really gauged BSV was questioned. Some explained that the market, particularly for HD, was moving rapidly and as a result customers either did not fully understand the services or that our research would be out of date quickly. Many argued that the market research had not demonstrated the services—particularly HD—to respondents and so they could not give a fully informed view. Our separate publication on market research and paragraph A2.179 below explains how we amended our 2007 market research in order to take account of views regarding this latter point. Our assessment of spectrum use for SD channels and HD in paragraphs A2.180-A2.192 addresses other points related to market research.

6 Digital Dividend Review Market Research 2007
Respondents’ new evidence and arguments concerning HD services

A2.164 The BBC commissioned economic consultants Indepen, who submitted a report titled ‘Intervening to secure UHF spectrum for HD PSB 20 March 2007’ alongside the BBC consultation response. Indepen argued that PSB broadcasters:

- cannot capture the incremental private value associated with HD, since advertisers will not pay more for advertising in an HD format;
- will not capture BSV where they are privately owned (ITV and Five); and
- will not have the resources to reflect BSV where they are publicly owned (BBC and Channel 4)

A2.165 Indepen applied our total value framework and estimated the resulting loss of private and social value from the absence of HD PSB services on the DTT platform under two scenarios. The first scenario also had no free-to-view HD PSB services on cable or satellite; the second had free-to-view HD PSB services on satellite. Indepen estimated the lost total value under scenario 1 at £15.6bn and under scenario 2 at £5.4bn. Using data from our consultation document concerning potential other uses of the spectrum, Indepen estimated the opportunity cost of reserving spectrum for HD PSB services to be around £2bn-3bn.

A2.166 The BBC concluded therefore that there is a good case for reserving spectrum for HD PSB services.

A2.167 We consider arguments related to the advertiser funded model and BSV in general below, in paragraphs A2.232–A2.237 and A2.214–A2.226. On the specific point of the size of the loss of private and social value from the absence of HD PSB services on the DTT platform we believe that the Indepen work significantly overstates this value. This is because this work estimates the BSV of PSB as the annual investment in PSB. This calculation overstates the BSV because the annual investment reflects the total value (i.e. private plus BSV) of these services. We note in this context that the BBC’s own research in support of its work on Building Public Value estimated that of the total value of the BBC, 80-90% was consumer value and only 10-20% citizen value. Therefore, the Indepen work plausibly overstates the BSV generated (which makes up the majority of their total value estimate) by a factor of five to ten times.

A2.168 However, more importantly the Indepen conclusions are based upon scenarios which are no longer relevant to the assessment of whether we should intervene in the award of the digital dividend. Their scenarios model the impact of there being no HD PSB services on the DTT platform. As the recent announcement by the PSBs concerning the multiplex reorganisation has shown, this is no longer a realistic outcome.

A2.169 Moreover we note that the size of any BSV generated by a use of spectrum is not evidence of a market failure per se; rather it is the presence of this distorting the relative rankings of the services by total value as compared to by private value, plus when this is the case, a failure of market processes to reflect this into relative willingness to pay, that result in market failure. We explain below why we believe that this does not hold in the case of the BSV associated with HD.

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7 [http://www.bbc.co.uk/foi/docs/bbc_constitution/bbc_royal_charter_and_agreement/Building_Public_Value.pdf](http://www.bbc.co.uk/foi/docs/bbc_constitution/bbc_royal_charter_and_agreement/Building_Public_Value.pdf)
Respondents’ evidence on market research for HD

A2.170 Awareness and expectations of HD services is seen to be high by a number of respondents, who cited market research and other data in favour of this conclusion. The relatively fast take up of HD in Japan and the United States was remarked upon by some respondents.

A2.171 Furthermore a number of respondents including the BBC and Five put forward evidence and studies concerning consumer views of HD services and picture quality. Broadly speaking these respondents concluded that many consumers rate highly and so derive value from HD picture quality, as opposed to SD.

A2.172 Concerning expectations of the availability of the PSB channels in HD, a number of respondents remarked that studies and evidence point to an expectation by consumers that the main PSB channels should be provided in an HD format for free. In the DTT HD Trial for example, trialists rated the five PSB channels above all others as channels that ‘should’ be broadcast in HD on Freeview as a minimum. The same study found that about half the trialists would not be prepared to pay any extra to receive their five favourite channels in HD.

A2.173 Regarding willingness to pay for HD services, the Human Capital study argued that its results show that the “total value (the combination of consumer and citizen value) that people place on the five main public service channels rises by approximately a third if they are offered in HD rather than SD”. One BBC conclusion from this is that “people are more interested by HD after it has been demonstrated to them, tending to demonstrate that HD is an ‘experience good’”. The same study estimates that the HD format is valued at £1-3 per month above SD.

A2.174 The BBC also argued that, from evidence in its possession, over half of customers would find it worthwhile to purchase satellite equipment if the Freesat service were to offer one HD BBC service (in addition to Freeview SD free to air services). The BBC put this forward as evidence that migration would occur between platforms if HD were not to be offered on the Freeview platform.

A2.175 BBC modelling for its iPlayer Public Value Test forecast that on-demand video services would account for only 7% of BBC television consumption by 2011. By extrapolation, the BBC argued that if innovative services like HD are to be enjoyed by all, they should not be provided using only on-demand platforms.

A2.176 Nevertheless we note that the evidence put forward by respondents generally does not set the use of spectrum for HD broadcast in the context of other uses, nor does the evidence consider in detail the BSV of this versus other uses. It is difficult therefore to draw strong conclusions concerning the award of spectrum from such evidence and arguments in isolation.

A2.177 However, our own 2007 market research (discussed below) tends to confirm a number of the points from the respondents’ research.

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8 A Higher Definition: The Digital Terrestrial HD Trial BBC, ITV, Channel 4, Five
9 HD TV A Deliberative Research Project by Human Capital July 2006 BBC
Market Research

A2.178 We commissioned a second tranche of market research during 2007 designed both to address comments on the first 2006 tranche and to obtain data that reflects current views. This included commissioning deliberative research which included demonstrations of the services including HD to participants, and quantitative research which contained booster samples of, among other things, those who had experience of HD technology. We published this second tranche on 28 November 2007.

Market research: SD channels on Freeview

A2.179 Our 2006 market research indicated a relatively high personal value for having more SD channels on the DTT platform, although the research noted that interest tailed off quickly as price increased. The 2007 research tends to confirm the view that more channels are valued to some extent, but this value has fallen over the last year. The qualitative research highlighted that respondents emphasise quality over quantity of channels. Regarding willingness to pay, more than three times as many say they are unlikely to pay for additional premium SD channels (64%) on Freeview than say they are likely to pay (20%).

A2.180 Respondents continued to place a medium to high societal value on having more DTT channels in relation to other uses, although again valuation was lower compared with 2006. Further DTT channels is now ranked equal first with mobile broadband in the quantitative research, in terms of value to society.

A2.181 The type of channel also had a bearing on the perceived importance of additional DTT channels. For example the 2007 qualitative research included ranking of the types of channel which were most important. From a private perspective ‘Community’ channels were included by 24% of respondents in the assessment of the top 5 categories of channel, while from a societal perspective ‘Community’ channels were included in the top 5 by 37% of respondents.

A2.182 The 2007 qualitative research highlighted that respondents perceive more channels as being a ‘fair’ option in that it benefits all at no extra cost (at point of use). Nevertheless quality of channels was cited as an issue, with both sets of research noting that the five main channels, news and education are seen as the most socially valuable.

Market research: HD

A2.183 Our most recent quantitative research continues to reveal large differences in UK households’ knowledge and use of HD. For example although around a quarter of households already own an HD ready television set, a further one seventh of households say that they have not heard of it. Of those who own an HD ready television set, reasons for purchase also varied markedly. One third said that they wanted a newer set that would not become obsolete, with up to two in five citing ‘wanted a better/clearer picture’ as the reason for purchase.

A2.184 The consultation document noted that HD is a relatively expensive new service, and that this was reflected in market research, with many respondents seeing it as a niche service, providing relatively little BSV. The 2007 quantitative market research tends to confirm this view, with overall value to society rated lower in 2007 than it was in 2006.
A2.185 The 2007 qualitative research was reorganised so that participants were shown HD material, and allowed to judge this against the same material in SD format. Participants were able to discuss and evaluate their perceptions of the differences and their reactions to it. An indication that the quality of HD had an impact on respondents comes from the fact that, from a personal perspective, the proportion who ranked HD first or second increased by 4 percentage points to 33% following demonstration of the technology. Nevertheless, following further discussion, final ratings for HD fell to 21% from a personal perspective and to 12% in terms of importance to society. A common remark from participants here was that HD is seen as a luxury rather than as a necessity. However, some participants saw some elements of BSV, such as benefits to those with poor eyesight.

A2.186 These results were also reflected in a ‘chip allocation’ exercise in which participants were asked to imagine that they were us and to allocate spectrum to its different uses, i.e. in ways which are seen to maximise value to society from the use of spectrum. Only 7% of chips were allocated to HD.

A2.187 Our research suggests that although ownership of HD ready television sets is increasing, expectations of it and the perceived benefits are relatively unchanged. The proportion thinking HD will be ‘very beneficial or essential’ to the viewer is at just under a quarter of the population, while two in five still think it will be ‘slightly or not beneficial at all’. Reasons for buying an HD ready television set accord with this, since around two in five respondents said that they made the purchase because they wanted a flat screen, among other reasons, and around one in four cite “the look and style of it” and “wanted a large screen” as reasons.

A2.188 Bearing in mind comments from stakeholders and the recognition that one plausible scenario is that HD transmission becomes the expected standard, the qualitative research asked participants to discuss a future scenario in which they were told that three quarters of people had HD ready television sets, and set top boxes had dropped in price to be easily affordable to most people. In this scenario, just under three quarters of respondents said that they would prefer to have the five PSB channels in HD, accompanied by 45 SD channels. This is set against 12% who said they would prefer 13 HD channels and no SD channels, and 17% who said they would prefer 60 SD and no HD channels.

A2.189 A further indication of the relative valuations of HD come from the deliberative research where respondents were asked to choose from a list of channels those that they thought were most important on Freeview and which would make the top five. The five main channels in HD was given as one choice. From a personal perspective, the five main channels in HD was chosen by 38% of respondents to be in the top five, giving a ranking of seventh out of 15, compared with 20% and a ranking of 10th out of 15 from a societal point of view.

A2.190 The quantitative research includes the result that three quarters of respondents feel that it is important that that – in addition to the channels available on Freeview today - some HD channels such as BBC1, ITV1 and Channel 4 are broadcast on Freeview with no subscription charges. However, when current non HD subscribers were asked about willingness to pay for set top boxes to access HD services, 35% of respondents said that they would be willing to purchase set a box if it cost £20. The proportion falls to 24% where the cost is £40 and to 13% where it is £60.
Regarding consumers’ propensity to change platform to access HD broadcasts, the quantitative research found that if HD channels were not available on Freeview but could be obtained to varying degrees on Freesat, Virgin Media, or Sky TV, around just over one quarter would be likely to change, while more than a half say that they would not be likely to pay to change. Were the five main channels to be available on Freeview in HD, with other platforms offering more HD channels with subscription, again around one quarter would consider switching platform, with around three fifths saying that they would not be likely to pay to change.

Other developments

During the year we have held separate discussions with the PSBs concerning the prospect of technical upgrades which could significantly increase the capacity on the DTT platform. In our future of DTT consultation, we included our first thoughts on the prospects and possible process for this.

Additionally, the BBC, ITV, Channel 4, and Five announced in November 2007 that they had signed a nonbinding memorandum of understanding aimed at reorganising their Freeview services such that a technical upgrade process could begin on the platform, enabling up to four HD channels (one each for the BBC, ITV, Channel 4, and Five) to be broadcast on it from 2012. This will be achieved through the introduction of new technologies which will increase Freeview’s capacity.

The House of Commons Select Committee for Culture, Media and Sport in November 2007 published their report on Public Service Content. Among other things this concluded that appropriate use of the digital dividend would be best determined by a market led approach, noting that such an approach would still give broadcasters an opportunity to purchase additional spectrum.

The following sections reassess the case for intervention against each of the identified market failure risks, which are coordination failures, capital market failures, BSV from additional SD or HD content, advertiser funding issues and the potential for detrimental effects on the DTT platform.

Coordination failure (for HD and SD)

Recap from DDR consultation document

We noted in the DDR consultation document that DTT broadcast uses a multiplex which provides capacity for a number of channels. This implies that broadcasters must coordinate their activity, including spectrum acquisition, through some form of joint venture, or work with a third party multiplex capacity provider such as National Grid Wireless (NGW). Were this coordination to be costly or impractical, it could represent an impediment to the purchase of and reduction in willingness to pay for additional spectrum, even where such purchase has positive private or external value, and so be a market failure.

We also noted that the PSBs already cooperate between themselves and with other broadcasters on a number of issues and that demonstrated that they were capable of so doing for the purposes of spectrum purchase. Furthermore there are already multiplex operators, who effectively procure and lease aggregate multiplex capacity and this potentially provides another means of procuring additional spectrum in a way that overcomes any coordination difficulties. We therefore concluded in our consultation document that there was no strong evidence to suggest that coordination was a significant market failure.
Responses and evidence

A2.198 It is clear from views expressed in responses to the DDR consultation document responses and elsewhere that some appetite exists for the enhanced provision on the DTT platform of further services, particularly HD. The acquisition of additional spectrum is seen as one way of achieving this. Some respondents in this case, including the BBC, alluded to the difficulties of coordination in order to achieve an increase in the capacity of DTT platform, albeit in the context of redistribution between multiplexes.

Reassessment

A2.199 In our view the incentives and possibilities for broadcasters to cooperate to procure additional spectrum are if anything enhanced since 2006, and it is clear that it remains the case that broadcasters using the DTT platform will need to coordinate in some manner if they wish to expand the capacity of the DTT platform. To the extent that there is private value to be obtained through this process, we would expect broadcasters and multiplex owners to be willing to achieve this coordination and therefore do not see this issue as underlying a significant market failure.

Capital market failures (for HD and SD)

Recap from DDR consultation document

A2.200 In the DDR consultation document, we stated that a market led award process will typically require an up front payment for spectrum purchase. We considered the case where it might be difficult for a DTT operator to raise such up front payments. Where such difficulties exist, bidders will tend not to be able to access spectrum for DTT use even if such access represents the highest value use to society. We noted in particular that not-for-profit broadcasters face borrowing constraints as a result of their statutory funding arrangements.

A2.201 We concluded that there may be an issue for the BBC and Channel 4. Nevertheless it was not fully clear to us what the effects of their statutory borrowing limits would be in the context of spectrum purchase and concluded that the question required further examination.

Responses and evidence

A2.202 The few DDR consultation respondents that mentioned this issue recalled the statutory borrowing limits on the BBC and Channel 4 and so tended to confirm this view. This is potentially an important impediment to these bodies’ ability to purchase spectrum, should they wish to do so in order to fulfil statutory and other relevant objectives and perhaps where such purchase might deliver BSV.

A2.203 We understand in this context that the Government has considered the financial and institutional framework for the support of providers of socially valuable applications who may wish to access the digital dividend and presently sees no reason to believe that it would in principle prevent public service users—or other providers of socially valuable services—from bidding for access to spectrum in accordance with the award process proposed by us in the consultation document.
Reassessment

A2.204 Given that we have not received new evidence that leads us to alter our conclusions from previously, our assessment remains unchanged. Regarding the BBC and Channel 4, this means that we consider that it is clear that statutory limits on borrowing for the not-for-profit public sector could in principle, result in a capital market failure for the not-for-profit PSBs. We believe that this is a matter for discussion between the Government and the BBC and Channel 4.

A2.205 Regarding the remaining broadcasters, we have seen no new evidence that would lead us to believe that capital market failures exist which result in a broadcaster having difficulties in accessing capital even where such access could result in an expected positive payback. Any capital market difficulties that might arise here are therefore more likely to reflect the value of services offered or projects undertaken rather than any inherent market failure.

A2.206 We note in this context that significance of this market failure can be placed in context by recalling the estimated opportunity cost of intervention. An intervention on behalf of further SD channels or HD is likely to require up to six channels or 48 MHz. Estimates in table A40 in annex 8 give opportunity costs in the range £1bn-2.5bn for setting aside this amount of spectrum. These relatively high opportunity costs suggest that we would need to be very sure about the significance of market failure when considering the possible need for intervention to address any market failure.

BSV generated from the use of the spectrum for additional SD channels or HD may not be factored into willingness to pay

Recap from consultation document

A2.207 We assessed in the DDR consultation document the argument that there may be BSV associated with additional SD channels and/or HD broadcast over additional spectrum capacity, hence the need to consider whether the size of this could alter the rankings of these services by total value when compared to the private value rankings.

A2.208 We concluded in the consultation document that the evidence regarding the level of BSV associated with additional SD services depended heavily on the content associated with those services. We considered that any new services on the DTT platform were likely to be commercial in emphasis, rather than public service and that there was therefore little evidence to suggest that the incremental BSV associated with additional SD services would be disproportionately large compared to other potential uses of the digital dividend.

A2.209 Regarding HD, we concluded that there was little evidence of BSV associated with the digital dividend for this use (over and above the BSV which could be generated by offering HD using the existing capacity). In this case, there was little evidence of market failure.

Responses and evidence

A2.210 In response to our conclusions, some respondents raised general points about the ability or desirability of public bodies purchasing spectrum in order to be able to provide services giving BSV. The BBC considered that free-to-view PSBs, whether licence fee funded or advertiser funded, are unable to recoup the costs of an auction through incremental revenues and would therefore find it difficult to build a business case for additional capacity.
A2.211 Responses and views regarding additional SD channels per se were few, although one respondent took the view that there is more value associated with a wider range of television channels than a niche service like HD. Further and stronger views were associated with the type and worth of particular additional channels, particularly those with community or social aspects. A response from Teachers TV for example, argued that we had failed to consider the BSV associated with similar genre broadcasters who existed solely to produce content of public value, primarily on a not-for-profit basis. They did not agree that the auction process we proposed would take account of the social and citizen value generated by these organisations, which they found surprising given our duty to take into account the interests of citizens and consumers. They suggested that it might be worth weighting the auction by attaching discounts to certain categories of bidders in order to reflect this citizen value, although they acknowledged that setting such weightings could be difficult.

A2.212 Regarding HD, responses to the DDR consultation document presented a number of arguments in relation to the importance of BSV:

- the BBC noted that there were significant difficulties in classifying and measuring BSV, particularly where consumers have not yet experienced HD. They did not think our market research adequately assessed BSV and that as a result, the full value of HD was not represented. Deliberative research undertaken for the BBC by Human Capital indicated that the total value (the combination of consumer and citizen value) people place on the five main public service channels rises by approximately a third if they are offered in HD rather than SD; and

- HD for All (and other supporters of HD) noted that HD technology is not just broadcasting technology. It is also the future of camcorders, gaming consoles and DVD. They pointed out that the growth in HD ready television sales suggests we are on the edge of the adoption tipping point in the UK: more than five times as many HD ready television sets (2.3 million) were sold in the year to December 2006 as in 2005. On the basis of current trends, GfK estimate that there will be 36.9m HD ready televisions in the UK by 2012.

Reassessment

Funding

A2.213 Regarding the arguments about the difficulties or inappropriateness of publicly funded bodies purchasing spectrum, we would argue that in a market economy such as the UK’s, in general it is quite usual for publicly funded bodies to acquire inputs necessary to provide BSV from markets at the market price. Among other things, such an approach enables choices to be made regarding the most efficient mix of inputs for a particular output, where appropriate funding is in place. This issue is discussed further in section 5 of the statement.

Additional SD channels

A2.214 Our additional market research offers some support for the idea that more SD channels on the DTT platform offer BSV. The deliberative research suggests that more channels is perceived as ‘fair’ since it would be available to all with no cost at the point of use. Some participants saw potential value in community channels and educational and informative content. Nevertheless valuation for additional SD channels appears to have diminished compared to the 2006 research, and is now broadly speaking at similar levels to local television and mobile services. We note in this context that some market research participants remarked that the issue remains quality of output rather than the number of channels per se.
The issue for us remains the extent to which additional SD channels, including those with social or community value, might generate BSV that can only be delivered using additional spectrum capacity. The greater the opportunity to deliver additional SD channels via other means, the less the risk exists of a spectrum market failure in the DDR associated with BSV. We note in this context that plausible alternative delivery mechanisms exist, such as Internet broadcasting or recording on a personal video recorder (PVR). We would expect such alternatives to diminish the chances that there is market failure in the DDR award associated with BSV for additional SD channels.

Additionally, whilst it is clear that additional SD channels generate BSV, it is not clear that this could result in a market failure in the award of the digital dividend. The 2007 market research in particular suggests that the BSV of this use of spectrum is not very different from local television and mobile broadband services. Therefore, there are both reasons why the BSV generated by these channels may not be as great as expected, and why the level of BSV which is generated is insufficient to suggest a market failure in the DDR award.

Furthermore, when considering the delivery of additional SD channels on the DTT platform, the issue is not so much access to spectrum capacity per se, but access to multiplex capacity. Arguably multiplex capacity already exists and could be increased. Hence intervention in the allocation of the digital dividend may not be the best approach to resolving this issue. The wider question we need to address is one of resolving any difficulties in securing broadcasting slots on existing multiplexes or even future multiplexes.

We also suggest that, to the extent to which BSV does exist for certain additional SD channels, socially valuable content is an important PSB issue that cannot be dealt with solely or satisfactorily within the award process for the digital dividend. It will be more properly treated within the framework of PSB obligations.

Overall, we conclude that there is no significant market failure associated with the BSV of additional SD channels and critically the incremental spectrum that might be used to provide these. Accordingly, those channels with socially valuable or community dimensions cannot be seen as a market failure to be dealt with through some form of intervention in the purchase of the digital dividend. Nevertheless such services are potentially a valuable element of PSB and the potential problems they face are wider than just the DDR, we intend therefore to continue to address the issue through our second PSB Review.

We again note here that the opportunity cost estimates from table A40 in annex 8 help give context to any market failure. An intervention to reserve spectrum for SD channels could take up 6 channels of the digital dividend if it is necessary to set aside spectrum for an additional high coverage multiplex. The opportunity costs of this range from £1bn-2.5bn (NPV over 20 years). Therefore, we should only consider intervention in the DDR award where there is strong evidence of market failure.

Regarding HD services, we note that consumers who are familiar with HD products and services value these relatively highly in a private manner. Nevertheless the present evidence is that consumers place relatively little BSV on these services. Hence, based on current evidence alone, there is no compelling argument that BSV is associated with the digital dividend for HD or that a market failure exists here. Overall therefore we do not see a strong case at present for market failure in the procurement of this spectrum for the provision of HD services.
A2.222 Notwithstanding this present position, we recognise that the market is rapidly evolving and it is clear that consumer and citizen expectations regarding HD services are rapidly developing. An increasingly plausible scenario is that HD comes regarded as the broadcast standard and that PSB content would be expected to be delivered in this format. In this case, whilst there would be significant BSV generated by PSB content in HD, this does not imply that there would be significant market failure in the award of the digital dividend.

A2.223 Our current consultation on the future of DTT shows how it is possible (if required) for four new HD services to be offered universally on the existing DTT capacity by 2012. We also note that the PSBs have also agreed a nonbinding memorandum of agreement which supports this proposal.

A2.224 Therefore it is reasonable to assume that the digital dividend would not be required to offer the PSB services in HD if this is required in the future. The technical upgrades which can be applied to the DTT platform would allow this using existing spectrum. The digital dividend would be used to add incremental HD (or SD) content on top of what can be provided using the existing capacity. It is not at all clear that the BSV attributed to further HD channels in this situation would be large.

A2.225 Hence, given the opportunity cost of intervention on behalf of HD (which as discussed in the background section could be in the range of £1bn-2.5bn), we conclude that there is an insufficient case for intervention in the DDR award for HD services. The magnitude of the opportunity costs suggests that any market failure here would need to be very significant in order to prompt a serious consideration for intervention.

Advertiser funded business model may result in producer value (and hence willingness to pay) under representing total value (for HD and SD)

Recap from DDR consultation document

A2.226 We considered in our consultation document the argument that revenues derived from an advertiser funded business model might reflect a lower proportion of consumers' value than alternative funding models, particularly a subscription model. Since the commercial PSBs use an advertiser funded free-to-view model, to the extent that this argument holds, there could be a market failure.

A2.227 We noted that the argument for market failure rested on two key assumptions. These are: that compared to other potential uses of the spectrum there is a less direct relationship between the consumer and citizen value for new free-to-view channels and broadcasters' willingness to pay for spectrum to provide these, and that the free-to-view model is the only viable or welfare maximising way to deliver that value.

A2.228 We noted in the consultation document that the establishment of some new free-to-view channels on the DTT platform such as E4 and FilmFour tended to discount the first assumption. Regarding the second assumption, we noted that the establishment and potential future expansion of some pay television services, such as Top Up TV on the DTT platform, and Setanta's plans for pay-per-view for Premiership football, indicates that subscription models are viable and deliver consumer value.

A2.229 We concluded therefore that there was insufficient evidence of market failure in relation to advertiser funded models.
Responses and evidence

A2.230 A number of respondents, particularly broadcasters, argued this point particularly in relation to HD services, suggesting for example that for HD services advertisers would be unlikely to pay more to advertise in an HD format compared to an SD format. They concluded for example that the private benefits to viewers of HD would not be realisable by broadcasters in a free to air or advertiser funded model.

Reassessment

A2.231 As discussed in the background, we have not found general evidence of systematic differences in the ratio of consumer to producer value across the free-to-view and subscription based models which could be employed by the potential uses of the digital dividend.

A2.232 We now consider whether there are any particular characteristics of the use of the digital dividend for free-to-view SD and HD which might cause it to deviate from this general rule.

A2.233 For SD there do not appear to be strong arguments to suggest that this ratio would differ significantly. If incremental free-to-view SD channels using the digital dividend generate low advertiser revenues, this could suggest two things. Firstly, that they generate low consumer value in (as the low advertiser revenues reflect low viewing figures). In which case the ratio of producer to consumer value would not be significantly affected. Secondly, that if their viewing figures are low but consumer value it high (and hence the ratio of producer to consumer value is relatively low), this is likely to reflect the fact that they are niche channels, which it may be more efficient to fund via a subscription model.

A2.234 In addition, it is plausible for incremental free-to-view SD channels to generate relatively high producer value (where they are channels which are very attractive to viewers and high capture viewer share both from other channels on the DTT platform and from other platforms). However, in this case the relatively high producer value would be correlated with a relatively high consumer value.

A2.235 In relation to the HD issue, it may be true that, all other things being equal, HD generates limited incremental advertising revenues, which could suggest that the use of the digital dividend for free-to-view HD may generate low producer value relative consumer value. However, this assessment of the revenue effect fails to capture the full impact of HD on free-to-view broadcasters. If free-to-view HD generates high consumer value, there are two reasons why the advent of HD would also have a significant impact on free-to-view broadcasters’ revenues, and hence why the ratio of producer and consumer value may not be as low as it first seems. Firstly, a failure to move to HD could adversely affect a broadcaster’s current share of the advertising market if viewers switch away to other channels and/or platforms to access this new service. Secondly, in the longer term, the move the HD will act to reduce the number of services offered (relative to the number of services which could have been offered in the future if all services are offered in SD). This would be expected to have a positive impact on the advertising revenue available per channel on the DTT platform. Therefore, to the extent that the digital dividend is required in order to be able to offer sufficient HD content to prevent viewers switching away, there are reasons why the incremental producer and consumer value of offering this are sufficiently correlated.
A2.236 Therefore we do not believe that there is evidence to suggest that the use of a free-to-view advertiser funded model by SD or HD broadcasters would result in a market failure in the award of the digital dividend.

**Detrimental effects on DTT platform (SD and HD)**

*Recap from DDR consultation document*

A2.237 We identified and assessed in the DDR consultation document six potential reasons why the DTT platform might be weakened as a competitor to other platforms if it does not secure more capacity through the digital dividend, and so perhaps resulting in a detriment to consumers and citizens—a negative externality—that is not reflected in bidders' willingness to pay for additional spectrum capacity to provide extra SD or HD. Table A9 summarises our identification and assessment from the consultation.

A2.238 Overall we concluded that there were no significant reasons to expect that negative externalities existed that would be manifested through a weakening of the DTT platform.

**Table A9. Summary of the DDR consultation document's assessment of detrimental effects on the DTT platform**

<table>
<thead>
<tr>
<th>Market failure argument</th>
<th>Assessment</th>
</tr>
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<tbody>
<tr>
<td><strong>Applying to SD and HD:</strong></td>
<td></td>
</tr>
<tr>
<td>1. Without additional capacity viewers would switch away from DTT, which would lead to a reduction in the efficiency of the existing DTT spectrum</td>
<td>Viewers switching platform cannot be expected in aggregate to reduce the efficiency of the use of spectrum</td>
</tr>
<tr>
<td>2. Without additional capacity viewers would switch away from DTT, which would make the DTT platform a weaker competitor and would hence reduce competition in retail broadcasting services</td>
<td>The evidence for the diminution of competition is not clear. In any case such competition concerns are not solely a spectrum market issue</td>
</tr>
<tr>
<td>3. Without additional capacity viewers would switch away from DTT, and this would have a negative effect on the funding of PSB</td>
<td>The effect is uncertain here; reducing competition to the PSBs on the DTT platform may result in viewers switching to alternative platforms to gain access to other services</td>
</tr>
<tr>
<td><strong>Applying to SD:</strong></td>
<td></td>
</tr>
<tr>
<td>4. Without additional capacity viewers would switch away from DTT, which could impact on the realisation of public policy goals such as universal access to PSB content (in SD)</td>
<td>There is no evidence that DTT platform would be less able to deliver PSB content universally</td>
</tr>
<tr>
<td><strong>Applying to HD:</strong></td>
<td></td>
</tr>
<tr>
<td>5. Without additional capacity for HD, HD will not be available, which would prevent the realisation of BSV from the universal availability of PSB content in HD, this would call into question the role of the DTT platform in delivering universal access to PSB</td>
<td>The occurrence of this market failure depends on a number of assumptions, at the time of consultation, all of which are uncertain. These include the universal requirement for PSB content in HD, the need to realise this objective via the DTT platform and the need for additional spectrum to allow the DTT platform to achieve this</td>
</tr>
<tr>
<td>6. Without additional capacity for HD, HD will not be available on DTT, hence as other platforms’ transition to HD this will result in viewers switching away from DTT for HD content and so weaken the attractiveness of the DTT platform (and therefore the delivery of universal free-to-view content)</td>
<td>Widespread or complete transition to HD is possible, although uncertain. PSBs have a range of strategies to deliver PSB content in HD, including on existing multiplexes</td>
</tr>
</tbody>
</table>
A2.239 Regarding the question of PSB content in HD, the DDR consultation document identified the circumstances which would need to hold for a transition to HD to result in a BSV market value failure which required intervention to secure additional capacity on the DTT platform in order to allow universal access to PSB content. The first two conditions were that other platforms need to convert largely or entirely to HD, and that many viewers expect and require most content to be provided in HD. Beyond this, other conditions included that the PSBs would be required to provide (universally) the five main channels in both SD and HD on the DTT platform and that this would require additional capacity or a substantial reduction in the number of services on the existing DTT platform. And finally, that these factors would not be reflected in the PSB’s willingness to pay for spectrum.

Responses and evidence

A2.240 A number of these arguments were addressed or advanced by stakeholders in their responses. The PSBs in particular put forward arguments and evidence, broadly speaking, that consumers are increasingly aware of, purchasing and expecting HD services, and that there is an expectation or desire for HD to be provided free to air on DTT. They argued in addition that HD potentially delivers significant BSV and PSB content. They contend that failure to obtain additional spectrum capacity for the DTT platform in order to broadcast HD will significantly weaken the DTT platform. A number of other stakeholders also explicitly argued that a market failure existed in relation to detrimental impact on the DTT platform, arguing for example that without HD viewers would switch to other platforms.

A2.241 Our second tranche of market research has found mixed evidence regarding expectations of HD services and the potential impact on DTT platform. The research for example gave little evidence of viewer willingness to pay for HD, gauged for example from questions on willingness to purchase set top boxes to access HD. However, 43% of viewers expected HD to be available on Freeview, and about 69% of these expected this to be provided free-to-view.

A2.242 Regarding the viability of the DTT platform, the qualitative research suggested that a significant proportion of DTT viewers are presently relatively indifferent to the availability of HD on the DTT platform. Around half of respondents for example say that they would not be willing to pay to change platform from Freeview to another, in order to access HD.

Reassessment

A2.243 Responses and new evidence since 2006 confirm the growing awareness and expectations among viewers for HD broadcast services. However this is far from universal and there is little evidence of viewers valuing HD material so much that a majority is willing to pay for it or switch platforms. Alternative platforms such as Sky and Virgin Media are offering some HD content but the overall availability of content is small compared to SD and it is not yet clear whether HD linear broadcasting will be expanded or whether other delivery mechanisms such as video on demand might be used for HD content. Table A10 sets out our revised assessment of each of the six arguments.

A2.244 Overall we see no new evidence or views regarding the first four arguments above to counter our conclusion from the DDR consultation that these do not represent significant market failure.
### Table A10. Assessment of market failure (negative externalities) arguments on the DTT platform

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
<th>Assessment</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reduction in the efficiency of use of the existing spectrum</td>
<td>A large amount of spectrum is already set aside for DTT. The value to society, and therefore efficiency of that use could decline if the DTT platform were less attractive and large numbers of viewers switched to cable and satellite services. Therefore the most efficient outcome for the use of the spectrum could be to maintain the attractiveness of the DTT platform by increasing its capacity through using additional spectrum, even if that is not the optimal use of the particular frequencies to be released at switchover.</td>
<td>Assessment unchanged since the DDR consultation. For ease of reference this is: If the DTT platform loses viewers, it may represent a less efficient use of resources; but other platforms, which have gained viewers, will be using their resources more efficiently. There is no net loss of efficiency for society as a whole. However, it could be argued that this does not take into account the value lost by those viewers on the DTT platform who would not switch to other platforms even if the DTT platform does not acquire additional capacity. It is reasonable to assume that if the DTT platform becomes less competitive, some channels will leave the platform, reducing the value provided to those viewers who remain. However, the majority of viewing on the DTT platform is to the channels operated by the PSBs, which would presumably remain on the DTT platform even if its market share declines, suggesting that the impact on remaining DTT viewers of any loss of market share is likely to be small.</td>
<td>Unclear that this would result in a (net) negative external effect</td>
</tr>
<tr>
<td>2. Weaker competitor</td>
<td>It could be argued that if the DTT platform becomes less competitive in future, leading more viewers to switch to cable and satellite, this would ultimately dilute competition in broadcasting services as a whole. If the dilution of competition were significant this could lead to weaker incentives to innovate, greater opportunities for uncompetitive practices by operators and worse outcomes for all consumers. Providing additional spectrum for the DTT platform might maintain or increase competition, leading to better outcomes for all consumers.</td>
<td>Assessment unchanged since the DDR consultation. For ease of reference this is: If the DTT platform were to be weakened to such an extent that it offered less competition to cable and satellite platforms, it is not clear how significant a lessening of competition in provision of broadcaster services in the UK would result—this depends upon the degree to which DTT is an effective competitor to the satellite and cable platforms or whether they are generally serving different groups of viewers. If they are competing for viewers it is unclear why the DTT platform would not have strong incentives to acquire additional spectrum if it is required. If the problem is that DTT is just a weak competitor, it is not clear that this is a failure of spectrum markets per se, or that the award of additional spectrum is likely to be an effective remedy. Competition law and sector specific regulation creates a range of mechanisms for assessing and addressing weak competition. Competitor subsidies are not a solution that would usually be considered.</td>
<td>Unclear that this would result in a negative external effect</td>
</tr>
<tr>
<td>Argument</td>
<td>Description</td>
<td>Assessment</td>
<td>Conclusion</td>
</tr>
<tr>
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<tr>
<td>3. Funding of PSB</td>
<td>The advertiser funded PSBs have a more significant presence on the DTT platform than on the cable and satellite platforms, because they represent a greater proportion of the channels broadcast on that platform. Increasing the capacity of the DTT platform through additional spectrum would be likely to increase their market share and revenues, either indirectly (by making the DTT platform relatively more attractive, and therefore potentially taking customers from the cable and satellite platforms) or directly (if the PSBs acquire capacity to operate more channels in a new multiplex). By supporting the PSBs’ competitive position in this way, giving additional capacity to the DTT platform could arguably help support their future ability to invest in public service content. It could also create the capacity for them to launch further public service channels, which might not be viable on strictly commercial terms if they had to bid for capacity but which could deliver significant benefits to citizens.</td>
<td>Assessment unchanged since the DDR consultation. For ease of reference this is: The PSBs command a higher market share on the DTT platform, and (within the terms of any regulation) they could use additional capacity to maintain their competitive position against the cable and satellite broadcasters, or to develop additional channels generating commercial returns that they could reinvest in their core PSB services. In general, our first PSB review suggested that the strategy of supporting PSB by limiting competition was unlikely to be effective in future, or in viewers’ best interests. This strategy may shore up market share of the DTT platform, but may also encourage viewers to switch to other technologies—on-demand services, video downloads, DVDs or mobile services—to access the content they want to watch, if it is not available on their main digital television service. It is highly unlikely to be in the interests of citizens and consumers to intervene to suppress competition in this way.</td>
<td>Costs of intervening in this way likely to be greater than the negative external effect</td>
</tr>
<tr>
<td>4. Universal access to PSB content in SD</td>
<td>As a matter of public policy, there is a commitment to the DTT platform as the means of delivering near universal availability of PSB (in SD). If the DTT platform is weakened to the point where its viability is uncertain, it is possible that its ability to meet this public service goal could be diminished. Additionally, it has been argued that there is an expectation held by UK society that the DTT platform will deliver an attractive service and that viewer expectations would not be met if additional capacity is not available, as this may result in it becoming a less attractive platform for...</td>
<td>Assessment unchanged since the DDR consultation. For ease of reference this is: The commitment is to ensure near universal availability of the public service channels, using the DTT platform as the means of delivering this. This commitment is reflected in the 2003 Communications Act, in licences issued by us to Channel 3, 4 and 5 licensees and in regulation of the BBC by the Government. This commitment is not threatened by any risk that the DTT platform might become less attractive and competitive in future, since the public service channels will always be available on the platform as long as this policy commitment persists</td>
<td>Current policy position and the potential for technical upgrades means there is unlikely to be a negative external effect</td>
</tr>
<tr>
<td>Argument</td>
<td>Description</td>
<td>Assessment</td>
<td>Conclusion</td>
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<tr>
<td>broadcasters, leading to reduced quality and range of services available on the platform. Therefore as a matter of ‘public policy’ it might be appropriate to maintain a strong DTT platform, by ensuring it has increased capacity after switchover.</td>
<td>There is no broader policy commitment to particular content or service offerings on the DTT platform. There is a commitment to achieving digital switchover (DSO), but this is a platform neutral policy which does not favour any particular platform over another.</td>
<td></td>
<td></td>
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<tr>
<td>5. Universal access to PSB content in HD</td>
<td>If the availability of PSB content in HD becomes important for the realisation of BSV from universal availability of PSB content, the impact of the availability of additional capacity on the ability to realise this value to society may not be adequately represented in terms of DTT providers’ and operators’ total value for spectrum as opposed to the total value for other spectrum uses.</td>
<td>It might be argued that consumers have come to expect a high quality offering on the DTT platform, particularly in the context of DSO, and will suffer if the platform’s ability to keep up with cable and satellite is compromised after DSO. This argument might particularly apply if the DTT platform is unable to offer some of the enhanced services now in development on other platforms, such as HD. The occurrence of this market failure depends on a number of assumptions. These include the universal requirement for PSB content in HD, the need to realise this objective via the DTT platform and the need for additional spectrum to allow the DTT platform to achieve this. Whilst demand for HD is clearer and the requirement for universal provision of PSB content in HD is increasingly plausible, the case for a requirement for additional spectrum to achieve this is certainly not well established. The technical work on the future of DTT has established that existing spectrum could be used to allow PSB content to be delivered in HD if this is the best use of this capacity.</td>
<td>Unlikely that this external effect would emerge</td>
</tr>
<tr>
<td>6. Viewers switching away for HD</td>
<td>If other platforms move to HD in future, there may be a negative external value impact on consumers and citizens because of the impact of this on the attractiveness of the DTT platform if sufficient capacity is not available on the DTT platform to enable both HD and SD services to be broadcast. This impact on consumers and BSV will not be factored into the DTT providers’ and operators’ willingness to pay for spectrum.</td>
<td>Widespread or complete transition to HD is possible. If this transition does take place there is a range of strategies PSBs could use to deliver the main five channels in HD, including on the existing multiplexes. Additionally, our latest market research suggests that by far the majority of DTT viewers would not actively consider switching to alternative platforms in this situation. Therefore benefits of providing more DTT capacity for HD in the available digital dividend spectrum may be relatively limited. Additionally, it is unclear why the broadcasters would not take this into account when deciding how much additional spectrum is worth to them.</td>
<td>Unclear that external effects are present</td>
</tr>
</tbody>
</table>
A2.245 Regarding the fifth argument concerning PSB content, we recognise that recent market trends are starting to move in this direction. Some DTT competitor platforms are beginning to offer HD broadcasts and may expand this in the immediate or near future. Viewers’ expectations regarding this and in due course the desirability of PSB content to be provided in HD on the DTT platform can be expected to develop.

A2.246 Against this we note that our recent work and current consultation on the future of DTT suggests that it is technically possible for existing spectrum to be used to deliver PSB content in HD, if this is the best use of this capacity. Therefore, we consider that if in the future there is a requirement to offer PSB content in HD this can be fulfilled using the existing spectrum available for the DTT platform. Therefore, we do not believe that this would be expected to result in a significant market failure in relation to the award of the digital dividend (and its potential to further increment the capacity available on the DTT platform).

A2.247 We note here that our economic modelling work has considered a range of scenarios for the development of the DTT platform and its ability to offer new services such as HD. This work shows that the fewer HD services which can be offered over the existing spectrum the higher the valuation for additional spectrum, and presumably, also the higher the incentives to upgrade the existing spectrum to further increase its capacity. However, neither the general message from our modelling work nor our policy conclusions here are dependent on the precise number of HD services that can be offered on the existing spectrum. Our conclusions rely only on the opportunity to offer HD services on the existing spectrum through the use of technical upgrades, if this is the best use of this spectrum given the level of demand for HD.

A2.248 Regarding the sixth argument, on switching away to other platforms that offer HD, we suggest that possibilities for the DTT platform to combat any competition from HD broadcast on other platforms will be enhanced to the extent that the DTT broadcasters are able to upgrade the platform to use more efficient technologies, as discussed in our future of DTT consultation. We note that the DTT broadcasters’ incentive so to do will be enhanced to the extent that serious competition for HD viewing begins to emerge. Hence it is not at all clear that external effects or market failure is present here. However, we also note our latest market research which suggests that only a minority of viewers would consider switching away from the DTT platform if it was unable to offer HD when other platforms are offering this service.

A2.249 Overall, having considered each of the potential reasons, we do not consider that new evidence or developments have changed the balance of arguments in relation to these. That is, we do not see the potential for significant market failure in relation to potential detrimental effects on the DTT platform. Therefore, given the size of the opportunity cost of intervention (which as we mention earlier ranges from £1bn-2.5bn) we do not believe that there is sufficient evidence of a market failure to warrant intervention in the DDR award.

Summary of market failures assessment

A2.250 Our reassessment above has identified one issue that may carry a risk of market failure. This relates to the problem of capital market failure.

A2.251 In reaching this conclusion we note that the opportunity cost of intervention on behalf of the DTT platform for either SD or HD is reasonably significant, at up to £1bn-2.5bn in total (NPV over 20 years). This opportunity cost is plausibly of the
same order of magnitude as the potential value of using the digital dividend to provide additional SD or HD channels. Therefore, this suggests that there is uncertainty over whether intervention to resolve a market failure in relation to this use would result in greater total value from the use of this spectrum. This suggests that we should only consider intervention when we believe that the evidence of the market failure risk is sufficiently strong.

A2.252 We recognise the possibility that demand and expectations for HD services may increase and that BSV is generated through this, and HD PSB material is increasingly expected to be delivered on Freeview. However, we do not consider this to be a cause of significant market failure in relation to the award of the digital dividend.

A2.253 Table A11 summarises our reassessment of the five issues.

Table A11. Summary assessment

<table>
<thead>
<tr>
<th>Argument</th>
<th>Coordination</th>
<th>Capital market failures</th>
<th>BSV</th>
<th>Advertiser funded business model</th>
<th>Detrimental effects on DTT platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problems with coordination result in DTT bidders not representing their true value in an auction</td>
<td>Capital market failures may prevent the BBC and Channel 4 from raising funds to purchase spectrum</td>
<td>BSV generated by use of the digital dividend may not be factored into willingness to pay for spectrum for additional SD or HD channels</td>
<td>Advertiser funded business model may result in producer value (and hence willingness to pay for spectrum) under representing total value</td>
<td>Detrimental effects on the DTT platform may not be taken into account in DTT providers’ willingness to pay for spectrum</td>
<td></td>
</tr>
<tr>
<td>Relevant new evidence</td>
<td>Capital market failures may prevent the BBC and Channel 4 from raising funds to purchase spectrum</td>
<td>BSV generated by use of the digital dividend may not be factored into willingness to pay for spectrum for additional SD or HD channels</td>
<td>Advertiser funded business model may result in producer value (and hence willingness to pay for spectrum) under representing total value</td>
<td>Detrimental effects on the DTT platform may not be taken into account in DTT providers’ willingness to pay for spectrum</td>
<td></td>
</tr>
<tr>
<td>Commercial incentives and ability to coordinate clearly demonstrated to exist</td>
<td>Borrowing limits could constrain BBC and Channel 4 from entering auction for spectrum</td>
<td>Confirm view that no strong case for significant incremental BSV associated with additional SD or HD channels</td>
<td>Choice of business model should be determined by market circumstances and no a priori reason to expect that one is more or less representative of willingness to pay than another. Note that advertiser model already well established on DTT platform</td>
<td>There is no strong evidence to suggest that detrimental effects would exist, or if they did, that they would result in a market failure in relation to the award of the digital dividend</td>
<td></td>
</tr>
<tr>
<td>No significant market failure—no intervention in DDR award</td>
<td>Potential for market failure—consider intervention options</td>
<td>No significant market failure—no intervention in DDR award</td>
<td>No significant market failure—no intervention in DDR award</td>
<td>No significant market failure—no intervention in DDR award</td>
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</tbody>
</table>

Recognise PSB point in relation to HD but PSB content can be provided using the existing capacity.
Intervention: Remedies and risks

A2.254 This section considers the set of remedies that may effectively address potential market failures in the provision of additional SD and HD services on DTT and assesses the risks of regulatory failure associated with them. In considering the set of potential interventions and remedies, we draw on the description of market failure remedies relating to spectrum awards set out in A2.44–A2.60 and tables A1–A3.

A2.255 The main market failure risk in relation to additional SD services and HD is the ability of PSBs to access capital markets.

A2.256 We also give consideration in this section to what options would existing within our market led approach for intervening to resolve market failure associated with BSV in relation to extra SD or HD channels. This is because whilst we do not consider there to be evidence to suggest that we should intervene in the DDR award, we recognise that there is uncertainty over the BSV generated by these uses and that this could change in the future and/or others may decide that their worth (in aggregate) warrants the provision of funding. Hence, to assess whether our proposal not to intervene in the DDR award is future proof, we first assess whether under a market led approach there are intervention options which could be used in the future to support the delivery of BSV by these services if the Government or other funding bodies decided that the BSV generated by these uses warranted public funding.

A2.257 We note again here that the opportunity cost of intervention on behalf of the DTT platform is reasonably significant, at up to £1bn-2.5bn in total. In considering any intervention therefore we would need to be particularly sure that it was robust to the risk of regulatory failure in order to avoid the overall cost of any intervention exceeding the significance of the market failure it is designed to address.

Capital market failure

A2.258 In our view, the best option in terms of efficacy of resolving the potential capital markets market failures faced by the BBC and Channel 4 is to address the issue through a revision of borrowing constraints. This would enable the bodies concerned to make their own assessment of the worth of spectrum, bearing in mind their duties and objectives, and allow full participation in the spectrum market. Willingness to pay revealed in this manner is likely to result in the allocation of spectrum that can be expected to maximise total value. Since the option is direct, it is likely to have fewer unintended consequences.

Table A12. DTT: assessment of effectiveness and regulatory risks of intervention options

<table>
<thead>
<tr>
<th>Option</th>
<th>Capital market failure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Directness/ achieves</td>
</tr>
<tr>
<td></td>
<td>Is efficient/no or few</td>
</tr>
<tr>
<td></td>
<td>outcome</td>
</tr>
<tr>
<td></td>
<td>unintended consequences</td>
</tr>
<tr>
<td>Address capital market issue:</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>revise borrowing limits</td>
<td></td>
</tr>
<tr>
<td>Phased payments</td>
<td>✓ ✓</td>
</tr>
<tr>
<td>Administrative allocation</td>
<td>✓</td>
</tr>
</tbody>
</table>

54
A2.259 Phased payments are also an option for resolving this sort of market failure. In theory, this option would enable bidders to increase their bids by reducing the amount of capital which needs to be raised up front. The risk of failure to achieve the desired outcome appears relatively low given that it admits both a market process and considerably facilitates participation in the auction. Disadvantages of this option include the possibility that statutory constraints might still limit the extent to which a body is able to commit to a future payment stream. In addition, this option creates credit risks for us, since a body may be awarded spectrum on the basis of a future payment stream. We would also take the risk of having to reallocate spectrum in the future if a body were to default on payment. This can encourage speculative bidding, and has significant costs for consumers and citizens, since if spectrum is handed back to us this will tend to result in it being unused for a potentially significant period given the administrative requirements we need to meet when awarding spectrum. Overall we consider that the regulatory risk associated with the introduction of phased payments is medium.

A2.260 Administrative allocation is likely to be a very costly option for resolving this form of market failure. Not only does it not allow the market to test whether the opportunity cost is worth incurring, it is also likely to be subject to a significant risk of regulatory failure. Intervention options that require a significant degree of regulatory input in terms of deciding on the allocation or worth of spectrum are likely to be particularly susceptible to significant regulatory failure. The regulator is unlikely to have a full set of information about the present or future value of a particular service or how this compares with other services. Additionally, administrative allocations can have negative effects on the efficiency of spectrum use both now and in the future.

A2.261 Revising the borrowing limits is the best intervention option available if this market failure is considered to be a significant issue. This change is a matter for discussion between Government, the BBC and Channel 4. The risk of regulatory failure with this intervention option is relatively low.

A2.262 Table A13 summarises the extent to which the possibilities for regulatory failure associated with intervention options might be significant. A revision of borrowing limits is likely to allow the purchasing body the freedom to choose among competing inputs, including spectrum, in order to meet its objectives. In this context there is unlikely to be a significant regulatory failure. Phased payments tend to introduce potentially significant risks that a bidder defaults if it is unable to service the phased payments. In this case it is possible that the spectrum is returned to us and not used efficiently in the meantime. Administrative allocation of spectrum places responsibility on the regulator and implies that it has sufficient knowledge and data to make an informed decision. Since it is unlikely that the regulator has this necessary information, the significance of any regulatory failure will be high.

<table>
<thead>
<tr>
<th>Capital market failure: significance of regulatory failure</th>
</tr>
</thead>
</table>
| Revise borrowing limits | • Purchasing body is able to make decisions on inputs including spectrum  
• Significance of regulatory failure relatively low |
| Phased payments | • Risk that spectrum is returned to us if bidder defaults—so spectrum use is suboptimal and we carry credit risk  
• Overall risk of misallocation of spectrum low to medium |
| Administrative allocation | • Places strong burden on regulator to make decision concerning value of spectrum for this relative to other uses  
• Negative effects on efficiency of spectrum use both now and in the future  
• Significance of regulatory failure relatively high |
A2.263 We consider here regulatory remedies which might exist in the future if the assessment of the significance of the market failure risk in relation to BSV generated by SD or HD were to change. In so doing, we assess the remedies which are available to resolve this type of market failure under a market led approach to the release of the spectrum.

A2.264 The assessment of the intervention options in this situation are the same as the comparable assessment for local television in paragraphs A2.138–A2.146 above. The discussion of these arguments is not repeated here, but the summary tables are shown for information.

Table A14. DTT: assessment of effectiveness and regulatory risks of intervention options

<table>
<thead>
<tr>
<th>Option</th>
<th>Directness/ achieves outcome</th>
<th>Is efficient/no or few unintended consequences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct funding</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Direct funding + match winning bids</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Direct funding + phased payments</td>
<td>✓</td>
<td>?</td>
</tr>
<tr>
<td>Bidder credit</td>
<td>✓</td>
<td>×</td>
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</tbody>
</table>

Table A15. Assessment of significance of regulatory failure

<table>
<thead>
<tr>
<th></th>
<th>BSV: significance of regulatory failure</th>
</tr>
</thead>
</table>
| Direct funding                 | • Purchasing body chooses how best to purchase inputs including spectrum  
|                                | • Significance of regulatory failure relatively low |
| Direct funding + match winning bids | • Facilitates publicly funded bodies participation by revealing likely levels of bids  
|                                | • Risks of distorting behaviour—pre qualification for match winning bids status, may reduce liquidity in initial auction  
|                                | • Overall risk of regulatory failure medium |
| Direct funding + phased payments | • Fits better with public funding and market approach, tends to help market based outcome  
|                                | • Risk that spectrum is returned to us if bidder defaults—so spectrum use is suboptimal  
|                                | • Overall risk of regulatory failure medium |
| Bidder credit                  | • Requires assessment of size of bidder credit, in turn implying regulator holds adequate information and foresight  
|                                | • Requires view on who is eligible  
|                                | • Method could distort behaviour in terms of seeking bidder credit  
|                                | • May reduce future flexibility of the spectrum by tying the obligation to deliver BSV to the spectrum licence  
|                                | • Overall risk of regulatory failure is relatively high |

A2.265 To summarise, it is clear that possible regulatory failures associated bidder credit could be significant. Possible regulatory failures associated with phased payments, matched winning bids are of medium significance. Direct funding is an option where the significance of regulatory failure is likely to be relatively low.
**Is intervention justified given the risks and opportunity costs?**

A2.266 Our assessment of the risk of capital market failures indicates that there is in principle a significant market failure risk for the BBC and Channel 4. Our assessment of the intervention options still suggests that the removal of borrowing constraints is still the best option for resolving this if it turns out to be a significant issue. This is a matter for discussion between the Government, the BBC and Channel 4.

A2.267 In relation to arguments that spectrum should be made available because of the BSV generated by SD or HD services, we have assessed these arguments carefully and identified that the risk of market failure is not significant and hence that intervention in the award of the digital dividend is not justified. Our assessment here is also made in the light of the potential opportunity costs of intervention, which are relatively high at £1bn-2.5bn, for the 48 MHz which may be required to support a new multiplex.

A2.268 However, we recognise that there is uncertainty over how BSV may develop over time and hence have assessed whether a market led approach is future proof to such changes. We have identified, that if the assessment of the risk of market failure in relation to these uses because of BSV were to change in the future, there are options within a market led approach for funding bodies to intervene to realise this value. In fact, our assessment suggests that the most efficient option for intervening to resolve this form of market failure is to provide direct funding, which is consistent with our market led approach to the award of the spectrum.

**Mobile broadband**

A2.269 Mobile broadband services encompass a wide variety of uses. First, the digital dividend can be used to provide wireless access to broadband services, such as facilitating access in cafés or libraries, or to support fully mobile applications including on hand held devices. It can also be used for more established or new, third generation like, communications services for voice and data. The DDR consultation document set out the potential spectrum requirements and the relevant technical features of such services.

A2.270 Our consultation document identified and assessed reasons why there may or may not be market failure associated with the procurement of the digital dividend for mobile broadband services. We identified one market failure argument, this being:

- BSV generated from the universal access to mobile broadband may not be fully reflected in a bid in an auction, owing to relatively high levels of BSV generated by this service when compared to other potential uses of the digital dividend.

A2.271 Our assessment of this argument led us to conclude that, although there was some evidence of BSV for universal access to this service, there was significant uncertainty over a) the proportion of this value generated by mobile broadband rather than by broadband per se, and b) the requirement for the digital dividend to realise this value. Hence we considered that the risk of this market failure occurring was low and no intervention was required.
A2.272 Nevertheless we suggested that spectrum should be packaged in a market led award process in a way that allows mobile broadband to be one possible future use of the digital dividend. We also noted that it was plausible that BSV of the wireless application of this service may increase over time as data transfer speeds increase and the limitations of wired broadband (especially in rural areas) become more severe.

A2.273 Responses to the consultation document and discussions with stakeholders have not led us to believe that there are any further market failure arguments to consider.

A2.274 The following sections set out relevant new evidence and views, and reassess the case for market failure and intervention. In particular we have carefully considered views expressed and evidence provided concerning the BSV of mobile broadband services. Our latest tranche of market research informs our reassessment.

New developments, evidence and responses

Responses

A2.275 Responses to the DDR consultation document included a range of views concerning our assessment of and approach to the issue of mobile broadband services. In relation to risk of market failure, responses on mobile broadband fell into three main groups.

A2.276 One group of respondents, representing most organisations and individuals, broadly supported our proposal that spectrum should be packaged in order to allow mobile broadband to be one possible use of this in the future. Some mobile operators raised the issue of European harmonisation of a sub band for mobile broadband, arguing that such harmonisation would facilitate economies of scale and roll out of services. Some respondents from this group suggested that we needed to be careful in any such packaging in order not to preclude other uses, or to avoid interference.

A2.277 A second group, including the Scottish Executive (now the Scottish Government) and Welsh Assembly, favoured reserving some portion of the digital dividend for mobile broadband use. Reasons put forward included a desire to promote more widely the social benefits of broadband access, both geographically and for particular groups amongst whom digital service penetration is presently low. Broadly speaking this group of respondents said that in their view mobile broadband services deliver significant BSV and/or that we had underestimated this in our consultation document.

A2.278 Electrical retailers and some individuals comprised the third group, which argued for mobile broadband use to be excluded in order that the spectrum is used for HD on the DTT platform. Some individuals also put forward the view that the physical properties of the digital dividend made it more suitable for uses other than mobile broadband.

A2.279 Some respondents also commented on our proposed packaging of spectrum in order to allow mobile broadband to be one possible use of the digital dividend in future. Many agreed with this. Some suggested that we needed to be careful in any such packaging in order for example not to preclude other uses or to avoid interference. Some other respondents suggested that other spectrum bands were technically more suitable for mobile broadband uses because of the available data transfer rates.
Market research

A2.280 Our 2007 research confirmed that mobile broadband services are valued both from a personal and societal perspective.

A2.281 Our deliberative research revealed that two of every three respondent’s ranked mobile services (improved coverage and access to mobile phone and mobile broadband services) first or second, from a societal point of view, compared with three in five from a personal perspective. Both results place mobile services as the highest ranked service. In the quantitative research, the percentage ranking this service as first or second was smaller at 40% in terms of importance to society, however mobile services were still the highest ranked service (alongside extra channels on Freeview).

A2.282 In a ‘chip allocation exercise’ in the deliberative research, each participant was asked to imagine that they were us. They were asked to take into account the needs of consumers, citizens and the communications industry and allocate ‘chips’ representing portions of spectrum for particular uses. Better mobile phone and mobile broadband services received 30.5% of the allocation (the highest allocation to any service).

A2.283 In a separate question, the deliberative research asked participants about geographical coverage and access to services that might be provided using the digital dividend. There was a clear preference for all citizens and consumers, whether living in urban or rural areas, to have access to one service, compared to a situation where most people would have access to the first and second preferred services, but some people in rural areas would not.

A2.284 When asked about future scenarios in which for example more people worked from home, the deliberative research produced positive comments about the benefits of mobile broadband services in enabling home working and flexibility, but also some negative comments concerning the blurring of the distinction between work and home life.

A2.285 Regarding the utility of being able to use such services whilst mobile, the 2007 deliberative research found some evidence of personal value attached to this—for example, one participant noted that mobile service could enable users to make use of ‘dead’ time when travelling and so on. The 2007 quantitative research suggested that respondents see considerable value in being able to make voice calls in different locations including in buildings and in both rural and urban areas, but the importance of the availability of mobile data services in a variety of locations was gauged as being significantly less.

Technical developments

A2.286 Section 3 of this statement notes that the European Commission published a Communication on a common approach to the use of the digital dividend in the EU. With the goal of promoting competitiveness and economic growth, this has raised the idea of identifying common spectrum bands whose use can be optimised by creating ‘clusters’ of services using a similar type of service. This approach for mobile communications has the potential to open up economies of scale for the rollout of services and so increases the value of the digital dividend for the use of this spectrum for that service as well as the value to society derived from it. Since the DDR consultation, the likelihood that some of the digital dividend could be used for two way mobile use has increased.
BSV externalities

Recap of DDR consultation document

A2.287 In the consultation document our assessment of the potential for market failure associated with the provision of mobile broadband services was concerned with the following:

- whether the BSV associated with mobile broadband services relates to mobility or its potential to provide universal coverage; and
- whether the digital dividend provides a superior solution to the provision of mobile broadband services compared to other alternative spectrum bands, particularly in rural areas.

Responses and evidence

A2.288 As discussed above, respondents who commented on this potential market failure in the main emphasised their view that mobile broadband services could both be best provided using the digital dividend and that they generate significant BSV. They considered that bids for spectrum were unlikely to reflect this BSV and that a significant market failure exists which requires intervention.

A2.289 Our market research suggests that significant value is attached mobile broadband services both from a private and societal perspective. It consistently ranks first or second out of all services, from a societal perspective. The deliberative research also demonstrated that participants’ ranking of mobile broadband services both personally and for society increased following further discussion of the service and its applications, and in the light of possible future scenarios.

A2.290 We can infer from the research results regarding geographical coverage and access to services that, should mobile broadband be seen as the most preferred service to be provided through use of the digital dividend, people attach value to this being universally available.

A2.291 Additionally, our economic modelling work suggests that access to the digital dividend for mobile broadband services is a high value use of the spectrum. Alongside the further technical developments and increased prospect for Europe wide economies of scale in this band, this suggests that the value of the digital dividend to mobile operators is likely to be high.

Reassessment

A2.292 Overall it is clear that mobile broadband services continue to be valued from a societal point of view, and to some extent the market research evidence suggests that this value is higher and more strongly entrenched than in 2006.

A2.293 However, given that such a service simultaneously embodies attributes of universal access, access to broadband, and mobility, it is not clear to what extent the BSV associated with this service is driven by universal access to broadband per se, or universal access to mobile broadband.
A2.294 Where BSV arises from universal access to broadband per se, a question arises as to the extent to which BSV can be delivered by and associated with incremental use of the digital dividend. For example, other delivery platforms such as existing fixed networks or other spectrum bands are plausible alternative delivery methods for this service. It is possible that these methods have limits concerning ability to deliver full coverage or are, depending on market circumstances, more costly than delivery via the digital dividend. In our view, these alternatives suggest that there is uncertainty over the incremental benefit of this spectrum—its role in securing universal access to broadband could plausibly be low, but equally there is a possibility it may be high.

A2.295 Where BSV arises from universal access to mobile broadband, a similar line of argument leads us to conclude that spectrum other than the digital dividend is a plausible alternative delivery option for this service. Such alternative spectrum could be more expensive because of availability issues and because of the advantages of the digital dividend over higher frequencies, which allows good quality coverage to be achieved at lower cost. Overall, the incremental benefit of this spectrum associated with universal access to mobile broadband is uncertain; it could plausibly be either low or high.

A2.296 Taking both arguments together suggests that, while it is not certain, we can not disregard the argument that the digital dividend may have significant incremental BSV associated with it through its role in securing universal access to mobile broadband.

A2.297 These factors by themselves do not imply that intervention is required in the spectrum auction in order to ensure the delivery of BSV. It is important to note that where other delivery platforms are difficult or costly, use of the digital dividend may—since it reduces overall costs—facilitate rather than guarantee roll out of the service. Considerable motivation and investment will still be required from mobile broadband operators. Where their commercial incentives do not extend to motivating such a roll out, the most effective means in our view of ensuring the provision of BSV will be to provide funds to commercial operators to roll out services beyond the commercially viable level. Such funding for network rollouts might be particularly applicable to rural areas.

A2.298 Overall, we conclude that the existence of BSV associated with the digital dividend which could be used to facilitate universal access to mobile broadband could in principle result in a significant market failure (see table A16). However, a key point is that this would be a market failure in the decision of operators to rollout, and not necessarily a market failure in the bids made by these operators in a DDR award process. Given the level of interest in this spectrum by these operators, and the particular advantages it offers them to rollout mobile broadband networks at lower cost, the risk of this market failure impacting upon the outcome of the award process seems unlikely.

A2.299 The potential opportunity cost of intervention to address any market failure is also particularly relevant here. As set out in the modelling annex, the opportunity cost of intervention to set aside spectrum for mobile broadband could be £1bn-2.5bn in total. Therefore, as any market failure associated with the failure to roll out fully the service might be addressed in a number of ways, including options which do not require a spectrum intervention, and given that the high private value of the digital dividend is likely to be sufficient to avoid a spectrum market failure (i.e. mobile broadband operators not gaining access to this spectrum when their total value suggests they should), the evidence of market failure is not significant enough to warrant intervention in the award of the digital dividend.
Table A16. Summary assessment

<table>
<thead>
<tr>
<th>Argument</th>
<th>BSV generated from the universal access of mobile broadband may not be fully reflected in rollout decisions made by mobile broadband operators. And, where this rollout is dependent upon access to the digital dividend, may not be appropriately reflected in bids for spectrum.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevant new evidence</td>
<td>Mobile broadband continues to be attributed relatively high societal value. Value can be attributed to universal access to broadband per se, and also from mobile element of this service. However, it is becoming increasingly clear that the private value of this spectrum to mobile operators is also particularly high.</td>
</tr>
<tr>
<td>Reassessment</td>
<td>Whilst there are alternative delivery mechanisms and platforms which may allow universal access to both broadband and mobile broadband, we cannot disregard the argument that the digital dividend may have significant incremental BSV associated with it through its role in securing universal access to these services. However there is not sufficient evidence of a likely market failure in the award of the digital dividend. We believe that operators have strong private incentives to bid for spectrum. Therefore, we do not expect there to be a market failure in the award of the digital dividend. It is possible that there may be a market failure in relation to the rollout decisions mobile operators make once they have acquired spectrum.</td>
</tr>
<tr>
<td>Conclusion</td>
<td>No intervention required in the award. Package spectrum in appropriate manner to allow mobile broadband to be one possible use of the digital dividend. Check that this decision is future proof i.e. following a market led approach does not remove the opportunity to intervene to resolve the market failure in relation to rollout in the future.</td>
</tr>
</tbody>
</table>

Intervention: Remedies and risks

A2.300 Given our view that the BSV associated with universal access to mobile broadband could be significant this section considers possible approaches to the market led award approach that might in principle accommodate the need to address at some future date a market failure in relation to operators’ rollout decisions.

A2.301 In line with our previous reasoning in this statement and the DDR consultation document, we consider that some form of direct funding is in principle the most direct and efficient solution to this issue. Under this approach we would adopt a market led approach to the digital dividend. Were roll out to be incomplete and were significant BSV to be demonstrated to be associated with a further roll out of the service, the most efficient approach would then be for funding bodies would to provide mobile broadband operators with appropriate resources to undertake the necessary further roll out in order to achieve wider or universal coverage. We note in this context that access to and awareness of broadband in some areas or for some sectors of society has been funded by the EU, the UK Government via Regional Development Agencies, and the Welsh Assembly Government. Funding would reflect both the cost of universal coverage—over and above the coverage that would otherwise be provided—and the BSV associated with providing universal coverage. We would expect funding bodies to place an obligation on mobile broadband operators to ensure wider or universal delivery in return for providing this funding. Mobile broadband operators would then at that point take a view as to whether the digital dividend is the most efficient mechanism for the wider or universal delivery of mobile broadband services.
A2.302 The use of a market led approach in the first instance is in our view consistent with such possible future developments. Private and consumer value of mobile broadband coverage are significantly correlated; hence in the first instance mobile broadband operators will already have commercial incentive to seek out the necessary inputs, including where appropriate the digital dividend, to achieve commercially desirable levels of roll out.

A2.303 All spectrum related interventions (i.e. auction design and packaging, matching winning bids, phased payments, bidder credits or administrative allocation) are likely to be ineffective and inefficient options for resolving this form of market failure. The market failure is not tied to access to the digital dividend, rather it is tied to the decisions operators make once they have access to either this or alternative delivery mechanisms.

A2.304 Table A17 sets out our high level assessment of these items.

Table A17. Mobile broadband: assessment of effectiveness and regulatory risk of options

<table>
<thead>
<tr>
<th>Option</th>
<th>BSV associated with rollout decisions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Directness/achieves outcome</td>
</tr>
<tr>
<td>Auction design and spectrum packaging</td>
<td>✗</td>
</tr>
<tr>
<td>Direct funding</td>
<td>✓</td>
</tr>
<tr>
<td>Match winning bids</td>
<td>✗</td>
</tr>
<tr>
<td>Phased payments</td>
<td>✗</td>
</tr>
<tr>
<td>Bidder credit</td>
<td>✗</td>
</tr>
<tr>
<td>Administrative allocation</td>
<td>✗</td>
</tr>
</tbody>
</table>

A2.305 Clearly direct funding in principle provides a direct and efficient way of addressing market failure. The risk of a significant regulatory failure associated with this form of intervention is relatively low.

Is intervention justified given the risks and opportunity costs?

A2.306 The views and evidence put forward since publication of the DDR consultation document suggest that mobile broadband services are increasingly attributed a relatively high BSV. The evidence suggests that the significant part of this BSV derives from universal access to broadband. Another part will derive from mobile access to broadband. Given uncertainty over spectrum other than the digital dividend as alternative methods of delivery of these services, it is possible that the digital dividend has significant incremental BSV associated with it.

A2.307 Nevertheless we believe that there are strong commercial incentives on mobile operators to roll out these kinds of services, and so the presence of BSV is unlikely to distort the outcome of a market led award. In addition, opportunity costs for intervention on behalf of mobile broadband are relatively high, at up to £400m per channel. Hence overall we do not see a significant market failure here and hence in the first instance there is no necessity to intervene. We confirm our original conclusion in the DDR consultation document that it will be appropriate only to package spectrum in an appropriate manner to allow mobile broadband to be one possible use of the digital dividend.
A2.308 We would also emphasise that such an approach is consistent with any future development regarding the perceived BSV of roll out beyond levels provided for on a commercial basis. Direct funding of the further costs of roll out would be an appropriate approach. This would allow mobile operators to optimise inputs, including where necessary spectrum, in order to achieve the socially valuable outcome.

**PMSE services**

A2.309 In this section we focus on how our application of the total value framework to PMSE services has evolved over time and has allowed us to conclude on the need to intervene. Our in depth discussion of the remedies and risks is available in annex 3.

A2.310 In the DDR consultation document we distinguished in our analysis between PMSE community and professional users because of their different needs and abilities. PMSE professional users loosely refer to users who require an assurance of high quality of services and who therefore need assignments that are planned and coordinated. PMSE community users relate to those who can accept shared (i.e. uncoordinated) use.

A2.311 In what follows, we review to what extent, and why, our application of the total value framework has evolved over time. We first look at the case of PMSE professional users and then at that of PMSE community users.

**PMSE professional use**

Recap of DDR consultation document

A2.312 By applying the total value framework to the PMSE professional users (see annex 8 of the DDR consultation) we identified four potential sources of market failures: transaction costs, inability to raise funds, external values, and transition to market model. We assessed the risk of market failure as low for the first three of these issues and as high for the last one (see table A18). This is a market failure which is present during the transition of the PMSE sector to a market model, and is driven by the time it takes for the appropriate mechanisms to be put in place to overcome the barriers faced by the PMSE sector to participating in a market for spectrum access, including transactions costs they face during this period.

<table>
<thead>
<tr>
<th>Identification</th>
<th>Transaction costs</th>
<th>Inability to raise funds</th>
<th>External values</th>
<th>Transition to market model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Nature of user base makes coordination of demand expensive or impossible, depressing willingness to pay</td>
<td>Sector is unable to raise funds to allow a bid for spectrum</td>
<td>Use generates significant BSV or spillover effects</td>
<td>Risk of disruption associated with transition.</td>
</tr>
<tr>
<td>Risk assessment</td>
<td>Low/moderate—reasonable potential for band manager emerging to coordinate demand, though this may take time</td>
<td>Low—end users are accustomed and capable of playing market prices for other inputs</td>
<td>Low—external values from PMSE are assessed to be comparable to other users</td>
<td>High—PMSE providers and their clients likely to need time to put appropriate mechanisms and funding in place</td>
</tr>
</tbody>
</table>
A2.313 In the DDR consultation we concluded that the best option would be to follow a market led approach (namely, to package the spectrum in a manner that is consistent with PMSE needs and to auction it) while also providing some transitional protection to address the risk of disruption to the PMSE sector.

New development, evidence and responses

A2.314 The number of PMSE responses to the DDR consultation was high. Most respondents agreed with our identification of market failures, but rejected the proposed market led approach option. Many of the respondents argued that, in one way or another, we had underestimated certain factors at play in the PMSE sector—which they expected to increase the risks of market failures—and these could lead to regulatory failure under our preferred option.

A2.315 In reaction to these responses we furthered our understanding of the issues at stake by carrying out additional work, this included analysis completed by us, the commissioning of further consultancy studies, and engagement with PMSE stakeholders.

Reassessment

A2.316 We reassessed the significance of market failure risks based on the responses received and other evidence accumulated through our further work.

A2.317 Neither our additional analysis nor the responses provided evidence to suggest that we should overturn our initial risk assessment. The results of our investigation reinforced our understanding of the significant risk posed by the transition to a market model and the reasoning behind it. In particular we developed a clearer understanding of the barriers which currently would prevent the PMSE sector from acquiring spectrum in a market. Additionally, we assessed the degree to which these barriers were likely to be enduring. Our work suggested that, given sufficient time, the PMSE sector should be able to overcome the difficulties they faced and hence, would, in the future, be able to engage in a spectrum market.

A2.318 Our reassessment identified no additional evidence to suggest that our assessment on the risk of market failure due to transaction costs (in the longer term), ability to raise funds, and external values was wrong.

A2.319 Therefore the conclusions of our reassessment is broadly the same as the conclusion reached in the DDR consultation: the transition to a market model carries a significant risk of market failure whereas the existence of (longer term) transaction costs, the inability to raise funds, and the presence of external values represent a low risk of market failure. We remained therefore convinced that there is no need to intervene for these last three potential sources of market failure, but there are strong reasons for intervening to address market transition issues.

A2.320 In arriving at this conclusion we have considered the opportunity cost of any potential intervention to set aside spectrum for PMSE use. It is important to consider the opportunity cost at this point because if it is high, this suggests that we would need very strong evidence of market failure before we decide to intervene.

A2.321 As discussed in the background section, we think it is plausible that the opportunity costs of the PMSE use is less than £250 million (NPV over a 20 year period).
A2.322 If this indicative opportunity cost is contrasted with the expected benefits of intervention we can see that the expected benefit of ensuring that the PMSE sector is not disrupted are plausibly of a comparable order of magnitude to the opportunity cost. Our modelling work (see annex 8 for more details) provides an initial indication of the likely range of producer and consumer value generated by the PMSE sector, varying from £150m-500m.

A2.323 Given that the opportunity cost of the spectrum likely to be comparable to the benefits of intervention we need strong evidence of market failure before intervention can be considered. We believe that the evidence of transitional market failures is sufficiently strong to justify action.

**Intervention: Remedies and risks**

A2.324 On the basis of our reassessment of market failure risks we conclude that there is a need to intervene by packaging the spectrum in manner that is consistent with PMSE professional use and providing some form of transitional protection to address the risk associated with transition to a market model.

A2.325 We analyse and discuss the best manner to implement this intervention in detail in annex 3. In summary, we looked at a wide range of options, we assessed these options against our objectives to minimise disruption to the PMSE sector, to facilitate its participation to a market based approach to spectrum, to promote the efficient use of spectrum and avoid the risks of regulatory and market failures. Avoiding regulatory failures is important given the relatively high opportunity cost of intervention. We concluded that our need for a regulated transition would be best met by reserving a single package of spectrum for PMSE use and allocating it via beauty contest, with the winner paying an AIP and having an obligation to meet reasonable demand from the PMSE sector under fair, reasonable and non discriminatory conditions.

**PMSE community use**

**Recap of the consultation document**

A2.326 By applying the total value framework to community users in the DDR consultation we identified transaction costs, the potential for free riding and the presence of BSV as potential sources of market failures. This meant that were we to proceed with an auction there was a risk that a bid would not adequately reflect the total value, both private and BSV, of this use and possibly might not emerge at all.

A2.327 Our technical, modelling and demand analysis combined with our market research, our stakeholder engagement and our understanding of the opportunity costs led us to propose in the DDR consultation to make some or all of channels 69 licence exempt in the interests of community PMSE use. The justification for this was twofold: licence exemption appeared to fit well with the low power use and geographically dispersed nature of PMSE community needs would be an effective option for dealing with the issue of transaction costs and free riding. In addition this proposal represented a step towards light touch regulation.
New development, evidence and responses

A2.328 In their responses professional PMSE users opposed the proposal to allow licence exempt use of channel 69. Their argument was that channel 69 is highly valued by many professional PMSE users, especially by those whose needs are nomadic, as channel 69 is the only channel available UK wide for PMSE use. The many professional PMSE users who use this channel need high quality and interference free access to spectrum and would find it disruptive if some or all of this channel was to be made licence exempt.

A2.329 In contrast there were few responses from the PMSE community users, which is probably reflective of the disparate nature of these users and of their acceptance of shared use.

Reassessment

A2.330 The above responses made us realise that there was a significant risk of regulatory failure if we were to proceed with the initial proposal. On the basis of the evidence received during consultation we decided to explore as an alternative remedy the option of encouraging the licence exempt use of channel 70 in the interests of community users. Indeed we asked a question about this in the June 2007 PMSE consultation.

A2.331 The number of responses to that question was small. Some responses signalled that the amount of spectrum available in channel 70 for licence exempt PMSE use is quite limited (to 2 MHz), and that this would constraint the extent to which that spectrum could be more intensively used. Other responses indicated that this idea was worth exploring. We will encourage and consider what more can be done to promote greater licence exempt use of channel 70 by community PMSE users and those who do not need the quality of service afforded by licensed use of channel 69.

A2.332 We consider that the opportunity cost of encouraging the use of channel 70 more intensively is likely to be small. The reason is that many wireless microphones are already able to share channel 70 on a licence exempt basis. This would mean that additional PMSE equipment on a licence exempt basis is unlikely to prevent other devices from accessing channel 70. Hence it would seem that the opportunity cost of additional PMSE is likely to be low.

A2.333 Another aspect to this opportunity cost might be increased interference to existing PMSE community users (who are already using channel 70) if the channel is to be used more intensively and this causes significant congestion. As PMSE community use is geographically dispersed, infrequent, and low power, it is reasonable in our view to consider that additional PMSE use of channel 70 would not be expected to create significantly greater levels of congestion.

Intervention: Remedies and risks

A2.334 On the basis of our reassessment of market failure risks and of low opportunity costs of intervening, we will encourage the licence exempt use of channel 70 for PMSE community users. We believe that this is likely to reduce transaction costs and free riding as well as to help to realise BSV. We are of the view that the risk of increased interference if congestion emerges as a result of our intervention is low.
Annex 3

**Programme making and special events: proposals, responses and decisions**

**Introduction**

A3.1 This annex sets out our decisions in relation to intervention in favour of PMSE use of the digital dividend. In particular, we recap on our analytical framework and objectives for PMSE as set out in both the DDR and PMSE consultation documents, where we made our proposals. We then discuss the key responses from stakeholders to our proposals. In conclusion we explain how we reached our decisions, their main features and how they meet our objectives.

**The DDR consultation document**

A3.2 The DDR consultation document recognised that the PMSE sector comprises many thousands of broadcasters, theatres, charities, community organisations and others with diverse needs. As a consequence, when applying our total value framework to potential PMSE use of the digital dividend, we distinguished between community users and professional users.

**Community users**

A3.3 We identified transaction costs, free riding and BSV as potential sources of market failure for community PMSE users. We considered the first two risks to be significant but were unable to quantify the third. As a consequence, we proposed making some or all of channel 69 licence exempt for PMSE use because most community use is low power and geographically spread and so requires little or no coordination.

**Professional users**

A3.4 We identified four potential sources of market failure for professional PMSE users: transaction costs, an inability to fund spectrum acquisition at market prices, the presence of externalities (BSV and other spillover effects) and the need to transition to a market model. We considered only the last risk to be significant. We considered three options for resolving this market failure:

- packaging spectrum in a manner suitable but not reserved for PMSE use and auctioning it;
- reserving spectrum for PMSE use; and
- packaging spectrum in a manner suitable but not reserved for PMSE use and auctioning it with transitional arrangements to secure access for PMSE use for a limited period.

A3.5 Our assessment led us to the conclusion that the first option risked significantly disrupting the PMSE sector; while the second risked distorting incentives to use spectrum efficiently as well our reserving the wrong amount of spectrum. Therefore, in the DDR consultation we proposed the third option because of the high risk of regulatory failure associated with the first two.
Responses

A3.6 We received a large number of responses to our proposals for PMSE in the DDR consultation document. These came from a variety of respondents, who argued that these existing and long established users of interleaved spectrum were not in a position to take part in a market led approach to spectrum access and so our proposed intervention was likely to be subject to a significant risk of disruption for the PMSE sector.

The PMSE consultation document

A3.7 As a result of these responses, and following further reflection, our PMSE consultation document explored in depth the features of a well functioning market, the barriers that hinder professional PMSE users from engaging in a market for spectrum access and the kind of transition required to minimise disruption while removing those barriers.

A3.8 In addition, in annex 2 of this document, we have reapplied our analytical framework to confirm that our assessment of transitional market failures in relation to PMSE users still holds.

Barriers to the formation of a well functioning market

A3.9 Our analysis in the PMSE consultation indicated that there are barriers to the formation of a well functioning market for spectrum access by professional PMSE users. In particular:

- there is little incentive to use spectrum efficiently because prices for access are calculated to recover administrative costs—possibly set significantly below the rates that would prevail in a market—and so users are not faced with the opportunity cost of their use;
- users neither own nor have enduring rights to access spectrum;
- there is no mechanism to bring together users to aggregate their demand, and achieving this is likely to involve high transaction costs; and
- information flows are limited in the absence of market prices.

A3.10 Many of these barriers have been created by regulation, particularly the administrative approach to spectrum allocation and assignment adopted in the past.

A3.11 The PMSE consultation document examined how these barriers could be removed to the benefit of professional users. Experience shows that, under a market led approach, users are more likely to obtain rights to access spectrum on a longer and more certain basis, making them less dependent on regulation and better placed to plan their business. We also anticipate that prices more closely reflecting the opportunity cost of spectrum use are likely to stimulate innovation and developments in equipment manufacture that increase choice for users.

A3.12 But we recognised that removing these barriers posed significant challenges for professional PMSE users. We therefore identified four key objectives to be pursued in designing the future arrangements for access to interleaved spectrum:
Digital Dividend Review: annexes to the statement on our approach to awarding the digital dividend

- avoiding disruption to PMSE users that adversely affects their ability to provide a wide range of services to citizens, consumers and business customers;
- facilitating participation of the PMSE sector in a market based approach to spectrum;
- promoting the optimal use of spectrum in relation to all potential users over time; and
- avoiding the risks of regulatory and market failure.

Institutional options for future PMSE access to interleaved spectrum

A3.13 Our four key objectives led us to the following six options for future access to interleaved spectrum by PMSE users which we consulted upon in June 2007.

Table A19. Options for future access to interleaved spectrum

<table>
<thead>
<tr>
<th>Status quo</th>
<th>Transition</th>
<th>No intervention</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1</td>
<td>Option 2</td>
<td>Option 3</td>
</tr>
<tr>
<td>Status quo</td>
<td>Status quo</td>
<td>Beauty contest</td>
</tr>
<tr>
<td>with AIP</td>
<td>with AIP</td>
<td>with AIP</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Options 1 and 2

A3.14 These seek to maintain the status quo by replicating the present approach to PMSE spectrum management. In these scenarios, we would appoint a contractor who would license users for a maximum of a year at a time. Option 2 would differ from option 1 only in that users would have to pay AIP to reflect the opportunity cost of their spectrum use.

A3.15 These options would minimise the risk of disruption to the PMSE sector but not resolve the problems that prevent it from engaging in a market, leaving it dependent on us for spectrum access. The impact on other users, citizens and consumers of these options would be medium to high because other users would be denied access to spectrum reserved for PMSE. The introduction of AIP under option 2 would encourage PMSE users to use spectrum more efficiently than under option 1. But both options carry a high risk of regulatory failure because we would remain responsible for making decisions about PMSE spectrum access based on less information than would be conveyed by a well functioning market and because PMSE users would not get secure access to the spectrum they use.

Options 3 to 5

A3.16 Options 3–5 seek to move PMSE users to a market based approach over time. The details of how this would be done vary between the three options, as does the length of the transition period. The major difference between the options is the method by which the licensee would be chosen. Option 3 involves a beauty contest, while options 4 and 5 envisaged prospective licensees bidding against each other at auction.
A3.17 The risk of disruption would be lowest under option 3 and highest under option 5 as a beauty contest offers more scope for protecting the interests of PMSE users and appointing a licensee whose own interests align with theirs. The impact on other users, citizens and consumers is lowest under option 5 because PMSE users would be confronted with the cost of preventing others from using spectrum more quickly. That impact is highest under option 3 as other users would not be able to acquire direct access to the spectrum but would have to secure access through the licensee. However, there is a risk of regulatory failure under option 5 because the level of protection provided to PMSE users might be insufficient to enable them to overcome their transitional barriers before the end of the transition period. The main regulatory risk under option 3 is linked to the nature of beauty contests, which involve difficult judgments set against the need for objectivity, transparency and non-discrimination. Moreover, the outcome might not see spectrum awarded to those able to use it most efficiently because of an absence of relevant information.

Option 6

A3.18 Option 6 moves PMSE users to a market based approach straight away. This would carry a significant risk of disruption in both the medium and long term. There would also be a very high risk of regulatory failure if PMSE users were unable to aggregate their demand to participate at auction. We estimate the impact on other users, citizens and consumers to be medium as PMSE users would be directly confronted with the cost of preventing others from accessing spectrum and others would be likely to acquire the access that they need directly.

A3.19 We were clear that option 6 would not meet our objectives and was included for completeness only.

Summary

A3.20 The six options and our analysis of them against our four key objectives are summarised in table A20.

Table A20. Summary and analysis of the six options

<table>
<thead>
<tr>
<th>Option</th>
<th>Objective 1 Avoid disruption</th>
<th>Objective 2 Facilitate market</th>
<th>Objective 3 Promote optimal use</th>
<th>Objective 4 Avoid regulatory failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Status quo</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>2. Status quo with AIP</td>
<td>High</td>
<td>Low</td>
<td>Low-medium</td>
<td>Low</td>
</tr>
<tr>
<td>3. Beauty contest with AIP</td>
<td>Medium-high</td>
<td>Medium</td>
<td>Medium</td>
<td>Low-medium</td>
</tr>
<tr>
<td>4. Auction with additional safeguards</td>
<td>Medium</td>
<td>Medium</td>
<td>Medium-high</td>
<td>Low-medium</td>
</tr>
<tr>
<td>5. Auction with DDR safeguards</td>
<td>Low-medium</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>6. Auction without safeguards</td>
<td>Low</td>
<td>Low</td>
<td>Medium</td>
<td>Low</td>
</tr>
</tbody>
</table>
Our proposals

We favoured options 3 and 4

A3.21 The PMSE consultation document assessed each option against our four key objectives. We concluded that options 3 and 4 both go some way to meeting our objectives. Both have the advantage of increasing the ability of PMSE users to participate in a market led approach to spectrum access with reduced risk of regulatory failure. Option 3 has the advantage of enjoying the support of users, while option 4 offers greater security of tenure, thereby scoring well in helping to avoid disruption.

A3.22 The PMSE consultation document concluded that options 3 and 4 were most likely to meet the criteria for enabling professional users to move to a market led approach for spectrum access and that we were not in a position to favour either option over the other at this stage.

We favoured awarding a single package of spectrum

A3.23 This reflected users’ negative experiences of dealing with more than one service provider prior to 1996.

We favoured greater use of channel 70 by community users

A3.24 The PMSE consultation document broached the possibility of greater use of licence exempt spectrum in channel 70 for wireless microphones. Given the greater potential for interference from licence exempt use, this would primarily suit community users. At the same time, the document left open our proposal to make some or all of channel 69 licence exempt in the interests of community users.

Responses

DDR consultation document

A3.25 Some 10% of the 750 responses to the DDR consultation document specifically addressed our proposals for PMSE. Other responses addressed how we should deal with interleaved spectrum more generally.

DDR consultation, question 6: Do you agree with our proposals to continue making available channel 69 for use by low power PMSE devices?

A3.26 In relation to this question responses largely favoured continued exclusive access to channel 69 for PMSE. Few respondents supported licence exemption because of the need for coordination to ensure interference free access. JFMG nonetheless suggested that the channel could be partitioned, with high power coordinated use at the lower band edge and low power licence exempt use at the higher band edge.

A3.27 A number of respondents raised concerns that, both as a UK wide channel and in areas of high demand, channel 69 alone would be insufficient to meet the demands of professional PMSE users.
DDR consultation, question 7: Do you agree that there should be transitional protection for PMSE users to ensure that they continue to access interleaved capacity until at least the end of 2012? Do you have any views on the mechanism for providing future access to this spectrum?

A3.28 Responses from PMSE users favoured a transition period but did not support its ending in 2012. There was broad consensus that a longer period would be needed to ensure that wireless equipment realised its life expectancy, that it would take a long period of time for the sector to be able to come together for any market based approach to spectrum access and that a single licensee (similar to JFMG) would probably be needed to facilitate this. The PMSE pro-user Group suggested a transition period ending in 2026.

A3.29 Respondents also argued that there was not a sufficiently persuasive case to move away from the current system whereby JFMG administers spectrum allocated to PMSE on behalf of the regulator. It was suggested that the system worked well and that changing it was therefore unnecessary.

**PMSE consultation document**

A3.30 We received 140 responses, 92 of which (primarily from small and medium sized technical companies, distributors and individuals) were expressions of support for the PMSE pro-user Group’s response. This set out the Group’s own proposals for future licensing of PMSE spectrum access.

A3.31 Other responses came from a cross section of the PMSE sector, giving us some breadth of representation of opinion. Among the respondents were 13 trade associations, four broadcasters, three equipment manufacturers, two MNOs and two theatres as well as a number of individuals.

A3.32 The following paragraphs summarise responses to the questions asked in the PMSE consultation document. In addition to in this section, specific points made by the PMSE pro-user Group are also addressed separately later in this annex. This is in recognition of the widespread support that this response received from the PMSE sector and the importance that we attach to responding to all major points that emerge from consultation.

**PMSE consultation, question 1: Do you agree with our identification and analysis of the options for how the PMSE sector could make use of the digital interleaved spectrum? Which options, if any, do you favour?**

A3.33 Most responses highlighted the difficulties that the PMSE sector would face if it was exposed to market mechanisms for acquiring spectrum access. There was very little support for option 4, with users emphasising that there is no mechanism for bringing together disparate groups and organisations and little scope for creating one in the future.

A3.34 Broadly speaking, different groups of respondent focused on different parts of our analysis.

A3.35 JFMG saw some merit in option 2 as a step toward a market based approach.
A3.36 Trade associations pointed to the inherent difficulties faced by a diverse sector in participating in a market led approach. Most suggested that none of the proposed options fully dealt with the realities facing users. However, recognising that some change was likely to happen, there was general agreement that option 4 was inappropriate as PMSE users could not participate at auction. Option 3 was identified by a number of respondents as being stronger, albeit with specific provisions to protect continued spectrum access. These were:

- guaranteed access to existing analogue interleaved spectrum until 2013;
- guaranteed access to digital interleaved spectrum until 2026; and
- continued access to channel 69 on a licensed basis.

A3.37 Three out of four broadcasters who responded favoured option 1 in light of the PMSE sector’s perceived inability to participate in a market led process and the dangers of AIP being set at too high a level. ITV viewed AIP under option 2 as preferable to option 3, which it believed would be potentially damaging for PMSE users if based on full opportunity cost.

A3.38 T-Mobile and Vodafone favoured option 5, arguing for greater efficiency of spectrum use by the PMSE sector and the introduction of AIP in channel 69. They pointed to the costs of delaying valuable alternative uses of interleaved spectrum and argued that restricting alternative uses until 2018 under option 4 would deter bidders from entering the auction.

A3.39 Some manufacturers cautioned that our analysis had not taken account of the development time required to produce modified equipment for the market by 2012. This point was also made by PMSE representative bodies, in particular the PMSE pro-user Group, who expressed concerns that any delay in providing information on the frequencies available for PMSE after DSO would lead to difficulties in acquiring a sufficient quantity of suitable equipment.

A3.40 A number of responses, from the PMSE and other sectors, including mobile operators, urged caution on the timing of any award because of uncertainty arising from TG4’s proposals for harmonising channels 62-69.

**PMSE consultation, question 2: Do you agree that we should offer one package of digital interleaved spectrum?**

A3.41 All but two responses on this question favoured offering one package of digital interleaved spectrum for PMSE use. The main reason cited was that this would ease transactions for spectrum access. Many PMSE users had to transact with more than one licensee for spectrum access before 1996 and found it complex and time consuming. Respondents understood that this would result in a dominant supplier of spectrum access for many PMSE applications but hoped to receive protection by virtue of price controls placed on the licensee.

A3.42 Exceptions were the BBC, which saw some merit in stimulating competition by awarding multiple packages, and T-Mobile, which saw multiple packages as a possible way of protecting spectrum access for PMSE users.

A3.43 Most responses from PMSE representatives wanted to ensure that a single licensee demonstrably had the interests of the PMSE sector at heart. There was concern about how this could be achieved, with respondents pointing to the inherent risk in a licensee selling spectrum access to non PMSE users able to pay higher prices.
PMSE consultation, question 3: Do you believe that greater licence exempt use could be made of channel 70 by the PMSE sector? Are there any obstacles that would need to be overcome first?

A3.44 Most respondents approached this question from the perspective of professional rather than community PMSE use.

A3.45 Some responses resisted this proposal because there was already too much risk of interference in channel 70. This was particularly true for professional users, who would find the quality offered by channel 70 wholly inappropriate for their needs.

A3.46 One radio broadcaster and two MNOs did support this proposal. The MNOs further argued that PMSE users should investigate migrating to spectrum higher than channel 70.

PMSE consultation, question 4: Do you have any comments on the scope for applying the options discussed above to bands other than the digital interleaved spectrum?

A3.47 With the exception of JFMG’s response to the DDR consultation document, we received few detailed comments on this question. Those who did respond agreed that there was merit in extending the licensee’s remit to other bands.

A3.48 JFMG submitted a detailed analysis of the scope for extending any of the available options to bands outside the digital dividend. It identified potential issues relating to clarity of spectrum usage rights and the application of AIP that indicated a single solution might be difficult to implement. JFMG suggested that we might therefore have to adopt different approaches for different bands.

Our response

Question 1: Future institutional arrangements

A3.49 In our response to this question we first explain why we have rejected options 1, 2, 5 and 6, then we look at the implications of our four key objectives for the transition period and explain why we choose option 3.

Why we have rejected options 1, 2, 5 and 6

Option 1

A3.50 Respondents who favoured option 1 focused on the perceived dangers posed to PMSE access by elements of the other options. We think that these arguments are unduly pessimistic and that any such concerns can be addressed without retaining the status quo by adequately designing the transition phase. In particular, we intend to deal with the risk of setting AIP too high by proposing to phase in AIP and to set it conservatively to begin with. We believe that the strong incentive a band manager might have to sell spectrum to non PMSE users performs a valuable function in encouraging more efficient use of the spectrum. We address the risk that a band manager may not satisfy the reasonable PMSE spectrum demand by proposing a licence provision to protect the PMSE users against this.

A3.51 We continue to believe that this option would not help PMSE users coordinate their demand for spectrum in an economically efficient manner. It does not provide long term stability as access to spectrum would continue, as now, to be subject to future regulatory decisions. There is no evidence that it would promote the optimal use of
spectrum in relation to all potential uses and users. We as regulator would need to trade off availability to PMSE versus other uses, yet we are less well informed than the market in making such decisions, which could be prone to error. Finally, it would not confront PMSE users with the opportunity cost of their spectrum access, so they would face no financial incentive to use spectrum more efficiently or to innovate and use frequencies at which spectrum is more plentiful.

Option 2

A3.52 We think that arguments in favour of option 2 which stem from concerns about the level of AIP under option 3 are unduly pessimistic. We also remain of the view that option 2 does little to move PMSE users toward a market led approach to spectrum use. Access would still be via us as regulator. PMSE users would not benefit directly from releasing spectrum for new uses except through avoiding AIP. And they would continue to hold short term licences with limited tenure, reducing their security and adversely affecting their incentives.

Option 5

A3.53 Responses provided no new evidence to persuade us that option 5 would do enough to reduce the risk of disruption to PMSE users or to facilitate their engagement in a market for spectrum access.

Option 6

A3.54 In the absence of any responses supporting option 6, we consider that it remains unviable.

The importance of transition for PMSE

A3.55 In the PMSE consultation document we highlighted the importance for the PMSE sector of its transition to a market led regime. We have deepened our study of why transition matters and what type of transition is required, guided by our four key objectives. There are tensions between them, which our analysis has taken into account. This is set out below and leads to the selection of our preferred option.

Avoiding disruption to PMSE users that adversely affects their ability to provide a wide range of services to citizens, consumers and business customers (Objective 1).

A3.56 This is at the heart of our concerns. It means that the nature of the transition from the status quo to a more market led approach is important.

A3.57 We believe that two aspects characterise the nature of this transition period:

- how long it lasts; and
- the type of protection afforded.

A3.58 The length of the transition period matters because PMSE equipment can be used for several years. It will also take time for information on technology alternatives and the value generated by PMSE spectrum access to emerge and for business plans and strategies to be adjusted accordingly. We view the flow of this information as an important aspect of a well functioning market, which PMSE users will need to engage in a market led approach to spectrum.
A3.59 The type of protection afforded matters because, as responses to the DDR and PMSE consultation documents argued, disruption may arise if the amount of spectrum available to PMSE users and/or the prices they face for accessing that spectrum change too quickly. This argues for progressive change during the transition phase. This also calls for safeguards to prevent a single band manager exploiting its market power while the PMSE sector is unable to evade it in the short to medium term.

Facilitating participation of the PMSE sector in a market based approach to spectrum (Objective 2).

A3.60 Because the existing fee structure for PMSE spectrum access is based on cost recovery rather than opportunity cost, it gives little incentive to use spectrum efficiently. We are therefore committed to enabling the introduction of some pricing scheme that reflects opportunity cost. When facing the prices which are more reflective of resource costs, PMSE users would be able to consider whether they can use it more efficiently so as to minimise costs (see below the illustrative ideas about how PMSE users may respond to market signals). In the process of developing strategies to adjust to this change, information on the cost of spectrum will flow through the value chain and PMSE users will progressively acquire an understanding of the value that PMSE spectrum generates.

A3.61 Installing a band manager is another contribution to meeting Objective 2. Indeed by creating an organisation to ease the coordination of the diverse spectrum requirements of the numerous PMSE users, we hope to generate the conditions for a trusted forum to emerge where PMSE users can meet and discuss issues and develop initiatives. We are convinced that the nature of the institution should be such that its interests are closely aligned with those of PMSE users. Indeed this is important for a trust relationship to develop between the band manager and the PMSE users.

A3.62 We also believe that the band manager should have an incentive to contribute to this forum and encourage any initiative likely to generate spectrum efficiency gains. In order for the band manager to have this incentive it will need to have clear and enduring rights of spectrum access. This is because, without this, the ability of the band manager to reap the benefits in the future from its efforts to increase the spectrum efficiency of PMSE users is uncertain. In our proposal, the band manager will have such spectrum access rights and they will not reside with the regulator as in the current regime.

A3.63 The need for a band manager is likely to be indefinite. It resolves one of the barriers to market formation—transaction and coordination costs—which are unlikely to go away given the nature of PMSE use of spectrum. However, this does not mean that the transitional protection afforded to PMSE users should also be indefinite. For there to be incentives to engage in the market and use spectrum efficiently the protection afforded to meet the first objective should be limited in time. Indeed the possibility of an indefinite protection period would run the risk of seriously lessening the incentives to invest in using spectrum more efficiently and engaging in a market based approach.

Promoting the optimal use of spectrum in relation to all potential users over time (Objective 3).

A3.64 This means that incentives provided to the band manager will play a key role. Two features of the band manager’s incentives which are of particular significance are the duration of its licence and the source and level of revenues.
A3.65 The duration is important because a sufficient length of tenure would allow a band manager to invest in working with the sector to help them understand better their spectrum needs. We expect that up to a certain point, the longer this period is, the stronger the incentive is for the band manager, because this type of work—adapting to changes in spectrum markets—takes time. However, there might be a threshold beyond which the role of the licence tenure in providing this incentive weakens and we will, in our further work on award design, attempt to clarify the circumstances under which this may happen.

A3.66 To invest in improving spectrum use may for example involve exploring whether other bands could be used as alternatives and encouraging PMSE users to move to any suitable alternative bands for which there is less competing demand and so are available at lower cost. This could enable PMSE users to obtain longer and more secure access to spectrum and make them less dependent on regulatory decisions. The band manager could also look into promoting the development of more efficient equipment; this in turn would benefit PMSE users if they can save spectrum costs and/or rely on higher quality equipment and/or equipment offering greater flexibility. The band manager will also need time to recoup its investment. As a result we are clear that we should provide an assurance to the band manager that we will not revoke its licence for a sufficiently long period, except for reasons of national security or compliance with international obligations and not spectrum management.

A3.67 Part of our work to understand the PMSE sector and its challenges shows that there is scope for developing the interleaved spectrum. Technical studies into existing use of spectrum by PMSE users expose where and how efficiency gains may be achieved (see below the illustrative ideas section where more details are given on such possibilities). Some other studies indicate which alternative (i.e. non PMSE) users could be interested in accessing the interleaved spectrum making it attractive for the band manager to manage PMSE needs more efficiently so as to be able to meet their reasonable demands and also be able to supply remaining spectrum to these competing users.

A3.68 We want the band manager to find it attractive to take that responsibility and be rewarded for its efforts in developing the spectrum in an efficient manner. A band manager without its remuneration linked, at least to some extent, to how well it manages spectrum, would not score well against this objective. This is why we are keen to provide adequate flexibility to the band manager to develop and implement its strategies. Therefore, we do not think it would be appropriate for us to be prescriptive about what the band manager should and should not do.

A3.69 Similarly a band manager who would see its cost base change as information about the value of spectrum becomes clearer would have little incentive to choose strategies that contributes to this information revelation. This means for example that if the band manager is charged an AIP, the level of this AIP per MHz of spectrum used should not be revised too frequently.

**Avoiding the risks of regulatory and market failure (Objective 4).**

A3.70 We used our total value framework while developing our PMSE policy (for more details, see the paragraphs discussing the case of PMSE in Annex 2). Our initial analysis of the market failures relevant to the professional PMSE sector identifies four market failure arguments: transaction costs, ability to fund spectrum purchase, external value (including both BSV and other spillovers), and transition to market model. We have estimated that the barriers to participating to a market led
approach to spectrum present a potential source of a coordination failure during the transition phase with significant risks of disruption to the PMSE sector. Our assessment of whether to intervene to resolve this market failure shows that the opportunity costs of intervention may plausibly be of a similar order of magnitude to the value that might be generated by using this spectrum for PMSE. However, since our evidence of market failure risk is compelling we believe that this is sufficient to warrant intervention. However, given that it is not clear cut that the benefits of intervention significantly outweigh the costs, we have developed our option analysis work further taking into account the need to mitigate the risk of regulatory failure.

A3.71 We are aware of the risks associated with the identified remedies to market failures. In the case of a beauty contest intervention, the regulatory failures include the selection of a sub optimal band manager, AIP being set at the wrong level, and incorrectly formulated licence conditions to protect PMSE users. A sub optimal band manager might be one which sets excessive prices, refuses to supply, or simply one that manages the spectrum inefficiently and does not help the sector to better understand its needs and adapt. We are of the view that the protection scheme set to protect PMSE users will help minimise that risk.

A3.72 The level of the AIP can be either too high, in which case it may hurt the band manager as well as the spectrum users by having to pay too high a price, or too low, in which case it may not provide a strong incentive to optimise the spectrum use. We believe that we can best mitigate the risk of setting an incorrect AIP level by phasing its introduction, from a low introductory percentage towards a price which is reflective of the opportunity cost, over a number of years. We could in addition opt for a conservative approach when setting the AIP, combined with a review of this level after a predetermined number of years.

A3.73 Similarly, poorly targeted licence conditions to protect the PMSE users can be either too severe or too lax or simply ineffective. Our analysis has already provided some indication of what we will need to pay attention to if we want to minimise this risk. We plan to further our understanding of how best to control for this risk when designing the spectrum award process.

A3.74 In case of an auction with safeguards, risks of regulatory failures were also identified, namely that: the safeguards are insufficient for a band manager to emerge, the period of guaranteed access is too short for the PMSE sector to overcome the transitional barriers, or the licence conditions may not fully protect PMSE users. We would attempt to mitigate these risks as much as possible through carefully designing the auction process.

Conclusion on approach to the transitional regime which balances our objectives

A3.75 The above considerations confirm the need for a well designed transition period with:

- an explicit protection scheme that covers both the amount of spectrum and the payment for spectrum, enables PMSE users to adjust their business over time to spectrum pricing signals and become more confident to engage in a more market based environment; and
- sufficient incentives for the band manager to come forward and manage spectrum efficiently, both in terms of duration and of revenues.
A3.76 The above discussion also reveals that there are obvious tensions between Objectives 1, 2, 3 and 4. In designing the transition for PMSE users we are keen to ensure a balance between these objectives that reflects our commitment to reaching our long term aims. We explicitly revisit these trade offs below when we describe the features of our proposal for a transition to market led PMSE regime.

A3.77 Before that, we look into some illustrative examples of what may happen during the transition phase. We believe that this may better our understanding of the options for economising on spectrum and improve our perception of the potential scale of disruption. This would contribute to further refine our proposal for transition.

Illustrative ideas of what may happen during the transition phase

A3.78 One source of disruption mentioned by many respondents is the gap between existing payments by PMSE users and what they may be asked to pay by a band manager. To understand the intensity of this potential source of disruption, we looked into existing JFMG fees and how they translate into daily costs for PMSE users. When expressed as a daily rate, the radio microphones fixed site fees (long term and indoor use) amount to very little compared to the 48 hour fee. As a daily rate, the annual fixed site fee is less than £0.08 per day compared to 48 hour fee which is £4.25 per day. We note that for indoor use, it is attractive to ask for a long term licence as soon as the equipment is used more than six days. This price structure is likely to partly explain the apparent lack of motivation from PMSE users to invest in improving their spectrum efficiency.

A3.79 The spectrum access price charged by the band manager will depend on the award mechanism. Under a beauty contest, the price can be expected to be linked to the AIP to be paid. Detailed work will be required to set AIP for the interleaved spectrum accessed by the band manager. Hence we are unable to say at this point what level AIP would be set at. However it seems very likely that, on a daily access rate basis, it will be higher than the eight pence currently charged for long term licences. Following an auction, the spectrum access price charged by the band manager will be influenced by the bid paid by the winner. As for the beauty contest, we are unable to say how much the bid may amount to, but consider it likely that on a daily basis the price will exceed the low fees charged at present for long term licences.

A3.80 Hence we investigated some illustrative options that might be open to PMSE users when faced with prices signalling the opportunity costs of spectrum.

A3.81 The improved spectrum efficiency analysis considered the scope for reviewing current use of PMSE equipment and identifying ways of economising on it while providing reasonable quality. Previous consultancy work identified scope for how PMSE users can revise their spectrum and equipment use in order to cope with spectrum scarcity during special circumstances. For example the evidence gathered on how theatres and shows use microphones reveals different levels of efficiency: most efficient theatres manage to use up to 12 microphones per channel, typical efficiency level is at about eight microphones per channel, and poor efficiency can lead to as few as four microphones per channel.

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A3.82 Inefficient use of spectrum for a specific time limited event may block channels for a whole year. A small change in equipment use—for example, to increase the average number of microphones per channel by one—could significantly reduce the total spectrum requirement for that event and hence free spectrum that would then become available for the whole year. An example of this is the Live8 event in Hyde Park in which 104 microphones and in-ear monitors were used over 26 channels, that is an average of about four microphones per channel. An increase in the average number of microphones to five per channel for that type of peak activity in that area would have the potential of freeing up to five channels for the whole year. Given the levels of efficiency achieved in theatres we believe that, even after taking into account the difficulties of planning PMSE use in a one off outside event, an increase in the number of microphones per channel from four to five is not unreasonable given the size of the potential gains (i.e. potentially freeing up five channels for the whole year).

A3.83 Other responses to facing the opportunity costs of spectrum may involve exploring alternative equipment, whether wireless or not, and considering alternative spectrum access. Our consultancy work identified various technical options and alternatives that may, in the longer term, lead to a more efficient use of spectrum. These included digital microphones, which, in time could meet the performance needs of the professional PMSE community. There may also be scope for increased tuning ranges on equipment to enable users to be more flexible in accessing different parts of the spectrum.

Features of our proposal for a transition to market led PMSE regime

A3.84 We now use these considerations and conclusions to describe in some detail the features of our option for transition from the existing regime to one in which PMSE users engage in a market based access to spectrum. We pay particular attention to the elements of this transition which attracted the attention of respondents such as: the level of spectrum access prices, PMSE user protection, alignment of interests between band manager and PMSE users, duration of protection, and minimum term of band manager’s licence.

Payment for spectrum access based on opportunity cost

A3.85 One essential part of developing a market based approach is to face PMSE users with the opportunity cost of the spectrum that they use. Many stakeholders in the PMSE consultation expressed their concerns that a high AIP or winning bid will make access to spectrum prohibitively expensive. This shows some tension between Objectives 1 and 2.

A3.86 Keeping the stakeholders’ concerns in mind, we intend to seek to avoid disruption to PMSE users by managing the increase in their spectrum fees towards a price which reflects the opportunity cost over a significant period of time. If we levy AIP, this would involve a progressive phasing in—that is, the band manager would be charged an increasing percentage of the full opportunity cost AIP, over a defined period—at least five years and quite conceivably longer—with the full AIP being charged at the end of it. We would also initially set it on a conservative basis. In the absence of an AIP payment, we would be keen to obtain a similar gradual increase in spectrum access prices.

A3.87 The level of AIP or the gradual price increase scheme is yet to be determined. We intend to give more details on our thinking on this feature in our consultation on the awards process in spring 2008.

A3.88 At the same time we are keen to provide enough financial incentive for the band manager to make unused spectrum available for other uses and hence to promote spectrum efficiency—Objective 3. The existence of higher value uses for the spectrum now used by PMSE users would make it attractive for the band manager to make some of it available to competing, non PMSE users with higher value. We would allow the band manager to provide spectrum for these competing uses at non regulated prices. We would balance this Objective 3 with Objective 1 by introducing an obligation on the band manager to meet reasonable demand for PMSE use, to ensure that PMSE users are provided with sufficient protection (see below).

**PMSE protection obligations**

A3.89 We see two elements to the protection itself, both to be expressed in the form of obligations that we would reflect in the band manager’s licence:

- a requirement to meet reasonable demand for spectrum access from PMSE users where possible. This would allow the band manager to make spectrum available to new, non PMSE uses but only where it was not needed to satisfy the reasonable needs of the PMSE sector; and

- a requirement to make spectrum available to PMSE users on fair, reasonable and non discriminatory terms. It would, however, be free to set unregulated prices for spectrum made available to new, non PMSE uses.

A3.90 Some stakeholders expressed concerns that the band manager would set excessive prices and that some PMSE users would opt to use spectrum illegally in the face of high prices. We appreciate that the prices charged to PMSE users could be a source of concern. We do not believe that a band manager would have an incentive to set prices above what PMSE users are prepared to pay since this would reduce its revenue given the need to meet reasonable PMSE demand for spectrum.

A3.91 When it comes to pricing we intend to enforce fair, reasonable and non discriminatory terms and conditions. This obligation will effectively mean no excessive prices. For example, if there are concerns about excessive prices this may include assessing whether the prices charged are reasonable given the costs of providing the services.

A3.92 We intend to clarify as part of the consultation on the award process how we would assess whether or not the band manager is adequately meeting PMSE users’ needs. For example, we would specify the conditions that should be met before some spectrum could be made available for non PMSE users. This may cover how long the particular spectrum has been unused, at what price and/or what alternatives have been proposed to PMSE users to encourage them to switch to other suitable bands. Our initial view is that given our plan to manage a gradual increase in spectrum charges for PMSE users over time, reasonable demand should be interpreted relative to the AIP applicable at the time. This means that all PMSE demand, based on a price which reflects the level of AIP at that time, is likely to be considered reasonable for that time.
A3.93 We also believe that we can reasonably expect the combination of these two obligations to deter the band manager from managing the spectrum inefficiently through reducing quantity and/or increasing prices, something that could be feared as a result of putting in place a single band manager.

A3.94 We accept that there is some likelihood that we may have from time to time to arbitrate disputes between PMSE users and the band manager regarding these obligations. However, enforcing such requirements is common. Settling disputes at the time, and in the light of the facts at hand, is to be preferred to the significant risk of regulatory failure inherent in trying to frame detailed licence provisions which may not take into account all possible scenarios.

**Alignment between the interests of the band manager and PMSE users**

A3.95 An important aspect of managing the transition to a market led approach to spectrum for PMSE is to bring about through the award process an entity that on the one hand is trusted by PMSE users to accompany them in the transition and to enable them to take advantage of the changes that are resulting from it, and on the other hand is able to respond to the incentives given to it to improve the efficient use of spectrum.

A3.96 The emergence of a band manager that the PMSE users respect matters because PMSE users recognise the need for a party to act as a coordinator of their demands, which they recognise as dispersed and varying considerably across users. It is also important to create an environment in which PMSE users are more inclined to cooperate with the band manager when moving towards a market led approach to spectrum.

A3.97 We believe that the band manager best placed to stimulate trust among PMSE users is one whose interest is aligned with those of the PMSE users. This would ideally be reflected in its institutional structure as well as in its technical, financial and managerial capabilities to manage the spectrum efficiently on a day-to-day basis for PMSE and other uses. This band manager would also show the motivation and the expertise to encourage a more efficient use of the spectrum over the long term, in relation to both PMSE use and to other potential uses and users.

A3.98 We intend to consult on these proposals in spring 2008.

**Duration of the protection period**

A3.99 The PMSE consultation argued that we might extend the period during which the sector had protected access to the interleaved spectrum from at least the end of 2012, as proposed in the DDR consultation, to 2018.

A3.100 Respondents argued for longer—a popular end point was 2026, aligned with the longest period over which existing DTT multiplex licences can be renewed—but did so in the belief that this date represented a cliff edge at which they could lose all of their access to the spectrum. We believe that our proposals for managing the transition greatly diminish this risk.

A3.101 Objective 1 would lend itself to requiring a longer period whereas Objectives 2 and 3 would tend to favour a shorter period. Based on the evidence gathered we are of the view that a decade of protection would offer a reasonable balance between the lifecycle of equipment and the opportunity cost of precluding alternatives uses of the spectrum. This would give the sector sufficient time to prepare for any change that a
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band manager felt compelled to introduce. We have also mitigated against the pressing concern of users having to change equipment in the first areas that are undergoing DSO. To do this, we have permitted access to the upper cleared digital dividend (channels 63 to 68) until the time when the new licensee needs access to these frequencies.

Minimum term of band manager’s licence

A3.102 Options 3 and 4 in the PMSE consultation document provided different options for the minimum term of the band manager’s licence during which it could be varied or revoked only for reasons of national security or compliance with international obligations and not spectrum management:

- a minimum five year term. This is typical of licences that we do not award by auction (e.g. business radio) However, we do not believe that so short a duration would provide the band manager with sufficient incentive to develop the spectrum (possibly including encouraging PMSE users to change the nature of their use of this spectrum) and so would not meet our objective to promote the optimal use of the spectrum in relation to all potential uses and users over time;

- a minimum 18 year term. This is our working proposition for the cleared spectrum and had widespread support in the PMSE consultation. While it would be long enough to provide the band manager with the incentive to develop the spectrum, we believe that it would be longer than is necessary to recoup any upfront investment and so could again restrict our ability to promote the optimal use of the spectrum.

A3.103 We recognise that these options define a range. JFMG favoured a 10 year term in its submission to the consultation as the best way to motivate the band manager to improve the efficient use of the spectrum. Objective 3 suggests that this duration should be long enough to give an incentive to invest in improving the efficient use of spectrum. At the same time Objective 4 cautions against providing too long a licence in case there emerges a need to intervene in order to promote the optimal use of the spectrum. (This could happen, for example, if some new highly valuable applications require that spectrum or part of it, for example, as a result of some international harmonisation measures). We acknowledge the need to balance the band manager’s incentive to develop the spectrum with the possibility of regulatory intervention to promote the optimal use of the spectrum. We intend to explore more precisely which minimum term in that range would best satisfy our objectives and to consult on a specific minimum term proposal in the subsequent consultation on the design of this award.

A3.104 Now that we have clarified which transition we envisage to a market led regime for the PMSE sector, we assess which of option 3 and option 4 is best suited to enable us to deliver that transition.

Why we are choosing option 3

A3.105 Option 3 involves a beauty contest to assign the PMSE spectrum licence to a band manager. That band manager would then pay AIP set by us. In contrast, option 4 involves financial bids by potential band managers with the licence assigned to the highest bidder. If the auction were competitive, the winning financial bid could reflect the opportunity cost of the spectrum (modified by the restrictions on value imposed by the licence obligations). AIP would therefore not be charged to the band manager.
A3.106 The regime we are proposing for PMSE is a managed transition to a market oriented approach with significant regulation on the band manager during the transition path. This is a very different context from the spectrum awards for the remainder of the digital dividend and indeed other spectrum awards. The benefit of using an auction to reveal the opportunity cost of spectrum in this case are lower, as this opportunity cost is to a large extent determined by the licence obligations required for our managed transition.

A3.107 For example, one aspect of the managed transition is a phasing in of increases in spectrum charges to PMSE users towards a price which reflects the opportunity cost over a significant period of time. Therefore, the advantage of an auction in other contexts, i.e. that it uses a market process to reveal the opportunity cost of spectrum, is substantially reduced in this context.

A3.108 Another aspect of the managed transition is a requirement to make spectrum available to PMSE users on fair, reasonable and non discriminatory terms. If an auction were used to assign the spectrum licence, the question would arise whether the financial payment to win the auction should be taken into account when judging whether this requirement has been satisfied. In this context one problem with doing so would be that reflecting the winning bid in PMSE user fees might involve too rapid a move to spectrum costs based on opportunity cost.

A3.109 Another problem is that bids in the auction itself could be distorted. If the higher the winning bid, the higher the spectrum fees would be to PMSE users, then bidders would have an incentive to overbid, because it would in effect be inappropriately underwritten by regulation.

A3.110 On the other hand, if we ignored the winning bid when judging whether the band manager's fees to PMSE users were fair, reasonable and non discriminatory, then the auction would be distorted in the opposite direction. That is, bidders would have an incentive to underbid, because regulation might subsequently prevent them from recovering the auction payment.

A3.111 Therefore, given our proposed approach of a managed transition path which we consider is necessary to strike the correct balance between our objectives, option 3 is more suitable than option 4.

A3.112 We are aware that beauty contests are not our standard approach for awarding spectrum, but we consider that the requirement to manage a transition for PMSE users (including restrictions on the band manager's ability to charge for spectrum access) differentiates this spectrum award enough from other ones and hence justifies this alternative approach.

A3.113 We are determined to enforce the protection measures we establish in order to make the transition as smooth and effective as possible, and will deal with any complaint brought by PMSE users. We intend to set out further thoughts on how we will interpret fair, reasonable, and non discriminatory prices in our consultation on the spectrum award in spring 2008.

A3.114 The above analysis leads to our proposing as a preferred option, the beauty contest with AIP with the following characteristics:

- criteria designed to attract a band manager with technical, financial and managerial capability, that has the motivation and expertise to develop the spectrum efficiently, and that commands trust among PMSE users;
• indefinite licence, with limited grounds for revocation during a set period of time;
• licence would be tradable and technology and application neutral; the band manager would be free to acquire additional spectrum in auctions and/or the secondary market;
• we set AIP for the band manager and the band manager sets fees for users;
• the AIP is set for an agreed number of years after which it can be reviewed;
• we set licence conditions to protect PMSE users: clauses that explain under what conditions spectrum can be made available to PMSE users and to non PMSE users, both in terms of access to spectrum and to prices;
• the band manager may make spectrum available for other uses but only where it is not needed to satisfy the reasonable needs of the PMSE sector; and
• the band manager will need to make spectrum available to PMSE users on fair, reasonable and non discriminatory terms. We will interpret this to preclude excessive pricing. The band manager will be free to set unregulated prices for spectrum made available for other uses.

A3.115 Table A21 summarises the key aspects of our proposals against our four objectives (some aspects relate to more than one objective, but for ease of presentation we abstract from this in the table below).

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Our proposals</th>
</tr>
</thead>
</table>
| Avoiding disruption to PMSE users that adversely affect their ability to provide a wide range of services | • via 10 year transition period offering protection in terms of spectrum access and fair, reasonable, and non discriminatory terms and conditions  
• via selection of a band manager with interests aligned with PMSE users  
• via the phasing of AIP over a certain number of years |
| Facilitating the participation of PMSE users to a market based approach to spectrum | • via price signals on the true costs of spectrum that flow through the value chain  
• via the provision of clear and enduring spectrum access rights to the band manager |
| Promoting the optimal use of the spectrum | • via the signal of opportunity costs of spectrum through AIP  
• via the possibility of the band manager to allocate spectrum to competing uses |
| Avoiding the risks of regulatory and market failures | • via the selection of one band manager for reason of trust and transaction costs  
• protection against monopolistic behaviour by the part of the band manager  
• ensuring that the band manager has sufficient incentives to promote efficient spectrum use (e.g. by charging AIP and allowing the band manager to allocate spectrum to competing uses) |

A3.116 Option 3 also has the advantage of being more in tune with PMSE users’ preferences and of offering the potential of a possible extension to other bands used by PMSE users.
Question 2: A single package of spectrum

A3.117 The PMSE consultation favoured awarding a single package of spectrum for PMSE use. This reflected users’ negative experiences of dealing with more than one service provider prior to 1996.

A3.118 Our view is that dividing the spectrum into separate packages is unlikely to have significant competition benefits, at least in the short term, because of restrictions on the tuning range of equipment and/or the need by users to access large quantities of spectrum for special events.

A3.119 Responses showed a strong preference for a one stop shop for spectrum use and hence for a single package of spectrum to be assigned to a single band manager. Stakeholders understood that this would result in a dominant supplier of spectrum for many PMSE applications but hoped to receive protection by virtue of price controls placed on the band manager.

A3.120 As a consequence, we favour awarding a single package of spectrum for PMSE use.

A3.121 We continue to work on the basis that there will be broadly sufficient capacity to allow existing PMSE use to be accommodated within this spectrum.

Question 3: Licence exempt use of channel 70

A3.122 The PMSE consultation broached the possibility of greater use of licence exempt spectrum in channel 70 for wireless microphones. Given the lack of coordinated access to spectrum and hence the greater potential for interference, this would primarily suit community users who want quick and easy access to spectrum and do not require the assurance of quality of service provided by a coordinated assignment. 2 MHz of the channel is available, as shown in table A22.

Table A22. Availability of licence exempt spectrum in channel 70

<table>
<thead>
<tr>
<th>Frequency (MHz)</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>862-863 MHz</td>
<td>Used for security applications</td>
</tr>
<tr>
<td>863-865 MHz</td>
<td>Available for licence exempt use for wireless microphones and domestic audio equipment</td>
</tr>
<tr>
<td>865-868 MHz</td>
<td>Used for Radio Frequency Identification applications</td>
</tr>
<tr>
<td>868-870 MHz</td>
<td>Used for various short range devices including security alarms</td>
</tr>
</tbody>
</table>

A3.123 Few responses addressed this proposal as intended—most thought it aimed at professional PMSE users and so considered it unsuitable—but those that did saw merit in it. We will therefore promote greater licence exempt community use of channel 70 and will consider what more could be done to support this.

A3.124 We remain of the view that there is potential for greater use of channel 70 because many wireless microphones can easily tune into and share it on a licence exempt basis. Indeed most of the wireless microphones that are sold tune into frequencies in the upper 60s channels, including 70. In addition community users who do not require the assurance of quality of service are typically geographically dispersed and infrequent users. Given the nature of this type of PMSE usage and the low power of the equipment, we believe that 2 MHz may accommodate a significant number of users without generating a noticeable deterioration of the quality of service.
A3.125 Community users requiring high quality spectrum have the option to request spectrum on a licensed basis in order to guarantee interference free spectrum access. Given the nature of community PMSE use, namely geographically dispersed and infrequent, we expect that in most cases the conditions to access their required licensed spectrum would be reasonable and unlikely to provoke disruption.

**Question 4: Scope for extending this approach to PMSE use in other, non interleaved spectrum**

A3.126 PMSE users currently have access to approximately 80 spectrum bands. These cover a wide range of frequencies and are mostly shared with other users as shown in table A23 below.

**Table A23. Spectrum available for PMSE use**

<table>
<thead>
<tr>
<th>Band (MHz)</th>
<th>Assignments (% of 2006 total)</th>
<th>MOD</th>
<th>Broadcast</th>
<th>FWS</th>
<th>Mobile</th>
<th>Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>47-62</td>
<td>0.6</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>67-86</td>
<td>0.1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>139-148</td>
<td>0.3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>173-225</td>
<td>1.2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>420-450</td>
<td>2.4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>450-470</td>
<td>36.1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>470-854</td>
<td>46.7</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>854-862</td>
<td>6.4</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1488-1800</td>
<td>0.2</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>2025-2690</td>
<td>3.8</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3400-3600</td>
<td>0.2</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5427-5925</td>
<td>0.1</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>7110-7424</td>
<td>3.3</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>8460-8500</td>
<td>0.0</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10300-10360</td>
<td>0.0</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11740-12500</td>
<td>1.6</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>24250-24500</td>
<td>0.0</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>48000-48400</td>
<td>0.0</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

A3.127 The PMSE consultation invited comments on the scope for applying the options discussed above to bands other than the digital dividend. We received few detailed comments, although those who did respond agreed that there was merit in extending the band manager’s remit to other bands.

A3.128 We believe that we can adapt our proposed approach to these bands so that they are more efficiently used. We may need to differentiate how we deal with the various bands depending on their characteristics and ownership. We will explore this in detail in the consultation on the design of this award.

**Question 6 of the DDR consultation document: Continued licensing of channel 69 for PMSE**

A3.129 The DDR consultation document proposed licence exempting some or all PMSE access to channel 69 in the interests of deregulating wireless microphone use by community bodies. The PMSE consultation left this issue open.
A3.130 In proposing to licence exempt channel 69 in the DDR consultation, we relied on our understanding that most of PMSE users in this channel did not require coordination of their spectrum use with other users. This was because their usage was often for community purposes, small scale and occasional, as well as requiring small amounts of spectrum. Additionally the evidence that many users in that channel do so unlicensed seemed to confirm the lesser need for coordinating use.

A3.131 We were also of the view that this proposal amounted to a step towards light touch regulation, enabling both us and the channel 69 users to save on the time and costs of licensing requirements.

A3.132 However we acknowledged the presence of some professional PMSE users needing quality spectrum. We encouraged stakeholders to let us know if they agreed with our analysis and were in favour of our proposal.

A3.133 Most bodies representing professional PMSE users and some individuals argued in the DDR consultation responses for channel 69 to remain licensed in order to avoid interference. However, some respondents were willing to countenance licence exemption for a small portion of the channel to cater for community use. Many respondents to the June 2007 PMSE consultation reiterated their opposition to channel 69 being made licence exempt.

A3.134 They put forward the following reasons. Firstly, channel 69 is heavily used by professional PMSE users because it is the only channel available UK wide. This allows travelling productions to use the same equipment and the same frequency plan at all UK venues. Secondly, professional PMSE users of channel 69 require high quality, interference free spectrum. Thirdly, there are also community PMSE users of channel 69 who acquire and pay for a licence in order to guarantee the high quality, interference free spectrum they need.

A3.135 At the same time, few respondents argued explicitly for significant licence exemption in the interests of community users, which could in any event be accommodated to some extent in channel 70 (see above). We believe that there is more scope for licence exempt use of channel 70 for community users.

A3.136 We recognise the importance that professional and community PMSE users attach to the high quality, interference free spectrum that licensing produces in channel 69. We also note the unique role played by channel 69 as only UK wide available channel for PMSE usage. Taking into account these considerations and our objective to minimise the disruption to the PMSE sector we are inclined to revise our proposal for channel 69. We will continue licensing all of channel 69, which we will include in the single package of spectrum to be awarded by beauty contest.

A3.137 The DDR consultation noted that potential developments at European level could be very relevant to the digital dividend in the UK. In particular, we noted that proposals for action at European level might come forward, and that in some cases European decisions could be binding on the UK. The international position is also important because the use of spectrum in other countries can affect the use of spectrum in the UK, either by imposing constraints on use or by creating opportunities to realise economies of scale with other countries.

A3.138 We propose leaving the market to decide whether different use should be made of channel 69 by allowing potential new users to transact with the band manager for access. The terms on which this may be possible, while meeting reasonable PMSE demand up to 2018, would be a matter for the band manager to determine.
Digital Dividend Review: annexes to the statement on our approach to awarding the digital dividend

Question 7 of the DDR consultation: Future access and transitional protection

A3.139 Our proposals for the future access of spectrum by the PMSE sector in the DDR consultation document stimulated a lively debate. In the June 2007 PMSE consultation document we examined the DDR responses to this question and also responded to them by setting out our further analysis of these issues and the challenges that the transition to a market led approach to spectrum represents.

Points made by PMSE pro-user group

A3.140 The PMSE pro-user group submitted a response to the PMSE consultation on 28 August 2007. Subsequent to this submission, we received 92 expressions of support for the PMSE pro-user group’s proposals. This level of support accounted for a significant proportion of all the responses that we received.

A3.141 Although we have tried to address the concerns of the PMSE community in our wider proposals, we think it appropriate that we respond to the key points made in this submission (reproduced in bold below). This is partly in recognition of the level of support that it attracted, and partly in light of the detail that the PMSE pro-user group went into in preparing its submission. We thank this group for the time and consideration that went into the formulation of its proposals.

Access to analogue spectrum must be guaranteed until 2013 to help avoid disruption to PMSE

A3.142 There was concern that there would be a shortage of new equipment as manufacturers need sufficient lead times to build equipment suitable for new frequency allocations in the digital interleaved. The PMSE pro-user group’s submission stated that manufacturers would need a significant lead time to ensure that new equipment was ready for the market.

A3.143 We will shortly publish details of the frequencies that will be available for PMSE use in the digital interleaved. A three year lead time, as suggested in the submission, would therefore ensure that equipment could be made for all areas where DSO occurs from 2011 onwards. Importantly, this would include the highest demand area of London in 2012, as well as others. Current wireless microphone usage figures, obtained from JFMG’s database indicates that areas that will be undergoing DSO from 2011 onwards account for 87% of all annual licensee assignments and for 72% of all temporary assignments.

A3.144 There may be challenges in manufacturing sufficient new equipment to access new frequencies and the complexities in building up the right stock for effective substitutable UK wide use. However we believe that licensees and manufacturers will have a significant period of time to adjust. This relates more to the issue of DSO itself and its timetable, as opposed to the determination of what uses should have access to the spectrum.

A3.145 To assist the PMSE community in making these adjustments, in October 2007 we announced that PMSE users could temporarily access channels 63 to 68 of UHF bands IV and V. This would be until the time that the newly awarded licensee requires access to this spectrum. Whilst it is unclear when this will be, we do not anticipate this access to end any earlier than late 2009. This should further ensure that the PMSE community has a sufficient period of time to manage transition in those areas that are undergoing earlier DSO.
PMSE users need to know which frequencies will be available for use in the digital interleaved in good time for DSO

A3.146 We are aware of the importance of the PMSE community having sufficient time to plan for DSO and will be publishing a list of available frequencies shortly.

It is impossible for the PMSE sector to enter a spectrum auction for spectrum release

A3.147 The PMSE pro-user group gave a number of reasons as to why it believes the PMSE sector cannot enter into an auction process. We believe that an auction process, for now, is incompatible with our stated objective of avoiding disruption to the PMSE community and are therefore proposing a band manager selected by beauty contest.

A single band manager should be gifted spectrum on an annual rental basis, to be charged at a rate that does not increase above the rate of inflation

A3.148 We agree with the proposals to have a single band manager for PMSE spectrum. In terms of charging an annual rental, as stated elsewhere in this statement we will be charging the band manager AIP which will be recovered from end users. We do not consider that there will be sufficient incentive to use spectrum efficiently if access were to be set at today's prices and raised by annual inflation only. This is because prices are currently calculated to recover administrative costs—possibly set significantly below the rates that would prevail in a market—and so users are not faced with the opportunity cost of their use. To provide the appropriate incentives for the spectrum to be used efficiently we are firmly of the view that AIP should ultimately reflect opportunity cost. However, we will avoid disruption to PMSE users by phasing in the increases over time. We also believe that an annual licence will also be too short a time for a band manager to promote incentives.

Channels 67 and 68 should be held back for PMSE use

A3.149 Although we note the desire to maintain UK wide PMSE coverage, we must also balance the demands of spectrum in light of our statutory duties to ensure optimal use of the spectrum. With regards to these two channels, we have strong evidence of demand from a number of different uses and technologies.

A3.150 We believe that the provisions and safeguards made for the PMSE community in our broader proposals meant that the further allocation of this potentially high value spectrum would be inconsistent with our duties.

We must revaluate our estimate of the value and quantity of PMSE equipment

A3.151 The PMSE pro-user group believe that we have valued the total equipment for PMSE use at £10 million. As stated in our PMSE consultation, this appears to have arisen from a misunderstanding based on a table that Sagentia produced in its report for the DDR consultation document. That table put the value of community use PMSE equipment at £10 million, whereas the total value of relevant PMSE equipment was estimated to be around £35 million. This is consistent with the figure of ‘in excess of £30 million’ cited in the PMSE pro-user group submission.
The PMSE sector must be given sufficient time to amortise the value of current equipment that will become redundant under current plans

A3.152 We note the concerns that the PMSE sector has over not realising the full value of its equipment and will consider these in the context of the notice period provided to PMSE users in respect of DSO.

PMSE users should be given access to the digital interleaved spectrum until 2026, in line with broadcasters

A3.153 PMSE provides a valuable input to broadcasting as well as other entertainment media such as theatres and community users. However, we do not see that as a compelling reason in itself, to align spectrum access for PMSE and broadcasters.

A3.154 We deal with the issue of digital interleaved spectrum access duration when we discussed the PMSE protection period earlier in this annex. We consider that continued access to spectrum until 2026 is in this case inappropriate because our proposal for managing the transition provides adequate time and protection for PMSE users to prepare to engage in a market led approach to spectrum. We consider that a 10 year protection period balances the opportunity cost of precluding alternative uses of the spectrum and the lifecycle of equipment. To guarantee access to digital interleaved spectrum for a longer period would potentially be against our duty to promote optimal use of the spectrum.

Channel 69 must continue to run on a licensed basis

A3.155 Based on the submissions and representations received from the PMSE community, we agree with this proposal and channel 69 will continue to operate on a licensed basis.

A3.156 Current TG4 proposals do not mandate that we set aside channel 69 for a technology specific purpose such as two way mobile use. As mentioned in our response to Question 6 of the DDR consultation, we propose to let the market decide on the uses of channel 69, enabling the band manager to respond to market signals (taking into account its obligation with respect to PMSE users).

The band manager must meet the legitimate demands of the PMSE sector

A3.157 The band manager will be subject to licence conditions that ensure it will satisfy the reasonable demands of PMSE users where sufficient spectrum exists to allow this.

The commercial band manager must have an understanding of the market and its needs and be responsive to the demands of the PMSE sector

A3.158 We agree and will ensure that selection process and licence conditions reflect this.

A band manager must grant licences that do not exceed a year, and maintain a prepaid online booking system

A3.159 We do not have a view on this and believe that this would be a commercial decision for a band manager to be discussed with its customers.

A band manager should be able to acquire rights to other parts of the spectrum

A3.160 We agree.
Annex 4

Summary of stakeholder comments and our responses

Introduction

A4.1 The DDR consultation document elicited a very large number of responses, more than 750 in total. We received comments from a wide range of interested parties across the industry, from those with a specific interest in particular uses of the digital dividend (including local television, HD and SD DTT services, PMSE, mobile broadband and cellular services, mobile television and low power uses), as well as a large number of individuals (580 in total, but a large majority of these wrote to register their interest in HD DTT services). Since consultation, we have also received a large number of emails from individuals lobbying for extra broadcasting time for Teachers TV.

A4.2 A full breakdown of respondents by number is as follows:

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL responses</td>
<td>751</td>
</tr>
<tr>
<td>Individuals</td>
<td>580</td>
</tr>
<tr>
<td>HD</td>
<td>496</td>
</tr>
<tr>
<td>PMSE</td>
<td>48</td>
</tr>
<tr>
<td>Competition/market approach</td>
<td>16</td>
</tr>
<tr>
<td>Local television</td>
<td>5</td>
</tr>
<tr>
<td>Other</td>
<td>15</td>
</tr>
<tr>
<td>Other stakeholders</td>
<td>171</td>
</tr>
<tr>
<td>PMSE</td>
<td>61</td>
</tr>
<tr>
<td>Public Bodies, including MPs</td>
<td>22</td>
</tr>
<tr>
<td>Broadcasters</td>
<td>21</td>
</tr>
<tr>
<td>Local television</td>
<td>21</td>
</tr>
<tr>
<td>Citizen/community groups</td>
<td>12</td>
</tr>
<tr>
<td>Telecoms</td>
<td>10</td>
</tr>
<tr>
<td>Ofcom Advisory Committees</td>
<td>6</td>
</tr>
<tr>
<td>Low power applications</td>
<td>6</td>
</tr>
<tr>
<td>Consumer bodies</td>
<td>5</td>
</tr>
<tr>
<td>Mobile television</td>
<td>4</td>
</tr>
<tr>
<td>Network providers</td>
<td>3</td>
</tr>
<tr>
<td>Additional emails from Teachers TV</td>
<td>617</td>
</tr>
</tbody>
</table>

A4.3 A summary of the proposals we made in the DDR consultation document and the key issues raised by respondents on potential services which may use the digital dividend are addressed principally in section 7 and annex 2 of this document.

A4.4 We asked for views on matters ranging from our general approach (i.e. whether to pursue a market led approach to the digital dividend), to our analysis of the potential for market failure. We also asked some service specific questions regarding our approach to the use of those services in the spectrum.
The service specific questions relate to:

- Local television
- PMSE
- DTT
- Mobile broadband

In addition, we asked for views on award packaging, award timing, award design as well as technical issues. These issues are all summarised within the relevant sections of this statement (see sections 8, 9, and 10 respectively). Responses regarding our impact assessment are addressed in annex 5.

Although we did not ask ‘service specific’ questions on them, stakeholders also commented on low power uses and mobile television which we have set out and respond to in sections 6 and 7 of this statement respectively.

PMSE responses are also not dealt with in this annex because we undertook a subsequent consultation during 2007 to address further concerns raised by the industry. Annex 3 details our response to stakeholder comments on PMSE issues.

**Issues raised by respondents: application of the social value framework and analysis of market failures**

The following part of this annex sets out a summary of responses on our general approach to the digital dividend. These addressed questions 1, 5, 13 and 14 of the DDR consultation document principally, but issues were also raised in relation to specific services (questions 6-12).

We received many comments regarding risks of or concerns about the likelihood of market failure under our general approach. A summary of the substantive points is provided in sections 5 and 7 of this statement and annex 2.

<table>
<thead>
<tr>
<th>Issue raised</th>
<th>Our response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Market based approach</strong></td>
<td>The digital dividend is a valuable input to a potentially wide range of communication services. It is likely to experience high demand from a wide range of uses and users. In these circumstances we believe that the market led approach is most likely to maximise the value that using the spectrum will generate for society. We will facilitate a market based approach by releasing the spectrum with minimum constraints and making its future use as flexible as possible. The alternative is for us as the regulator to make subjective judgements about what might be the best use of this valuable resource—we believe that this carries a greater risk of failure. There are strong reasons why an auction process will promote spectrum efficiency in this situation:</td>
</tr>
<tr>
<td><strong>General</strong></td>
<td></td>
</tr>
<tr>
<td>Issue raised</td>
<td>Our response</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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</tbody>
</table>
| it reveals the value which different users (across different uses) place on  | • it reveals the value which different users (across different uses) place on the spectrum; and  
| the spectrum; and                                                           | • it ensures that those with the highest valuation  
|                                                                              | (and hence those who can get the most out of the spectrum) are those who gain access.  
|                                                                              | While market failure can justify regulatory intervention in a market based allocation (see annex 3), we do not believe the evidence supports such an intervention in relation to other potential uses of the digital dividend. Annex 2 considers in detail the likely causes of market failure in the DDR award.  
|                                                                              | Section 5 of the statement explains how, absent market failure, a market can maximise the value to society and result in efficient spectrum use.  
|                                                                              | Auction costs are only passed onto consumers—any inflated fees may distort the market.  
|                                                                              | The extent to which auction costs are passed on to consumers will depend on the nature of the market. However, there are several reasons why charging for spectrum use is important to promote efficiency and will remove rather than create distortions:  
|                                                                              | • given convergence, if we were to give away spectrum for free, this would create a distortion between wireless and wired delivery mechanisms  
|                                                                              | • failing to charge for an input, results in inefficient use—when users do not understand the cost their use of spectrum imposes on others (by denying them access to this resource) they tend to use more spectrum than they should from a societal perspective. Given the importance of spectrum as an input to many valuable uses the impact of this is likely to be significant.  
|                                                                              | Bidding for spectrum will divert money from programme making, compromising production.  
|                                                                              | For the reasons set out above, it is important to charge for spectrum. However, the funding provided for all socially valuable services must be at an appropriate level. The funding authorities together with those who deliver the socially valuable services are best placed to make that judgement. For example, if broadcasters find that they are unable to fund programming (either because of the cost of spectrum or the cost of other inputs), this is something which is best addressed through their overall funding settlement.  
|                                                                              | A market based approach is unable to guarantee innovation.  
<p>|                                                                              | A market based approach to releasing spectrum is generally considered to promote innovation as it provides strong incentives for efficient spectrum use. Our proposals to release spectrum with the minimum constraints necessary, will allow the digital dividend to be traded and its use changed in response to the development of new innovative applications and services. |</p>
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<td>Approach is at odds with the Government’s decision to allocate spectrum to</td>
<td>Our approach is entirely consistent with the Government’s spectrum policy and plans for DSO. Over two thirds of the spectrum used for analogue television has already been reserved for DTT. There is no change to this.</td>
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<td>the existing multiplexes post DSO, unless the intention is to introduce spectrum pricing based on a true opportunity cost for the use of allocated spectrum. If so, this could result in significant increases in the licence fee, as new and more valuable uses of spectrum drive up the opportunity cost for it.</td>
<td>Separately, it has been decided through consultation that AIP is appropriate for broadcasting use of spectrum and will be applied from 2014.12</td>
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| If particular users fail to acquire spectrum (for example for police radio), there is a risk of compromising public safety. | Currently, none of UHF bands IV and V are used for public safety purposes. Therefore, we do not believe that a market led approach to releasing the digital dividend raises any immediate issues which compromise public safety.  
Looking forward, it is possible that this spectrum could be used for public safety requirements, however, we believe that the necessity to use the digital dividend (rather than other spectrum bands), has to be considered jointly by those organisations who have a public safety remit and their funding bodies.  
The Cave Review stated that all public service/safety users should be subject to full spectrum pricing based upon the opportunity cost of the occupied spectrum to discourage over consumption. Providing it does not restrict efficient and effective public safety service communications, this approach to expose public services to the market mechanism for spectrum is supported by the Government.  
In line with this approach, if in the future there is no viable alternative to the digital dividend for certain public safety uses, funding bodies would need to make the funds available to enable the public safety organisation to acquire the necessary spectrum. |

Secondary market concerns

| How can we be certain that an efficient secondary market develops and will it be able to reflect social value. | In line with our general approach to spectrum allocation, we believe that rights should be defined in a way which facilitates effective secondary trading. When considering auction design and packaging one issue which we will consider is how this can help to promote efficient secondary markets.  
The method for reflecting social value in the secondary market is the same as in the primary award. Socially valuable uses need to be appropriately funded to allow them to acquire the inputs they need to provide their socially valuable output. |

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<tr>
<td>Risk of speculation with tradable licences.</td>
<td>Speculation behaviour can have positive effects. Section 10 lists the mechanisms we have available to us to promote competition, and details of the auction and licence design which could be used to address this issue. Where speculation may adversely affect competition we will consider this in the next phase of the DDR.</td>
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<tr>
<td>UK assets should be under UK control—concerns about trading of non UK interests and foreign ownership of a national asset.</td>
<td>In a global economy, inward investment into the UK brings significant benefits, as do investments by UK companies in other countries. In this context we do not believe that restricting ownership of spectrum would increase the value generated by it, and could plausibly significantly decrease the value generated for society.</td>
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<tr>
<td>Nations and Crown Dependencies</td>
<td>We consulted on whether we should award UK wide licences and there appears to be strong support for this. Additionally, the licences will be tradable so there will, in principle, be the option to acquire regional licences in the secondary market; direct funding can be used to help facilitate the provision of particular services in particular areas if there is social importance in this.</td>
</tr>
<tr>
<td>Regulatory intervention is required in Wales, Northern Ireland, the Isle of Man and rural areas to optimise spectrum use due to different market and social characteristics (e.g. lack of bidders and greater level of digital deprivation in particular areas).</td>
<td>We are in discussions with the Crown Dependencies and will be consulting on our proposals in the next phase of DDR work.</td>
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<td>Spectrum trading is not permitted in the Isle of Man.</td>
<td>We are considering the detail of packaging design in the next phase of DDR work. We aim to publish our proposals in consultations in spring 2008. We are discussing these issues with the Irish authorities and will take account of this in our work.</td>
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<td>There should be joint auctions for all-Ireland licences (between us and ComReg).</td>
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<td>International competitiveness</td>
<td>We believe there is a major potential benefit available from auctioning this valuable spectrum on a technology and service neutral basis and thus allowing it to be used by new users as soon as possible. The release of the digital dividend on this basis will increase competition for traditional communications platforms. For further details on the appropriateness of a market led award of this spectrum with regards to mobile television and HD programming please see section 7 of the statement.</td>
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<tr>
<td>PSB</td>
<td>This issue is fully addressed in section 7 and annex 2 of this statement. Spectrum allocation is driven by concerns about economic efficiency as opposed to revenue generation. We also discuss above the issues with allocating spectrum at prices which do not reflect its opportunity cost.</td>
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<td>Capacity should just be allocated to PSBs. Funding either comes from consumers/citizens, or if financed by the Government it creates a circular flow of funding back to the Government through PSBs and us.</td>
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<tr>
<td><strong>Comments on market failures assessment</strong></td>
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<tr>
<td><strong>Exclusion of high social value uses</strong></td>
<td>As set out in section 7 of this statement we have considered the BSV that the most likely uses of the digital dividend may potentially deliver e.g. local television, Mobile Broadband, PMSE and extra SD channels. We have considered the evidence associated with such BSV alongside the risk of regulatory failure resulting from interventions in a market based process. In the case of local television, we are proposing to intervene to address coordination issues. For PMSE, we propose to assign most available interleaved spectrum by beauty contest to a band manager who would pay AIP, earning revenue by charging all users for access. In relation to other services we do not believe the evidence in relation to social value from incremental spectrum use is sufficiently strong to justify intervention given the opportunity cost of intervention in the award and the attendant regulatory failure risks.</td>
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<td>Concerns that the approach would lead to a suboptimal outcome as socially valuable uses (and even smaller companies) will be unable to compete effectively. Two reasons were given for this:</td>
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<td>• Unable to bid at a level representing total value as they lack the funds;</td>
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<td>• Coordination issues/aggregation risk: A large number of users who provide high social value services may not be able to coordinate bids alone e.g. PMSE users and low power uses of spectrum. Additionally, PMSE respondents felt that an auction would mean that it is less likely a third party would consider band managing as a commercial investment and therefore want to do it.</td>
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<tr>
<td><strong>Social value</strong></td>
<td>This issue is fully addressed in sections 5 and 7 and annex 2 of this statement.</td>
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<td>The conclusion that a purely market led approach would deliver more benefits to citizens and consumers than a policy which permits carefully designed intervention is wrong.</td>
<td>We assume this comment refers to the possibility of having spectrum directly allocated as a way of ensuring the delivery of social goals. As we have discussed, there are significant benefits from pricing spectrum at its opportunity cost, and significant risks from regulatory intervention in a market based allocation process—particularly through implementing an administered process. This is discussed in detail in sections 5 and 7 and annex 2.</td>
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<td>Broader social goals are not best achieved by acquiring spectrum rather than having it allocated.</td>
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<td><strong>Competition</strong></td>
<td>As discussed in section 10, we will consider in the next stage of the DDR those market failures that may result from the strategic holding of spectrum for anti-competitive reasons. As the competent competition authority for communications matters in the UK, we have a wide range of ex-ante and ex-post powers that we can use to promote and protect competition.</td>
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<td>Concerns about our approach leading to an abuse of market power, particularly in relation to:</td>
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<td>- risk of monopolies and anti-competitive behaviour developing—spectrum bought by few (or single entity) with the greatest financial capacity; and</td>
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<td>- risk of spectrum hoarding—spectrum remaining unused for a long period.</td>
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<tr>
<td><strong>Protection of consumers and prevention of market failure</strong></td>
<td>We agree that there are situations in which intervention is required in a market to protect the interests of citizens and consumers. This is why we have paid particular attention to all types of market failure. Sections 5 and 7 and annex 2 provide our detailed analysis of its likely causes in the DDR award, and the evidence we have considered in relation to these issues. It also provides our conclusions on whether we should intervene (i.e. impose any conditions on the use of the spectrum or the way we release it) on behalf of a particular set of uses that have the potential to deliver BSV. We will consider in the next stage of the DDR, market failures that may result from strategically holding spectrum for anti-competitive reasons.</td>
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<tr>
<td>Although supportive of a market approach, thought that licence conditions/safeguards should be imposed to protect consumers in special cases like high social value uses, particularly given that this concerns the use of a national resource e.g. to take account of public interest, minimise market failure risk and to deliver social value.</td>
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<tr>
<td>Once spectrum is sold, it cannot be put back in public domain to address any competition or social value issues.</td>
<td>Our proposals to define spectrum rights in a technology and service neutral way, enables a secondary trading market to access that spectrum, should a more valuable use arise in the future. If direct funding is provided, the secondary market can work to provide access to spectrum for socially valuable uses as well as privately valuable ones. We will consider the risk of anticompetitive behaviour and hoarding as part of the next phase of DDR work. When designing spectrum auctions the impact of the award on the development of an efficient secondary market (i.e. spectrum trading) is an important consideration.</td>
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<tr>
<td><strong>Creation of a ‘digital underclass’</strong></td>
<td>Our work does not preclude intervention to meet wider public objectives, but suggests that it is not appropriate to intervene in the DDR award to achieve these. This does not preclude the use of other interventions such as direct funding, which are better able to meet wider public goals. This form of intervention is consistent with our market led approach. For example, as set out in the mobile broadband part of section 7, we explain how the market led approach leaves the opportunity for subsequent intervention to secure wider coverage.</td>
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<td>The characteristics of a market led approach (e.g. highest bidder allocation or service/coverage neutrality) mean benefits were unlikely to accrue to all citizens. It is likely to exclude certain consumer groups (rural areas, low incomes, vulnerable consumers/citizens, and military personnel) if they are not a commercially attractive part of market.</td>
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<td>Issue raised</td>
<td>Our response</td>
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<tr>
<td><strong>Difficulty of measuring/quantifying social value</strong></td>
<td><strong>Why are ‘market efficiency’ benefits to the consumer of selling spectrum placed above other benefits to society.</strong></td>
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<td></td>
<td>Our framework accords equal weight to BSV (i.e. value to citizens) and private value and recognises that if there is clear evidence of a market failure as a result of the existence of BSV associated with particular activities, there is a <em>prima facie</em> case for intervention.</td>
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<td></td>
<td>BSV is difficult to measure. However, we believe that we have used the best available approaches for its measurement. Our work involved both top down analysis (economic modelling and demand estimation—trying to understand which services are likely to make use of the digital dividend and the benefits they could deliver) and bottom up analysis (asking consumers (and citizens) for their opinions on which services they believe deliver societal value) to give a wider overview of value to society. We do not believe that our approach will systematically over or understate the value of any use relative to others.</td>
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<tr>
<td><strong>The risks and losses associated with high social value uses which fail to gain access to spectrum are significant yet underestimated for many services.</strong></td>
<td>It is because the BSV generated by these uses is so uncertain and difficult to quantify that we should not intervene to allocate spectrum to some uses at the expense of others; to do so is likely to result in an incorrect judgment. This does not mean that we do not believe there should be intervention to support uses which generate BSV. In some cases there should be. However, generally this should take the form of direct funding, rather than via an intervention in the award of spectrum. These issues are discussed further in section 5.</td>
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<tr>
<td><strong>The analysis did not reflect the full value of broadcasting because it failed to consider the impact it can have on all areas of life. An effectively regulated group of broadcasters and communicators that sought to provide wider social value could save the British economy £69.9 billion per year by reducing 'costs to the economy' and existing public expenditure.</strong></td>
<td>We agree that broadcasting uses can generate significant BSV. This is largely why 256 MHz of the spectrum currently used by analogue television has been reserved for DTT. However, the relevant question in the DDR is not the BSV these uses generate in aggregate but whether access to the digital dividend would significantly increase this value. We think our analysis of BSV has appropriately considered these incremental effects. Additionally as discussed in section 5 and annex 2 there is a range of intervention options which can be used to secure value to society from uses such as broadcasting. Generally, the most appropriate method for ensuring access to spectrum by uses with high societal uses is through direct funding, not the gifting of spectrum.</td>
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<td><strong>Issue raised</strong></td>
<td><strong>Our response</strong></td>
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<td><strong>Flexibility</strong></td>
<td><strong>Picking a preferred use reduces the ability of potential users to express their value of the spectrum in the primary allocation. In contrast, the use of a market based allocation process, liberalisation and trading of licences will facilitate flexibility so that high value uses can access spectrum. If localised spectrum use has a higher value, we would expect this to be demonstrated either in the primary allocation or through subsequent unbundling and trading of rights.</strong></td>
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<td>Interest in how the approach will create maximum flexibility and efficiency in spectrum use. Both are likely to be lower than an interventionist outcome and may lead to a dominance of supply by a few entities on a skewed usage basis towards UK wide rather than local uses.</td>
<td>Interleaved spectrum will be packaged to address local television geographical markets and the PMSE band manager will be appropriately incentivised to make the most efficient use of spectrum, whether at a local or UK level. The risks of anti-competitive hoarding of spectrum will be considered as part of our further work on competition (as discussed in section 10).</td>
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<td>Picking a preferred use is likely to increase flexibility compared to a market led approach.</td>
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<tr>
<td><strong>Future proofing/innovation reserve</strong></td>
<td><strong>Given the number of competing uses/users for the digital dividend, and the significant uncertainty which exists over future technological developments, we believe that the best approach to ensuring a high degree of ‘future proofing’ is to release this spectrum with the minimum constraints. This will ensure flexibility to allow the market to respond to changes in the value of spectrum use. We believe our proposals are future proof, because:</strong></td>
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<tr>
<td>Need to consider how outcomes for consumers and citizens will develop, so any social benefit which forms part of an award is maintained in the long term.</td>
<td>• a technology and service neutral release of the digital dividend allows flexible use; • cognitive access will allow new, innovative use of the interleaved spectrum; • the band manager will be incentivised to make efficient use of the interleaved spectrum; • work on DTT upgrade means encouraging more efficient use of the spectrum by paving the way for more efficient modes of transmission and new technologies—such as DVB-T2 and MPEG-4; and • our approach also allows funding bodies to continually review their position on spectrum acquisition—and provide incremental funding for acquisition of rights in the secondary market in due course if this is required.</td>
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<td>Most respondents thought spectrum should be held back in an innovation reserve, to protect against future changes and potential market failures, but only for a limited time. However others did not think this was necessary due to spectrum trading and minimum constraints on use.</td>
<td>This issue is addressed in section 6.</td>
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<td>Issue raised</td>
<td>Our response</td>
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<tr>
<td><strong>Assessment of market failure risks</strong></td>
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<td>The risk of market failure is low in the proposed approach, and long term, transaction costs can be addressed by market mechanisms.</td>
<td>We agree with this position—given the high opportunity cost associated with this spectrum, we believe that regulatory intervention carries a significant risk of failure.</td>
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<tr>
<td><strong>Market/auction based issues</strong></td>
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<td>We are obsessed with auctions—need to recognise it is not the only option and in many cases (e.g. PMSE) it is not the right one and can have serious negative implications for the industries involved.</td>
<td>We favour auctions but also recognise that markets do fail and there may be a role for intervention where there is strong evidence of a potential market failure which is material enough to outweigh the potential risks associated with regulatory failure. See section 7 for our proposals on PMSE.</td>
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<tr>
<td><strong>Omissions from market failure analysis</strong></td>
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<td>Effects of auction process on those participating</td>
<td>Our analysis of possible market failures does consider the potential for capital market failure, and whether interventions such as permitting phased payments could address any potential issues (see annex 2). The detail of the auction arrangements will be considered in full during the next stage of the process, and consideration will be given to participation costs and risks.</td>
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<tr>
<td>The analysis understated inefficiencies and cost to industry of the auction fees, including the financial risks/costs of bidding.</td>
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<td>Link between DTT and PMSE professional use</td>
<td>This requirement for high quality, interference free PMSE use of spectrum is taken into account in the analysis in section 8 and annex 3.</td>
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<tr>
<td>The risk analysis failed to identify the link between professional PMSE use and television/multimedia production. The individual applications were considered in isolation, and not the interdependence between them. Any corruption of programme content at the PMSE stage can affect the production chain into the future.</td>
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<tr>
<td>Broadcasting as a whole</td>
<td>Throughout the DDR process we have engaged proactively with all stakeholders in order to understand their perspectives on our framework and analysis. We have considered carefully all points on the scope of our analysis (including the evidence submitted to us from stakeholders) and the potential uses of the spectrum which have been put to us.</td>
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<td>Was not adequately considered in the consultation document.</td>
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<tr>
<td>Environmental impact of different uses of spectrum</td>
<td>The focus of our analysis has been on the identification of potential market failures in relation to awarding the digital dividend. While there are environmental impacts of different uses of the spectrum (the DCMS/DTI (now BERR) impact assessment included changes in energy consumption, and increased television/set top box disposal) it is not clear that these are likely to result in market failures which would justify regulatory intervention in the digital dividend award. To the extent that environmental externalities related to energy consumption or equipment disposal arise, these are unlikely to be most appropriately dealt with through spectrum allocation and pricing.</td>
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<td>Costs of failing to achieve harmonisation benefits</td>
<td>Work is underway in a number of fora on harmonisation issues, particularly for mobile communications. Packaging of some of the spectrum will be designed to maximise benefits of harmonisation. We support the harmonisation of a sub band of the digital dividend for mobile communication applications on a non exclusive, non mandatory basis.</td>
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<td>Material risks should include lost international capability if policy is not harmonised internationally, or the upside of economies of scale and export if it is harmonised.</td>
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<td>Development of proposals</td>
<td>The key risks for us when considering how to release the digital dividend are that of market failure and regulatory failure. We believe the framework we are adopting is broad enough and captures all the risks identified by stakeholders (sections 5 and 7 detail the total value framework and the relevant risks).</td>
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<td>Whilst we have included the most material risks in the analysis, there are concerns that not all of the risks have been included in the conclusions when developing proposals, and the weighting of those that were included was incorrect.</td>
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<td>Did not show how the DCMS/DTI 2005 cost benefit analysis of the DSO estimate of the carbon emissions externality will inform spectrum decisions.</td>
<td>Our analysis has focussed on identifying potential market failures in relation to the DDR award process. While there are environmental impacts of different uses of the spectrum (those highlighted in the DCMS/DTI impact assessment include changes in energy consumption, and increased television/set top box disposal) it is not clear that these are likely to result in market failures which would justify regulatory intervention in the award process. To the extent that there are environmental externalities related to energy consumption or equipment disposal, these are unlikely to be most appropriately addressed through spectrum allocation and pricing arrangements.</td>
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<tr>
<td>Impact on future viability of DTT platform</td>
<td>The impact on the DTT platform of the possible failure of broadcasters to win incremental spectrum rights is covered in section 7 of this statement and in annex 2.</td>
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<tr>
<td>The long term effects of PSBs failing to win spectrum or if pay television providers win additional DTT spectrum. The DTT platform may lose viewers to pay television alternatives where HD services are available or a monopoly in UK broadcasting may develop. They indicate that this will also impact upon manufacturing and retailing of DTT services.</td>
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<tr>
<td>Commitment to research results</td>
<td>We consider the BSV generated by local and community television in section 7 and annex 2. In this assessment we consider the appropriate action to take when uses generate this type of value in order to maximise the total value of the spectrum. In sections 4 and 5, we explain how our analytical framework is consistent with our duties to citizens and consumers.</td>
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<td>Our research shows 'firm and unambiguous interest' in local and community television, but a market led approach would not guarantee its use. It was noted that this was contrary to our duties to citizens and consumers.</td>
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<td><strong>Issue raised</strong></td>
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<tr>
<td><strong>Corporate UK vs. consumer UK</strong></td>
<td>Our analysis has focussed equally on the value to consumers, citizens and producers. If the concern is consumer exploitation, we have considerable ex post and ex ante powers available to us to deal with anti-competitive, exploitative behaviour.</td>
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<td>The approach may only benefit corporate UK over consumer UK.</td>
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<td><strong>Universal service obligations (USO)</strong></td>
<td>Our approach to releasing the digital dividend should not raise barriers to any future USO. For example, for mobile broadband, if it is profitable operators will be able to acquire additional spectrum in the secondary market or extend their rollout using existing capacity. If further incentives are required to bring about rollout to specific areas, it would be more appropriate to achieve this through specific support rather than through the pricing or allocation of spectrum.</td>
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<td>Need to consider whether the digital dividend can be separated from a future role of the USO.</td>
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<td><strong>Comments on interventions assessment</strong></td>
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<td><strong>In support of intervention</strong></td>
<td>We have fully considered the issues associated with BSV for all key uses, as well as the possible interventions which could be deployed to address market failures. This analysis is presented in annex 2. We agree that intervention may be required to support uses which generate high BSV but this has to be considered by assessing the strength of the evidence in each case, the likelihood that the intervention itself may fail to deliver the socially desirable outcome and whether the solution should lie at the spectrum allocation layer. In general, we believe that the most appropriate means of intervention for securing BSV is direct funding.</td>
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<td>Some form of explicit intervention is needed in certain areas to prevent market failure (e.g. high social value uses) to maximise the value for society as the private sector would be too motivated by profit. This also includes protection of minority broadcasting interests otherwise large media/telecoms companies may buy all the spectrum, limiting access for smaller broadcasters.</td>
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<td>There is a strong alternative case to the market led approach; that it is actually inappropriate/inadequate regulation rather than excessive regulation that has damaged competition and innovation in some spheres of PSB.</td>
<td>The DDR has carefully considered the options for intervention open to us (see sections 5 and 7 and annex 2). In general, we believe that the risks of regulatory failure in an uncertain environment are too high. We strongly believe that a market led approach to releasing the digital dividend, coupled with an efficient secondary market should facilitate competition and innovation in the long term.</td>
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<tr>
<td>Although it is difficult to remedy market failure through intervention, this does not mean the uses which will give the best possible benefits to the UK’s consumers and citizens should not be facilitated.</td>
<td>We agree that designing interventions to address market failure is difficult, but intervention may be required in some cases. This is why we have completed a detailed assessment of market failures and intervention options (see sections 5 and 7 and annex 2). Any intervention must be proportionate and targeted and the risk of regulatory failure must be considered. For the DDR, our 2006 and 2007 market research demonstrated that consumers and citizens valued all potential uses. Therefore, we do not believe it is appropriate to design an intervention to favour one use over another.</td>
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<td>Issue raised</td>
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<td>A market led process requires preventative measures such as spectrum caps to</td>
<td>We will consider competition issues in the next phase of the DDR process. As mentioned in section 10, there is a wide range of mechanisms we can use to resolve competition issues.</td>
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<td>minimise risk of anti-competitive behaviour. Action under the Competition Act</td>
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<td>too slow.</td>
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<tr>
<td>Market led and interventionist approaches are not mutually exclusive; the</td>
<td>We agree. We will intervene where there is strong evidence that there is likely to be market failure and that the benefits of intervention outweigh the costs, including the risk of regulatory failure.</td>
</tr>
<tr>
<td>optimal approach was likely to be a mixture of them.</td>
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</tr>
<tr>
<td><strong>Against intervention</strong></td>
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<tr>
<td>The risk of regulatory failure through intervention is higher than market</td>
<td>We agree with the comments made against intervention. These are consistent with the position we have taken in our assessment of market and regulatory failure (for example, see our discussion of regulatory failure in section 5 of this statement).</td>
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<tr>
<td>failure risks and that there is no evidence to justify regulatory intervention</td>
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<tr>
<td>as an interventionist approach does not prevent market failure, and can</td>
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<td>have unpredictable effects. Intervention should only deal with packaging</td>
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<td>mechanisms, efficient auction design and interference management.</td>
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<tr>
<td><strong>Our role</strong></td>
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<tr>
<td>Decisions on subsidies should not be left to Government—that there is a role</td>
<td>Decisions on subsidies must be made by the Government as this is ultimately where public funding will come from. However, we have and will continue to work closely with the Government on these matters, providing input and evidence where required to help support decision making.</td>
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<td>for us. Especially true as if it is left to Government, it means we cannot</td>
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<tr>
<td>operate independently of the Government.</td>
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<tr>
<td>Questions on whether we are the right body to decide what to do with the</td>
<td>We are the authority responsible for electromagnetic radio spectrum management in the UK and have been conferred specific duties in the Communications Act by Parliament, to ensure the optimal use of the radio spectrum.</td>
</tr>
<tr>
<td>spectrum.</td>
<td>That said, our stated policy is not to decide what to do with the spectrum but to release the spectrum by adopting a service and technology neutral approach, hence allowing the users of spectrum to decide what uses to put it to.</td>
</tr>
<tr>
<td><strong>Reserving/ring fencing/gifting spectrum</strong></td>
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<tr>
<td>This was a good way to ensure access to spectrum for particular uses as it</td>
<td>We agree that in some cases the costs of intervention can be mitigated. See the discussion in section 5 and annex 2 of interventions which are consistent with a market led approach. One of the reasons why direct funding is a superior intervention to gifting spectrum is because of this very reason.</td>
</tr>
<tr>
<td>promotes the best social efficiency objectives. The risk associated with</td>
<td>We do not agree that our analysis has ignored the benefits of intervention. Our detailed assessment of market failure risks is set out in section 7 and annex 2.</td>
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<tr>
<td>this intervention was overrated and could be mitigated, whilst the benefits</td>
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<td>were ignored in our analysis. This method can also be temporary, for example</td>
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<td>by loaning spectrum to PSBs who then return the spectrum once MPEG-4 boxes</td>
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<tr>
<td>are universal.</td>
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<tr>
<td><strong>Issue raised</strong></td>
<td><strong>Our response</strong></td>
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<tr>
<td>Service neutrality does not imply technology neutrality; that spectrum efficiency is improved by packaging and reserving it for suitable uses to avoid interference and to limit the need for guard bands.</td>
<td>We believe technology neutrality and service neutrality together will maximise spectrum efficiency as well as foster flexibility. We have an obligation to manage spectrum usage so as to prevent interference, and this role will continue after the DDR award. We will consider this issue further in the next phase of DDR work.</td>
</tr>
<tr>
<td>Criticism of gifted/reserved/ring fenced spectrum on the basis of opportunity cost, competition concerns both on a UK wide basis and internationally (e.g. between delivery platforms of television), the idea that incumbents already have a ‘head start’ and so should not be given further advantages, and implications for future uses of ring fenced spectrum.</td>
<td>We agree that gifting spectrum may give rise to all these concerns.</td>
</tr>
<tr>
<td>Solutions offered to address market failure issue</td>
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<tr>
<td>Need to adopt a different approach to enable high social value uses that may not be commercially attractive to gain access to spectrum. This will maximise benefits to society rather than monetary return in markets. Suggestions included reserving spectrum, using a beauty contest or having a benefits led auction rather than market led. Remaining spectrum can be auctioned.</td>
<td>As discussed in section 5 and annex 2, we have considered a wide range of intervention options for delivering BSV, including the use of administrative allocations and bidder credits. Our analysis of these options suggests that the provision of direct funding to allow socially valuable uses to take part appropriately in an auction process is the first best option. This position is supported by the Government.</td>
</tr>
<tr>
<td>Important that spectrum be made available regionally as well as UK wide to ensure parts of licences are not wasted, and to close the digital divide.</td>
<td>Interleaved spectrum will be made available on a regional/local basis—first by us—when auctioning local television and DTT suitable assignments and secondly by a band manager, who will be incentivised to use the interleaved spectrum efficiently (see section 8 and annex 3).</td>
</tr>
<tr>
<td>Successful bidders should be required to provide socially valuable content.</td>
<td>We do not believe it is appropriate to attach social obligations on new licensees as this can have a negative impact on the flexibility of the use of the licence. These types of obligations are appropriately addressed by funding bodies.</td>
</tr>
<tr>
<td>A licence exempt or 'light licensing' approach for at least some of the spectrum will prevent under utilisation and promote flexibility—increasing spectrum efficiency, especially if used for low power uses.</td>
<td>This is considered fully in section 6.</td>
</tr>
<tr>
<td>‘Use it or lose it’ licence conditions and short term licensing should be introduced to prevent wastage, inefficient use and to facilitate adjustments based on technical changes/advancements.</td>
<td>Licence conditions which can promote competition and efficient use will be considered in the next phase of the DDR. This will include consideration of whether there are incumbency advantages and the appropriate response to these.</td>
</tr>
<tr>
<td>Use of clauses specifically blocking any commercial bidder introducing closed or propriety technology using the released bandwidth.</td>
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<thead>
<tr>
<th>Issue raised</th>
<th>Our response</th>
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<tbody>
<tr>
<td>Spectrum should not be allocated to existing or potential preferred uses or users, particularly for DTT. Incumbents have a huge historical advantage.</td>
<td>Issues surrounding payment design are a relevant aspect of the auction design process and will therefore be considered in the next phase of the DDR.</td>
</tr>
<tr>
<td>Alternative pricing methods to cash bids exist, for example PQR (percentage of qualifying revenue). This ensures the Treasury gets a fair share of the spectrum value without overcharging for capacity.</td>
<td></td>
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<tr>
<td>Need to ensure a level playing field for bidders and sufficient information to facilitate this.</td>
<td>We broadly agree, and will consider this issue further in the next phase of the DDR.</td>
</tr>
<tr>
<td><strong>Public funding to address high social value use</strong></td>
<td></td>
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<tr>
<td>Public funding is an unlikely solution as it is often retrospective and short term, and means we do not/cannot operate independently of Government.</td>
<td>We have considered the potential issues arising from institutional arrangements around public funding, which centre on the timing of spending reviews, the difficulty of securing contingent and/or ill defined funding commitments, and the borrowing limits of publicly funded organisations. We will give further consideration of how auction design can help bodies reliant on public funding to take part in an auction of the digital dividend.</td>
</tr>
<tr>
<td>Public funding has inherent problems as it would be administratively difficult, there is a lack of resources available to be spent in this way, it is difficult to know how much will be required in advance and to whom it should be paid to (especially problematic for PMSE users), and the need for such services to remain independent from political control.</td>
<td>We note that the Government believes that adequate financial frameworks are in place (see annex 10).</td>
</tr>
<tr>
<td><strong>Efficiencies</strong></td>
<td></td>
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<tr>
<td>Not enough consideration given to auction inefficiencies in the approach put forward. Spectrum regulation can sometimes lead to positive outcomes and does not necessarily lead to over consumption, while auctions can lead to suboptimal outcomes with lower returns to citizens and consumers (e.g. 3G auction slowed down investment).</td>
<td>As discussed above and set out in annex 2, we have considered carefully the risks of market failure. Where we have identified such a risk, we have also carefully considered the risk of regulatory failure. This is not least because of the wide range of potential uses of the digital dividend and the considerable uncertainty over which of them are likely to generate the highest value. We will be considering auction design issues very carefully in the next stage of the DDR. This involves detailed assessment of how to design an award process which promotes efficiency and minimises the risk of suboptimal outcomes.</td>
</tr>
<tr>
<td><strong>Public policy</strong></td>
<td></td>
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<tr>
<td>Should not use spectrum as an instrument of public policy.</td>
<td>Using spectrum as a policy instrument may have been appropriate when the variety of uses was less and there was little choice about how to secure value for society, but this no longer holds. As a result, the potential opportunity cost of using spectrum in this way has significantly increased. The appropriate means to achieve public policy purposes which require spectrum access is to provide direct funding to allow this resource to be acquired through the market.</td>
</tr>
<tr>
<td>Need to look more carefully at the wider public policy implications of the decision, especially as there is no evidence to support the conclusion that using spectrum to achieve policy purposes is undesirable.</td>
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<tr>
<td>Issue raised</td>
<td>Our response</td>
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<tr>
<td>Further work is needed on creating a financial framework that could provide</td>
<td>This is covered in section 5 of this statement. The Government considers that appropriate financial frameworks are in place to allow publicly funded organisations to take part in auctions. Issues surrounding payment design are a relevant aspect of the auction design process and will therefore be considered in the next phase of the DDR.</td>
</tr>
<tr>
<td>smaller organisations with the financial capacity to bid at auction instead of finding the resources to do so.</td>
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<tr>
<td>Other issues</td>
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<tr>
<td>International coordination/harmonisation</td>
<td>Work is underway with CEPT on harmonisation issues, particularly mobile communications where respondents felt harmonisation would generate the highest benefits. We will consider this issue when packaging the spectrum in order to allow benefits of harmonisation to be realised. We support the non exclusive, non mandatory harmonisation of a sub band of the digital dividend for mobile communication applications.</td>
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<tr>
<td>EU harmonisation and international coordination are extremely important in</td>
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<td>relation to spectrum and its release, particularly to achieve economies of scale</td>
<td>This is addressed in section 3 of this statement.</td>
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<td>and the benefits it can generate. One example given was for EU wide</td>
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<td>harmonisation of a sub band of at least 100 MHz for mobile services.</td>
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<td>We should consider the success of GSM and IMT-2000 and so should ensure that</td>
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<td>IMT-2000 can acquire suitable spectrum. Its development and growth means</td>
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<td>that intervening to licence it would be justified.</td>
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<td>The current proposals were unmanageable from an interference point of view, and</td>
<td>This issue has been considered as part of our technical research and in section 8. This will be a key area of further work in the next stage of the DDR, where we consider spectrum usage rights and the nature and shape of technical licence conditions.</td>
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<td>prevent gains from a long term harmonised solution (e.g. interference risk</td>
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<td>between low power and PMSE uses).</td>
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<tr>
<td>Timing</td>
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<td>Some respondents wanted an early auction to maximise benefits, whilst others</td>
<td>We prefer an auction to take place as early as possible as this allows services to be offered to consumers and citizens as soon as possible. At any point in time there will be some uncertainty surrounding potential uses, and so delaying the process will not resolve the problem.</td>
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<tr>
<td>thought it should be delayed to allow greater consideration of use-specific</td>
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<td>issues, and completion of relevant international work.</td>
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<tr>
<td>An early award of channel 36 to enable early deployment of infrastructure and</td>
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<td>the extra benefits this will generate was supported, given it is available earlier.</td>
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<td>Timing decisions should take account of the London Olympics in 2012, and the</td>
<td>Timing issues, including release and award of channel 36, are discussed in more detail in section 9. We discuss our approach to the London Olympics in section 10.</td>
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<tr>
<td>unparalleled opportunity for broadcasting it will provide (from entertainment to improved public safety information). The opportunity was deemed to be so significant that it provided a case for intervention.</td>
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<tr>
<td>Issue raised</td>
<td>Our response</td>
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<tr>
<td><strong>Substitute spectrum</strong></td>
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<td>A distinction should be made between services which can only use DTT spectrum and others where substitutes are available as, for example, if spectrum is allocated to the latter, it may not be the most efficient use of this spectrum.</td>
<td>For all services, our analysis has considered the alternate delivery mechanisms available. In a number of cases (e.g. local television) the availability of alternatives increases the risk of regulatory failure arising from intervention.</td>
</tr>
<tr>
<td><strong>Impact/relationship with DSO</strong></td>
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<tr>
<td>Important to ensure DSO is not jeopardised by the auction process so consumers continue to have a positive experience of DSO, and that the public benefits rationale for DSO is supported by our current proposals.</td>
<td>One of our key concerns (and stated objectives) is that new uses do not interfere with DTT and we are confident that our proposals to release the spectrum via a market led process will have no adverse impact on DSO.</td>
</tr>
<tr>
<td><strong>Further work suggested</strong></td>
<td></td>
</tr>
<tr>
<td>Greater clarification of auction rules is needed for bidder groups.</td>
<td>These will be set out and subsequently confirmed in the next phases of the DDR.</td>
</tr>
<tr>
<td>Need to set out more clearly the regulatory role and tools we have available to correct a possible market failure after the auction, and how these can ensure maximisation of social value of a service.</td>
<td>See discussion of intervention options in section 5 and annex 2, and competition in section 10 of the statement.</td>
</tr>
<tr>
<td>Concerned that there would be extra compulsory costs for consumers for no extra benefit to them, as in order to receive HD services, they will have to pay the cost of transferring to a pay television platform to receive HD services if it is not available on DTT.</td>
<td>Given that no services will be lost as a result of awarding the digital dividend, it is not clear how it could result in ‘compulsory’ costs. Any costs to consumers (e.g. related to new set top box equipment or subscription charges) will be the result of individual decisions as to cost and likely value. We also note the opportunity to provide HD content on the DTT platform through an upgrade of existing technologies; hence it may remove the need to switch platforms to gain access to some HD services.</td>
</tr>
<tr>
<td>Confirm our position with reference to refarming 2G spectrum allocation.</td>
<td>See 2G spectrum liberalisation consultation document.14</td>
</tr>
<tr>
<td>We have missed ‘system level risks’ and ‘wider scale system interactions and their effect’.</td>
<td>It is unclear what risks and interactions are being referred to here. Since publication of the DDR consultation document, we have engaged actively with stakeholders in order to understand their perspectives on our framework and analysis. We have considered carefully all points on the scope of our analysis which have been put to us.</td>
</tr>
</tbody>
</table>

**Issues raised by respondents: service by service**

A4.11 This part of the annex sets out the issues raised by respondents to the service specific questions in more detail below, along with our response to those issues, by service type. Wherever possible, we have tried to group the issues thematically, particularly as our response to some issues may be similar or the same.

### Local Television

<table>
<thead>
<tr>
<th>Issue raised</th>
<th>Our response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Social value (and importance to society) of local television</strong></td>
<td>There is evidence that local television generates BSV, but the evidence for market failure in relation to the digital dividend is not clear.</td>
</tr>
<tr>
<td>Respondents (individuals and those with local television interests) thought</td>
<td>Using this spectrum for local television may not generate the most value for society if viewers’ demand is for only a few hours a day.</td>
</tr>
<tr>
<td>it was important to reserve spectrum for local television in recognition of</td>
<td>The 2007 market research indicated that the most likely uses of the digital dividend all generate BSV to some extent. Overall local television was ranked</td>
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<tr>
<td>its social value. Some went further to argue for gifted spectrum for existing</td>
<td>third in our quantitative and second in the qualitative market research compared to other services.</td>
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<td>local television operators.</td>
<td>However, our modelling work has suggested that the amount of economic value associated with both local television and rival services for the digital</td>
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<td>dividend is very uncertain. It is also uncertain whether or not local television is the most economically valuable use for the spectrum.</td>
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<tr>
<td>The Community TV Trust was unconvinced by our economic modelling arguments</td>
<td>Social value is difficult to quantify. Throughout the DDR we have expended considerable effort in collecting evidence, undertaking research and using</td>
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<tr>
<td>because it felt that it is difficult to quantify social value. Six TV thought</td>
<td>extensive economic modelling estimate social value. Reserving spectrum for local television would not help improve its business case given our strong</td>
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<tr>
<td>that it would not be helpful to try to quantify citizenship benefits of local</td>
<td>presumption in favour of operators facing the opportunity cost of their use. We believe that it is likely that a failure by local television to acquire</td>
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<tr>
<td>television in monetary terms because these benefits would not be delivered</td>
<td>spectrum at auction would be due to that challenging business case.</td>
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<tr>
<td>without access to DTT.</td>
<td>Our framework considers the incremental benefits that the digital dividend could bring to all services. Therefore, we have taken into account alternative</td>
</tr>
<tr>
<td>Some respondents said that distinction should be made between services such</td>
<td>delivery platforms (for local television and HD—Internet and satellite and cable) but also alternative spectrum bands such as 900 MHz.</td>
</tr>
<tr>
<td>as local television and HD which can only use UHF bands IV and V and others</td>
<td>Many respondents argued that the social value of local television would not be reflected in commercial willingness to pay. Community media would be</td>
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<tr>
<td>such as mobile communications, which can use many different spectrum</td>
<td>unable to compete in an auction because a) there is insufficient time to find appropriate funding before the auction, and b) public funding is often</td>
</tr>
<tr>
<td>frequencies. Some broadcasters considered that it would be hard to justify</td>
<td>short term, retrospective and difficult to quantify in advance. These difficulties would likely lead to market failure.</td>
</tr>
<tr>
<td>reserving spectrum for local television and not for HD television on a social</td>
<td>We believe that if community media is unable to acquire spectrum at auction it should be able to acquire spectrum through secondary trading or via a</td>
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<tr>
<td>value basis, because they suggest consumers have little appreciation of local</td>
<td>band manager selected by us. The band manager will manage and allocate the remaining interleaved spectrum after the auction process has been completed.</td>
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<tr>
<td>television compared to HD television.</td>
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<tr>
<td>Issue raised</td>
<td>Our response</td>
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<tr>
<td>Spectrum assigned for local television should not be tradable (outside this use), as the social value that such a service would bring would be lost.</td>
<td>We will package interleaved spectrum in around 25 locations suitable for, but not restricted to local television. This is consistent with our high level strategy to release spectrum on a service and technology neutral basis. As set out in section 7, restricting the use of spectrum to a particular service affects the future flexibility of the spectrum which can ultimately result in inefficient future use. Even if the spectrum is tradable users will not be required to trade their spectrum. We believe that to restrict spectrum to a particular use risks inefficient spectrum use now and in the future.</td>
</tr>
<tr>
<td>Spectrum could be better used for other important services (such as HD television).</td>
<td>As stated above, we do not favour one use over the other. We are making local television suitable packages available because we have identified that local television operators face a coordination type market failure. However, we are not restricting the use of these packages to local television. Hence, if there are other higher value uses of interleaved spectrum (such as HD television) they will have the opportunity to acquire the spectrum. Having said this, there may be more interest in using cleared rather than interleaved spectrum for HD services.</td>
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</table>

**Demand for local television**

<p>| Some stakeholders claimed there was no real demand for local television and even if there was, this could be better delivered via national broadcasters or other platforms, particularly the Internet. One respondent in particular urged us to be cautious given previous unsuccessful attempts at providing local television. In contrast, a number of other citizen/consumer groups felt that satellite and Internet provision of local television would prove too costly for most local television operators. | We have further developed our local television proposals. We believe that for a variety of reasons it is not appropriate to reserve spectrum for local television, not least because of existing options for delivering local television via other platforms. Our analysis of this issue is discussed in section 7. However, our evidence shows that there may be high value in the digital dividend providing a platform for local television. As a result, we will ensure that the packaging of the spectrum allows this use, as well as the other potential high value uses. |
| Arqiva was sceptical about demand for local television but suggested that it could be a viable use of interleaved spectrum if operators shared networked programming and administrative costs across a quasi national range of commonly branded local stations. | We note that a city based television model, as suggested by Arqiva, may be a viable option for commercial local television operators. |
| Spectrum should only be made available in areas where there is demand for local television. | This is consistent with our approach. We have carried out further analysis to determine where there is likely to be demand for local television (see section 8 of the statement in which we set out our indicative list of 25 sites). We will consult further in spring 2008 on the key areas identified and in particular whether this list requires further additions (or subtractions). |</p>
<table>
<thead>
<tr>
<th>Issue raised</th>
<th>Our response</th>
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<tbody>
<tr>
<td><strong>Licence obligations</strong></td>
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<tr>
<td>To ensure that local television content is diverse and representative, licence conditions which oblige the delivery of social value should be required. They thought that such conditions could, for example, be used to help the public better engage with Government.</td>
<td>We do not consider that licence obligations will ensure that local television provides social value to viewers. Such conditions are contrary to using market mechanisms for spectrum management.</td>
</tr>
<tr>
<td>It was also suggested that ‘must offer’ conditions be attached to licences to ensure provision of local television services.</td>
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<tr>
<td>The BBC should be prevented from rolling out local television.</td>
<td>If the BBC was to consider introducing any new local television services, this would require a Public Value Test under the BBC Charter and we would be required to conduct a Market Impact Assessment. The BBC Trust would take these assessments into account in deciding whether to approve the service.</td>
</tr>
<tr>
<td><strong>Auction approach</strong></td>
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<tr>
<td>A market based approach is contrary to our duties to citizens and consumers.</td>
<td>We believe that subject to certain safeguards, a market based approach would lead to the optimum outcome for citizens and consumers—see sections 5 and 7 and annex 2 concerning options for intervention for further information.</td>
</tr>
<tr>
<td>Spectrum auction for local television would not achieve our objective of maximising spectrum efficiency if delivered over a multifrequency network (MFN) (and proposal could not work over SFN).</td>
<td>We propose to auction spectrum using a technology neutral approach within the constraints of existing arrangements such as the use of MFN for terrestrial broadcasting. We consider, aside from other effects, that optimal use of spectrum is best secured through this approach. Given the existing arrangements, we have said that local television might find best application in the interleaved spectrum using an MFN network. We note that it is also open to local television providers to purchase cleared spectrum or enter into arrangements with existing multiplex providers for carriage of channels.</td>
</tr>
<tr>
<td>We should offer the interleaved spectrum to the market after the main DDR award of cleared spectrum to minimise delay risks given the complexity of accommodating potential uses in interleaved spectrum.</td>
<td>See section 9 concerning the timing of the awards. This is something that we will be looking at in more detail in our next consultations to be issued in spring 2008. We note that awarding interleaved spectrum after a cleared spectrum award represents a real risk to existing RSLs and imports an element of uncertainty to other uses of interleaved spectrum, for example PMSE users.</td>
</tr>
<tr>
<td>Some respondents suggested that we should award the spectrum by beauty contest, selecting the highest bidder from satisfactory proposals (e.g. those demonstrating social value).</td>
<td>We do not believe that there is a strong enough case for awarding local television type assignments by beauty contest. We recognise that local television operators face coordination issues that preclude them from taking part in a UK wide auction, but we believe that our packaging proposals will address this issue. Our conclusions are discussed in sections 7 and 8 of the statement.</td>
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<td>Issue raised</td>
<td>Our response</td>
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<tr>
<td>The local television industry may not be able to coordinate bids without assistance.</td>
<td>We agree that local television operators may face additional transaction costs from acquiring spectrum for local television. Therefore we proposed to make spectrum available on a geographic basis. This will allow local television operators to acquire spectrum in a given location without having to coordinate their bid with other local television operators. See section 5 on social value for more information.</td>
</tr>
<tr>
<td>Our Advisory Committee for Scotland felt that it was unlikely that public agencies would be able to bid for spectrum on behalf of local television operators.</td>
<td>Public agencies will have to consider whether they need to make funding available for local television purposes based on their own spending priorities.</td>
</tr>
<tr>
<td>Packaging and local television suitable assignments</td>
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<tr>
<td>Packaging should not preclude the possibility of deploying other services in this spectrum.</td>
<td>These comments are entirely consistent with our proposals.</td>
</tr>
<tr>
<td>Packaging of geographic, in-group frequencies suitable for local television.</td>
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<tr>
<td>Using interleaved spectrum for local television is inefficient because services cannot be received in one third of areas (e.g. LS Telecom study). Main transmitter relays would not be universally available in many target communities in the appropriate aerial group.</td>
<td>Our research shows that there is at least one available frequency at each of the main transmitter sites. In most cases, at least two are available, and we have selected (where available) those which maximise coverage.</td>
</tr>
<tr>
<td>Further research is needed for potential bidders to help provide an accurate assessment of the potential coverage and reach of each packaged assignment, availability of space on existing masts and potential to offer targeted coverage.</td>
<td>We have commissioned further research and have published the findings along with this statement (see annex 9 for a summary of the findings and links to full reports). These include available channels, coverage patterns, and coverage maps for the one channel identified with maximum coverage.</td>
</tr>
<tr>
<td>Interleaved frequencies should be packaged to reflect addressable local communities rather than locations of individual transmitters. North West TV requested that we consider offering packages which would cover a whole city, where necessary including assignments at more than one transmitter. This would provide for viewers’ aerials within a particular locality which point at different transmitters.</td>
<td>It is not our role to ascertain availability of space on existing masts. It would be costly, time consuming and not in keeping with our approach and responsibilities for spectrum management if we commissioned planners to identify frequencies for every local community. A local community can be defined in a number of ways, for a variety of reasons and is not subject to fixed and static boundaries. However our technical work was commissioned to identify all available channels and coverage patterns by transmission site which will help to inform potential bidders. Individual channels will be awarded which can be aggregated to cover a range of differing levels: whole city, region, nation and near UK wide.</td>
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<tr>
<td>Issue raised</td>
<td>Our response</td>
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<tr>
<td>The packaging size for channels should be smaller to ensure viability of a local television proposal.</td>
<td>Smaller spectrum packages could possibly be made available after the award via the band manager.</td>
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<tr>
<td>Important to include relay sites in the proposed packages to ensure coverage in certain areas.</td>
<td>Where appropriate, we will consider packaging relay sites along with main transmitter sites.</td>
</tr>
<tr>
<td>The number of sites that should be included in our proposed local television suitable packages ranged from 40 to 100 (there was considerable debate on this point). Some respondents felt that further work was needed to determine the appropriate number of sites.</td>
<td>After careful analysis of the responses and further technical research, we have concluded that around 25 sites would be commercially viable (see section 8 for list of likely sites). We will consult further in spring 2008 on the exact number and location of sites, but we plan to make assignments available to cover at least the main urban areas and existing RSL locations. We propose to request information regarding demand for additional sites not in this main list. Local television operators may also be able to acquire additional spectrum packages through the band manager.</td>
</tr>
<tr>
<td>Some respondents noted the risk that operators could use local television assignments to form a quasi-UK multiplex for further DTT services, and these would offer less public service value than local television.</td>
<td>It is not clear that intervention to prevent a quasi-UK multiplex operator entering the market would result in higher social benefits. While local television appears to generate high BSV, so too do additional national or near national SD channels. Where feasible we will make two DTT type assignments available in the nominated locations, which could facilitate local television and quasi-UK wide services to coexist.</td>
</tr>
<tr>
<td>Further research needed on availability of assignments and award options (suggest sealed bid, non combinatorial approach).</td>
<td>We will investigate the options concerning the auction design in our next consultation to be published in spring 2008.</td>
</tr>
<tr>
<td><strong>Interference concerns</strong></td>
<td></td>
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<tr>
<td>Spectrum should be reserved for certain services to avoid interference and to limit the need for guard bands in a technology neutral but not a service neutral allocation mechanism.</td>
<td>We have carried out further technical analysis work on the compatibility between different potential service types. Results indicate that a guard band may be required to limit interference between some services and networks with different transmitter densities. In the next phase of the DDR, we will continue to consider the impact of our research on the design of the award to achieve the most efficient outcome. One of many award design options is to allow similar types of technologies/networks to be adjacent users of spectrum.</td>
</tr>
<tr>
<td>Local television transmitters should be co-sited with existing masts, to help avoid adjacent channel interference.</td>
<td>We do not propose to mandate where assignments will be made and will define emission requirements to minimise interference. We will consult further on this in spring 2008.</td>
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<td>Issue raised</td>
<td>Our response</td>
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<tr>
<td>Concerns were raised about co-channel interference to DSO reception from local television assignments. Rules defining protection for main DTT services should be used, making better use of the advantages of converting to digital for relay stations through rechannelling. It believed that these measures would redefine the spectrum available.</td>
<td>Our technical research suggested that sub UK multiplexes can be integrated with very minimal impact on existing DTT services. We will ensure existing services such as DTT are protected from interference by local television packages. Further work on the design and packaging of the award will feature in the next phase of DDR work.</td>
</tr>
<tr>
<td>PMSE users called for greater clarity on how they would share interleaved spectrum with local television. As existing users, it is crucial to address their concerns before enabling new uses. Some respondents went further by preferring that no special provision be made for local television. Others suggested we should consider assigning management for coexistence of PMSE and local television in interleaved spectrum, to ensure optimal coexistence and to manage interference.</td>
<td>We are carrying out technical analysis to determine interference parameters for all spectrum licences awarded. We will ensure existing services such as PMSE are protected from interference by local television packages. We will appoint a band manager, who will assign spectrum for a range of uses after the auction of some local television suitable spectrum.</td>
</tr>
<tr>
<td>Add/drop</td>
<td>We believe that reserving DTT capacity for local television would not provide optimum use of the spectrum because it would prevent access for other services and may not be utilised in all areas. Broadcasters could still utilise add/drop technology by acquiring a multiplex at auction. Securing capacity on an existing DTT multiplex is also an option already available to operators subject to commercial negotiations.</td>
</tr>
<tr>
<td>Direct subsidies are unlikely to guarantee local television and state buy back of spectrum auctioned by us would not be appropriate.</td>
<td>We are looking at ways to facilitate the funding process for local television services. However, we do not consider that subsidised access to spectrum would guarantee local television. We believe that the level of subsidy is a question for public funding bodies and that if there is a compelling requirement for local television, then this should be reflected in the level of subsidy allocated by the public funding body. This approach has been endorsed by the government in its response to the Cave audit.</td>
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<tr>
<th>Issue raised</th>
<th>Our response</th>
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<tr>
<td>Oppose local television suitable auctions on technical grounds because of the difficulties for operators to provide EPG data.</td>
<td>We have been in discussions with network operators and broadcasters regarding this issue. We believe that there is no fundamental problem with including local television services on the EPG. However the details of how this would be done remain to be clarified.</td>
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<tr>
<td>Public bodies raised a number of regional and national concerns. The Welsh Assembly felt that coverage limitations for use of the interleaved spectrum in Wales should be clearly explained to local television operators. The Scottish Executive felt that rural areas may be less likely to have adequate broadband provision so there may be a role for local television in these areas. The Communications Commission of the Isle of Man advocated specific local television proposals for the Isle of Man.</td>
<td>We believe that regional or national coverage of local television services could be met via aggregation, and/or via other platforms and/or through the band manager if local television operators are unsuccessful or unable to bid at auction. Provisions for the Isle of Man have been discussed in the statement.</td>
</tr>
<tr>
<td>A number of local television operators were concerned about whether our proposals were consistent with our statutory duties; to ensure availability of a wide range of television and radio services and to have regard to different interests of persons in different parts of the UK.</td>
<td>We discuss how our approach to the DDR meets our statutory duties in section 4 of this statement.</td>
</tr>
<tr>
<td>EU planning suggests that the digital dividend should be reserved for broadcasting purposes and therefore there is a danger proposals could be challenged by the EU.</td>
<td>We are continuing to work closely in the EU to develop proposals for the digital dividend. There has been no requirement to return this spectrum for broadcasting purposes. In fact, the Commission’s Communication on the digital dividend stated that the spectrum should permit alternative uses.</td>
</tr>
<tr>
<td>Some respondents suggested that under these proposals households would need to purchase new aerials in order to receive local television.</td>
<td>We will offer, where possible, spectrum packages that are in-group and compatible with existing aerials in each location.</td>
</tr>
<tr>
<td>Some respondents requested us to look at ITV’s failings to carry out its duties to provide local content before we allocate valuable spectrum for this additional use.</td>
<td>We are addressing this as part of our second PSB Review during 2008.</td>
</tr>
<tr>
<td>An innovation reserve could help support pilot local television stations.</td>
<td>We have decided not to hold any spectrum back in an innovation reserve (refer to section 6 for our discussion of an innovation reserve). However we have agreed to vary existing RSL licences and to issue short term event RSLs for digital transmissions where it is legally and technically feasible to do so.</td>
</tr>
<tr>
<td>Importance of ensuring international coordination of frequencies. Particularly essential for Northern Ireland.</td>
<td>This is an ongoing issue for us and we continue to work with our international partners on this matter.</td>
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### Digital Dividend Review: annexes to the statement on our approach to awarding the digital dividend

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<th>Issue raised</th>
<th>Our response</th>
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<td>Microsoft maintained that making the interleaved spectrum available for licence exempt applications would future proof local multimedia services more efficiently than via the DVB-T broadcast model.</td>
<td>We will permit licence exempt access to interleaved spectrum for cognitive technologies subject to establishing no harmful interference for licensed users. We would achieve this by specifying a number of parameters to which equipment would need to adhere. It may take some years to undertake the work necessary to enable certification of equipment and gain appropriate international harmonisation.</td>
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### DTT services (covering SD and HD services)

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<th>Issue raised</th>
<th>Our response</th>
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<td>General approach</td>
<td>We discuss our approach to how the DDR has taken account of our statutory duties in section 4. However, we note the DDR is not the only way we can ensure these objectives are met; there is already a wide range of television and radio services available as a result of the Government reserving two thirds of the spectrum presently used for analogue television for DTT. In any case, an opportunity which allows us to further both duties has arisen separately and is discussed in our consultation document the future of DTT published in November 2007.</td>
</tr>
<tr>
<td>The market has changed on HD</td>
<td>We stand by the results of both our 2006 and 2007 research, both of which returned consistent results on HD. Our 2007 market research demonstrates that of all the different channels sought by consumers, the five main PSB channels in HD come relatively low in their priorities (after other SD services for films, and light entertainment channels, particularly those like the PSB services). The future of DTT consultation looks at upgrading the DTT platform with new technologies to enable an increase in capacity for new services, which may include new HD channels. Looking forward, if HD becomes the standard mode of broadcast for PSB content, then we would expect the DTT platform to continue to evolve through the technology upgrades outlined in that consultation.</td>
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<td>The market research we undertook was flawed because it is out of date and did not demonstrate services—particularly with regards to HD.</td>
<td>We undertook further market research during 2007 which took on board criticisms and comments received from stakeholders. In particular, we held five day long deliberative workshops where HD services were demonstrated. These results have shown to be broadly consistent with our 2006 research.</td>
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<td>Issue raised</td>
<td>Our response</td>
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<td>There is strong evidence that consumers want HD, that they want the PSBs in HD, and on free to air DTT. Although other respondents acknowledged that we were not yet at the tipping point for public demand for HD. Research shows people expect HD to be available after DSO: - of customers with HD ready televisions, 45% said satisfaction with Freeview would decrease significantly if HD was not available (satisfaction currently 94%) - 59% expect the platform to keep up with majority of technological advances offered by cable/satellite (nearly 50% for those currently without digital equipment). - 55% of Freeview customers expect HD on DTT post DSO (no HD demo, rising to 75% of those who own HD ready televisions) - HD on Freeview preferred to more/new or local television channels - 66% did not want to swap existing services for HD, including non PSB content - Age or class made little difference</td>
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<td>Our market research does not provide strong evidence for the claims that demand for HD content on DTT is very strong, although we note that demand may change over time. Consumers valued additional SD more than HD channels, and certainly noted the benefits of other uses of the digital dividend over HD. Our market research is the most comprehensive research done to date, and one of few which asks consumers to trade off different potential uses against each other. We believe that this may account for the difference between our results and the research undertaken, or referred to, by stakeholders; its not that consumers do not value HD, but that other services are more important personally and to society (i.e. more SD channels, local television and better mobile services rank more highly).</td>
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<td>ICM research in Feb07 shows (a) up to 81% of purchasers/intended purchasers of HD ready televisions planned to use them to view HD content, (b) awareness of HD at 92% (awareness of DSO only 84%); (c) 43% expect to watch HD on DTT, 50% on satellite and 37% on cable.</td>
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<td>Social value of DTT services</td>
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<td>Other uses of the digital dividend (e.g. rural broadband) have higher social benefits (than more DTT services).</td>
<td>Our market research shows that extra SD channels on DTT have high social value, but at around the same level as better mobile coverage and mobile broadband services and local television services. Our assessment on whether intervention is needed for any of these services is shown in sections 5 and 7 and annex 2.</td>
</tr>
<tr>
<td>Should reserve a DTT multiplex for socially valuable services; DTT is highly important for the socially excluded. Request for reservation of spectrum for access services (sign language channel, audio descriptions).</td>
<td>We believe that spectrum capacity and resources to gain access to multiplex capacity already exist, so it is not appropriate to intervene at the spectrum level. Socially valuable channels will be considered as part of the PSB Review. We will also package interleaved spectrum in a way suitable for local television use; this spectrum may be used to deliver socially valuable content. Our strategy to enable a technological upgrade to existing DTT multiplexes will allow capacity to be freed up on the platform for HD but also additional SD services – increasing over time.</td>
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<td>Issue raised</td>
<td>Our response</td>
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<td>Where potential uses of spectrum likely to be of broad value to society are identified, we should give further consideration to prioritising that use. HD has widest value to society. Suggests offering bidder credits in return for licence conditions covering rollout milestones, minimum hours of HD television broadcasting.</td>
<td>Our evidence does not support the conclusion that HD has widest value to society, and therefore we do not consider it appropriate to intervene to reserve spectrum for HD television. We have looked carefully at the range of intervention options for securing value to society (these are discussed in section 5 and annex 2). We note that direct funding is the preferred intervention option for securing BSV.</td>
</tr>
<tr>
<td>DTT is particularly susceptible to hoarding.</td>
<td>We will be consulting further on non technical licence conditions and specifically set out our analysis of hoarding and other effects of competition in the next phase of DDR work to be published in spring 2008 (see section 10 on competition for further information).</td>
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**Future of the DTT platform**

| Consumers have invested in DTT and are paying for DSO (through equipment and licence fee). | More than two thirds of the spectrum resulting from DSO has already been reserved for DTT. Consumers are greatly benefiting through DSO through improved coverage (increasing to 98.5% of the UK for services carried on the three core PSB multiplexes) and access to a wider range of television services. |
| There are no spectrum alternatives to the digital dividend for broadcasting, therefore should ring fence spectrum. To not allocate to HD now is an irreversible decision for at least a generation. | Our current consultation on the future of DTT provides a credible alternative to reserving additional spectrum for new DTT services. Through upgrading the technologies used on the existing multiplexes, the total capacity available on the platform could in time, increase by up to 160% enabling a large number of new services to be delivered in the long term, including HD. Our immediate proposals enable up to four HD (or 20 SD) services by 2012, in time for the London Olympics and in advance of DTT services that could be made available through gifting the digital dividend. We are working closely with the broadcasters to implement this proposal by late 2009/early 2010 at end of DSO in Granada. |
| Ensuring continuing viability of the DTT platform as competitive against others (cable/satellite) is important as otherwise it may undermine DSO – a key government objective. | Our proposals to upgrade the multiplexes will enable new services to be delivered which will help the DTT platform to maintain a competitive level of services (including enabling new entrants over time). The potential for our decisions to impact on the DTT platform is discussed in section 7 and annex 2. The proposals also take account of the potential impact on DSO (see annex 5). |
### Issue raised

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<tr>
<th>Without HD, Freeview (the platform of choice for more than ten million homes) will be a second class television service.</th>
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<tr>
<td>We have considered the impact of our decisions on the DTT platform in section 7 and annex 5. We do not think that the case to intervene to reserve spectrum for HD services has been made. Our detailed assessment is made in annex 2. Additionally, the digital dividend is not the only option for HD on DTT. Our multiplex reorganisation proposals on which we are currently consulting (as explained above) could enable HD services to be available on the DTT platform as early as late 2009 in Granada (three services then, rising to four in 2012 and possibly five in 2015). Over time, other DTT multiplexes could upgrade enabling further new services to be provided (see section 7).</td>
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<tr>
<th>Additional spectrum should be reserved to ensure 98.5% UK coverage of the DTT platform for all multiplexes.</th>
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<tr>
<td>All PSB multiplexes will have 98.5% coverage at DSO, while the three COM multiplexes will increase from the current level of 73% to 90%. We note that current coverage levels are not a result of a lack of spectrum. We would welcome any proposals from the COM multiplex operators to increase the coverage of their multiplexes, but we note that this will be a commercial decision for those multiplex operators to take.</td>
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<th>Many respondents from across a wide range of stakeholders did not agree with our conclusion that five HD channels could be possible on the existing DTT platform.</th>
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<td>We have been working closely with the PSBs throughout the year and have recently issued a consultation which outlines how five HD channels can be achieved (by 2015).</td>
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### Future of broadcasting is HD

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<tr>
<th>HD is the future (similar to the black and white move to colour) and a global development, so it is important to ensure the UK is not left behind. Without HD the platform will become less attractive and lose viewers, It is more than just a broadcasting technology—also used for gaming consoles, camcorders and DVD—so consumers are getting used to the high quality.</th>
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<tr>
<td>We believe our proposals to package spectrum in a way suitable for a UK wide DTT multiplex is sufficient and there is no need to further intervene in the award for HD. We consider the potential for our decisions to have a negative impact on the DTT platform in section 7 and annex 2. In addition our proposals to upgrade the multiplexes will provide the opportunity for an HD future on the DTT platform—see section 7. For example, technological advances will drive the opportunity to make use of existing capacity for a new format (e.g. HD).</td>
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<tr>
<th>HD on DTT is just a consumer benefit—simply an upgrade in picture quality.</th>
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<td>Our market research supports this view, showing that in comparison to other uses of the digital dividend, consumers consider HD to be a luxury and not a necessity.</td>
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<tr>
<th>Important for HD to be available free to air, and not only under subscription. Respondents (particularly individuals) did not want a subscription only HD future on Sky citing competition fears as the basis to intervene.</th>
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<tr>
<td>We agree that a competitive broadcasting industry provides the best outcome for consumers. Enabling HD services on the DTT platform is important in encouraging future competition. We believe the future of DTT consultation enables this to happen in advance of HD services that could be launched in the digital dividend.</td>
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<td>Issue raised</td>
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<td>Launch of HD services on DTT will serve as a positive impact on UK production of programming.</td>
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<td>A large majority of respondents asked us to reserve some or all of the digital dividend for PSB HD services. This was most frequently referenced as the reservation of a seventh multiplex using a ‘spend to save’ strategy (gift spectrum to broadcasters now to assist them to introduce HD on the DTT so they can use other efficiency gains from DSO to upgrade the platform in the long term. Broadcasters could return unused spectrum at a later date). However, others thought it was difficult to justify a public subsidy of gifted spectrum for HD, stating that to do so could damage UK consumers and international competitiveness.</td>
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<tr>
<td>To take advantage of more efficient technical standards (DVB-T2 and MPEG-4), additional spectrum will be needed to prepare for a second switchover from MPEG-2 to MPEG-4.</td>
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<tr>
<td>HD could be used as a strong driver in the take up of MPEG-4 reception equipment. Could begin a natural replacement cycle by installing MPEG-4 decoders in all STBs as well as giving certainty to manufacturers.</td>
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<tr>
<td>Uncertainty about uptake of HD and its level of demand makes reservation of spectrum for it inappropriate.</td>
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<tr>
<td>Reserving spectrum which confines other uses/users not supported, particularly for widening services for rural areas.</td>
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## Issue raised

| Costs and funding likely to lead PSBs to replace some SD services with HD simulcasts if new spectrum not provided. |
| We do not believe that replacing SD services with HD services is required or a strong possibility given the PSBs support for our proposals to upgrade the multiplexes, as described in the future of DTT consultation. In any capacity created for new services, our proposals seek to ensure that benefits for consumers are at the forefront of decision making by requesting evidence that new services will contribute to the interests of PSB. However, consumer tastes may change over time and should PSBs propose to replace SD services with HD simulcasts, we would consider the proposals very carefully, with a view to ensuring that the range and quality of services on the platform would not be unduly diminished as a result. |

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<tr>
<th>Alternative platform delivery</th>
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<tr>
<td>DTT is not the optimum solution in terms of cost, coverage, energy use and spectral efficiency. UHF satellite broadcasts could do this (available now, free to air, and 99% coverage).</td>
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<tr>
<td>We agree that there are alternative ways of introducing additional broadcasting, including HD, to the UK and that satellite is one platform for this, as well as cable and broadband. We support a competitive broadcasting industry in the UK with universal coverage being a very desirable element of any new services.</td>
</tr>
<tr>
<td>Broadband is not a substitute for the digital dividend and Freesat not as ubiquitous as claimed.</td>
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<tr>
<td>We are pleased that plans to proceed with launch of PSB HD services on Freesat are proceeding; agreement from the BBC Trust for a BBC service has now been given. Freesat is now emerging as an additional delivery mechanism choice for consumers. On-demand broadcasting is growing in popularity as an alternative delivery mechanism, although we note that delivery of some television services via broadband remains difficult at current access speeds. While broadband may not be a full substitute for UHF bands IV and V in the delivery of broadcasting services, it is certainly an attractive complement which can add significantly to the suite of services available to consumers and citizens—as is Freesat, and other broadcasting platforms such as cable and satellite.</td>
</tr>
<tr>
<td>It is difficult to predict the broadcasting model post 2012; television is now available on a variety of platforms, with people choosing what, how and when they watch it</td>
</tr>
<tr>
<td>We agree that the present broadcasting model is changing. Any intervention to support the traditional model, beyond our current proposals to enable more efficient use of the DTT platform, may result in a regulatory failure.</td>
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</table>
### Issue raised | Our response
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**Other issues** |  
We need to make consequences of an auction approach clear to consumers in readiness for DSO. | We and Digital UK continue to work closely together in communicating the changes that will come with DSO across the UK. We believe that new uses of the digital dividend will bring a range of benefits to consumers and this is at the forefront of our strategic approach. We will ensure our final decisions on the DDR are communicated clearly to consumers.  
Important to ensure DTT services can use this spectrum but need to see in context of whole market for broadband distribution systems. | Our approach to the digital dividend award permits DTT use but does not exclude other uses of the spectrum. Beyond the spectrum that has already been reserved for DTT, we believe it is appropriate for the market to decide appropriate distribution systems for broadcasting and support innovative approaches which encourage new entrants.  
PSBs have no ability to compete in an auction for spectrum. HD is an example of a service’s total value being disproportionately large compared with the willingness to pay. | Our consideration of PSBs ability to access funding for additional spectrum is dealt with in section 7 and annex 2.  
Need to give consideration to cross border packaging issues which allow for integrated DTT (e.g. all Ireland services). | We are considering the detail of packaging design in the next phase of DDR work. We aim to publish our proposals in a consultation in spring 2008. We will take account of cross border issues as part of this work.  
O2 noted the inconsistent approach taken with DTT vs DAB multiplexes. | The Broadcasting Act 1996 specifies the maximum data requirements which may be carried on DAB and DTT multiplexes; these were set at 10%. It is open to the Secretary of State to amend these requirements by Order, which has been done with DAB multiplexes which now permit up to 30%. |

### Two way mobile services

### Issue raised | Our response
---|---
Precluding mobile broadband from the digital dividend |  
The majority of individuals (two thirds) disagreed with our proposal and thought we should preclude mobile broadband use; for the most part because they thought the spectrum should be reserved for other uses (e.g. HD television or PMSE). Mobile telephone companies already have enough or too much spectrum and should therefore be restricted from bidding. | As discussed in sections 5 and 7 of this statement, we do not intend to reserve spectrum for DTT and therefore does not believe that this is a valid reason to preclude mobile broadband. While we are making provision for continued PMSE access to the spectrum, we also do not intend that this provision should preclude other technologies, including mobile broadband, from bidding for some of the interleaved spectrum.  
Other individuals and most organisations agreed that mobile broadband use should not be precluded but no further action was required to reserve spectrum for this use. | Our reassessment shows that there is significant evidence of BSV for mobile services, however we think it is unlikely that lack of intervention will lead
## Issue raised

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<tr>
<td>The Scottish Executive, the Welsh Assembly Government, ACOD and MPs who responded felt there was a strong case to reserve spectrum for mobile broadband use—to correct fixed broadband coverage gaps (e.g. in rural areas), or for wireless/mobile broadband use.</td>
<td>To a risk of market failure (e.g. there are sufficient incentives for mobile operators to rollout networks without the need for intervention). We also note the consultation on the liberalisation of 900 MHz spectrum, which will widen effective coverage at low cost. We believe that if commercial incentives were to diverge from social value in relation to mobile broadband, the most effective intervention is not at the spectrum layer but rather local funding to extend geographical coverage.</td>
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<tr>
<td>Some community based organisations supported reserving some spectrum for community broadband networks.</td>
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<td>Some local television organisations noted that mobile broadband could be used to deliver community/local television services.</td>
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### Interference issues

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<th>Issue raised</th>
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<tr>
<td>The potential for interference to DTT from mobile uplinks was noted by multiplex operators, broadcasters and others with a broadcasting interest. Mobile network operators encouraged us to do more technical work to investigate the likelihood of this interference, and seek solutions where possible.</td>
<td>We have undertaken further technical work to look specifically at the likelihood of interference to DTT by mobile uplinks. The results of this technical work are described in detail in the technical report published alongside this statement. The work shows that operation of mobile transmitters is feasible in cleared spectrum subject to appropriate technical conditions. We plan to undertake further technical work to establish licence conditions, potentially including spectrum usage rights, which would be suitable for a wide range of uses including two way mobile applications in the digital dividend. See annex 9 for further details of technical reports. We will publish our results in spring 2008.</td>
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</tbody>
</table>

### Use of other frequency bands

<table>
<thead>
<tr>
<th>Issue raised</th>
<th>Our response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respondents across all interests stated that mobile broadband is able to use other spectrum and mobile telephone companies already have sufficient access to spectrum, so should be restricted from bidding for the digital dividend.</td>
<td>We recognise that other spectrum is available for use by mobile broadband. However, as detailed in our update on technical work (a list of reports can be found at annex 9), UHF bands IV and V substantially reduce the cost of infrastructure to provide mobile broadband services to rural areas and built up areas compared with higher frequency bands, even after interference constraints are taken into account. These advantages are even larger at higher data rates. We would tend to agree that the digital dividend is not a direct substitute for 900 MHz, but is comparable to it in physical properties and reduces the number of sites required substantially compared with other higher frequency bands. The 900 MHz band alone is unlikely to be sufficient to support next generation mobile broadband services beyond 3G if substantial demand for such services emerges.</td>
</tr>
<tr>
<td>Mobile network operators argued that the digital dividend is particularly well suited for mobile broadband, especially in rural areas due to favourable propagation characteristics, and because of this, introduction would be cost effective in these areas (which could be passed on to citizens). They stated that we have a ‘huge opportunity’ to use the digital dividend to ensure there is no digital divide. There were concerns that there may not be enough capacity in the 900 MHz band. They also noted the environmental benefits of using this spectrum, with far fewer masts required, thereby limiting the concerns of local communities over site building.</td>
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</tbody>
</table>
## Digital Dividend Review: annexes to the statement on our approach to awarding the digital dividend

<table>
<thead>
<tr>
<th>Issue raised</th>
<th>Our response</th>
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<tbody>
<tr>
<td>One respondent argued that using the digital dividend to cover the digital divide was a short term solution because, in the long run, high data rates would be important and other frequency bands were better suited to provide this. It was suggested that the high infrastructure cost for these bands could be mitigated by mobile companies sharing infrastructure.</td>
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</table>

### Harmonisation

Telecoms network operators, manufacturers and the UMTS Forum noted that the cost savings and environmental benefits arising from the use of the digital dividend are to a large extent dependent on European and/or international harmonisation of at least part of the band. T-Mobile suggested a sub band of at least 100 MHz was needed. Most of the major operators did not think our analysis took sufficient account of the benefits of international harmonisation and called for us to actively pursue a pan European sub band of UHF bands IV and V which could support mobile broadband. They also called on us to support the development of a European Common Proposal for a co-primary mobile service allocation in the band 470-862 MHz at WRC-07. They point out that harmonised spectrum is extremely important for cellular mobile communications in order to minimise interference, ensure ability of terminals to roam and provide economies of scale for terminal and infrastructure manufacturers. |

We have been closely involved in the work of TG4 during 2007. See our summary in section 3.

### Licence exemption

Licence exempt use of the digital dividend for mobile broadband was supported. Open Spectrum UK called for the reallocation of at least 24 MHz of fully cleared spectrum for high speed internet access on a UK wide licence exempt basis, with a higher power allowance in rural areas. They argued that DSL alone cannot solve the digital divide and that it is not necessarily the most cost effective solution. They noted the development of an open global standard (IEEE 802.22) for licence exempt broadband equipment in interleaved television spectrum.

As discussed in section 6, it seems very unlikely that the advantages that would be gained by setting aside cleared spectrum for licence exempt applications would exceed that of using it for licensed applications. Hence we conclude that cleared spectrum should not be set aside for licence exempt applications. Cleared spectrum is in great demand from licensed uses and as such carries a high opportunity cost. Our proposals to allow cognitive access to the interleaved spectrum (with a greater prospect of harmonisation) are likely to realise most of the benefits of licence exempt use in the digital dividend, and there is likely to be little additional gain from setting aside cleared spectrum.
<table>
<thead>
<tr>
<th>Issue raised</th>
<th>Our response</th>
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<tbody>
<tr>
<td>CM Solutions also supported a licence exempt approach, although they felt that use of the digital dividend needed to be weighed against other possible spectrum that may be appropriate for this purpose.</td>
<td>We also note that several other bands are already available for licence exempt wireless broadband. For example, the 5.8 GHz band is available for broadband fixed wireless access systems. We recently approved an increase to the maximum power limit for systems in the 5.8 GHz band, from 2 to 4 Watts EIRP, and this could help to increase access to wireless broadband in rural areas. An ongoing consultation on amendments to the Wireless Telegraphy (Exemption) Regulations 2003 proposes the licence exemption of low power satellites in the 27.5-27.8185 GHz, 28.4545-28.8265 GHz and 29.4625-30 GHz bands. This may benefit consumers not served by conventional terrestrial networks such as those in some rural areas of the UK, enhancing the ability to deliver broadband and other services.</td>
</tr>
<tr>
<td>Microsoft favoured licence exemption and noted that services that may act as a substitute for mobile broadband or even DTT may emerge through the innovation fuelled by opening up the spectrum to low power licence exempt applications.</td>
<td>We also note that several other bands are already available for licence exempt wireless broadband. For example, the 5.8 GHz band is available for broadband fixed wireless access systems. We recently approved an increase to the maximum power limit for systems in the 5.8 GHz band, from 2 to 4 Watts EIRP, and this could help to increase access to wireless broadband in rural areas. An ongoing consultation on amendments to the Wireless Telegraphy (Exemption) Regulations 2003 proposes the licence exemption of low power satellites in the 27.5-27.8185 GHz, 28.4545-28.8265 GHz and 29.4625-30 GHz bands. This may benefit consumers not served by conventional terrestrial networks such as those in some rural areas of the UK, enhancing the ability to deliver broadband and other services.</td>
</tr>
<tr>
<td>Other issues</td>
<td></td>
</tr>
<tr>
<td>Licences should be awarded on a regional or sub regional basis to encourage smaller, alternative wireless/mobile broadband providers to bid for spectrum thus allowing known problem areas in a region to be geographically targeted.</td>
<td>We propose to auction assignments of interleaved spectrum in this way; suitable for, but not exclusive to local television. Alternative uses of these assignments could include wireless/mobile broadband. As explained in the DDR consultation document, we do not believe that splitting up cleared channels into regional assignments represents the best use of this valuable resource. The secondary market (via spectrum trading) potentially offers greater scope for regional use to emerge post award from a UK wide licence, than for UK wide use to emerge if regional licences were awarded to different parties.</td>
</tr>
<tr>
<td>Similarities from spectrum viewpoint of mobile broadband and mobile television therefore markets may need to be combined or bundled to make a return on spectrum related investments.</td>
<td>We note that two way mobile broadband services involve the provision of uplink transmissions in the same band as the downlink, whereas mobile television is predominantly one way and can use uplinks in other bands, so there is a distinction in spectrum requirements.</td>
</tr>
<tr>
<td>Consider all Ireland negotiations with ComReg to reach a shared understanding on the spectrum.</td>
<td>We are considering the detail of packaging design in the next phase of DDR work. We aim to publish our proposals in a consultation in spring 2008. We are discussing these issues with the Irish authorities and will take account of this in our work.</td>
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</table>
Annex 5

Impact assessment

Impact assessments are an important part of policy making

A5.1 The analysis presented in this annex represents an impact assessment, as defined in section 7 of the Communications Act.

A5.2 Impact assessments are a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy making. This is reflected in section 7 of the Communications Act, which means that generally we have to carry out impact assessments where our proposals are likely to have a significant effect on businesses or the general public or when there is a major change in our activities. But as a matter of policy, we are committed to carrying out and publishing impact assessments of the great majority of our policy decisions. For further information about our approach to impact assessments, see ‘Better policy making: Ofcom’s approach to impact assessment,’ available from www.ofcom.org.uk/consult/policy_making/guidelines.pdf.

This impact assessment extends previous analysis to incorporate new analysis and decisions

A5.3 We published an earlier impact assessment of our proposals in the DDR consultation document published on 19 December 2006.17 This impact assessment updates that analysis by incorporating new evidence and decisions. It starts by restating:

- our goals; and
- a summary of our earlier impact assessment.

A5.4 It then provides:

- a summary of the responses to our earlier impact assessment; and
- an updated cost/benefit analysis.

Our objective for the DDR is to maximise the total value to society that using the digital dividend generates over time

A5.5 The DDR statement considers how the spectrum released by DSO should be awarded for new uses. This is an important issue since the digital dividend could be used for a wide range of services generating substantial value for society.

A5.6 Our primary duties are to further the interests of citizens in relation to communications matters, and to further the interests of consumers, where appropriate by promoting competition.

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A5.7 Therefore, the potential benefits to citizens and consumers have been a focal point of our analysis. When deciding between competing policy options, we have been guided by the total value each one of them could generate for society. This includes the benefits for consumers, for producers and for citizens. Section 4 of the statement explains this total value framework. In order to assess the value associated with each option, we used many sources of evidence, including market research and responses to the DDR consultation document.

A5.8 We also have a number of other duties relevant to the DDR. These are to secure the optimal use of radio spectrum and to secure certain public policy aims in relation to broadcasting and electronic communications services (ECS).

A5.9 Awarding spectrum almost always involves trade-offs between different potential uses because demand almost always exceeds supply. Hence, in the optimal outcome, some uses may not gain access to spectrum because others generate higher value for society.

A5.10 Our starting point is that generally, the market is best placed to make these trade-offs and determine the optimal use of spectrum. When markets work efficiently, market players are better placed than the regulator to make decisions over the best use of spectrum and other resources. Market players are likely to have superior information and incentives, which is especially important when the total value of different uses is uncertain.

A5.11 However, we recognise that there may be circumstances in which the market would not result in the holding and exploitation of spectrum by the users and for the uses that generate maximum value to society over time. For the purposes of the DDR, we refer to this as a market failure.

A5.12 Therefore, a major part of the DDR has involved assessing:

- the risk that markets might fail;
- the availability of regulatory remedies to mitigate that risk; and
- the costs and benefits of those remedies, relative to the costs to society if the spectrum is not used optimally.

**Our earlier impact assessment favoured a market based approach**

A5.13 In our earlier impact assessment, we found that a market led approach offered a better cost/benefit trade off overall than the alternative, interventionist approach. We proposed the use of auctions as the main instrument for awarding the digital dividend.

A5.14 In addition, we found that certain specific measures were justified in the case of two services: PMSE and local television. PMSE users currently enjoy regulated access to the spectrum. We found that transitional measures between the current system and a market based approach were justified to avoid costly disruption. In the case of local television, we found that packaging the spectrum in a way that resolved the coordination difficulties faced by potential operators was also justified.
We listened to consultation responses and considered new evidence

A5.15 The DDR consultation document generated a large response from stakeholders. We also conducted new market research and further economic and technical analysis.

A5.16 We have reviewed and, where appropriate, changed our earlier impact assessment in two ways:

- in light of responses to the impact assessment itself; and
- in light of new evidence.

Some responses called for additional evidence to be included in our impact assessment

A5.17 There was a wide range of responses to our earlier impact assessment. Many views were linked to the analysis concerning a respondent’s specific sector of interest. We also received views on our analysis of the impact of the market led approach and on the overall scope of our analysis.

A5.18 Several broadcasters and many individuals advocated intervention to set aside some spectrum for DTT services in HD. There were three lines of argument:

- that this would benefit the UK economy;
- that this would meet the expectations of consumers who had bought HD ready television sets; and
- that this would safeguard the future of the DTT platform, thereby improving consumer choice.

A5.19 In particular, the BBC provided an assessment of the loss of value to society of failure to provide DTT services in HD, which was estimated to be in the order of £5bn-16bn.

A5.20 The BBC and many other responses were based on the assumption that without intervention, PSBs would be unable to offer DTT services in HD. In some cases, they stated that this was a spectrum issue as HD could not be offered within the spectrum already reserved for DTT. Sony and some individuals also argued that broadcasters in general and PSBs in particular, would not be able to fund competitive bids at auction.

A5.21 PMSE users believed that they would be unable to take part in any market based approach to spectrum access. They warned of disruption to the sector, with consequences for others (such as theatres and event organisers) that use PMSE as an input.

A5.22 PMSE users argued that there would be consequences for the entertainment industry and for voluntary and community organisations. They argued that the need for PMSE users to replace equipment should be taken into account.

A5.23 Intellect and other respondents, including OSAB, said the impact assessment ignored the consequences of European harmonisation and the economies of scale associated with it.
A5.24 Some respondents argued that the market led approach was not proved or should include criteria other than financial resources. Sony and others also mentioned that the impact assessment ignored the cost to industry of auction fees and auction inefficiencies.

A5.25 OSAB supported the general conclusions of the impact assessment but argued it was incomplete. It mentioned that there could be a wider range of services, particularly in the health and transport sectors, that could want to use the digital dividend.

A5.26 OSAB and other organisations also argued that the impact on UK competitiveness should be taken into account.

Our response

A5.27 Our research and analysis on DTT services in HD, conducted since the DDR consultation document was published, gives further support for our original assessment that there is no market failure justifying intervention. Section 7 explores this further.

A5.28 We also believe that the DTT platform is capable of delivering services in HD by making more efficient use of its existing spectrum. We took the first steps to ensure that capacity for carrying new services using existing spectrum (which could include DTT in HD) becomes available by publishing our future of DTT consultation document in November 2007.

A5.29 We have carefully studied responses from PMSE users to both the DDR consultation document and a further PMSE consultation document published on 20 June 2007. As a result of this and further analysis, we have changed our proposals. We remain of the view that PMSE users should move to a market based approach to spectrum access over time. However, we now believe that additional measures are necessary to ensure that the sector will not suffer costly disruption. The effect of these measures is discussed later in this impact assessment.

A5.30 We believe that we took the benefits of European harmonisation into account in our earlier impact assessment. We recognise the added value of harmonisation in creating economies of scale. However, we do not believe that a mandatory harmonised approach is justified given the risk associated with selecting the wrong use. This idea is presented in more detail in our Spectrum Framework Review (SFR).

A5.31 The benefits of a market led approach are also discussed in detail in the SFR. They are touched on briefly below, but the main purpose of this impact assessment is to discuss the application of the market led approach to the DDR, rather than its general validity. For the latter, our assessment remains the same.

A5.32 In particular, the fact that costs are incurred by winning participants is a feature of an auction. This is necessary to encourage the efficient use of spectrum. Annex 2 discusses this issue in more detail.

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A5.33 We believe that a market led approach to awarding the digital dividend will provide an opportunity for other potential users to access the spectrum. Responses indicate that most interest comes from the sectors that we anticipated in our earlier impact assessment.

A5.34 We recognise that our earlier impact assessment focused on the impact on specific sectors that are direct users of spectrum rather than on the overall UK economy and competitiveness. The latter is sometimes calculated in impact assessments by applying a multiplier to the direct impacts quantified. In other words, the value generated for producers and consumers by a particular service could be multiplied to account for ripple effects on other economic agents. For instance, increased use of mobile data services could encourage more software developers to create applications for mobile phones.

A5.35 This was not considered necessary for the modelling work completed to support the DDR for the following reasons:

- we expect that these ripple effects will occur for all valuable uses of the digital dividend in a roughly comparable magnitude. In general, we believe that the sectors in the value chain linked to most uses of the spectrum are more or less equally competitive. Therefore, these ripple effects should be similar for all uses;

- we also believe that the incremental magnitude of these ripple effects is likely to be relatively small because most or all services could be delivered by means other than using the digital dividend; and

- in determining whether we should intervene in awarding the digital dividend and when making decisions on award design and packaging, the relative values of uses are more important than the absolute values. We need to understand whether some uses generate much more value than others rather than knowing precisely how much value each use generates.

**Our analysis continues to favour a market led approach**

A5.36 Our proposal to adopt a market led approach to awarding the digital dividend prompted polarised responses from stakeholders. Some supported this approach, some proposed an interventionist approach and some argued for a point in between.

A5.37 Having reviewed the responses and the evidence available, we still believe that our initial analysis is correct and that a market led approach presents the best cost/benefit trade off. Section 5 and annex 4 give a summary of the issues raised and our responses to these issues. Overall, the cost/benefit analysis presented in the DDR consultation document still stands. Table A24 summarises this.
Table A24. Strategic options for the award of the digital dividend

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
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</table>
| Market led: we impose as few constraints on use of spectrum as possible | • Maximum flexibility in use of spectrum, now and in future  
• Maximum opportunities for new users and uses  
• Users incentivised to use spectrum as efficiently as possible  
• Allows direct funding of users who generate BSV—a more transparent and accountable form of support  
• Lower risk of regulatory failure (although potential risk of market failure)  
• Transparent process | • Risk of market failure if potential uses that generate BSV but have low commercial value are under represented in market outcomes—can be mitigated by appropriate direct funding and institutional frameworks  
• Could increase risk of anticompetitive behaviour, under certain circumstances—can be mitigated through award design | |
| Interventionist: we impose constraints on use of spectrum beyond the minimum necessary. Examples are allocating spectrum to particular uses, technologies, or types of user  | • Ensures spectrum available for particular uses (e.g. those that generate BSV)  
• Reduces risk of market failure (although potential risk of regulatory failure) | • Excludes some uses and users from the award and future access to spectrum, even if they could generate high total value for society  
• Distorts incentives because true cost of spectrum not paid by users  
• Could reduce efficiency of competition between different service providers and platforms  
• Reduced scope for experimentation and innovation except by preferred users  
• High risk of regulatory failure if preferred use is not the use that generates greatest total value for society  
• Little transparency in process | |

We have refined our proposals and updated our impact assessment

A5.38 As in our earlier impact assessment, our analysis of the market led approach to awarding the digital dividend has been complemented by detailed examination of specific risks of market failure.

A5.39 We have also reconsidered our proposals in light of some more detailed issues and new evidence. Each decision was taken after evaluating its costs and benefits.

A5.40 This impact assessment summarises the cost/benefit analysis for each of the key decisions set out in the DDR statement, concerning:

- licence exemption for low power and cognitive applications;
- an innovation reserve;
- PMSE;
- local television;
- DTT services in SD and HD;
- mobile broadband;
• mobile television; and
• channel 36.

Licence exemption for low power and cognitive applications

A5.41 When releasing spectrum, we assess the possibility of making it licence exempt. This means that users might be free to use the spectrum without the need for individual licences provided they comply with rules of use.

A5.42 The test we use to decide whether we should make spectrum licence exempt is based on economic value. If the total economic value generated through licence exemption exceeds that from licensing, spectrum should be reserved for licence exempt use and vice versa.

A5.43 As section 2 explains, there are two types of spectrum in the digital dividend: cleared and interleaved. Cleared spectrum will be free of other UK uses, while interleaved spectrum is shared on a geographic basis with DTT.

A5.44 The DDR consultation document stated that we did not have sufficient evidence on the value of low power licence exempt use of the digital dividend and sought views. Respondents were generally not in favour of setting aside cleared spectrum for such use. However, some respondents believed that interleaved spectrum had large potential for low power use and that our earlier impact assessment had not accounted for this. Section 6 summarises these responses.

A5.45 The analysis in section 6 examines licence exemption, including for cognitive radio. This is a new technology that can detect spectrum that is otherwise unused and transmit without causing harmful interference.

A5.46 Two possible options were ruled out after further analysis:

• a dedicated licence exempt allocation for low power equipment in interleaved spectrum. This could have detrimental effects on the existing DTT network and/or for the use of remaining interleaved spectrum; and

• cognitive use of cleared spectrum. It is not at all clear whether cognitive radio technology will be able to share spectrum in the manner described above with the full set of potential uses of cleared spectrum.

A5.47 The remaining available options require a more complex analysis, which table A25 summarises.
Table A25. Costs and benefits of options relating to licence exemption

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1: reserve cleared spectrum for licence exempt use</td>
<td>• Secures full value to society of low power uses</td>
<td>• Denies alternative uses access to the spectrum</td>
<td>• Benefits are uncertain but more likely to be low than high</td>
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<td></td>
<td>• Incremental benefits may be relatively low given the availability of alternative licence exempt spectrum</td>
<td>• Level of demand for this type of use currently unclear</td>
<td>• Additional benefit compared to alternative approach (e.g. allowing licence exempt cognitive use of interleaved spectrum) may be low</td>
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<td></td>
<td>• Makes spectrum available at lowest cost for these uses</td>
<td></td>
<td>• Costs likely to be high—the opportunity cost of a channel of cleared spectrum could reach £400m</td>
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<td></td>
<td>• Certainty for low power users</td>
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<td></td>
<td>• Could promote innovation</td>
<td></td>
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<tr>
<td>Option 2: allow cognitive use of interleaved spectrum</td>
<td>• May secure full value to society of cognitive devices</td>
<td>• Could be close to none if cognitive devices are able to share with other users without causing harmful interference</td>
<td>• Low costs if cognitive devices are able to avoid interference. Therefore, careful assessment of equipment used will be needed</td>
</tr>
<tr>
<td></td>
<td>• Incremental benefits may be relatively low given the availability of alternative licence exempt spectrum</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Makes spectrum available at lowest cost for these uses</td>
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<td></td>
<td>• May provide additional competition in established markets</td>
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<td></td>
<td>• Likely to result in greater spectrum availability than reserving cleared spectrum for licence exempt use</td>
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<tr>
<td></td>
<td>• Use of interleaved spectrum is often concentrated in time and place, so there is scope for sharing</td>
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<tr>
<td>Option 3: auction with no allowances for licence exempt uses in either cleared or interleaved spectrum</td>
<td>• Makes spectrum available for other uses</td>
<td>• Potentially high opportunity cost if licence exempt use generates high BSV but is excluded, though this is unlikely</td>
<td>• Benefits could be high (if other uses generating high total value to society exist)</td>
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<tr>
<td></td>
<td></td>
<td>• This cost is reduced by the availability of other licence exempt bands and/or licence exempt access for cognitive use of interleaved spectrum</td>
<td>• Costs are uncertain but more likely to be low than high</td>
</tr>
</tbody>
</table>

A5.48 We believe option 1 has high costs. While option 3 seems acceptable, option 2 may offer added benefits, with potentially low costs. Therefore, we favour option 2.
Innovation reserve

A5.49 The DDR consultation document invited views on the case for holding back a small amount of the digital dividend as an innovation reserve for future technological developments.

A5.50 Many respondents were in favour of an innovation reserve, but very little evidence that a market led approach could hamper or stifle innovation was provided. Section 6 summarises these responses.

A5.51 We have assessed the costs and benefits of an innovation reserve. These are discussed in detail in section 6 and summarised in table A26.

Table A26. Costs and benefits of an innovation reserve

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
</table>
| Hold some spectrum as an innovation reserve | • If some new and valuable use emerges that is not foreseeable today, spectrum would be readily available. This would avoid the need for this new use to rely on mechanisms such as secondary trading | • Society loses the use of reserve while it is being held back  
• Even spectrum that is released to the market may have its total value reduced. This is because some uses depend on gaining access to a combination of spectrum packages  
• Trigger point at which reserve is released may be hard to identify  
• Reserve may end up being held for a considerable period as some better technology is always around the corner | • The benefits could be large but only if the new use was much more valuable than the alternative and, for some reason, it would be too costly or impossible to change use of spectrum  
• The costs are very likely to be large given that we estimate the overall value of the digital dividend to producers and consumers £5bn-10bn (NPV over 20 years) |

A5.52 On balance, the costs of an innovation reserve seem to outweigh the benefits.

PMSE

Access to interleaved spectrum and selection of a band manager

A5.53 The DDR consultation document proposed moving PMSE access to interleaved spectrum to a market led approach after a transition period lasting until at least the end of 2012. It also proposed licence exempting some or all PMSE use of channel 69.

A5.54 Many respondents argued that a fragmented PMSE sector could not compete successfully at auction and/or that a longer period of transitional access to interleaved spectrum was needed. They also argued that channel 69 was important for professional users who require coordinated, interference free access across the UK and so should remain available on a licensed basis. Annex 3 contains a more extensive summary of responses.
A5.55 We reflected on these responses and in June 2007 consulted on new proposals for future spectrum access for PMSE. An impact assessment of these proposals was published with the consultation document.\(^{20}\)

A5.56 In summary, the PMSE consultation document proposed awarding a single package of interleaved spectrum to a band manager who would have obligations towards PMSE users.

A5.57 We identified two out of six options as acceptable for selecting the band manager:

- option 3—a beauty contest, following which the band manager would pay AIP. This seeks to ensure that users face the opportunity cost of their spectrum use (i.e. the value it could generate if put to alternative use) and therefore creates incentives for efficient use. The criteria for the beauty contest would seek to ensure that the band manager’s interests were aligned with those of PMSE users; and

- option 4—an auction with additional safeguards to those proposed in the DDR consultation document, including guaranteed access to interleaved spectrum until 2018.

A5.58 The main differences between these options are discussed in detail in section 7 and annex 3, and summarised in table A27. Options that our previous analysis discounted as undesirable are omitted.

\(^{20}\) http://www.ofcom.org.uk/consult/condocs/pmse/
### Table A27. Costs and benefits of options for selecting the band manager

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
</table>
| **Option 3: beauty contest with AIP** | • Easier to enforce protection of PMSE users, especially in pricing. This reduces the risk of disruption  
• Easier for PMSE users and/or representative bodies to participate in the award process as the need to bring forward future revenues in the form of a financial bid is removed  
• May extend well to PMSE use of spectrum outside the digital dividend | • Risk that the process does not award the spectrum to those able to use spectrum most efficiently because information available to us or candidates is limited  
• Risk that AIP will not be set at the correct level to provide PMSE users with full incentives to use spectrum efficiently | • Reduction in risk of disruption may be a significant benefit  
• Benefit of scalability to other spectrum may be relatively modest as different bands may require different approaches  
• Risk of selection of suboptimal user may be significant |
| **Option 4: auction with additional safeguards** | • Should reveal information about candidate best able to use spectrum most efficiently. However, ability to do this is likely to be heavily constrained by the protection we think we need to protect PMSE users from disruption  
• Open and transparent process  
• Minimises risk of regulatory failure | • PMSE price protection may distort the outcome (e.g. create considerable uncertainty for bidders, negatively affecting willingness to participate)  
• Price protection may be more difficult to enforce  
• Risk that PMSE users and/or representative bodies find it difficult to participate directly in the award process given the need to bring forward future revenues in the form of a financial bid | • Benefit of information revelation could be significant. However, there could be doubts about the quality of this information given likely distortions introduced by the safeguards  
• Risk of disruption to the sector due to difficulties with price protection could be a significant concern |

A5.59 On balance, we favoured option 3 as the benefits of option 4 are limited by the regulatory requirements we think are needed to manage PMSE users’ transition to a market led approach to spectrum access.

A5.60 A related decision is how much spectrum and what spectrum should be awarded to the band manager. This discussion is set out in detail in section 8, and summarised in table A28.
Table A28. Costs and benefits of awarding different packages to the band manager

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1: all interleaved spectrum</td>
<td>- PMSE users have more spectrum to use</td>
<td>- Credible alternative uses of the spectrum may be prevented or delayed. This may be corrected by the band manager later, but uncertainty and time delay are likely to be greater</td>
<td>- Costs may be high as there are credible alternative uses for interleaved spectrum, including local television, DTT and mobile broadband</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- May favour inefficient use of spectrum for PMSE if AIP is set too low</td>
<td></td>
</tr>
<tr>
<td>Option 2: all interleaved spectrum with the exception of assignments for which there is reasonable evidence of alternative demand</td>
<td>- Provides a direct route to access for credible alternative uses</td>
<td>- A relatively small reduction in the amount of interleaved spectrum available for PMSE</td>
<td>- In most locations, most of the time, PMSE use is expected to be less than the amount of interleaved spectrum awarded to the band manager, so in the majority of cases the cost is low. At peak times in a few locations, there may be a need for efficiency improvements. These are likely to be achievable via investing more effort in radio/logistical planning and/or more efficient equipment</td>
</tr>
</tbody>
</table>

A5.61 Given the costs and benefits detailed above, option 2 seems preferable.

Channel 69

A5.62 The DDR consultation document proposed licence exempting some or all PMSE use of channel 69. The advantage of licensed access to any spectrum is a better guarantee of interference free operation for users. Channel 69 is used for community as well as professional purposes. Community users are likely to prefer the reduced cost and greater simplicity of a licence exempt approach even if it comes with a higher chance of interference. However, we also acknowledged the interests of professional PMSE users.

A5.63 Respondents noted that channel 69 is more valuable than other channels for professional users. This is because it is the only channel available for PMSE on a UK wide basis, and so allows the same equipment to be used anywhere in the UK.

A5.64 Table A29 sets out the costs and benefits of licence exempting some or all PMSE use of channel 69.
### Table A29. Costs and benefits of licence exempting PMSE use of channel 69

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licence exempt some or all of channel 69</td>
<td>• Simpler and cheaper for community users</td>
<td>• Additional logistical difficulties and equipment expense for some professional users, such as travelling productions</td>
<td>• The benefits could be significant but are reduced by the availability of other licence exempt spectrum for PMSE use (see annex 3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Professional equipment tuned to channel 69 may have to be replaced if the channel loses the reliability required for professional use</td>
<td>• The costs are likely to be significant</td>
</tr>
</tbody>
</table>

A5.65 There is a balance to be struck between the needs of community and professional PMSE users. Our decision to promote the community PMSE use of channel 70 on a licence exempt basis means that the needs of these users should largely be met. Therefore, the costs of licence exempting some or all of channel 69 seem to exceed the benefits, and we reject this option.

**Local television**

A5.66 The DDR consultation document stated that local television operators may face coordination problems when bidding for UK wide packages of spectrum and that willingness to pay for spectrum may not reflect the BSV that local television might generate. However, the level of BSV is uncertain, and the costs of intervention by reserving spectrum for local television are potentially high.

A5.67 There was almost an equal split between respondents in favour of more intervention in support of local television and those against. Section 7 sets out responses in more detail.

A5.68 We considered these responses and reassessed the two market failure risks identified in the DDR consultation document. We concluded that there was a need to resolve the risk of coordination failures through appropriate award design and packaging. We concluded that the market failure risk in relation to the existence of BSV was insufficient to warrant intervention.

A5.69 Tables A30 and A31 summarise the options we considered in making these decisions and their associated costs and benefits. Sections 7 and 8 set out a more detailed explanation.
Table A30. Options to address coordination failures in relation to local television

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1: no action taken. Spectrum</td>
<td>• Spectrum could attract a wider range of uses</td>
<td>• Increases chances that local television may fail to win spectrum even if it is a high value use. Local television operators may have to club together to present an adequate bid at auction</td>
<td>• Costs could be large, and benefits are uncertain</td>
</tr>
<tr>
<td>packaged in a UK wide form</td>
<td>• Avoids aggregation risks for those bidders who require UK wide coverage</td>
<td></td>
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<td></td>
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<tr>
<td>Option 2: intervene by direct allocation of</td>
<td>• Facilitates launch of local television services</td>
<td>• May prevent a more valuable use from gaining access to spectrum</td>
<td>• Costs could be large as there are several other uses that could generate significant total value</td>
</tr>
<tr>
<td>spectrum</td>
<td>• Ensures local television services gain access to spectrum</td>
<td>• Does not solve essential funding problems of local television, caused by difficulties in the business model. Could result in under funded local television stations gaining access to DTT to present poor quality content or just a few hours of programming a day</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>• Distorts incentives for efficient spectrum use by limiting future flexibility</td>
<td>Benefits are uncertain as reserving spectrum are unlikely to solve funding problems of local television</td>
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</tr>
<tr>
<td>Option 3: offer geographic packages of</td>
<td>• Allows alternative high value uses the opportunity to bid for spectrum</td>
<td>• May make the spectrum less attractive to some other bidders</td>
<td>• Costs are more likely to be relatively small as alternative users still have an opportunity to bid. Benefits could be significant if it leads to a greater number of good quality local television stations</td>
</tr>
<tr>
<td>spectrum that more closely map local</td>
<td>• Question of whether local television should receive support is separated from question of whether DTT is the best platform for it: any subsidy can be made by appropriate funding bodies, leaving operators to decide how best to use it</td>
<td></td>
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</tr>
<tr>
<td>television demand</td>
<td></td>
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</tr>
</tbody>
</table>

A5.70 On balance, we continue to favour option 3 as the best solution to the coordination failures facing local television.
Table A31. Options to address BSV in relation to local television

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
</table>
| No spectrum based intervention, based on the view that, if intervening is necessary, the correct method is direct funding from appropriate bodies | - Allows alternative high value uses the opportunity to bid for spectrum  
- Provides local television operators with the ability to decide which platform is likely to be best to deliver their output  
- Does not distort incentives to use spectrum efficiently  
- Allows obligations to be tied to the desired output rather than the spectrum licence. This allows greater flexibility in changing the use of spectrum in the future | - Increased uncertainty for local television bidders                      | - Benefits could be large as there are several other uses that could generate significant total value. In addition, if direct funding is provided, this could give local television operators the right incentives to decide on the value of spectrum relative to other inputs  
- Costs are uncertain, as reserving spectrum would not solve funding problems of local television |

A5.71 For the reasons set out, we believe that this option is the correct approach to address the existence of BSV.

Amount of spectrum

A5.72 We have proposed awarding around 25 packages suitable for local television. These cover areas where there is clear evidence of demand (e.g. existing local analogue stations) for the service and those where it is reasonable to expect some potential for a successful business case under favourable market conditions.

A5.73 Our assessment is that offering a larger number of packages without reasonable expectation of demand would potentially take spectrum away from other uses. On the other hand, using more stringent criteria in selecting the packages could prevent credible local television services from being deployed.

A5.74 We will be willing to consider other locations if there is persuasive evidence of demand.

DTT

SD

A5.75 The DDR consultation document did not consider it likely that there would be an argument for intervention to deliver additional DTT channels in SD given the amount of spectrum already reserved for this purpose. Our further analysis continues to support this conclusion, although we have made additional observations on the possible relevance of direct funding options. Section 7 sets these out.

A5.76 A small minority of responses specifically sought additional capacity for DTT services in SD. Our 2007 market research and further analysis did suggest that this type of content could potentially generate significant BSV.
A5.77 We analysed the costs and benefits of such an intervention. This analysis is presented in detail in section 7 and summarised in table A32.

Table A32. Costs and benefits of reserving spectrum for DTT services in SD

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
</table>
| Intervene to reserve spectrum for DTT services in SD with community or citizen focus | • This type of service could have significant BSV. However, as section 7 sets out, there are a number of reasons why the incremental BSV generated by this use of the digital dividend may be relatively low  
• This type of intervention would ensure that this use gained access to spectrum | • Could preclude another use that may turn out to be more valuable  
• These channels do not normally operate their own broadcast networks. Reserving spectrum would require them to branch out of their core business of programme making and into spectrum management | • The incremental gain of intervening by reserving spectrum could be low or negative  
• Costs are likely to be high compared to other potential interventions. The magnitude of the opportunity cost of intervening to provide an additional DTT multiplex could be £1bn-2.5bn (NPV over 20 years), as annex 8 sets out |

A5.78 We believe that the risk of market failure relating to this use of the digital dividend is low. While it is likely to be valuable, the value of other potential uses it could displace is also likely to be high. Additionally, intervention by reserving spectrum does not seem appropriate. These channels do not normally operate their own broadcast networks. We therefore believe that any risk of market failure faced by this use would be related to gaining access to multiplex capacity rather than spectrum itself.

A5.79 We conclude that it is not appropriate to reserve spectrum for DTT services in SD. However, we believe it is important to consider the issues faced by such services that generate BSV. We will do so in our second PSB Review, which is currently under way.21

HD

A5.80 DTT services in HD have shown some positive early signs of future demand, such as rapid take up of HD ready television sets by consumers. However, our analysis has not shown any compelling market failure argument, and therefore the DDR consultation document did not propose to intervene in favour of this use of the digital dividend.

A5.81 Many respondents saw a need to reserve spectrum for DTT services in HD to allow a critical mass of five channels to be delivered. These responses, and our response, are set out in section 7 and in the earlier part of this assessment.

A5.82 Table A33 summarises the costs and benefits of intervention for DTT services in HD.

Table A33. Costs and benefits of reserving spectrum for DTT services in HD

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intervene to reserve spectrum for DTT services in HD</td>
<td>• Could help meet demand for HD on the DTT platform</td>
<td>• Could preclude alternative use that may turn out to be more valuable</td>
<td>• Benefits of intervention are unlikely to be very high: if benefits associated with DTT services in HD are very high, broadcasters have incentives to bid for spectrum or use existing spectrum to deliver services</td>
</tr>
<tr>
<td></td>
<td>• Magnitude of benefit is reduced because (i) spectrum already reserved for DTT can potentially deliver a number of services in HD without additional spectrum and (ii) if demand is very high, broadcasters have incentives to bid for spectrum or advance an upgrade of the DTT platform</td>
<td>• Alternative uses could have higher BSV</td>
<td>• The magnitude of the opportunity cost of intervening to provide an additional DTT multiplex could be £1bn-2.5bn (NPV over 20 years), as set out in annex 8</td>
</tr>
</tbody>
</table>

A5.83 The balance of evidence shows that the likelihood of market failure is low as broadcasters have incentives to provide this service if they expect high demand.

**Mobile broadband**

A5.84 The mobile broadband services we considered comprise future two way cellular and mobile data services. These include applications such as cellular voice, Internet access and high speed data and video.

A5.85 The DDR consultation document stated that the risk of market failure regarding this use was not significant and proposed packaging spectrum in a way that does not preclude mobile broadband use.

A5.86 Approximately a third of individual respondents agreed that we should not preclude mobile broadband use of the digital dividend, while two thirds disagreed. Most of those who disagreed did so because they supported reserving spectrum for other uses (e.g. DTT services in HD and PMSE). Most of the organisations that responded agreed with our proposals. Responses are described in section 7 and annex 4.

A5.87 Since the DDR consultation, international discussions to identify a harmonised sub band of UHF bands IV and V for mobile broadband have been taking place. This has the potential to increase the total value generated by this use because of potential economies of scale in producing handsets that could make them cheaper and more attractive for consumers if the same spectrum is in use in several countries.

A5.88 Our further analysis is detailed in section 7 and summarised in table A34.
Table A34. Costs and benefits of a market based approach for mobile broadband

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
</table>
| Package spectrum in a way that does not prevent mobile broadband use | • Allows mobile broadband access if operators believe this is a valuable use  
• Other high value users also have an opportunity to access spectrum | • Low: does not prevent other uses from bidding  
• The risk of the BSV generated by this use resulting in a market failure is judged to be low | • Benefits could be very high as the digital dividend could provide an opportunity for cost savings by operators, which are likely to be partially passed to consumers in a competitive market. It could also increase availability of advanced data services  
• The magnitude of the opportunity cost of intervening could be £1bn-2.5bn (NPV over 20 years), as set out in annex 8 |

A5.89 For the reasons set out, we continue to favour this option.

Mobile television

A5.90 The digital dividend is suitable for mobile multimedia applications, including mobile television. We have found a high level of interest from stakeholders in using the spectrum to provide this service.

A5.91 The DDR consultation document did not find any compelling market failure argument favouring intervention for mobile television and therefore did not propose intervening. Respondents typically agreed with our proposals. Section 7 summarises their arguments.

A5.92 Table A35 sets out our assessment of the costs and benefits of a market based approach for mobile television.

Table A35. Costs and benefits of a market based approach for mobile television

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
</table>
| Package spectrum in a way that does not prevent mobile television use | • Allows mobile television access if operators believe this is a valuable use  
• Other high value users also have an opportunity to access spectrum | • Low: does not prevent other users/uses from bidding  
• The risk of the BSV generated by this use resulting in a market failure is judged to be low | • Benefits could be very high as research indicates private value associated with this use  
• The magnitude of the opportunity cost of intervening could be £400m per spectrum channel (NPV over 20 years), as set out in annex 8 |

A5.93 As shown above, we believe that there are no material risks of market failure, and therefore we continue to favour our original option as described above.
Channel 36

Timing of use

A5.94 Channel 36 is unique in the digital dividend because it is the only channel that has the potential to be cleared on a UK wide basis before DSO ends in 2012. We have given notice to the existing user that we will revoke its licence to use the channel by 31 March 2009.

A5.95 However, early use could lead to potential for interference in Five's analogue television network as it uses neighbouring channels 35 and 37.

A5.96 Our analysis considered these costs against the potential benefits of early use. The analysis and our conclusions are detailed in section 9 and summarised in table A36.

Table A36. Costs and benefits of early use of channel 36

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early use of channel 36</td>
<td>• New use for channel 36 can start earlier</td>
<td>• Current use has to be cleared out earlier</td>
<td>• Benefits can be large. If channel 36 is used for mobile television and demand for this service is high, early use could generate additional benefits for the economy in the order of £200m-500m, as stated in annex 8</td>
</tr>
<tr>
<td></td>
<td>• New service could be up and running in time for the London Olympics, which could be very valuable for some uses such as mobile television.</td>
<td>• Any potential for interference to Five's analogue television network must be resolved</td>
<td>• Costs are relatively small. We believe that reception of Five's analogue television services could be degraded for approximately 3% of viewers</td>
</tr>
</tbody>
</table>

A5.97 Given that benefits are likely to outweigh costs, we favour early use of channel 36 on the condition that this does not materially degrade the reception of Five's analogue television service prior to 2012.

Timing of award

A5.98 The timing of the auction of channel 36 is a related but separate issue from that of early use. We have noted above that channel 36 should be available for UK wide use earlier than other cleared spectrum. We now consider the costs and benefits of awarding channel 36 earlier than that spectrum.

A5.99 The DDR consultation document proposed auctioning channel 36 at the same time as cleared spectrum while still potentially allowing early use after the auction. The majority of respondents argued for early award (see section 9 for more details).

A5.100 Given the procedural and legal steps necessary for an award, the earliest possible date for an auction of channel 36 would be around six months before the award of cleared spectrum. We have assessed the costs and benefits of early award. These are discussed in more detail in section 9 and summarised in table A37.
Table A37. Costs and benefits of early award of channel 36

<table>
<thead>
<tr>
<th>Option</th>
<th>Benefits</th>
<th>Costs</th>
<th>Assessment of magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>Early award of channel 36</td>
<td>• Use of channel 36 could start earlier as there is no need to await the award of cleared spectrum</td>
<td>• Creates risk of inefficient auction outcome because some bidders may require a combination of channels to offer their services and may not be able to use channel 36 by itself. In this case, they are likely to avoid committing to a bid for channel 36 in isolation</td>
<td>• The head start for network rollout due to early award would be around six months and could be worth up to £50m for a mobile television operator. • The cost from an inefficient auction outcome is the risk that channel 36 (and possibly other spectrum) will be put to a less valuable use than would otherwise be the case. As we estimate the value of the digital dividend to the economy at £5bn-10bn, even a small relative reduction in this value would be significant</td>
</tr>
</tbody>
</table>

A5.101 On balance, we have decided against early award of channel 36. This may delay rollout of the network of the eventual winner, but this is outweighed by the risk of an inefficient auction outcome by biasing toward bidders who can use channel 36 in isolation.

**We expect our decisions to lead to spectrum being used in the interests of citizens and consumers**

A5.102 In the future, we will need to evaluate the success of our decisions. In order to do this, it is helpful to state succinctly what we expect the outcomes to be. This is the purpose of this annex.

A5.103 Our decisions should allow the market to decide the best use of most of the digital dividend. We believe that the interests of bidders will be aligned, to a large extent, with those of citizens and consumers. We expect that this decision will:

- maximise the total value to society that using the digital dividend generates over time. As stated earlier, we estimate its value to the economy at £5bn-10bn (NPV over 20 years). Much of these will be in the form of benefits for consumers.

A5.104 In addition, we have decided on measures for PMSE users that we expect to:

- allow the sector to move to a market based approach to spectrum access after a transitional period; and
- increase the efficiency of PMSE spectrum use.
Annex 6

Legal framework and our duties

Our duties

A6.1 This annex provides an overview of the main UK and European legislative provisions relevant to the award of the digital dividend. It is not intended as a comprehensive statement of all our duties and functions.

A6.2 The wide variety of different potential uses of the digital dividend makes it relevant and necessary to consider a range of duties relating to spectrum, broadcasting and ECS and the interaction between them.

Our general duties

A6.3 Under section 3(1) of the Communications Act, it is our principal duty in carrying out our functions:

- to further the interests of citizens in relation to communications matters; and
- to further the interests of consumers in relevant markets, where appropriate by promoting competition.

A6.4 In carrying out this principal duty, we are required to secure a number of objectives in particular (section 3(2)) and to have regard to such of a number of matters as set out in sections 3(3) and 3(4). Those in section 3(3) must be considered in all cases, whereas those in section 3(4) have to be taken into account only insofar as we consider them relevant. Some of these objectives and matters are general, such as the desirability of promoting competition, investment and innovation. Others, as outlined below, are more relevant to spectrum, broadcasting or ECS, although the division is not always completely clear cut.

A6.5 There is no hierarchy in the legislation between the two components of the principal duty in section 3(1), between the objectives in section 3(2) or between the matters in section 3(4).

A6.6 Section 3(3) requires us to apply certain regulatory principles in all cases. We have a duty under this section to have regard in all cases to principles under which regulatory activity should be transparent, accountable, proportionate, consistent and targeted only where such action is needed, as well as to any other principles appearing to us to be best regulatory practice. We have stated that we will operate with a bias against intervention but with a willingness to intervene firmly, promptly and effectively where required; and, further, that we will intervene where there is a specific duty to work toward a public policy goal that markets alone cannot achieve. If a case for intervention can be made, we are committed to choosing the least intrusive means.

Our spectrum duties

A6.7 In carrying out our general duties, we are required by section 3(2) to secure in particular the optimal use of the electromagnetic spectrum for wireless telegraphy and by section 3(4)(f) to have regard to the different needs and interests of all persons who may wish to make use of the spectrum for wireless telegraphy.
A6.8 In addition, in carrying out our spectrum functions, we are specifically required by section 3 of the Wireless Telegraphy Act 2006\textsuperscript{22} to have regard in particular to:

- the extent to which the spectrum is available for use or further use for wireless telegraphy;
- the demand for use of that spectrum for wireless telegraphy; and
- the demand that is likely to arise in future for the use of that spectrum for wireless telegraphy;

and to have particular regard to the desirability of promoting:

- the efficient management and use of the spectrum for wireless telegraphy;
- the economic and other benefits that may arise from the use of wireless telegraphy;
- the development of innovative services; and
- competition in the provision of ECSs.

A6.9 Spectrum management in the UK is also governed by the EU regulatory framework for electronic communications. Section 4 of the Communications Act requires us when carrying out our spectrum functions to act in accordance with the six ‘Community obligations’ set out in that section. The following requirements are relevant to this statement:

- to promote competition (section 4(3));
- to secure that our activities contribute to the development of the European internal market (section 4(4));
- to promote the interests of all persons who are citizens of the EU (section 4(5));
- to take account of the desirability of carrying out our functions in a technology neutral way (section 4(6));
- to encourage to such extent as appropriate the provision of network access and interoperability (section 4(7)); and
- to encourage such compliance with international standards as is necessary for: (a) facilitating service interoperability, and (b) securing freedom of choice for the customers of communications providers (sections 4(9) and (10)).

\textsuperscript{22} This came into force on 8 February 2007 and consolidated into a single statute six separate Acts of Parliament dealing with wireless telegraphy, including some provisions of the Communications Act, and the Wireless Telegraphy Acts of 1949 and 1998 in their entirety.
Our broadcasting duties

A6.10 Section 3(2) requires us in carrying out our functions to secure:

- the availability throughout the UK of a wide range of television and radio services which (taken as a whole) are both of high quality and calculated to appeal to a variety of tastes and interests;

- the maintenance of a sufficient plurality of providers of different television and radio services;

- the application, in the case of all television and radio services, of standards that provide adequate protection to members of the public from the inclusion of offensive and harmful material; and

- the application in the case of all television and radio services of standards that provide adequate protection to members of the public from the inclusion of, unfair treatment in programmes and unwarranted infringement of privacy.

A6.11 In addition, we are required, where it is considered to be relevant in the circumstances, to have regard to the desirability of promoting the fulfilment of the purposes of public service television broadcasting in the UK (section 3(4)(a)).

Our ECS duties

A6.12 Section 3(2) requires us in carrying out our functions to secure the availability throughout the UK of a wide range of ECS.

A6.13 We are also required, where it is considered to be relevant in the circumstances, to have regard to the desirability of encouraging broadband availability and use throughout the UK (section 4(e)).

Summary of our key duties

A6.14 Table A38 summarises our key duties relevant to spectrum, broadcasting and ECS.

Table A38. Summary of our key duties

<table>
<thead>
<tr>
<th>Duty</th>
<th>Spectrum</th>
<th>Broadcasting</th>
<th>ECS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Principal duty in carrying out functions: section 3(1)</td>
<td>Further interests of: citizens; and consumers, where appropriate by promoting competition</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duty to secure in carrying out principal duty: section 3(2)</td>
<td>Optimal use of spectrum</td>
<td>Availability of a wide range of television and radio services</td>
<td>Availability of a wide range of ECS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maintenance of sufficient plurality of providers of broadcast services</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Adequate protection from offensive and harmful material</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Adequate protection from unfairness or invasions of privacy</td>
<td></td>
</tr>
<tr>
<td>Duty</td>
<td>Spectrum</td>
<td>Broadcasting</td>
<td>ECS</td>
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</tbody>
</table>
| Matters to have regard to in all cases: section 3(3) | • Regulatory principles of transparency, accountability, proportionality, consistency and acting only where necessary  
• Any other regulatory principles we consider represent best practice | | |
| Matters to have regard to where relevant in the circumstances: section 3(4) | • Competition, investment and innovation  
• Opinions of consumers and members of the public  
• Interests of persons in different parts of the UK, different ethnic communities and rural and urban areas  
• Needs of persons with disabilities, the elderly and those on low incomes  
• Promoting and facilitating the development and use of effective forms of self-regulation | • The different needs and interests of persons wishing to use spectrum | • Availability and use of broadband |
| To act in accordance with European principles: section 4 | • Promote competition  
• Develop European internal market  
• Promote interests of all citizens of the EU  
• Technology neutrality  
• Encourage network access and interoperability  
• Compliance with international standards | • Promoting the fulfilment of the purposes of public service television broadcasting in the UK  
• Standards to guarantee appropriate freedom of expression | |
| Additional matters to have regard to in carrying out spectrum functions: section 3 of the Wireless Telegraphy Act | • Availability of spectrum  
• Current and expected future demand for spectrum  
• Efficient management and use of spectrum  
• Economic and other benefits  
• Innovation and competition  
• Efficiency and sustainable competition and benefits for operators and customers | | |
| **Relationship between our duties** | | | |
| A6.15 Parliament recognised that our duties require us to pursue a range of objectives while taking a variety of matters into consideration and that this was likely to present us with a need to resolve conflicts between these duties and matters. We are therefore given a wide measure of discretion in such circumstances within an overall framework set out in the Communications Act and the Wireless Telegraphy |
Act. Thus when we are carrying out any of the functions mentioned in section 4(1)\(^{23}\) of the Communications Act, priority must be given to the duty in section 4(2) (duty to fulfil Community obligations) over our general duties in section 3(6) of the same Act. In cases of any conflict between the general duties in section 3 of the Communications Act, section 3(7) gives us broad discretion to resolve conflicts between our general duties in the manner we think best in the circumstances. The general duties referred to here include the principal duty under section 3(1), the duty to secure the objectives set out in section 3(2) and the duty to have regard to the matters in section 3(4).

A6.16 Similarly, with respect to our duties in sections 3 to 6 of the Communications Act, these take priority over our section 3 spectrum specific duties set out in the Wireless Telegraphy Act (section 3(5)) to the extent of any conflict between the Communications Act general duties and the Wireless Telegraphy Act specific duties. Again, however, section 3(6) of the Wireless Telegraphy Act gives us broad discretion to resolve conflicts between our spectrum duties in a particular case in the manner we think best in the circumstances.

A6.17 Where we resolve a conflict in an important case, we must publish a statement setting out the nature of the conflict, how we decided to resolve it and the reasons for resolving it in that manner. An important case is one that involves a major change in our activities, that is likely to have a significant impact on business or the general public or that we consider to be of unusual importance.

A6.18 In addition, we must comply with any direction issued by the Secretary of State relating to spectrum management (see in particular section 5 of the Communications Act and section 5 of the Wireless Telegraphy Act).

**Legal background relevant to wireless telegraphy licensing**

**Granting wireless telegraphy licences**

A6.19 Our legal power to grant wireless telegraphy licences is set out in the Wireless Telegraphy Act. Section 8(1) makes it an offence for any person to establish or use any station for wireless telegraphy or to install or use any apparatus for wireless telegraphy except under and in accordance with a licence granted by us under that section (a wireless telegraphy licence).

A6.20 Section 9(1) gives us the power to grant wireless telegraphy licences subject to such terms as we think fit.

A6.21 However, our broad discretion in relation to the terms that can be imposed in a wireless telegraphy licence is subject to the rule that we must impose only those terms that we are satisfied are objectively justifiable in relation to the networks and services to which they relate, not unduly discriminatory, and proportionate and transparent as to what they are intended to achieve (section 9(7)).

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\(^{23}\) Relating to regulation of electronic communications networks and services, management of the radio spectrum, resolution of disputes, and provision of information.
Providing for an auction of wireless telegraphy licences

A6.22 Under Article 5(2) of Directive 2002/20/EC on the authorisation of electronic communications networks and services (the Authorisation Directive), when granting rights of use of radio frequencies (wireless telegraphy licences in the UK context), Member States must do so through open, transparent and non discriminatory procedures.

A6.23 Under Article 7(3) of the Authorisation Directive, where the number of rights of use of radio frequencies needs to be limited, Member States’ selection criteria must be objective, transparent, non discriminatory and proportionate. (Section 29 of the Wireless Telegraphy Act requires us to make an order setting out the criteria).

A6.24 Within that context, we have power under section 14 of the Wireless Telegraphy Act (having regard to the desirability of promoting the optimal use of the electromagnetic spectrum) to make regulations providing that applications for the grant of wireless telegraphy licences must be made in accordance with a procedure that involves the applicants making bids for licences (e.g. an auction).

A6.25 We have broad powers in sections 14(2) and (3) of the Wireless Telegraphy Act to make provision in regulations for the form of the licences and the auction bidding procedure.

Charging fees for wireless telegraphy licences

A6.26 We also have power, under section 12 of the Wireless Telegraphy Act, to prescribe in regulations fees that are payable in respect of wireless telegraphy licences or a grant of recognised spectrum access (section 21). Under section 13(2) (and section 22(3) with respect to grants of recognised spectrum access), we may prescribe sums that are greater than necessary for the purpose of recovering costs incurred in connection with functions relating to the management of the radio spectrum, if we think it fits in light (in particular) of the matters to which we are required to have regard under section 3.

A6.27 The fees for most wireless telegraphy licences are set out in specific regulations (including those fees that we set in order to incentivise the use of spectrum). The current regulations are the Wireless Telegraphy (Licence Charges) Regulations 2005 (SI 2005/1378) as amended.\(^{24}\)

A6.28 Under Article 13 of the Authorisation Directive, any fees imposed for rights of use of radio frequencies must reflect the need to ensure the optimal use of the resources. Such fees must be objectively justifiable, transparent, non discriminatory and proportionate in relation to their intended purpose. They must also take into account the objectives set out in article 8 of 2002/21/EC on a common framework for electronic communications networks and services.

\(^{24}\) These Regulations have been amended by the Wireless Telegraphy (Licence Charges) (Amendment) Regulations 2006 (SI 2006/2894) and the Wireless Telegraphy (Licence Charges) (Amendment) Regulations 2007 (SI 2007/2326).
Legal background relevant to broadcast licensing

A6.29 Under section 13 of the Broadcasting Act 1990, it is an offence to provide a relevant regulated television service without being authorised to do so under a licence granted by us under that Act or the Broadcasting Act 1996. A relevant regulated television service means a service falling, in pursuance of section 211(1) of the Communications Act, to be regulated by us, other than a television multiplex service. Television multiplex services only have to be licensed under the Broadcasting Act 1996 if this is required by a provision of a wireless telegraphy licence (see section 241 of the Communications Act).

A6.30 In relation to radio services, section 97 of the Broadcasting Act 1990 prohibits the provision of a relevant regulated radio service without a licence under that Act or the Broadcasting Act 1996. A relevant regulated radio service means a service falling to be regulated by us under section 245 of the Communications Act, other than a radio multiplex service. Radio multiplex services only have to be licensed under the Broadcasting Act 1996 if this is required by a provision of a wireless telegraphy licence (see section 258 of the Communications Act).

Impact assessments

A6.31 We have a duty under section 7 of the Communications Act to carry out impact assessments. These provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy making and are commonly used by other regulators. This is reflected in section 7, which means that generally we have to carry out impact assessments where our proposals would be likely to have a significant effect on businesses or the general public or when there is a major change in our activities.

A6.32 In accordance with section 7 of the Communications Act, we have set out an impact assessment in annex 5.
Annex 7

Recent developments in two way mobile services

Introduction

A7.1 This annex examines recent developments in two way mobile services, including future cellular and broadband mobile access services such as future evolutions of 3G cellular mobile, mobile WiMAX and the family of IMT-2000 and IMT-Advanced technologies.

Market research and other market developments

A7.2 In our 2006 quantitative market research, extra SD DTT channels emerged as the highest ranked use of the digital dividend. In the 2007 quantitative research, however, better mobile phone coverage and mobile broadband were ranked as equally important to UK citizens, with 40% of participants choosing them as their first or second ranked service.

A7.3 In the 2007 qualitative market research, better mobile services scored relatively higher. At the end of the day participants ranked these (comparatively) as the most important use of the digital dividend to UK citizens, with extra SD channels coming second. Further, in an exercise in which groups were asked to allocate ten ‘chips’ representing spectrum to various services, better mobile services were awarded the greatest share, with extra SD channels the second highest.

A7.4 In other recent research, almost 60% of interviewed users would like to be able to email on the move, more than 45% wanted to be able to browse and search the internet and over 30% would like do their banking while mobile.

A7.5 There are indications that mobile Internet services have a number of important preconditions in place for rapid growth. About 11% of nearly 70 million UK mobile subscriptions were on 3G at the end of 2006, up from 0.4% in 2003. Nearly 80% of handsets sold in the first three months of 2006 had Internet capability, while the pricing of accessing the mobile Internet has reduced, with four of the five MNOs offering ‘unlimited’ data tariffs for £5 a month. Many Internet service providers are now providing mobile enhanced versions of their services, with all the MNOs promoting search facilities from Google, Yahoo or MSN and with multiple partnerships in place with major social networking sites (e.g. Bebo and MySpace).

A7.6 There is already an increasing take up of new services; for example, 20% of total UK mobile revenue in 2005 was accounted for by data, up from 12% in 2001. Analysts report that average revenue per user from data (including SMS) accounted for 25% of the total by the second quarter of 2007.

28 IDATE / estimates based on operator and regulator data/Ofcom research (op. cit.)
29 Merrill Lynch: European Wireless Matrix Q2 2007
International developments

A7.7 There have been a number of important international developments. These are set out below.

US 700 MHz auction

A7.8 In January 2008, the FCC will auction spectrum in the frequency range 698-806 MHz for a mixture of commercial services and public safety applications. While this range does not align directly with the UK’s cleared spectrum, it is sufficiently close to enable equipment to be designed to operate in both bands, creating economies of scale from the combined UK and US markets.

Long Term Evolution of 3G

A7.9 The 3GPP group is in the process of standardising Release 8 of UMTS, also known as Long Term Evolution (LTE). This incorporates both frequency division duplexing and time division duplexing (TDD) modes as options, with bandwidths varying from potentially 1.25 to 20 MHz.30

Adoption of WiMAX technology by ITU

A7.10 The ITU Radiocommunication Assembly decided on 19 October 2007 to include WiMAX derived technology in the IMT-2000 framework of standards. Specifically, a variant of the IEEE 802.16 WirelessMAN standard known as IMT-2000 OFDMA TDD WMAN was incorporated, as specified in ITU-R M.1457. This is a TDD air interface with channel bandwidths of 5 or 10 MHz.

Impact of economies of scale

A7.11 We recognise that sophisticated technology is involved in providing services of value to citizens, consumers and society and that this could make access to services costly. To realise economies of scale so that services can be delivered at an attractive price, equipment has to be produced in large quantities. In some cases this could require access to markets larger than the UK alone can provide. Furthermore, equipment also often needs to be interoperable, allowing consumers to benefit from roaming between countries and minimising the risk of cross border interference. This is especially the case for mobile handsets and other consumer devices, which must be produced in quantities of tens or hundreds of millions to yield economies of scale. For manufacturers to commit the funds needed to develop and manufacture such equipment, they need confidence that services will be available and taken up in a large market. To help achieve these benefits, we are committed to working closely with other administrations. These include European administrations, where cross border interference issues are additionally relevant, but economies of scale could equally be achieved via equipment development for large markets which are geographically separated.

Our preferred approach to harmonising services

A7.12 Access to economies of scale beyond the UK market has sometimes been achieved via mandatory harmonisation, where spectrum is allocated exclusively for a particular technology. A prime example is GSM, where over two billion mobile users worldwide benefit from these economies of scale. But this creates a

30 http://www.3gpp.org/ftp/Specs/html-info/36-series.htm
substantial risk of spectrum being underused if the service does not develop as expected as happened in the case of ERMES (a paging system) and TFTS (an in-flight mobile communications system). In both these cases valuable spectrum was sterilised for many years as the regulatory framework prevented it from being used for other purposes. As the range of possible uses of spectrum increases, so the risk that wrong decisions are taken rises, increasing the detriment to consumers.

A7.13 In the context of the DDR specifically, there are currently no agreed standards for two way mobile operation, and a wide range of bandwidths and duplexing schemes are currently under consideration, increasing the risk of regulatory failure if we attempt to specify the details of a band plan. The potential rigidities, constraints and scope for inefficiencies inherent in a regulatory approach can be avoided through more flexible approaches to spectrum management, based on the principles of technology and service neutrality combined with the introduction of spectrum trading. However, it is essential that such an approach does not result in the benefits of harmonisation being lost. This had led to the development of regulatory regimes that encourage market led harmonisation whereby industry is given the necessary confidence to develop equipment while giving the market the ability to select the services of highest value. In many ways this mirrors the approach that has already been adopted for DTT, where the technical approach was agreed across many countries, allowing DTT to realise substantial economies of scale, while the network scale and particular deployments were determined by individual administrations.

**Developments in Europe**

A7.14 The CEPT, via the Electronic Communications Committee has given a mandate to TG4 to study the feasibility of mobile services within the digital dividend. Our preferred approach to awarding this spectrum was presented to TG4, and we have actively engaged in its work through regularly attending meetings, commissioning supporting technical studies and providing regular input papers. In consultation with other administrations participating in TG4, we established the options for placement of mobile services that would minimise the potential impact on existing services and maximise the size of the potential market that manufacturers could address. This has resulted in the production of a report by TG4 that concludes:

the harmonisation of a sub band of the UHF band for mobile communication applications (i.e. including uplinks) is feasible from a technical, regulatory and administrative point of view, provided that it is not made mandatory.

A7.15 The report also concluded that:

the preferred sub band for such harmonisation is the upper part of the UHF band, and should include, as a minimum, the range of channels 62-69 (798-862 MHz).

A7.16 This aligns closely with the UK's upper cleared spectrum, although channel 62 is in interleaved spectrum. We strongly support this report's conclusions. The report was adopted by the ECC without change in July 2007. TG4 is continuing to study technical issues via supplementary studies, and has just finalised an additional supplemental report.
A7.17 The Commission Communication on the digital dividend aligns closely with the work of TG4 in suggesting ‘clusters’ of services using similar types of communications network, with the upper range of the spectrum identified for ‘bidirectional low power networks’ (i.e. typically for fixed and mobile broadband access services). See section 3 for further details.

A7.18 The WRC-07 agreement of a co-primary allocation for mobile services in Region 1 (which includes Europe) for the frequency range 790-862 MHz also aligns closely with the sub band identified by TG4 (again, see section 3 for further details). While this does not create any compulsion for individual administrations to make changes, it does add a degree of confidence for the industry in developing equipment for these bands and provides consistency with the work within Europe in TG4 and in the Communication.

Next steps and future work programme

A7.19 We intend to continue to provide policy and technical inputs to TG4 and other bodies as well as engaging in EU deliberations on these issues.

A7.20 We plan further technical work beyond that recently undertaken (see annex 9) to establish licence conditions, potentially including spectrum usage rights that would be suitable for two way mobile applications and further study of the viability of two way mobile applications in interleaved spectrum.

A7.21 We will engage with other international bodies and with stakeholders to explore the possibilities for market led harmonisation.
Annex 8

Economic modelling

Introduction

A8.1 This annex provides an overview of the economic modelling work that has been completed to inform our assessment of the total value to society that could be generated by using the digital dividend. Most of this work was originally conducted for the DDR consultation document and has now been revised and updated.

A8.2 This work has included assessments of the private producer and consumer value that might be generated by different potential uses of the digital dividend. It has also included an assessment of the possible magnitude of external values that might also be generated. (See section 4 of the statement for a discussion of the different sources of value relevant to our assessment of total value.) The external value analysis is based on our 2007 market research.

A8.3 The issues presented are as follows:

- our methodological approach to the modelling work;
- the approach taken to modelling producer and consumer value for each service (with the exception of potential licence exempt uses, which are considered separately);
- the approach taken to assessing external value;
- the approach taken to assessing opportunity cost;
- the approach taken to assessing the incremental benefits of making some of the digital dividend available for licence exempt use;
- the approach taken to assessing the costs and benefits of early use and early award of channel 36; and
- conclusions from the modelling work.

A8.4 None of the numbers presented in this annex should be taken as an indication of auction proceeds.

Purpose of modelling and interpretation of results

A8.5 Economic modelling has been conducted in order to help provide an indication of the magnitude of the total value that potential uses of the digital dividend might generate. This has been used to inform our estimate the total value to society of the spectrum and to ensure that the requirements of high value services are taken into account in our work on packaging and award design. Our modelling work has also informed our service by service application of the total value framework detailed in annex 2 and our assessment of the opportunity cost of intervention.

A8.6 The modelling was not intended to be a prediction of how any particular bidders may eventually roll out their networks and services. It is also not intended to influence any bidders’ estimations of efficient network or service operation.
A8.7 Therefore, we have provided sufficient detail of our modelling approach and assumptions to show that our analysis is fit for purpose, but we have not provided detailed information on each of the parameters that we have used.

Methodology

A8.8 In the course of preparing the DDR consultation document, we completed a comprehensive programme of economic modelling for many potential uses of the digital dividend. Descriptions of the methodology used in this work are available in annex 9 to that consultation document.

A8.9 This involved constructing models that allow estimation of the value that might be generated by each of the potential uses under a wide range of plausible market outcomes. The models allow estimation of the willingness to pay for spectrum of individual operators and of the private producer and consumer value that might be generated from use of the spectrum. Willingness to pay for spectrum is not reported in this annex.

A8.10 The services modelled are:

- mobile multimedia;
- DTT services in SD and HD;
- local television;
- PMSE (professional and community use);
- mobile broadband—data centric; and
- mobile broadband—voice and data. 31

A8.11 We did not construct models for the value of low power uses at the time of the DDR consultation document as there was limited information on the nature of these uses. Further information has become available, and we have now completed an indicative estimate of the value of these services. This is discussed separately below as the approach taken is more restricted given the limitations of the available data.

A8.12 The models have been developed to take account of the considerable uncertainty over how much future demand there may be for these services and how markets might develop.

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31 The DDR consultation document referred to these final two services as mobile broadband and mobile communications respectively. However, as our understanding of the mobile services likely to be deployed in the digital dividend has grown, we no longer feel that these descriptions accurately capture the nature of the services modelled.
A8.13 The models also take into account the availability of alternative ways of delivering the same services. Hence, the values taken into account are incremental values (i.e. the additional gain that comes from using the digital dividend rather than some other likely means of delivering the service).

A8.14 The incremental value approach is part of a generally conservative approach to estimating the value of the digital dividend. This conservative approach is mirrored in our choices of input assumptions. While we looked for a wide range of input variables, we avoided using values for inputs that were excessively aggressive. Even the high end of our range of scenarios was built to be representative of reasonably plausible outcomes rather than the absolute highest value possible.

A8.15 When considering the results of the modelling analysis, it is important to keep in mind the difficulties faced by this type of analysis. The high level of uncertainty and the complexity of some of the inter relationships between services mean that this type of modelling can at best provide an order of magnitude assessment of value. The figures presented in this annex should therefore not be interpreted as precise estimates.

A8.16 It is also important to recognise that the numbers quoted are not an indication of auction proceeds. This is for a variety of reasons, including the following:

- the private producer and consumer value includes all value generated for both producers and consumers;
- the producer value we have modelled is total producer value, including the impact on other producers operating in relevant markets, rather than the producer value generated by the potential bidder alone; and
- the producer value generated by a potential bidder is the maximum they should be willing to bid in an auction. The amount a bidder will have to pay (i.e. auction proceeds) will be determined by the design and rules of the auction and the market circumstances at the time of the award. Auction proceeds are likely to be only a proportion of the producer value of the winning bidder.

A8.17 Some consultation respondents commented on our approach to modelling. These responses in general also had implications for our total value approach and for the impact assessment. Therefore, they have been included in annexes 2 and 5 and are not repeated here. However, some responses relating to the spillover benefits of PMSE use are discussed below in the relevant part of this annex.

**Generic modelling assumptions**

A8.18 Certain modelling assumptions are common to all the models that we have developed:

- our producer and consumer value numbers both discount future costs and benefits using the Treasury’s social discount rate of 3.5%;
- all of the modelling considered costs and benefits over a time period of around 20 years from 2007, with all results shown in 2008 pounds; and
when presenting values derived from our modelling, we have rounded appropriately given the level of uncertainty attached to these results. Values up to £250m (after rounding) have been rounded to the nearest £50m. Values greater than this but less than £1bn have been rounded to the nearest £100m. For values greater than £1bn, we have rounded to the nearest £500m. When we have given the aggregate value of the digital dividend, which is derived from a number of model outputs, we have rounded to the nearest £5bn to account for any compounded uncertainties. A different approach was taken to the value of the individual low power applications, which are given to the nearest £1m if the value is below £5m and to the nearest £5m for values which are up to £100m.

Producer and consumer value of likely licensed uses of the digital dividend

A8.19 Our 2006 economic modelling was built to encompass a wide range of possible developments in markets, technology and consumer tastes over a 20 year period. As a result, most of the new evidence is consistent with the range of our existing scenarios.

A8.20 We have checked the consistency of new evidence with existing models on a case by case basis. In most cases, we found that the updated body of evidence either lent further support to, or was consistent with, our original range of scenarios.

A8.21 The exception was the modelling of two way mobile services, where significant market developments have occurred and we have improved our understanding of the technological implications of using the digital dividend. At the time of the DDR consultation document, there was still uncertainty over whether it would be technically feasible to deploy these services in the digital dividend. The work completed by us and others in support of TG4 has significantly reduced this uncertainty and improved understanding of the benefits of using this spectrum for mobile services. Therefore, we updated our approach to modelling these services by developing two distinct but interrelated models (mobile broadband—voice and data and mobile broadband—data centric) and revised our estimates. This revised approach still led us to broadly similar results in terms of the wide ranges of value associated with these uses.

A8.22 We updated our scenarios on what the overall picture of use of the digital dividend may look like after the award process and of the total value this may generate.

A8.23 The sections below set out briefly how we modelled each of the services and what relevant new evidence has been received. The new mobile broadband models are also set out in more detail.

A8.24 The discussion below details the particular scenario used to determine the high and low value range for each service. However, the modelling work has incorporated a wide range of alternative scenarios which fit between these two points.

Mobile multimedia

A8.25 The business case for mobile multimedia services is driven by projected demand for high quality mobile television. This is an emerging service. As such, the uncertainty surrounding future demand is particularly large. This was reflected in our modelling by using several demand scenarios. These include one scenario where interest in the service is high, another where it is low and a third scenario where interest eventually becomes high after a slower start.
A8.26 The modelling encapsulated a very wide range of possible future outcomes. Since the DDR consultation document was published, we have checked the initial modelling against a wide range of new information that has become available, including submissions from stakeholders on network build costs and market forecasts as well as developments in the mobile multimedia industry in a number of foreign markets. The results have not led us to revise our broad range of estimates for the development of mobile multimedia in the digital dividend.

A8.27 The key inputs that affect the outcome of the mobile multimedia model are:

- demand. This can vary from high demand for this service nationwide or low demand for mobile television concentrated mainly in urban areas; and

- harmonisation. The modelling allows us to examine a state of the world in which a technology becomes widely adopted throughout Europe, reducing the cost of network components and handsets through economies of scale and thus stimulating demand, and a state of the world where this does not happen.

A8.28 The high and low cases for value to consumers and producers have not changed from those detailed in the DDR consultation document:

- high value scenario. There is high demand for mobile multimedia services, but this is delayed because of technology adoption issues. After a period, the technology chosen by the bidder also becomes widely adopted throughout Europe. Ultimately, two operators roll out mobile multimedia using the digital dividend. Each acquires enough spectrum to offer 24 mobile television channels; and

- low value scenario. There is only low demand for mobile multimedia services. As such, it remains a niche market, limiting rollout to urban areas. However, adoption of the technology throughout Europe is still sufficient to bring about economies of scale. Two operators roll out mobile multimedia using the digital dividend. Each acquires enough spectrum to offer 24 mobile television channels.

DTT services in SD and HD

A8.29 Several types of bidder could be interested in launching additional SD or HD services on the DTT platform using the digital dividend. These include a broadcast network operator, a broadcaster or a consortium. Our modelling attempted to cover all these possibilities by examining the economic incentives for a notional combined entity of broadcaster and network operator.

A8.30 The future demand for both SD and HD services on the DTT platform may be strongly influenced by changes in consumer tastes, driven by the introduction of HD. As consumers buy larger HD ready television sets and as more programmes are broadcast in HD, consumers may gradually value HD more than they presently do. Similarly, current SD services may look too blurry on a large television set, and viewers may come to value SD channels less than they do at present.

A8.31 Since the DDR consultation document was published, the evidence of future demand for DTT services in HD has continued to grow, but a considerable degree of uncertainty still remains. This matches our range of demand forecasts. Taking these developments into account, the overall balance of inputs in our scenarios are broadly right, and we did not identify reasons to change the original modelling.
A8.32 We also note that the approach taken to our modelling of this service is consistent with the economic modelling performed in our consultation document on the future of DTT. This proposes an upgrade for the DTT platform that will create additional capacity via updated technologies. It is more conservative when choosing inputs and uses a narrower range of inputs. This is because the purpose of the modelling work for the DTT consultation document was to obtain a conservative estimate of the impact of the upgrade whereas, in the work presented here, we have tried to generate a broader range of possible values.

A8.33 The key inputs that affect the outcome of the DTT model are:

- demand for HD. This may become very high in the future, or it may always be confined to a certain niche;
- number of multiplexes. In digital broadcasting, programming channels are normally bundled together into what is called a multiplex. These can be seen as groups of channels that use the same spectrum. As the number of multiplex deployed in the digital dividend drives the number of programming channels offered, this is an important driver of value;
- HD or SD use of the digital dividend. A multiplex operator could use the spectrum to offer services in HD and/or SD;
- number of HD services on the DTT platform in the absence of the digital dividend. Our model used a wide range for the number of DTT channels that could be offered in HD without additional spectrum; and
- number of HD services and SD services offered using the digital dividend.

A8.34 The high and low case for value to consumers and producers has not changed from that detailed in the DDR consultation document:

- HD high value scenario. Two additional multiplexes are deployed, each offering new HD channels with broad population coverage (in the region of 95%). The consumer value of incremental HD channels is relatively high. If the digital dividend is not available, the DTT platform is constrained to a maximum of five HD channels;
- HD low value scenario. As above, but consumers’ tastes are different and, as a result, demand for HD services is lower. As a consequence, only one multiplex is deployed;
- SD high value scenario. Two additional multiplexes are deployed, each offering new SD channels with broad population coverage (in the region of 95%). The consumer value of incremental SD channels is relatively high, and demand for HD channels is restricted to a niche segment; and
- SD low value scenario. As above, but demand for incremental SD channels is lower and, as a consequence, only one multiplex is deployed.
Local television

A8.35 Local television services could be offered on a variety of different platforms (e.g. DTT, cable, broadband or satellite). Our modelling sought to identify incremental benefits from an advertiser funded local television operator offering its services on the DTT platform rather than these alternatives. An important driver of such value is the assumed increase in viewers that local television services gain if the DTT platform is used rather than these other means of delivery. There is significant uncertainty over the amount of this gain. However, for the purpose of the modelling, which is seeking to identify plausible high and low value cases for using the digital dividend for local television, we have modelled some scenarios in which offering these services on the DTT platform adds significantly to the value of this service.

A8.36 The key inputs used in this modelling are:

- consumer demand for local television services. Demand for such services is uncertain, and we used low and high hypotheses;
- how effective other platforms are in reaching audiences for local television content. Alternative platforms, such as broadband delivery, may or may not be able to reach comparable audiences to that reachable via DTT. An assumption that alternative platforms are significantly inferior is used in some scenarios to generate a range of values. If alternative platforms can perform similarly to DTT, the incremental value of DTT would be close to zero; and
- achievable population coverage—the proportion of households that would be able to receive local television services.

A8.37 We have not found evidence that justified changing our range of scenarios for local television. The scenarios that covered the high and low ends of this range were:

- high value scenario. To derive a high value for the range, we designed a scenario in which using the digital dividend is important for the success of local television services. Therefore, if this spectrum is not available, local television services are not offered on the DTT platform and coverage for local television on other platforms is more limited. In this scenario, overall demand for local television is high. If the digital divided is available, two programming channels are offered per transmitter area via a dedicated local television multiplex using 8 MHz in each location. The rollout extends to maximise producer and consumer value (resulting in approximately 70% population coverage); and
- low value scenario. Demand for local television is low. If the digital dividend is not available, local television services are not offered on the DTT platform and coverage for local television on other platforms is even more limited than in the high value case. If the spectrum is available, two programming channels are offered per transmitter area via a dedicated local television multiplex using 8 MHz in each location. The rollout extends to maximise producer and consumer value (resulting in approximately 40% population coverage).

PMSE: professional and community

A8.38 We have assessed the value of spectrum to PMSE users under the coordination of a band manager.
A8.39 Our modelling of the value to producers and consumers of PMSE use of the digital dividend is subject to a particularly high degree of uncertainty because PMSE is often an intermediate product rather than a final good sold to the general public and also because of the history of the sector. So far, PMSE users have not been exposed to a market led approach to spectrum use, and therefore past demand for the service is unlikely to be a good indicator of future demand under market conditions.

A8.40 These issues make it very hard to estimate the underlying value of PMSE to consumers and producers. Given the large uncertainty, we used hypotheses that could plausibly turn out to be a significant understatement.

A8.41 We received some consultation responses that focused on the value of PMSE for the value chain to which it is connected, including theatres and the entertainment industry. This type of effect is known as spillover.

A8.42 We did not include these effects in our modelling. As a general approach, when modelling each of the services, we focused on specific sectors rather than trying to model value for the whole value chain. In addition, our consultants’ work indicated that, while PMSE use is likely to have spillover benefits from its value chain, the same is likely to be true for other potential uses of the digital dividend. The spillover benefits of PMSE did not seem to be larger than that found for other sectors.

A8.43 We also received consultation responses about the value of equipment that may be lost if PMSE users have to migrate to other spectrum. Our modelling indicates that the total value of PMSE services (and other competing services) is likely to be substantially higher than the value of equipment, so this has not been modelled separately.

A8.44 For the reasons presented above, the main input for our modelling is the level of underlying demand for spectrum for PMSE.

A8.45 The scenarios that represented the high and low end of the value range for this service were:

- high value scenario. A band manager leases interleaved spectrum to PMSE users. Without this spectrum, PMSE users are forced to migrate to another band, opportunities for which are severely constrained because of spectrum scarcity and equipment incompatibility. PMSE users’ willingness to pay for spectrum is relatively high (but still could be considered conservative); and

- low value scenario. As above, except that PMSE users’ willingness to pay for spectrum is assumed to be lower.

Mobile broadband—voice and data and mobile broadband—data centric

A8.46 In this statement, we use the term ‘mobile broadband’ to refer to two way voice and data services that are offered over cellular networks. This term is neutral as to the technologies used to deliver these services.
A8.47 There are two potential uses to which a mobile broadband operator might put the digital dividend:

- currently used mobile technologies. An operator may acquire spectrum and decide to use it to augment current 3G services that focus on both voice and data. Currently, UMTS technology is used in the UK to provide these services; and

- data centric mobile technologies. An operator acquiring this spectrum may decide to roll out a service using a newer technology. There are a number of competing technologies in this field. Some (e.g. mobile WiMAX) are already being deployed around the world, while others (e.g. LTE, ultra mobile broadband—UMB—and variants of the already widely used 3G standards of UMTS and CDMA2000) are in active development. A number of factors set these technologies apart from 3G networks. These may include higher speeds, greater spectral efficiency, the ability to serve a large number of users with high speed access in the same area, low latency (for effective VOIP and video calling) and a completely Internet Protocol based network architecture. In essence, these are many of the characteristics that at present can only be found in fixed line offerings.

A8.48 It is conceivable that an operator may choose to offer either of these services in the digital dividend.

A8.49 The factors that influence the incremental value of using the digital dividend for mobile broadband are:

- the impact of the propagation characteristics of this spectrum. UHF bands IV and V offer significantly better propagation for radio waves than higher frequency bands such as 2.1 GHz and 2.6 GHz. This provides the dual benefit of greater range outdoors and better in-building coverage in cluttered urban areas for the same number of transmitters. The DDR consultation document concentrated mainly on the rural benefits of lower frequency spectrum, but it has become clearer that the advantages are not confined to rural rollout; and

- the level of consumer demand for mobile data services.

A8.50 In 2007, there have been a number of developments relating to potential mobile broadband use of the digital dividend that have led us to adjust the scenarios laid out in the DDR consultation document. These developments are set out in annex 7.

A8.51 To aid our analysis, we have developed two models, each focusing on one of the two potential uses of the digital dividend envisaged by two way mobile operators, namely mobile broadband—voice and data, and mobile broadband—data centric.

Mobile broadband—voice and data

A8.52 This model looks closely at how the digital dividend could be used to augment an operator’s 3G network. Here, we assume that the benefits of this spectrum’s better propagation characteristics are used to extend 3G coverage to 90% and also to reduce the site requirement for good in building coverage within cities. We assume a scenario in which voice use increases slowly over the modelled period and data use at a more rapid rate:
high value scenario. In this scenario, we assume that three operators each acquire 10 MHz (2 x 5 MHz) of cleared spectrum and this is the first low frequency spectrum (below 1 GHz) that they use to gradually roll out the base layer of their 3G networks; and

low value scenario. In this scenario, we assume that three operators each acquire 10 MHz (2 x 5 MHz) of cleared spectrum but that all three already possess some liberalised 900 MHz spectrum. They each use cleared spectrum in conjunction with 900 MHz spectrum to roll out the base layer of their 3G networks.

A8.53 The modelling work completed here is consistent with work completed to examine the benefits of liberalising 900 MHz spectrum. The digital dividend is not a direct substitute for 900 MHz spectrum, so our modelling takes into account the differences in arriving at estimates of value.

A8.54 Additionally, we note that, while our high value scenario is less likely than it would have been prior to the publication of our consultation document on liberalising 900 MHz spectrum, we do not believe this creates any potential inconsistencies between our work on these two areas:

- it would be inappropriate for us to prejudge the outcome of our work on liberalising 900 MHz spectrum by excluding this option from our analysis in the DDR;
- although our modelling work in the DDR helps to inform our judgement on the total value of the digital dividend, none of our decisions set out in the statement rests on any one of the specific scenarios modelled; and
- the scenarios set out above are indicative of a broad range of possible outcomes. Many other scenarios lie between the plausible high and low cases. Therefore, if one particular scenario turns out in the future to be unrealistic, this does not invalidate the overall order of magnitude of our assessment of value.

Mobile broadband—data centric

A8.55 This model looks closely at how the digital dividend could be used in conjunction with 2.6 GHz spectrum to roll out a newer, more data centric mobile service. Here, we assume that the benefits of the digital dividend’s better propagation characteristics are used to gradually roll out a new technology. The availability of this new technology with faster speeds than 3G drives a surge of data traffic:

- high value scenario. In this scenario, we assume that two new entrants acquire 24 MHz of cleared spectrum each along with 24 MHz of 2.6 GHz spectrum and use these bands to roll out a service to 80% of the UK population over five years. Since these new entrants have no existing sites with which to collocate, cleared spectrum is particularly effective in reducing rollout and operating costs. We assume a high demand for these services that grows rapidly over the period of the modelling; and
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- low value scenario. In this scenario, we assume that two incumbents acquire 24 MHz of cleared spectrum each along with 24 MHz of 2.6 GHz spectrum and use these bands to roll out a service to 60% of the UK population over five years. These operators reuse up to 80% of their existing 3G sites, and this serves to somewhat reduce the value of cleared spectrum. We assume a moderate demand for services that grows and peaks through the period of the modelling.

A8.56 We have used a number of data sources to ensure that the inputs into the mobile broadband—data centric model are reflective of current developments in these very new technologies. Many of the technical parameters used are those of mobile WiMAX as LTE and UMB are unreleased technologies. However, there are enough similarities between them that this should not unduly affect the analysis.

A8.57 For both these models, the site calculation elements have been updated to reflect how the network and cell site requirements for an operator will vary when disparate frequencies are used to provide a national network. This has led to a focus on how the incremental availability of lower frequency spectrum allows a reduction in the number of sites needed and thus costs of rolling out a network.

External value

A8.58 External value, including BSV, is derived from externalities such as the contribution of a service to a better informed democracy, higher educational standards or a more inclusive society. The nature of these concepts makes external value difficult to measure. In addition, some of the services are new, and it is difficult for individuals to estimate their value to society in future. Therefore, any estimates of external value are subject to high levels of uncertainty.

A8.59 These limitations were taken into account when deciding how our own estimates of external value fit into our overall analysis. The main goal of these estimates was to provide an indication of whether externalities could result in a market failure. This would be the case if there are likely to be significant differences in the relative level of BSV generated by different potential uses of the digital dividend. This may result in services becoming significantly more valuable, relative to other services, once external value is taken into account.

A8.60 Our quantitative estimate of external value was based on the market research results. We included several questions in the quantitative and qualitative market research for this purpose. Some questions required respondents to consider one service at a time. They were then required to compare the value of a given service to them as individuals with that to society as a whole. Other questions compared the benefits for the UK as a whole across services. We were also able to observe the order in which respondents ranked services from both points of view. Some services that ranked highly from a personal perspective were given a lower rank from the citizen (societal) point of view and vice versa.

A8.61 We combined statistics from all of these responses to arrive at a plausible indication of how much additional value is created from externalities and how this additional value varies from service to service. We have rounded each result to the nearest 5% to reflect the large uncertainties surrounding the estimates.
Summary of results

A8.62 Table A39 sets out for each potential service an estimate of plausible highs and lows for the producer and consumer value that could be generated from the use of the digital dividend. These values are based on the high and low value scenarios set out above. They are not an indication of potential auction proceeds. These scenarios were identified based on assessing value for a number of different combinations of the key modelling variables (i.e. for a wide variety of different plausible future states of the world).

A8.63 The table also includes an estimate of the possible range of spectrum requirements for each of these uses. As can be seen, the high and low values for each service are not additive as there is insufficient spectrum available to meet all potential sources of demand.

A8.64 Finally, the table presents our estimates of the external value that may be generated by use of the digital dividend. It is not possible to provide an indicative estimate of the external value that might be generated by PMSE as, owing to the nature of this use, it was not included within our market research.

Table A39. Summary of results by service

<table>
<thead>
<tr>
<th>Service</th>
<th>Range of producer and consumer value (£bn)</th>
<th>Range of spectrum requirements (total for this service) (MHz)</th>
<th>Indicative range of external value (as a % of producer and consumer value)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobile multimedia</td>
<td>0.3-3.0</td>
<td>8-48</td>
<td>Up to 5%</td>
</tr>
<tr>
<td>DTT services in SD</td>
<td>0.5-3.0</td>
<td>24-112 (using an MFN)</td>
<td>Up to 10%</td>
</tr>
<tr>
<td>DTT services in HD</td>
<td>1.0-3.5</td>
<td>24-112 (using an MFN)</td>
<td>Up to 5%</td>
</tr>
<tr>
<td>Local television</td>
<td>0.05-1.0</td>
<td>8 at each location (either cleared or interleaved)</td>
<td>Up to 10%</td>
</tr>
<tr>
<td>PMSE (professional and community use)</td>
<td>0.15-0.5(^{32})</td>
<td>8 cleared (preferably channel 69) and up to 32 interleaved</td>
<td>N/A</td>
</tr>
<tr>
<td>Mobile broadband—data centric</td>
<td>1-2.5</td>
<td>0-64</td>
<td>Up to 15%</td>
</tr>
<tr>
<td>Mobile broadband—voice and data</td>
<td>0.5-2.0</td>
<td>10-64</td>
<td>Up to 15%</td>
</tr>
</tbody>
</table>

A8.65 Although technical and market developments over the last year have clarified the position of a number of services, there is still a great deal of uncertainty over the future value of the use of the digital dividend and the spectrum required by each service. Still, the biggest source of uncertainty lies in the difficulty of predicting the future markets for these services. The degree of uncertainty is such that no single service emerges from our modelling work as clearly having the highest value.

\(^{32}\) For the reasons set out above our estimate of the producer and consumer value of PMSE may understate the true value. This should be taken into account when interpreting these results.
A8.66 The DDR consultation document judged that each of the services is likely to
generate a similar proportion of external value (including BSV), and evidence has
not come to light that this has changed significantly. Given the error margins of
these results, the differences in the indicative levels of external value should not be
considered to be particularly significant. Although there is uncertainty over the value
that might be generated, our work still shows that the incremental external value is
relatively small compared to the producer and consumer value.

A8.67 The ranges given above for the consumer and producer values assume that, in
each of the high case and the low case scenarios, each service gains access to the
requisite amount of spectrum. However, this is far more in total than the size of the
digital dividend. Therefore, to gain an appreciation of the total value that might be
generated by using the spectrum, certain specific scenarios have to be considered.

A8.68 The DDR consultation document illustrated a number of scenarios, based on the
best information we had at that time, of plausible uses of the digital dividend. We
have updated these scenarios to reflect both the updated modelling work and the
changes in the feasibility of certain services being able to use the spectrum. Figure
A8 sets these out.

**Figure A8. Updated illustrative combinations of the use of the digital dividend**

A8.69 The set of scenarios that we consider reflects some changes from those in the DDR
consultation document. First, the proportion of the digital dividend that is illustrated
as being used by mobile broadband—voice and data and mobile broadband—data
centric is greater in some scenarios. This is due to a greater confidence that these
services could make use of the digital dividend and the consequential increased
interest from these services. The amount of spectrum illustrated as being used by
mobile multimedia services is somewhat lower as a number of consultation
responses indicated that a smaller amount of spectrum may be sufficient to meet
market needs given that a large number of video streams can be carried in a single
8 MHz channel. Similarly, the spectrum used by DTT is lower in some scenarios,
partly due to our proposals to improve the efficiency of use of the spectrum already
reserved for this service.

A8.70 To value these aggregate scenarios, we have used our models to generate service
scenarios appropriate to each case. The value generated by a service does not
scale in a simple linear fashion with the amount of spectrum used. There are some
discontinuities when a specific amount of spectrum becomes available or is lost for
a given service. This can affect the number of networks that can be rolled out, for example. We have also used combinations of high and low value scenarios that differ in each case. We think it is unlikely that all the services will generate the value suggested by their high scenarios and also unlikely that all the services will generate the value indicated by their low scenarios. It is more likely that some services will generate high values and some low values, but since the digital dividend is limited, it is more likely that the higher value services will gain access to the spectrum. Therefore, it is not possible to simply add together the results from the service by service, table 39 in order to replicate the aggregate value results.

A8.71 Although there are changes in some of the combinations illustrated above from those combinations outlined in the DDR consultation document, this has not significantly changed the aggregate value figures that were stated there. A value to producers and consumers of approximately £5bn-10bn (NPV over 20 years) is still the best estimate of value. Our analysis of external value suggests that externalities could increase this value by up to 10% in total.

A8.72 These combinations represent a range of different technically feasible outcomes and, as such, are illustrative. There is still a large degree of uncertainty as to the value to consumers and producers that might be generated by any service and also as to their technical requirements. Hence, these combinations do not take account of all possible outcomes for the uses represented and also do not take into account all the potential uses of the digital dividend. For example, public safety and low power uses are not shown, and the assessment does not take account of the potential split of DTT demand between services in SD and services in HD.

A8.73 The combinations set out above cannot, therefore, be considered to be a prediction of the likely outcome of the digital dividend awards.

Opportunity cost

A8.74 We have used the economic modelling work to inform our work on the possible costs to consumers and producers of potential interventions.

A8.75 The cost of reserving spectrum for one use is the value to producers and consumers that is foregone as a result of another use being denied access to the same spectrum. This is an important measure of the costs of intervention.

A8.76 To estimate opportunity cost, it is necessary to hypothesise how the digital dividend would be used in the absence of intervention.

A8.77 In our analysis of cleared spectrum, we have used the eight aggregate value scenarios suggested above as our base cases. In the case of intervention reducing the spectrum available, we assume that the services displaced are those that generate the least value to producers. All of the estimates are NPVs of producer and consumer value over 20 years.

A8.78 In our analysis of interleaved spectrum, we have taken a different approach. There is still significant uncertainty over the level of demand for interleaved spectrum in general. Another consideration is that our proposed approach is to only auction geographic packages suitable for local television and DTT, and channels which may be useful for mobile broadband services, with the remaining interleaved spectrum being awarded by beauty contest to a band manager. As a result, we think that the best approach to identifying opportunity cost is to estimate the costs of precluding three different types of use of interleaved spectrum. These are:
the cost of precluding access to interleaved spectrum suitable for local television and DTT;

the cost of precluding access to interleaved spectrum suitable for mobile broadband downlinks; and

the cost of precluding access to other interleaved spectrum.

A8.79 Given the level of uncertainty involved in the modelling of both the opportunity costs and the value of each service, and the wide ranges of both of these results, it is not possible to compare the value of a service with the opportunity cost of its spectrum use and, based on this, conclude that it should or should not use spectrum. At best, these results can be used to provide an indication of whether the value of a service and the opportunity cost of its use of spectrum are of a similar order of magnitude.

Cleared spectrum

A8.80 Table A40 summarises the ranges that we have calculated for cleared spectrum. The opportunity cost increases with an increase in the number of channels withheld from the market through intervention. There is a range of values for each given number of channels because we have a range of hypotheses for what the use could be in the absence of intervention.

Table A40. Opportunity costs for cleared spectrum

<table>
<thead>
<tr>
<th>Number of channels</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low value</td>
<td>£100m</td>
<td>£200m</td>
<td>£400m</td>
<td>£700m</td>
<td>£1bn</td>
<td>£1bn</td>
</tr>
<tr>
<td>High value</td>
<td>£400m</td>
<td>£700m</td>
<td>£1bn</td>
<td>£1.5bn</td>
<td>£2bn</td>
<td>£2.5bn</td>
</tr>
</tbody>
</table>

A8.81 Our estimate of opportunity cost followed a two step procedure. First, we used scenarios A-H as described in figure A8 to create eight hypotheses (one for each scenario) about which services could be displaced in the event of an intervention that reduces available cleared spectrum by one channel. From this, we had eight different estimates of the opportunity cost of one channel. The second step was to select, from those eight estimates, the highest and lowest values, to generate the range shown above. The same procedure was used for the opportunity cost of two to six channels.

A8.82 The high and low ends shown in table A40 therefore combine information from scenarios A-H. The particular scenarios that sit on the top and bottom end of the range are different at different points. This approach can lead to some discontinuities in opportunity cost (i.e. if the numbers above were charted, they would not form a perfectly smooth curve).

A8.83 Such estimates can only illustrate the order of magnitude of the opportunity costs, for a number of reasons. The collection of scenarios A-H is only a representative collection of plausible outcomes. Many more scenarios are possible. The underlying estimates of value for each service are also subject to considerable uncertainty, as noted earlier.
Additionally, these results are generic and do not model a particular intervention. All channels are treated as being the same. However, some particular types of intervention, for particular channels, could have a much higher effect than suggested here. For example, the effects of European harmonisation for mobile broadband use would be focused on only a few channels. In a world where there is high demand for more mobile broadband services, taking away just one of these channels could lead to a higher opportunity cost than table A40 suggests.

Interleaved spectrum

As mentioned above, we have considered three illustrative scenarios in order to assess the magnitude of the opportunity costs of different types of intervention in interleaved spectrum.

Local television and DTT

The first scenario considers interleaved spectrum most suitable for broadcasting. This is in line with our decisions, detailed in section 8, to release some assignments that are suitable for local television and DTT.

For the purposes of this calculation, we considered around 25 geographic packages of interleaved spectrum that would be the best available, in each particular location, for broadcasting.

Our modelling assesses the value that would be lost by precluding access to these packages for DTT or mobile television. We exclude other potential uses for a variety of reasons:

- use for mobile broadband is less likely because of a combination of technical and commercial issues;
- we assume PMSE users, who will have access to most available interleaved spectrum, will not bid for a small additional amount; and
- we exclude local television as discussion of potential interventions focuses on their benefiting from the intervention, not being displaced.

In more detail, we hypothesise that if a package of interleaved spectrum suitable for television is awarded, it could be used:

- to expand coverage of a mobile television network with partial coverage; or
- for part of the coverage of a DTT network.

If these uses of interleaved spectrum were precluded, we estimate that this could result in a loss of producer and consumer value ranging from £30m-400m.

Mobile broadband

The next scenario we have examined is formed by using some interleaved spectrum for mobile broadband downlinks. To inform this scenario, we have assumed that a package of interleaved channels 61 and 62 could be made available in a way suitable for mobile broadband use.
A8.92 Some of the band plans being considered for harmonising spectrum in UHF bands IV and V for mobile broadband services include these channels. Although interleaved spectrum is not as useful as cleared spectrum, it could be used to provide additional mobile downlink capacity in certain areas of the country where it is not used for DTT.

A8.93 Our estimate of the opportunity cost under this scenario is based on the producer and consumer value lost by precluding access to this interleaved spectrum for mobile broadband use. Our analysis suggests that this could be up to £200m.

Other

A8.94 Finally, we examine a scenario where a package of two other channels of interleaved spectrum are made available.

A8.95 Our working hypothesis is that the most likely use of this type of package (assuming that the other two packages mentioned above are also available) is mobile multimedia. This is because technical considerations would exclude most other uses, including mobile broadband. Under this hypothesis, our modelling suggests precluding access to this interleaved spectrum could result in a lost of producer and consumer value of up to £60m.

Licence exempt uses of the digital dividend

A8.96 The potential licence exempt applications that might be deployed in the digital dividend include:

- home networks, including automation and control;
- business networks;
- community and campus networks;
- municipal Wi-Fi;
- Internet connection sharing by multiple households;
- industrial monitoring and automation;
- agricultural monitoring and automation;
- rural broadband provision;
- ubiquitous wireless networks;
- sensor based networks;
- remote patient monitoring and healthcare; and
- an alternative UK wide broadband wireless network.
A8.97 The analysis we used to assess the potential producer and consumer value of these uses is to look at the incremental cost savings that may be realised by installing equipment using the digital dividend rather than 2.4 GHz. This approach is consistent with the approach we have taken to assessing the incremental value of other potential uses of the digital dividend.

A8.98 Our analysis assumes that all of these uses are viable at 2.4 GHz. If they are not, the value may be higher than quoted. Furthermore, the value for some uses, such as remote patient monitoring, has not been modelled as it is not yet possible to make a sensible judgement of the scale and type of use. Conversely, no account is taken of risk or the potential interference issues that may arise or that some of these uses may not emerge. This would serve to overstate the value. Table A41 lists the main modelling assumptions employed.

A8.99 It is important to stress that our modelling is purely illustrative. It involves building hypotheses of how the different uses outlined above might be deployed, to what extent and with what cost, and then assesses the cost savings that would result at this level of demand using the digital dividend rather than 2.4 GHz. As such, it should be used with caution.

<table>
<thead>
<tr>
<th>Use</th>
<th>Modelling parameters</th>
<th>Understanding of use</th>
<th>Incremental cost savings (£m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longer range/more robust household WLANs</td>
<td>Assumes that 20% of UK households will be using Wi-Fi and that 10% of these will benefit from increased range and be able to use a single router instead of a repeater</td>
<td>Well defined</td>
<td>55-85</td>
</tr>
<tr>
<td>Longer range/more robust business WLANs</td>
<td>A wide category that includes use of WLANs in office, retail and public service based environments. The total UK service employment was used to estimate total UK office space. It was then assumed that, between 2012 and 2032, 75% coverage would be desired</td>
<td>Well defined</td>
<td>55-100</td>
</tr>
<tr>
<td>Municipal Wi-Fi access</td>
<td>The 8km² of UK central business district is assumed to get 100% coverage, as is 10% of the next 1,103 km² of densely populated areas</td>
<td>Well defined</td>
<td>25-35</td>
</tr>
<tr>
<td>Internet connection sharing by multiple households</td>
<td>A more speculative use. It is assumed that 5m households on average will not have access to DSL or cable over the period 2012-2032. Of these, 2% might seek to use schemes that allow DSL capacity to be distributed among users. This type of service may be initiated privately, aimed at lower income households or be provided by public bodies</td>
<td>Reasonably well understood</td>
<td>15-20</td>
</tr>
<tr>
<td>Industrial monitoring and automation</td>
<td>Similar to above, total UK manufacturing workspace was calculated from employment statistics and assumes 20% Wi-Fi coverage would be installed</td>
<td>Loosely defined</td>
<td>20-30</td>
</tr>
<tr>
<td>Agricultural monitoring and automation</td>
<td>A speculative use. It was assumed that 1% of the UK’s 300,000 farms would adopt smart monitoring technology and each deploy enough equipment to cover 5% of the area of their holding</td>
<td>Loosely defined</td>
<td>1-3</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td><strong>150-250</strong></td>
</tr>
</tbody>
</table>

33 This column represents how developed the proposals are for each use. ‘Well defined’ uses are based on products already on the market. ‘Loosely defined’ product uses have been suggested, but no firm proposals or prototypes have been developed.
A8.100 Clearly, this is an approximate analysis that seeks to give an order of magnitude range of the value to consumers and producers that might be delivered by identifiable licence exempt uses of the digital dividend. From this analysis, it appears that foreseeable applications might deliver around £150m-250m of value over 20 years. This analysis does not tell us anything about uses yet to be identified or about the dynamic innovation and competition benefits that might be brought about by licence exemption in this spectrum. However, our modelling of licensed uses also does not incorporate these wider effects.

Channel 36

A8.101 We used our economic models outlined above to assess the value to consumers and producers of potential early use and early award of channel 36.

A8.102 The first question we examined using the models was the value that could be generated by allowing use of channel 36 as soon as it is cleared in March 2009. If use were allowed from this date, channel 36 would be available UK wide three years before the rest of the digital dividend.

A8.103 We considered the potential uses of channel 36 to illustrate the magnitude of the benefits of early use:

- first, we considered the value to consumers and producers that might be generated by a mobile multimedia operator using channel 36 to enter the market three years earlier. We estimate that this could be £200m-500m, depending on the demand scenario chosen; and
- second, we considered the producer and consumer value generated by an SFN HD multiplex being available three years earlier. The modelling work suggests that this could range from nothing, if demand for DTT services in HD remains niche, to £170m, if there is stronger demand.

A8.104 The second question we examined using the models is the benefit that would arise from awarding channel 36 before cleared spectrum. To arrive at an indicative estimate of this value, we assume that early award may provide a six month advantage for an operator.

A8.105 The mobile multimedia analysis suggests that the NPV of the incremental value to consumers and producers generated by an operator having access to channel 36 six months earlier is in the order of £0-40m. The bottom end of this range is zero because, in some of the lower demand scenarios, the small benefits from increased demand are outweighed by higher earlier network equipment costs. There is more uncertainty over this value than that calculated for three years’ earlier use as our economic models were not originally designed to look at such short timescales.

Conclusions

A8.106 Our analysis in the DDR consultation document had reached the following conclusions:

- the high degree of uncertainty required consideration of a wide range of assumptions when assessing the value that each use of the digital dividend might generate;
• taking account of this uncertainty, the modelling work confirmed that there is very likely to be excess demand for this spectrum;

• it was plausible that high value to consumers could be generated by a wide variety of uses; and

• a number of uses could generate the highest total value, and no single use emerged as clearly the most valuable to society.

A8.107 Since the DDR consultation document was published, the body of evidence to support these conclusions has grown. In particular, the conclusion that there is likely to be excess demand for the digital dividend seems even more likely given the growing interest of the mobile broadband sector in these frequencies and continuing signals of demand for DTT services in HD.
Annex 9

Summary of technical studies

Background and introduction

A9.1 Alongside the DDR consultation document, we published a number of technical studies that looked at the suitability of the digital dividend for a variety of services as well as the established use of UHF bands IV and V for DTT and PMSE.

A9.2 Consultation responses raised further questions about how new services could use cleared and interleaved spectrum while providing appropriate protection to DTT, especially after DSO. This is an important issue to which we have given a great deal of thought during the past year.

A9.3 To help us understand in more detail how the full range of potential services could use the digital dividend, we commissioned a further series of detailed technical studies during 2007. These focused on two broad issues:

- how using the digital dividend for a wide range of new services could affect the coverage and reception of DTT and Five’s analogue television service both before and after DSO. These reports also looked at ways of minimising any potential impact on existing services; and
- assessing how these new services could interact with each other, especially when occupying adjacent channels, and whether there are ways of minimising this interaction to maximise flexible use of the spectrum.

A9.4 These annex contains high level summaries of these reports and links to the full reports on our website.

A9.5 We wish to make it very clear that we have not made any final decisions about what level of protection we will require to protect DTT and Five’s analogue television service from any new use of the digital dividend. The technical reports should therefore be viewed as an important contribution to our understanding of these issues rather than representative of our views. The consultations on detailed award design in spring 2008 will consider this very important issue.

Mason report: technical study into IMT systems in digital dividend spectrum

A9.6 To provide additional certainty on the feasibility of two way mobile operation in the digital dividend, we conducted further work internally and commissioned further work from Mason.34

A9.7 The Mason report concluded that, in the absence of interference constraints, using UHF bands IV and V can substantially reduce the cost of the infrastructure required to provide broadband mobile services to rural and built up areas compared with the use of higher frequency bands such as 2100 MHz. The benefits of using upper cleared spectrum are similar in scale to using the 900 MHz band.35 Infrastructure costs are further reduced in lower cleared spectrum, but this reduction is offset by the reduced antenna gain available in small mobile terminals such as handsets.

35 www.ofcom.org.uk/consult/condocs/liberalisation.
A9.8 The need to adhere to the international interference constraints agreed by the UK as part of GE-06 will cause higher levels of interference to a typical mobile network compared to a base case. The dominant interference constraint in most channels is the requirement to accept incoming interference from high power DTT services in neighbouring countries into base station receivers. The Mason report proposes a range of mitigation techniques that could be adopted. These include an increase in number of sites of 27-68% (compared to the non interference base case) for the channels assessed within lower cleared spectrum and of 4-54% for the channels assessed within upper cleared spectrum.

A9.9 The impact of interference from portable mobile transmitters into a range of DTT receivers was measured. These measurements showed significant variations in the level of interference that different receivers could accept. In the case of the most commonly used receivers, the interference tolerance was rather greater than had been indicated by our previous studies. However, the application of fast transmit power control, as commonly used in 3G mobile systems, imposed an extra requirement for interference protection of some 10-15 dB.

A9.10 A series of simulations was carried out. This examined the probability of DTT receivers using outdoor aerials suffering interference when mobile transmitters are deployed in the same area at typical densities, including the application of power control. The results suggested that a 3 MHz guard band between mobile transmissions and DTT reception was sufficient to reduce the probability of interference to below 1% for DTT receivers operating in low signal areas. This suggests that using cleared spectrum for mobile transmitters is feasible subject to appropriate planning and technical conditions.

A9.11 Interference from DTT transmissions into two way mobile systems was shown to be severe in some cases. This would require that mobile network designers take DTT transmitters and other potential high power transmitters into account when designing their networks. In some cases, this may limit service quality and capacity close to high power transmitters and require specific mitigations to be applied. However, measures such as filtering at base station receivers and interference cancellation techniques appear able to provide substantial lessening of these effects.

A9.12 Use of interleaved spectrum for two way mobile systems is under further technical consideration to determine its feasibility. It is noted that equipment produced for use in markets beyond the UK is likely to have to tolerate interference from DTT systems in channels accepted by the mobile receiver pass band. This may therefore mean that mobile equipment specifications need to be improved to deal with this case even if the UK does not make interleaved spectrum available for mobile use.

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36 Power control is a technique whereby the transmitter power may be varied automatically by the system to compensate for propagation conditions between the base station transmitter and the mobile terminal. This optimises the capacity of the mobile network and reduces the battery consumption of the mobile terminal.
Aegis & ERA reports: technical work to assess the implications of mobile television use in channel 36

A9.13 Considerable interest has been shown by stakeholders in the use of channel 36 for mobile television. Early of the channel during 2009 following its clearance could allow a mobile television service to commence while analogue television services were still in operation. In particular, Five broadcasts its analogue television service in some areas of the UK in neighbouring channels 35 and 37. We asked Aegis and ERA to investigate the potential for interference to Five’s analogue television service and to consider the possibilities and effectiveness of mitigating strategies.37/38

A9.14 The Aegis work concluded that approximately 3% of Five’s analogue television viewers in core reception areas using channel 35 or 37 could suffer some degree of interference to reception from a mobile service using a dense layer of medium powered transmitters in channel 36.

A9.15 ERA carried out some practical tests to assess the degree to which this interference could be mitigated in a variety of different scenarios. They concluded that mitigation was possible with improved filtering of the mobile transmitters but that the improvement was limited, variable and dependent to a significant extent on the characteristics of individual analogue television receivers.

A9.16 The overall conclusion of the adjacent channel interference work is that careful deployment of a mobile television service will be required to avoid any significant interference to the reception of Five’s existing analogue television service. We have yet to consider what conditions we would impose on the deployment of such a service. However, we expect that the use of channel 36 will be subject to conditions requiring protection of Five’s analogue television service.

A9.17 Aegis also considered whether mobile television services in channel 36 would affect reception of DTT in neighbouring countries. Aegis concluded that, although interference would be high, it could be held within reasonable bounds by careful attention to transmitter power and aerial directionality.

A9.18 We have yet to agree exported interference limits with these countries, but we are proposing a field strength limit at the coastline of Belgium, France and the Netherlands and at the coastline and international land border of Ireland and the UK of 45 dBµV/m (1% of the time at 50% of locations). The figure finally agreed bilaterally with each country will be on a reciprocal basis (i.e. the same levels of interference we export could be imported into the UK). This proposal is subject to consideration by each country, and the individual limits that are subsequently agreed may be different from the figure initially proposed by us.

NGW report: interleaved spectrum study

Summary

A9.19 We commissioned NGW to carry out a study on interleaved spectrum. This had the following objectives:

- to determine whether one or more channels suitable but not reserved for local television could be identified in interleaved spectrum at 71 large transmitter stations after DSO;

- to ensure that using these channels would protect the coverage targets for the PSB and COM DTT multiplexes; and

- to provide DTT channel use, antenna templates and field strength data for all interleaved channels to help assess the remaining ‘white space’ in interleaved spectrum for possible PMSE use. These data provided the basis for the Sagentia PMSE study, which is summarised later in this annex.

Working methodology

A9.20 The introduction of any new services within interleaved spectrum will inevitably have an impact on the coverage of the six DTT multiplexes. The methodology adopted in NGW’s study aims to protect the core coverage of a DTT transmitter station, as defined by the digital preferred service area (DPSA). Any impact of the new use is therefore limited to overlapping coverage areas between stations. This approach protects the coverage target of 98.5% coverage for the PSB multiplexes while allowing sufficient flexibility to identify interleaved channels for additional services.

A9.21 NGW considered various ways to define the DPSA. The chosen method provides for coverage by all three PSB multiplexes and the maximum number of COM multiplexes in each 100m square pixel. However, the effect of this DPSA algorithm is that some relay stations were not assigned any coverage as overlapping coverage from other stations is deemed to offer a better service. This algorithm also does not take account of national or regional borders. The DPSA algorithm could be refined in future to take account of these issues.

Planning rules

A9.22 We specified 71 transmitter stations to be considered in the study, as figure A9 shows. This does not exclude other stations from future consideration where interleaved spectrum may be available.

**Figure A9. Transmitter stations considered in NGW's study**

**Individual station results**

A9.23 Initially, NGW looked at each of the 71 stations in isolation to determine the best channel in terms of theoretical predicted coverage. The detailed results for all 71 stations can be found in the full report.

A9.24 NGW also looked at reducing the antenna height and the power used at each station. This improves the antenna template but at the expense of theoretical predicted coverage and indicates that a balance of parameters can probably be found to meet a variety of coverage targets.

A9.25 A particular channel may offer the best theoretical coverage at a station when considered in isolation. However, if the station is part of a regional or national network, other channels may be better to avoid interference to neighbouring stations in the network using the same channel, thus optimising the aggregated network coverage.
Network results

A9.26 An aggregated network of 71 stations was modelled. This is predicted to provide a maximum theoretical coverage of over 80% of UK households if the more robust QPSK 2/3 modulation is adopted. This falls to about 60% for the less robust but higher capacity 64 QAM 2/3 modulation. See table A42 for the details and figure A10 for an indicative coverage map.

Table A42. Theoretical maximum network coverage of the 71 stations

<table>
<thead>
<tr>
<th>Modulation</th>
<th>UK households</th>
<th>UK coverage</th>
</tr>
</thead>
<tbody>
<tr>
<td>QPSK 2/3</td>
<td>21,504,356</td>
<td>81.83%</td>
</tr>
<tr>
<td>64 QAM 2/3</td>
<td>16,857,312</td>
<td>64.15%</td>
</tr>
</tbody>
</table>

Figure A10. Theoretical maximum coverage of the 71 stations (70% locations)

A9.27 Predicted coverage is based on the theoretical antenna template and maximum ERP associated with each of the interleaved channels. Real antennas and ERPs will generally result in a reduction in predicted coverage.

A9.28 As noted above any new services launched using interleaved spectrum are likely to have some impact on the coverage of existing DTT services. This was also modelled by NGW and their predicted potential consequential impact of introducing a new 71 station network on the UK coverage of the PSB and COM multiplexes is shown in table A43.
The predicted theoretical worst case impacts on the six DTT multiplexes are very small on a UK scale. However, there are much larger impacts for individual PSB and COM multiplexes at individual stations as a result of removing overlapping coverage.

A list of all impacts on the overlap coverage of the six main DTT multiplexes at individual stations can be found in the full report. The impacts shown are a worst case as they have been predicted using theoretical antenna templates and maximum powers and heights. Practical antenna patterns and more realistic (i.e. lower) powers and heights will reduce the predicted coverage of the additional multiplex but will also mitigate the coverage impact on the PSB and COM multiplexes. The predictions also assume that all 71 stations will be implemented, which may not be the case.

On the other hand, if there is more than one additional service in interleaved spectrum (e.g. a seventh UK multiplex and a local television service), this will cause more interference and remove more overlaps in the coverage of the six main DTT multiplexes. The more new services use interleaved spectrum, the greater the potential interference to the six DTT multiplexes.

Comment

The results of the study should only be taken as a general indication of what may be possible in interleaved spectrum using the specified transmitter sites and given the assumptions made (e.g. the use of rooftop aerials or the need to gain international agreement for any of the proposed assignments). It is not a definitive plan. Different frequency plans will be better for different coverage requirements, such as a single town or city, a region, a nation the UK or a mixed permutation.

Certain criteria have been assumed for the protection of the three PSB and three COM multiplexes. We have not endorsed or made any decisions regarding these criteria. Thus, any future change in the protection criteria will affect the results of this study.
ERA report: investigation into the performance of a range of DTT set top box receivers

A9.34 ERA was asked to carry out detailed research on compatibility and interference issues between DTT receivers and some possible new uses of the digital dividend.  
A9.35 ERA measured the radio frequency performance of 15 domestic DTT receivers that are currently available to consumers. Measurements were carried out to assess the performance of each receiver in the presence of an unwanted interfering signal (such as mobile television) on one of a wide range of different neighbouring channels. A range of channel separations was tested, ranging up to 11 channels above and below the wanted DTT channel being received. These measurements enabled ERA to determine the spread in performance of different receivers and to enable subsequent comparison of the relative sensitivity of the DTT receiver to interference from other types of non television signal.

A9.36 The test involved increasing the power of the interfering DTT signal until the wanted DTT signal just failed. For DTT systems, this failure point can be very accurately determined since they have a relatively abrupt failure characteristic. The C/I at which the wanted DTT signal just fails is known as the protection ratio.

A9.37 The results show a peak of interference at nine channels above the wanted DTT channel. This is technically known as the image channel' or N+9. For example, when channel 31 is the wanted channel, the image channel would be channel 40. This peak represents the point at which the receiver is much more sensitive to interference than other channels nearby. It is almost as sensitive as the case when the interference is adjacent to the wanted channel (N+1 or N-1). This sensitivity is a facet of all superheterodyne receivers, which constitute the great majority of television receivers (of any type) in use today. The tested receivers varied in performance but indicated a significant response at the image channel. In practice, this means that care in network deployments needs to be taken to ensure unacceptable interference is not caused to receivers from transmitters operating in the image channel.

A9.38 Seven of the receivers were considered as having a ‘typical’ operating performance. Despite being available from different manufacturers, the typical performing receivers had the same generic processor and RF demodulator box inside the casing. Three of the receivers were considered as having the worst performance. Five of the receivers were considered as having the best performance.

A9.39 The adjacent channel responses of the receivers were found to be generally much better than the specifications found in the UK industry recognised ‘D’ Book. The tolerance of a DTT receiver to interference is improved as the frequency separation between wanted and unwanted is increased.

A9.40 Three of the 15 tested receivers were identified representing typical, worst and best case performance on which further more detailed analysis was carried out. These tests showed that:

- the protection ratios measured were reasonably constant over a range of input signal levels until the increasing signal level caused receiver overload, resulting in less interference signal level to cause picture failure;

the DTT receiver with a wanted signal modulated with 16 QAM was more tolerant to interference than a wanted signal modulated with 64 QAM; and

the results show that the receiver performance is broadly similar regardless of operating channel across cleared spectrum.

**ERA report: measurement of protection ratio between potential new and existing service types in digital dividend spectrum**

A9.41 ERA also carried out measurements on the protection ratios of DTT in the presence of other types of interferer.\(^{42}\)

A9.42 The measurements investigate the impact on the protection ratio of a number of different operational scenarios and frequency separations. These results were obtained in a similar way to the DTT receiver measurements, by testing for a failure of picture quality in the case of a DTT receiver or data readability in the other types of service, when in the presence of various levels of signal interference.

A9.43 The measurement scenarios investigated were:

- UMTS user equipment interference into a DTT receiver;
- DTT interference into UMTS user equipment;
- UMTS base station interference into a DTT receiver;
- DTT interference into UMTS base station receiver;
- WiMAX user terminal interference into a DTT receiver;
- WiMAX base station interference into a DTT receiver;
- DTT interference into a fixed WiMAX system; and
- DTT interference into a mobile television handset.

A9.44 Table 26 in the report (reproduced as table A44 below) shows a comparison of protection ratios for DTT, UMTS and WiMAX interference into a typically performing DTT receiver (64 QAM FEC 2/3). The handheld mobile phone is known as the User Equipment (UE), and this transmits to and receives from a base station.

<table>
<thead>
<tr>
<th>Interferer</th>
<th>Measured C/I protection ratio (dB)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N-2</td>
</tr>
<tr>
<td>DTT (static)</td>
<td>-52</td>
</tr>
<tr>
<td>UMTS UE (static)</td>
<td>-51</td>
</tr>
<tr>
<td>UMTS UE simulated at 3 kph</td>
<td>-33</td>
</tr>
<tr>
<td>UMTS UE simulated at 50 kph</td>
<td>-37</td>
</tr>
<tr>
<td>UMTS UE simulated at 120 kph</td>
<td>-33</td>
</tr>
<tr>
<td>Base station (static)</td>
<td>-51</td>
</tr>
</tbody>
</table>

A9.45 The table shows that the DTT receiver is some 10-15 dB more sensitive to interference from the UMTS mobile system (in the non static case) than it would be to interference from a DTT transmission on the same channel. This is due to the power control mechanisms employed in the UMTS system to compensate for the rapid signal fading as the UE moves. In the static case, the signal power is constant. At higher speeds, the UE has to compensate for more rapid fading, but the impact on the DTT receiver very similar to the slow speed case.

A9.46 The report also contains the results of tests performed with DTT as the interferer into UMTS and WiMAX.

A9.47 The results from the scenarios investigated reflect tests carried out on available test equipment to best represent compatibility between the systems available at this time. The report notes that the UMTS and WiMAX test equipment was not specifically designed for use in UHF bands IV and V. However, a system specification may be designed in the future to have characteristics for a higher degree of compatibility between services in this spectrum.

A9.48 The system types tested are not inclusive of all the possible technologies that could use the digital dividend.

**Aegis report: interference analysis of mobile WiMAX, DTT and DVB-H systems**

A9.49 We commissioned Aegis to investigate the compatibility of a potential mobile broadband wireless application using WiMAX technology adjacent to a DTT or mobile television (DVB-H) system.43

A9.50 Aegis developed the following eight interference scenarios using the statistical Monte Carlo modelling method to determine the probability of interference between the different networks.

**Compatibility between WiMAX and DTT**

**WiMAX base station transmitter into fixed DTT**

A9.51 This compatibility is dependent on the location of the WiMAX transmitters with respect to the DTT transmitter service coverage area. The analysis was carried out for a range of separations to calculate the interference probability over the whole DTT coverage area.

A9.52 The results indicate that DTT service would be lost over 42.8% of the DTT coverage area with no guard band and 11.9% with a 1 MHz guard band. The report notes that, with a guard band of 1-7 MHz, the probability of interference would not change significantly from the 1 MHz case due to the poor WiMAX transmitter filtering on adjacent channels. It also notes that if the real population distribution were taken into account, these figures could be significantly less.

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43 [www.ofcom.org.uk/consult/condocs/ddr/statement/Aegis2.pdf](http://www.ofcom.org.uk/consult/condocs/ddr/statement/Aegis2.pdf)
WiMAX user terminal into DTT

A9.53 The study analysed a worst case scenario where the WiMAX user terminals were located at the edge of coverage of the DTT transmitter station. The probability of interference was calculated to be less than 0.01% of coverage with no guard band. Although these results indicate compatibility for a wide simulation area, further analysis was carried out to determine how close the WiMAX subscriber station could operate to the DTT receiver without causing interference.

A9.54 These results indicate that a WiMAX user terminal located inside a building could cause interference to DTT reception at separations of 70m or less when it is directly in line with the boresite (direction of strongest signal reception) of a rooftop aerial of a DTT household. This is with no guard band. Table A45 gives the figures for different guard bands and for both on-boresite and off the back of the aerial (corresponding to poorest signal reception). Improved transmitter filtering in the WiMAX user terminal would significantly reduce these distances.

Table A45. WiMAX user terminal interference distances

<table>
<thead>
<tr>
<th></th>
<th>No guard band</th>
<th>1 MHz guard band</th>
<th>7 MHz guard band</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boresite</td>
<td>70m</td>
<td>44m</td>
<td>27m</td>
</tr>
<tr>
<td>Away from antenna main beam</td>
<td>11m</td>
<td>7m</td>
<td>4.3m</td>
</tr>
</tbody>
</table>

DTT transmitter into WiMAX base station

A9.55 The analysis indicates that the protection ratio of the WiMAX base station receiver is exceeded for almost all the possible locations with the DTT coverage area, such that the signal from the user terminal cannot be received with a guard band of 5 MHz or less. However, since the location of the planned base stations and DTT transmitter are fixed, potential interference can be mitigated to a significant extent with improved WiMAX receiver filters and careful network planning using antenna discrimination, separation and coordination between the DTT transmitter and the WiMAX base stations.

DTT transmitter into WiMAX user terminal

A9.56 The analysis gave an interference probability to the WiMAX user terminal coverage area of 1.24% with no guard band and 0.84% with a 1 MHz guard band, falling to 0.35% with a 6 MHz guard band. The report noted that these results are pessimistic due to the WiMAX receive filter characteristics used. Aegis modelled a 5 MHz WiMAX scenario to fit into an 8 MHz channel, but the filter protection ratios used are based on a 20 MHz filter measured by ERA. This wider filter will have less steep interference rejection for a given frequency offset than a 5 MHz filter, and therefore, in practice, the levels of interference calculated are likely to be much lower.

Compatibility between WiMAX and DVB-H

WiMAX base station into DVB-H

A9.57 In this scenario, the probability of interference to the DVB-H receiver coverage area is calculated to be 2.22% with no guard band and 0.47% with a 1 MHz guard band.
WiMAX user terminal into DVB-H

A9.58 The results indicate that the probability of interference from mobile WiMAX subscriber stations into a DVB-H receiver coverage area is very small, with the Monte Carlo simulations returning a zero probability. In a similar way to the DVB-T case, this compatibility is determined by the interference when the equipment is in close proximity, in this case a DVB-H handheld receiver operating within the same room or office building with the WiMAX user terminal. The results indicate 212m separation required with no guard band, reducing to 82m with a 7 MHz guard band. This could be improved with better mobile WiMAX user terminal transmitter filters than used in the analysis.

DVB-H into WiMAX base station

A9.59 In this scenario, the WiMAX base station receiver experiences significant interference for all of the calculated probabilities by the presence of the DVB-H transmitter, such that the subscriber station signal cannot be received with a 5 MHz guard band. In this case, the calculated effects are worse than those for the DVB-T transmitter due to the higher field strength requirement for reception of DVB-H with smaller coverage areas. As in the case for DTT transmitters, a significant level of mitigation can be achieved with careful network planning using antenna discrimination, filtering, separation and coordination between the DVB-H transmitter stations and WiMAX base stations.

DVB-H transmitter into WiMAX user terminal

A9.60 Due to higher field strength requirements of the portable DVB-H receiver, the probability of interference to the WiMAX subscriber station receiver is higher than that for DTT. The results indicate an interference probability of 32.5% with no guard band and 25.5% with a 1 MHz guard band, falling to 15.8% with a 6 MHz guard band. The report notes that these results are pessimistic due to the difference in the mobile WiMAX system 20 MHz bandwidth equipment available to determine the ERA protection ratio results used for this analysis and the 5 MHz bandwidth equipment modelled in the Aegis analysis.

Conclusions to the WiMAX, DTT and DVB-H compatibility analysis

A9.61 The Aegis study indicates that interference between WiMAX and either DTT or DVB-H operating in an adjacent channel could be a major problem if mitigation action is not taken. In every case considered, the dominant factor increasing the probability of interference into and from WiMAX is the WiMAX transmit and receive filtering in both the base station and the user terminal.

A9.62 It should be possible to improve the WiMAX filtering significantly such that the potential for interference is substantially reduced. This will have a consequential impact of lowering the guard band requirement to promote more efficient spectrum sharing with other technologies.

A9.63 Other mitigating actions for fixed terminals, such as careful siting and pointing of antennae through coordination between different operators, could also help significantly in reducing intersystem interference.
Mason report: international interference assessment

A9.64 We commissioned Mason to carry out a study to assess and plot the expected incoming international interference levels and permissible exported interference levels of all channels of cleared spectrum and a limited number of interleaved spectrum channels.\footnote{www.ofcom.org.uk/consult/condocs/ddr/statement/Mason2.pdf}

A9.65 An interference analysis was carried out for each channel using a combination of GE-06 and bilateral agreements with neighbouring countries. The analysis was used to provide maps on a channel by channel basis in the report, with plots representing the signal interference levels from individual neighbouring countries and, when these are combined, to give an overview of the maximum expected level of interference for each channel.

A9.66 The main report explains the methodology and contains the maps with the interference levels plotted. Figure A11 gives an example, showing permissible exported interference for the UK in channel 31 on the left and the combined coordinated exported interference from Belgium, France, Ireland and the Netherlands on the right.

Figure A11. International exported interference levels for channel 31
A9.67 We contracted Sagentia to carry out a study on PMSE issues. The report considers:

- spectrum usage rights;
- potential interference to channel 69; and
- use of UHF spectrum.

**Spectrum Usage Rights**

A9.68 Sagentia based its analysis of spectrum usage rights for PMSE on the assumption that DTT has unfettered use of the interleaved spectrum such that consumers can continue to receive television without suffering interference from PMSE.

A9.69 Sagentia concluded that the maximum Field Spectral Density measured in 25 kHz bandwidth should be:

- 30 dBµV/m/MHz for a single radio microphone in a television channel.

A9.70 For indoor use, the building penetration loss (about 12dB) can be taken into account. Sagentia also recommended that a 1 MHz guard band should be adopted to protect DTT from PMSE.

**Potential Interference to Channel 69**

A9.71 Currently, UHF channel 69 is used in the UK for PMSE services such as radio microphones and programme links. After DSO, the adjacent channel 68 may be used for a range of services including:

- additional DTT, which is also the current use and thus should present no new adjacent channel interference issues; and
- UMTS, third generation cellular mobile telephones.

A9.72 Sagentia considered the issues that might arise for PMSE in channel 69 if the adjacent channel 68 is used for UMTS handset transmissions.

A9.73 For radio microphones, where the UMTS handset is less than two thirds of the microphone distance to the receiver, the microphone service will fail. To protect radio microphones, the UMTS emissions should limited to -30dBm (measured in 200 kHz) in the adjacent channel.

A9.74 For programme links, to protect a 40m path, the UMTS emissions should be limited to -42dBm (measured in 200 kHz) in the adjacent channel or a guard band of 3.5 MHz should be maintained.

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**Use of UHF Spectrum**

A9.75 A radio microphone occupies 200 kHz of spectrum. However, each pair of microphones used in close proximity generates unwanted emissions known as intermodulation products (or intermods), which occupy spectrum outside of the 200 kHz channel. The amount of spectrum occupied by intermods grows in proportion to the number of microphones.

A9.76 In locations, such as theatres, where multiple microphones are used in close proximity, each theatre occupies some spectrum and renders other spectrum unusable due to intermods. Figure A12 illustrates this effect for three adjacent theatres.

*Figure A12. Illustration of three theatres’ spectrum use*

![Diagram of theatre spectrum use]

A9.77 Thus for any particular theatre, there is more spectrum made unusable by intermods than occupied by adjacent theatres. Effectively, spectrum is limited internally by intermods before it is limited by external factors (such as adjacent theatres).

A9.78 Currently, there are only a few locations with a shortage of spectrum for PMSE. Only a small amount of equipment, less than 1% of the total population of 50,000 microphones, is used in such geographic peaks. If this remains the case after DSO, there may be little demand for and therefore little incentive for manufacturers to supply more spectrally efficient equipment.
Annex 10

Letter from HM Government
Ed Richards
Chief Executive
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

October 2007

Dear Ed,

DIGITAL DIVIDEND REVIEW

I and my Ministerial colleagues have been following the progress of the Digital Dividend Review with interest. I am pleased to hear that Ofcom intend to issue a statement before the end of 2007 on the way forward following consideration of the issues raised by the consultation document which you published last December. As you prepare that statement, you may find it helpful if I reframe the Government's view both on the general approach to managing the spectrum freed up by digital switchover, and on the position of publicly-funded organisations which may seek access to that spectrum.

The Government decided to implement digital switchover in order, among other reasons, to ensure the optimal use of spectrum. The Government's established and declared policy remains that the spectrum freed-up by digital switchover should be released in a technology-neutral auction or auctions. As James Purnell said to the Royal Television Society meeting in Cambridge: "A sure way to freeze innovation would be to reserve new spectrum for existing users and incumbents. That's why we have a clear policy of using market mechanisms to allocate spectrum – because that is the best way of identifying the most productive use to which it can be put........... [Ofcom] has recognized that some uses of the spectrum may be socially as well as commercially valuable.
I welcome its moves to offer protection for the use of wireless microphones where there is a genuine special case. But the threshold for any such exception is extremely high, particularly if it means that large parts of the released spectrum are not available for new entrants to bid for.

The Government is pleased to see that Ofcom is pursuing its duties with respect to spectrum management by examining ways to improve the efficiency of use of the spectrum supporting the existing six digital multiplexes. Greater clarity on the nature and timing of improvements that technologies such as DVB-T2 and MPEG4 can bring to the platform and how these can be delivered in practice – through publication of Ofcom’s forthcoming consultation document - should come ahead of Ofcom’s statement on use of the spectrum interleaved between those multiplexes and the spectrum cleared nationally for reuse. The Government stands ready to work with Ofcom on measures to achieve this objective.

The consultation which Ofcom published in December 2006 made reference to the financial and institutional framework for the support of providers of socially valuable applications who may wish to access the digital dividend. We have considered this but have not identified any reason to believe that the current financial and institutional frameworks would in principle prevent public sector users – or other providers of socially valuable services - from bidding for access to spectrum in accordance with the award processes proposed by Ofcom. Our view is that current frameworks already provide clear and established processes which allow the need for spectrum to be taken into account when reaching funding decisions, including where necessary through an increase in the funding of such providers of socially valuable applications.

We do not therefore believe that Ofcom’s proposals on spectrum management will require substantive changes to existing public institutional and financial frameworks. However, if the Government were to decide that a specific outcome to any awards process was required, for example in terms of the nature of the service to be provided or the nature of the service provider, a different approach would need to be considered – as such certainty could not necessarily be delivered through changes to frameworks or funding levels. On the basis of our current understanding of Ofcom’s proposals, no such conclusion is in view for the awards process or processes following the digital dividend review.

I look forward to the publication of Ofcom’s statement later this year. Please keep me informed of progress.

I am copying this letter to James Purnell and Alistair Darling.

Yours ever,

Stephen

STEPHEN TIMMS

STpb1010