Digital dividend: clearing the 800 MHz band

Consultation

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Contents

Section 1

Executive summary

1.1 The UK has been the leader within Europe in planning for the release of a digital dividend. We now face an important decision. This is whether to align more of the spectrum being released in the UK as part of our digital dividend with the spectrum being released in an increasing number of other European countries.

1.2 The background to this issue is that the UK was the first country within Europe to identify a digital dividend. In 2003, before Ofcom came into existence, the Government decided to release a digital dividend of 112 MHz when digital switchover (DSO) was complete. The plan then developed envisaged this dividend should comprise two distinct bands of spectrum:

- a smaller, upper band of 48 MHz at 806-854 MHz (channels 63-68); and
- a larger, lower band of 64 MHz between 550 MHz and 630 MHz (channels 31-35, 37 and 39-40).

1.3 The details of this plan have played an important role in developments since 2003, notably in some of the technical planning for DSO and in underpinning international agreements reached with other countries at a major conference in Geneva in 2006.

1.4 Since 2003, we have acted to increase the size of the UK's digital dividend. We have done this by securing the clearance of channel 36 (of aeronautical radar) and channel 38 (of radioastronomy). This means that, when DSO is complete toward the end of 2012, the UK's digital dividend should amount to some 128 MHz of high-quality spectrum.

1.5 We have also set out a clear strategy for the way in which we will release this spectrum, through our Digital Dividend Review (DDR). Our goal throughout has been to maximise the total value to society that using this spectrum is likely to generate over time. We concluded that, in general, the best way to achieve this is by taking a market-led approach, creating freedom and flexibility for users to make decisions about spectrum use.

1.6 This approach means the release of the digital dividend will create huge opportunities for more innovation and competition in the wireless communications sector, including the deployment of new generations of mobile broadband technology and the expansion of digital terrestrial television (DTT) and mobile TV.

1.7 It is now increasingly clear many other European countries will also create a digital dividend, following the UK's lead. We warmly welcome this. However, the way in which they do this has important implications for us. In particular, we expect a critical mass of other European countries to release a larger, upper band of spectrum than we have previously planned. This will comprise 72 MHz at 790-862 MHz – channels 61-69, also known as the 800 MHz band. Some countries may also release a lower band as part of their digital dividend, but plans for this are much less clear.

1.8 So far, Finland, Sweden, France and Switzerland have decided to release the whole 800 MHz band as their digital dividend. From discussions we have held, we believe that a number of other European countries are likely to follow suit over the coming

months. The reason that these countries are planning to release more spectrum in the upper band is that, for various reasons, this spectrum is likely to be particularly suitable for new generations of mobile broadband services, though other uses are also technically possible.

1.9 This consultation document considers the costs and benefits for the UK of aligning the upper band of our digital dividend with the spectrum that we expect to be released in these other European countries. It concludes, in short, that we can expect very substantial net benefits to UK citizens and consumers if we make this change. We estimate these net benefits, conservatively, at £2-3 billion in net present value (NPV). A major reason why these benefits are so large is that, if we make the same spectrum available as other countries, better mobile broadband services can be provided to consumers at lower cost.

1.10 However, making this change does have important implications. This is because we have previously planned to use channels 61 and 62 for DTT and channel 69 for programme-making and special events (PMSE), mainly wireless microphones, after DSO.

1.11 To release the whole 800 MHz band, we need to clear channels 61, 62 and 69 of DTT and PMSE. But we need to do this in a way that does not adversely affect the important services that would have been provided using this spectrum. This means finding other spectrum that is a suitable replacement for channels 61, 62 and 69. It also means making sure we plan the change from using one set of frequencies to another very carefully so that we avoid any significant adverse effect on the users of DTT (including viewers) and PMSE.

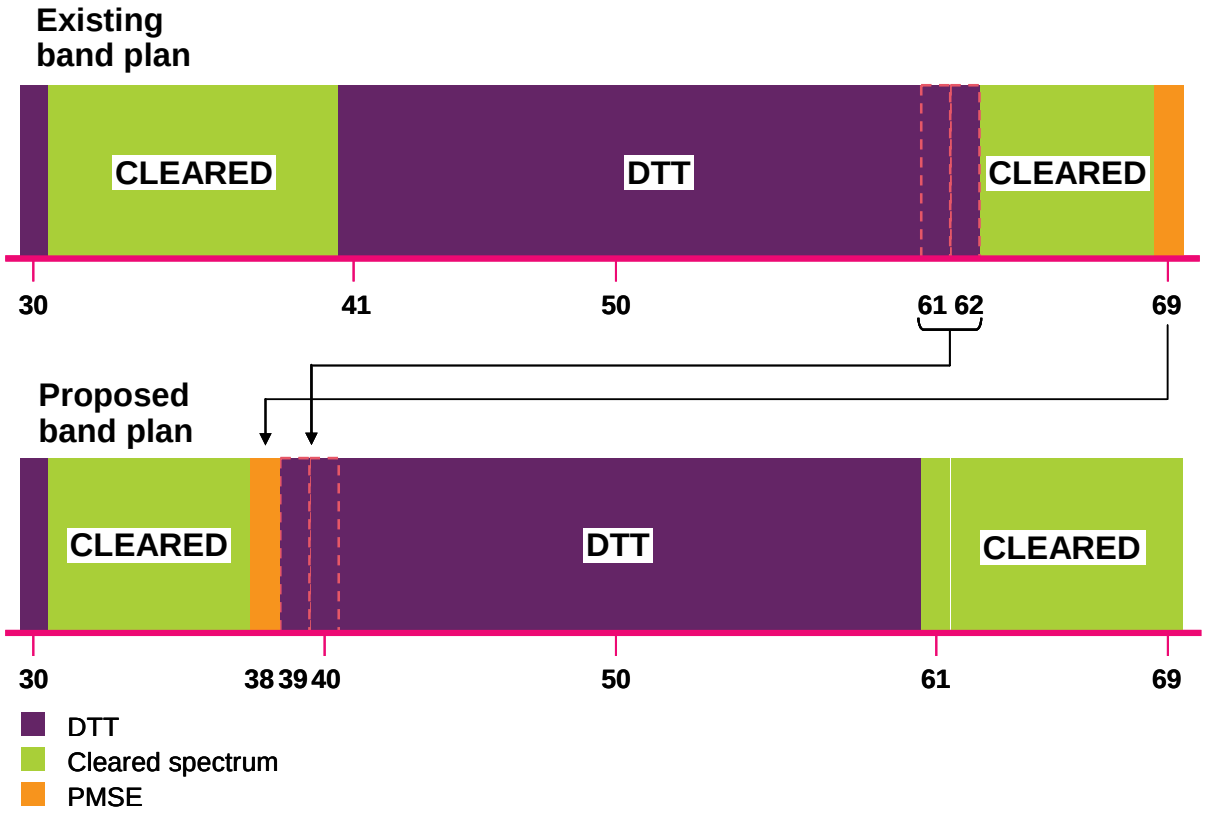
1.12 This is a complex and challenging task, but we believe it can be done. This consultation document proposes how. The key elements include:

- replacing channels 61, 62 and 69 with other channels (principally channels 38-40 from the lower band) for DTT and PMSE;
- timing the changes to avoid any disruption to DSO. This is likely to mean making these changes to the use of spectrum after DSO in most cases; and
- ensuring existing authorised and planned authorised users of channels 61, 62 and 69 do not bear extra costs that must reasonably be incurred to clear the spectrum.

1.13 We believe the costs of clearing channels 61, 62 and 69 will be modest compared to the benefits. Our estimate is that these costs lie in the range of about £90-200m. These costs could be met by new licensees in the 800 MHz band and/or the Government.

1.14 Figure 1 illustrates the effect of our proposals on the configuration of the UK's digital dividend. The main effect is that the upper band would now constitute channels 61-69, with DTT moving from channels 61 and 62 to channels 39 and 40 and PMSE from channel 69 to channel 38.

Figure 1. Changing the configuration of the UK's digital dividend



1.15 We believe that clearing the 800 MHz band is strongly in the interest of citizens and consumers given the large, long-term benefits they should receive. There will, however, be implications for some. We think the main impact will be a need for some DTT viewers to carry out an extra retune of their set-top box (or integrated digital television) to ensure their electronic programme guide (EPG) continues to operate correctly.

1.16 Retuning is a process that takes just a few minutes. Typically, it requires use of the menu function on DTT set-top boxes and integrated digital televisions. Periodic retuning is desirable in any event (e.g. to ensure new channels are properly identified in the EPG). But it will be very important to ensure practical help is available to assist any viewers who find retuning difficult. This consultation document contains proposals for how this should be done.

1.17 It also discusses the need for the UK and neighbouring countries, including France and Ireland, to agree some changes to the existing international agreements relating to the use of the spectrum in UHF Bands IV and V (470-862 MHz). We have already been asked to make such changes by other countries that also wish to clear the 800 MHz band.

1.18 These international agreements are important because they define the technical parameters of the UK's rights to use spectrum. These technical parameters are, by convention, based on optimising the use of spectrum for a particular type of use, though other uses are also allowed subject to meeting limits on interference.

1.19 At the moment, these international agreements are designed to optimise use of UHF Bands IV and V for broadcasting. We expect the outcome of our negotiations to be agreements that are based on optimising the use of the spectrum below 790 MHz for

broadcasting and above 790 MHz for mobile services. These agreements should, however, continue to allow use of either part of the spectrum for other services, subject to meeting limits on interference.

1.20 We support this approach, which is consistent with the principle of service and technology neutrality.

1.21 Finally, this consultation document contains an outline of the next steps in the award of the digital dividend itself. We now expect the main award of cleared spectrum to take place in 2010. This reflects the time required to conclude the international negotiations mentioned above and other technical discussions already under way in the European Conference of Postal and Telecommunications Administrations (CEPT).

1.22 We note and are grateful for the Government's support for our proposals, as set out in Digital Britain: The Interim Report.[1]

Next steps

1.23 We welcome all views from stakeholders on the issues that this consultation document raises. Responses are due by 20 April 2009. We recognise that these issues are complex, and we will hold briefing sessions during the consultation period for stakeholders who would find this helpful.

[1] www.culture.gov.uk/images/publications/digital_britain_interimreportjan09.pdf.

Section 2

Introduction

The UK's digital dividend

2.1 In January 2003, before Ofcom was established, the Government decided that 14 channels, each of 8 MHz of spectrum, in UHF Bands IV and V would be cleared of analogue terrestrial television as a result of DSO in the UK and made available for new uses.

2.2 The plan developed at that time envisaged a digital dividend comprising two distinct bands:

- a smaller, upper band of 48 MHz at 806-854 MHz (channels 63-68); and
- a larger, lower band of 64 MHz between 550 MHz and 630 MHz (channels 31-35, 37 and 39-40).

2.3 We have subsequently acted to clear channel 36 of aeronautical radar during 2009 and channel 38 of radioastronomy during 2012. This will extend the lower band to include the whole of 550-630 MHz (channels 31-40) and increase the amount of cleared spectrum in the digital dividend to 128 MHz in total.

2.4 We conducted a major review of our strategy for the release of this spectrum – the DDR – during 2005-07. The DDR also considered the future of a significant amount of capacity available within the spectrum that will be retained to carry the six DTT multiplexes after DSO. This is known as interleaved spectrum because not all this spectrum in any particular location will be used for DTT, and so is available for other services on an interleaved (or geographically fragmented) basis.

2.5 Figure 2 sets out the existing plan for UHF Bands IV and V after DSO. This includes continued use of channel 69 for PMSE, primarily wireless microphones.

Figure 2. Existing plan for UHF Bands IV and V after DSO

The importance of the digital dividend

2.6 The digital dividend is of great importance because the spectrum concerned provides a very attractive combination of capacity (bandwidth) and coverage (signals travel over long distances and readily penetrate buildings). This, in turn, means it can be used for a wide range of new wireless communications services. These include additional DTT (whether in standard or high definition), two-way mobile services

(including mobile broadband), mobile multimedia (MMS) including mobile TV, PMSE and potentially others.

2.7 As a consequence, the digital dividend provides opportunities both for new entry into existing markets and the introduction of new services, promoting competition and innovation in downstream markets in the interests of citizens and consumers.

The DDR statement

2.8 We set out our approach to awarding the digital dividend in a statement published on 13 December 2007.[2] This followed two years of analysis, market research and consultation that demonstrated there was significant demand for this spectrum from a wide range of services.

2.9 Our main decision was that, in general, we should take a market-led approach to releasing the digital dividend. This would allow users to make decisions about how the spectrum should be used and create more flexibility for the use of the spectrum to change in response to shifts in consumer demand and technology. It would also create stronger incentives for efficiency and (provided the award was well designed) increase opportunities to bring more competition and innovation into the communications sector.

2.10 Consistent with this view, we concluded that our approach to releasing the spectrum should be based on service and technology neutrality and that we should impose the minimum restrictions on use of the spectrum necessary to prevent harmful interference and meet the UK's international obligations.

2.11 This remains our strategy for releasing the digital dividend.

2.12 Throughout the DDR, we have stressed that our objective is to maximise the total value to society that using this spectrum is likely to generate over time. This includes not just the value that each of us derives as a consumer of services but also the wider value that wireless communications services can create by contributing to broad social goals like inclusion and promoting informed democracy. It is not our objective to raise revenue from managing the spectrum, nor, given our statutory duties, is this a relevant consideration for us.

2.13 We set out detailed proposals for the award of both the cleared and the interleaved spectrum in summer 2008. Among these was a proposal to include the interleaved spectrum in channels 61 and 62 (790-806 MHz) in the cleared award. We noted that this would help to reflect the outcome of the World Radiocommunication Conference 2007 (WRC-07) and potential European interest in a digital dividend (see below). The cleared award would therefore consist of 128 MHz of cleared spectrum and 16 MHz of interleaved spectrum.

2.14 We set out proposals for the detailed design of the cleared award in a consultation document published on 6 June 2008.[3]

[2] www.ofcom.org.uk/consult/condocs/ddr/statement/statement.pdf
[3] www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf

International developments

WRC-07

2.15 World Radiocommunication Conferences are held periodically by the International Telecommunication Union (ITU), which is an agency of the United Nations. One of their main purposes is to agree revisions to the ITU Radio Regulations (ITU-RR), which constitute an international treaty between ITU members. We represent the UK in the ITU under a direction issued by the Secretary of State for Business, Enterprise and Regulatory Reform.

2.16 WRC-07 took place from 22 October to 16 November 2007. One of the main agenda items considered at the meeting related to changes to the ITU-RR that could facilitate the provision of mobile systems in the future. WRC-07 considered several proposals to add a co-primary (with broadcasting) mobile allocation to UHF Bands IV and V and agreed to this for the 800 MHz band in Europe, the Middle East and Africa. This comes into effect from 17 June 2015.

2.17 The outcome of WRC-07 is of limited direct significance to the UK. This is because the UK's existing international agreements already provided flexibility for the UK to use UHF Bands IV and V for services other than broadcasting. This was, in particular, one of the outcomes agreed between the UK and many other countries at the Regional Radio Conference 2006 (RRC-06) held in Geneva.[4]

2.18 It is also important to note that ITU-RR do not, in general, specify how ITU members should use spectrum. Instead, the principal obligation they create relates to the protection that members must give to the use of spectrum in other countries.

2.19 However, the decisions taken at WRC-07 are still of considerable indirect importance to the UK. This is because the outcome was seen by many as sending a clear signal that the 800 MHz band would be used for mobile services in the future.

Europe

2.20 An increasing number of other European countries are now following the UK's example by creating a digital dividend and planning to release it in a way that will allow new services to be deployed, in particular new generations of mobile technology. However, these countries' plans differ in one important respect from the UK's: they comprise the whole 800 MHz band at the upper end of UHF Band V.

2.21 This reflects the fact that it now seems clear this spectrum is likely to be particularly suitable for the deployment of new mobile services. This is for two reasons in particular. The first is the signal sent by WRC-07, discussed above. This signal has increased the technical, commercial and regulatory momentum behind potential use of the 800 MHz band for new mobile services. The second reason is more concrete and technical. It is that using the upper end of UHF Band V for new mobile services means there is only one adjacency with broadcasting services (i.e. at the lower edge of the 800 MHz band). This is likely to reduce the cost and difficulty of managing interference. Use of other parts of UHF Bands IV and V for mobile services remains

[4] The RRC was another important ITU conference. It created a detailed new framework – known as Geneva 2006 (GE06) – for the use of UHF Bands IV and V to enable the transition from analogue to digital broadcasting in Europe, the Middle East and Africa.

technically possible, but the cost of preventing harmful interference is likely to be greater if there is more than one boundary with broadcasting to be managed.

2.22 The other European countries that have already publicly identified the 800 MHz band as their digital dividend are:

- Sweden on 19 December 2007;[5]
- Finland on 19 June 2008;[6]
- France on 20 October 2008;[7] and
- Switzerland on 13 November 2008.[8]

2.23 These countries have a combined population of 84 million. Germany, Ireland and Norway, who are known to be considering similar plans, would take this figure to 175 million. Other European countries may follow suit, not least given debate within the European Union (EU) about a common approach to the use of the digital dividend.[9] Population – or, more specifically, market size – is important because it affects manufacturers' ability to realise economies of scale and so set prices for network and handset equipment.

Implications for the UK

2.24 The plans of these other European countries differ from the UK's in that they envisage clearing the whole 800 MHz band, not just channels 63-68. In time, some European countries may also create a dividend lower in the frequency range, but plans in this respect are much less clear, and we think it is less likely that a common approach will be taken by many European countries.

2.25 Many respondents to our cleared award consultation document – principally those with an interest in the potential use of the 800 MHz band for new mobile services – argued for channels 61, 62 and 69 to be cleared of their current planned use after DSO so we could award the same spectrum as other European countries. Without alignment, they said the UK risked being a subscale market that manufacturers and service providers would either not enter or only be able to do so at an increased cost that would ultimately be borne by citizens and consumers.

2.26 We have assessed the benefits and costs of clearing the whole 800 MHz band compared with awarding only the cleared spectrum presently in the UK's digital dividend. We have concluded that clearing the whole 800 MHz band is likely to be strongly in the interests of citizens and consumers. The net benefits of clearance are positive in all the scenarios we have modelled and very large in the scenarios that we regard as more likely. Section 3 summarises our analysis, drawing on a fuller

[5] www.rtvv.se/_upload/infomatrial/Regeringsbeslut%20Sändningsutrymme%20för%20TV-sändningar.pdf
[6] www.lvm.fi/web/fi/lakihanke/view/276922.
[7] http://francenumerique2012.fr/pdf/081020_FRANCE_NUMERIQUE_2012.pdf.
[8] www.bakom.admin.ch/themen/frequenzen/00652/00653/02089/index.htm?lang=en.
[9] See the European Commission Communication of 13 November 2007 (http://ec.europa.eu/information_society/policy/ecomm/doc/library/proposals/com_dd_en.pdf), the conclusions of the Council of Ministers of 12 June 2008 (http://register.consilium.europa.eu/pdf/en/08/st10/st10820.en08.pdf) and the resolution of the European Parliament of 24 September 2008 (http://www.europarl.europa.eu/oeil/FindByProcnum.do?lang=2&procnum=INI/2008/2099).

explanation in the impact assessment in annex 5 and our economic modelling described in annex 6.

2.27 However, clearing these channels in the UK is likely to be a lengthy, complex and resource-intensive process. A task of this scale inevitably carries some risks, which will need to be managed carefully by all interested parties. Sections 4 and 5 set out our proposals for implementing this change and the considerations that we believe are key to success.

Structure of this document

2.28 Section 3 sets out the costs and benefits of clearing the 800 MHz band and the options we have considered. This is supported by the impact assessment in annex 5 and the economic modelling described in annex 6.

2.29 Sections 4 and 5 make detailed proposals for moving DTT from channels 61 and 62 and PMSE from channel 69. Our intention is to provide as much information as is possible at present as the basis for a detailed and comprehensive implementation plan. One key aim of this plan should be to clear channels 61, 62 and 69 in a way that minimises disruption to those currently planning to use this spectrum and, ultimately, the citizens and consumers who use their services.

2.30 Section 6 explains how we intend to secure the UK's interests in negotiations with neighbouring countries to enable both us and them to clear the 800 MHz band.

2.31 Section 7 sets out next steps, including the timetable for the cleared award.

Section 3

The costs and benefits of clearing the 800 MHz band

Introduction

3.1 This section considers the benefits and costs of aligning our upper band of cleared spectrum with the digital dividend emerging in other European countries (i.e. clearing the 800 MHz band) compared with maintaining the configuration planned to date (the base case). It proposes clearing the 800 MHz band as the option that, in our view, furthers the interests of citizens and consumers to the greatest extent.

3.2 A more detailed impact assessment and an explanation of our economic modelling, which underpins the analysis in this section, are set out in annexes 5 and 6 respectively.

3.3 Clearing the 800 MHz band will be a large, complex project with some associated risks. It is imperative that we identify the key risks and consider carefully how best to manage and mitigate them. Sections 4 and 5 set out our detailed proposals for implementation, but for the purpose of assessing the case for clearance, we believe it important to take account of two further objectives secondary to that for the DDR as a whole:

- minimising disruption to existing and planned authorised users of the 800 MHz band after DSO; and
- ensuring the timely award of this spectrum so citizens and consumers can start reaping the benefits as soon as possible.

Preferred option

3.4 To secure our objectives, we have considered a number of options (see annex 5 for further details). These are:

- continuing with the existing plan;
- clearing DTT from channels 61 and 62 in isolation;
- clearing PMSE from channel 69 in isolation; and
- clearing both DTT and PMSE from the 800 MHz band.

3.5 Our analysis demonstrates that the last option – clearing the whole 800 MHz band – provides the greatest benefit to UK citizens and consumers.

3.6 We have considered all of these options carefully. However, it is important to understand that, in practice, we do not consider it likely to be tenable simply to proceed with the cleared award in its existing configuration on the timelines previously proposed. The reason for this is that some neighbouring countries have already asked us to renegotiate the assignments agreed at RRC-06 on a bilateral

basis. We have received these requests because these other countries also wish to clear the 800 MHz band.

3.7 These international agreements are very important because they set the "envelope" within which the UK enjoys spectrum rights. It is therefore desirable to know the contents of these international agreements (at least to a certain level of detail) before awarding, for example, the cleared spectrum.

3.8 In theory, we could refuse to negotiate with our neighbours and insist on our GE06 assignments. However, we do not regard that as a realistic or sensible course of action for the UK. Successful spectrum management in a crowded environment such as Western Europe requires good cooperation between different sovereign states, and we do not believe it is in the UK's interest to adopt such an approach for this specific spectrum. Rather, we need to enter these negotiations in a constructive and purposeful manner in order to secure the greatest benefits for UK citizens and consumers. Section 6 explains how we intend to do this.

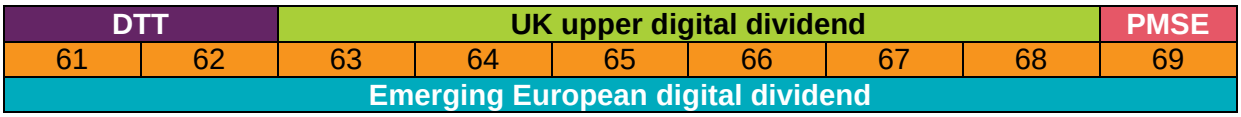
3.9 The significance of this point is that it means our analysis of the base case is relatively optimistic (i.e. it will tend to overstate the benefits of the base case compared to the alternatives).

3.10 The rest of this section sets out our analysis of the option that, in our view, furthers the interests of citizens and consumers to the greatest extent: clearing the whole 800 MHz band.

Clearing channels 61, 62 and 69

3.11 Figure 3 sets out the configuration of the 800 MHz band after DSO as currently planned in the UK and emerging in other European countries.

Figure 3. Current UK and emerging European plans for the 800 MHz band



3.12 Aligning the upper band of cleared spectrum in the UK with the digital dividend in other European countries requires us to clear DTT from channels 61 and 62 and PMSE from channel 69.

3.13 The costs of clearing DTT and PMSE are substantially independent of each other. We have therefore considered the likely benefits that would accrue if only one use were cleared. The results, as set out in more detail in annex 5, demonstrate the case for clearing either use is strong. However, the greatest benefits arise from the synergy of clearing both uses from all three channels in the same timeframe. We therefore focus on describing the relevant benefits and costs of this option.

Benefits

3.14 Clearing the 800 MHz band would deliver the following benefits:

- **lower equipment costs**. As more European countries clear the 800 MHz band and release it in a way that enables new uses, it becomes possible for manufacturers to realise greater economies of scale, reducing prices for network

and handset equipment. The bulk of these benefits should flow to UK citizens and consumers provided markets are competitive;

- **fewer restrictions on spectrum use**. As neighbouring countries seek to clear the same spectrum, we can renegotiate existing international agreements in a way that reduces restrictions and so enables more efficient spectrum use in both the UK and other parts of Europe;

- **more valuable spectrum made available**. The changes proposed in this consultation document would add 24 MHz to the spectrum available for new uses in the upper band of the digital dividend while removing 24 MHz from the spectrum available for new uses in the lower band. We believe this will create more value for citizens and consumers overall because new uses in the upper band are likely to generate more value. This is because the spectrum in the upper band is particularly suitable for uses with potentially very high value such as new generations of mobile broadband technology;[10] and

- **increased competition**. The availability of more spectrum suitable for mobile services might support a greater number of operators. This might, in turn, lead to greater competition in the provision of those services, yielding lower prices, higher quality and greater choice.

3.15 We assessed the size of some of these benefits in a range of scenarios that capture a wide range of possible demand for the cleared spectrum as a whole. The two most likely scenarios are:[11]

- strong demand for mobile communications; and

- strong demand for all services.

Costs

3.16 As set out above, there are costs and risk associated with clearing the 800 MHz band. However, we believe DTT can be moved from channels 61 and 62 to channels 39 and 40 in such a way as to cause minimum disruption to viewers (see section 4). Similarly, we believe channel 38 affords a suitable alternative (i.e. a UK-wide channel next to contiguous interleaved spectrum) to channel 69 for PMSE (see section 5).

Effect on cleared spectrum suitable for DTT

3.17 We expect the outcome of international negotiations to clear channels 61 and 62 will lead to the use of channels 39 and 40 for the six existing DTT multiplexes in the UK. The net effect would be less spectrum in the lower band of cleared spectrum suitable for new UK-wide DTT services. However, through careful planning and implementation, there should be enough capacity in the new lower band to support up to two multiplexes with up to 90% coverage. Any decision on the design and implementation of such a multiplex would obviously be a matter for any acquirer of the spectrum, who would have to make a trade-off between coverage and capacity. The cost of this in terms of potential loss to future DTT services in the lower band is

[10] This reflects in part the fact that only 70 MHz of spectrum below 1 GHz is otherwise available for mobile services while 256 MHz will be in use for DTT after DSO. The scarcity of high-quality spectrum for mobile services increases its incremental value.

[11] We have also used a third, and the most unlikely, scenario to test our modelling outputs. For this scenario, we envisaged strong demand for DTT and relatively weak demand for mobile services.

dependent on how much spectrum new DTT services would be likely to win at auction.

3.18 In addition, as more DTT moves below channel 61 in the UK and neighbouring countries in order to clear the 800 MHz band, channels 21-60 will become more intensively used. This may reduce the suitability of interleaved spectrum for local TV. The materiality of this impact will be highly dependent on the exact outcomes of international negotiations and the coordination and UK planning arrangements that will flow from them. However, we continue to believe there is likely to be suitable interleaved spectrum available which could be used for local TV. Therefore for the purposes of our assessment at this stage, we have assumed there will be no significant impact in aggregate (see annex 6 for more details).

3.19 While there could also be an impact on the suitability of interleaved spectrum for PMSE, we believe any reductions would be isolated to specific locations and unlikely to result in insufficient spectrum to meet historic peaks in demand. This is discussed further in section 5.

Implementation costs

3.20 There are direct implementation costs associated with:

- the necessary technical, engineering and planning work required to move DTT and PMSE from the 800 MHz band to new spectrum; and
- minimising impacts on citizens and consumers including –
  - DTT viewers and
  - PMSE users.

Clearing DTT from channels 61 and 62

3.21 To clear DTT from channels 61 and 62, we have considered three options:

- **a one-step option**. This is in effect a direct replacement of channels 61 and 62 with channels 39 and 40;
- **a two-step option**. This involves a systematic move of assignments in channels 61 and 62 to channels 48 and 51, with assignments in those channels having first been moved to channels 39 and 40; and
- **a hybrid option**. This is comparable to the two-step option but allows a wider set of channels to which assignments in channels 61 and 62 would be moved.

3.22 All three options are discussed in greater detail in section 4. We favour the hybrid option as it has the least impact on coverage and requires little or no adjustment to existing household aerials. We estimate the cost of implementing this option lies in the range of £85-185m.

Clearing PMSE from channel 69

3.23 In the cleared award consultation document, we suggested that channel 69 in isolation was of limited value to PMSE users because many touring companies, who

generally use channel 69, need to use more than 8 MHz to fulfil demand. In subsequent discussions with PMSE stakeholders, we have been informed that a large number of users continue to place great importance on the availability of UK-wide, interference-free spectrum able to accommodate at least eight wireless microphones.

3.24 Those discussions also sought to identify long-term alternatives to channel 69. We have evaluated six possibilities against three considerations:

- **technical**. Could the spectrum be used without interference by wireless microphones? How many microphones could use it? Would microphones interfere with adjacent users?

- **coverage**. Could the spectrum be used by wireless microphones across the UK? How close would it be to other spectrum usable by microphones? When would the spectrum be available for use by microphones? and

- **economic**. What other uses of the spectrum would be displaced by wireless microphones? How valuable would they be to citizens and consumers? What would the likely costs for PMSE users be?

3.25 We favour channel 38, which can provide 8 MHz of spectrum on a UK-wide basis and will be next to interleaved spectrum in and above channels 39 and 40 as a result of our favoured option for clearing DTT from channels 61 and 62 (see above). Section 5 contains a detailed analysis of all six possibilities as well as consideration of transitional arrangements (including funding) to ensure an orderly migration from channel 69 if we decide to proceed with our proposals for clearing the 800 MHz band.

3.26 We estimate the cost of implementing this option lies in the range of £5-18m.

Funding

3.27 We consider that the existing and planned authorised users of channels 61, 62 and 69 should not bear extra costs that they must reasonably incur in clearing this spectrum as proposed in this consultation document. We therefore propose that funding should be made available for this purpose. It will, of course, be important to ensure that these costs are efficiently and legitimately incurred to make these changes. We will also comply with any state-aid rules to the extent they are relevant.

3.28 We have identified two potential sources of funding to clear DTT from channels 61 and 62 and PMSE from channel 69. These are:

- the Government; and/or

- new licensees.

3.29 We would expect new licensees to be in broadly the same net position under either approach since, in the second case, we would expect bidding strategies at auction to reflect the extent of funding that new licensees would be required to provide. Therefore, the choice involves identifying the appropriate mechanism by which funding could be made available. Considerations likely to inform this choice include ensuring the chosen mechanism provides appropriate incentives for stakeholders and minimising the transaction costs involved.

3.30 We are discussing these options with the Government and expect to publish the details of the funding scheme later this year, including how it will be administered and who will qualify.

Conclusion

3.31 Under the most plausible demand outcomes, we assess the net benefits of clearing the 800 MHz band to be in the order of **£2-3bn**. They are greatest if both DTT and PMSE are cleared at or around the same time.

3.32 We therefore conclude that aligning the upper band of cleared spectrum in the UK with the emerging digital dividend in other European countries has the potential to generate significant value over time for citizens and consumers, with net positive impacts on most stakeholders.

3.33 We are confident that, if we proceed with the proposal to clear the 800MHz band following this consultation, we can mitigate and manage any short-term disruption to stakeholders by putting in place appropriate transitional arrangements, including funding where and to the extent appropriate. Any delays in awarding the cleared spectrum are likely to be limited compared to the timetable in the base case given the need to negotiate with neighbouring countries and await the outcome of work in CEPT in order to finalise technical licence conditions (TLCs) in the UK.

Question 1. Do you agree that clearing DTT from channels 61 and 62 and PMSE from channel 69 to align the upper band of cleared spectrum in the UK with the emerging digital dividend in other European countries is likely to further the interests of citizens and consumers to the greatest extent?

Section 4

Moving DTT from channels 61 and 62

Introduction

4.1 Section 3 considered the benefits and costs of clearing the 800 MHz band and indicated there are options for moving DTT from channels 61 and 62 to alternative spectrum. This section provides further context on DTT and proposes criteria to be satisfied in moving current and planned DTT assignments. It also considers implementation issues such as timing, governance and project control and potential implementation costs.

Context

DTT and DSO

4.2 DTT was launched in the UK in 1998 and currently covers around 73% of UK households (compared with the 98.5% coverage achieved by four of the five analogue terrestrial television channels). There are six DTT multiplexes[12] that collectively carry over 30 television channels, with some radio, digital text and interactive services. The geographic coverage of the three PSB multiplexes will increase at DSO to mirror that currently achieved by analogue terrestrial television. Commercial multiplex coverage is also expected to increase at DSO to around 90%.

4.3 DTT is an important part of the UK broadcasting landscape with around 65% of households watching DTT – 37% exclusively so.[13] As analogue terrestrial television switches off across the UK up to 2012, it is likely that the importance of DTT as a means of accessing free-to-air PSB television content will increase.

4.4 DSO is a major programme many years in the planning that has involved very significant resources and will affect virtually every household in the UK. It is being implemented on a regional basis, commencing with the Scottish Borders region in late 2008 and expected to conclude in late 2012. The planning and execution of engineering changes to the terrestrial broadcast network (i.e. upgrading transmission infrastructure and decommissioning analogue and installing new digital equipment) has been under way for several years. The nature of the network, with bespoke equipment and very tall masts (where changes are contingent on weather conditions), requires long lead times. This means many of the network changes for DSO have already been committed, are in progress or have even been completed.

4.5 A very high-profile DSO consumer-education and communications exercise is also under way. This exercise, involving broadcasters, Digital UK, the consumer-electronics supply chain and others, has been in train since 2005 (when Digital UK was formed). A material adjustment to the DSO programme (e.g. to alter its timing in some areas) could cause confusion and potentially dissatisfaction among viewers,

[12] These comprise three multiplexes that carry public-service broadcasting (PSB multiplexes) – Multiplexes 1 and B operated by the BBC and Multiplex 2 operated by Digital 3&4 – and three multiplexes that carry commercial services only (commercial multiplexes) – Multiplex A operated by SDN and Multiplexes C and D operated by Arqiva.

[13] Ofcom, "The Communications Market: Digital Progress Report – Digital TV, Q3– 2008" (see www.ofcom.org.uk/research/tv/reports/dtv/dtu_2008_03/q3_2008.pdf).

many of whom have already upgraded television reception equipment[14] in anticipation of receiving DTT services. As with DSO itself, those most at risk are likely to be the elderly and the vulnerable.

International

4.6 Section 3 noted the importance of international coordination in spectrum planning. This is particularly important for very high-power transmissions used in broadcasting. At RRC-06, countries in Europe, the Middle East and Africa agreed a high-level spectrum plan – GE06 – for the UHF spectrum on which the UK's (and other countries') post-DSO DTT network is now based. GE06 also provides a framework for bilateral discussions between neighbouring countries to allow them to agree modifications to that plan (e.g. to agree to the many lower-power assignments needed to complete each country's DTT network).

4.7 Figure 2 (on page 5) sets out the existing plan for UHF Bands IV and V after DSO. This supports three PSB multiplexes in channels 21-30 and 41-62, each with 98.5% coverage, and three commercial multiplexes, with around 90% coverage – six multiplexes in total.

4.8 GE06 also included two additional sets of interleaved assignments (referred to by the ITU as layers) covering the cleared spectrum, comprising channels 31-35, 37, 39-40 and 63-68. The agreements reached at RRC-06 allow this spectrum to be used for non-broadcasting services. However, if it were used for DTT, these assignments notionally would enable two additional multiplexes to operate at each major transmitter site. Previous studies have indicated that these multiplexes could achieve UK-wide coverage of around 90%. In addition, the interleaved spectrum could, if aggregated, enable a further multiplex with up to 50% UK coverage from 25 sites.

4.9 Channel 36 can also be used for a variety of different applications. For example, it could be suitable for a mobile broadcasting service (e.g. using DVB-H) or DTT or other potential new services. Channel 38 may be suitable for low-power use or higher-power use in regions away from continental Europe, while channel 69 is currently used by PMSE.

4.10 Clearing DTT assignments from channels 61 and 62 will require not just GE06 but also recent bilateral agreements with neighbouring countries to be modified. This, in turn, will require extensive planning and negotiation with the affected parties – principally Belgium, France, Ireland and the Netherlands. Preliminary bilateral discussions on these issues are already under way following requests from France, which has set out her plans to clear the 800 MHz band. We expect that, as other countries confirm their plans, multilateral discussions will also be necessary later this year involving these parties and others.

Minimising risks to DTT and viewers

4.11 In consultation with the Government and stakeholders, we have identified three criteria relevant to clearing DTT from channels 61 and 62 that we believe will help achieve our objective of minimising disruption to existing users. These **DTT migration criteria** are:

- there should not be a material adverse effect on DSO;

[14] This includes set-top boxes, integrated digital televisions and digital television recorders.

- existing authorised and planned users of channels 61 and 62 should not bear extra costs that must reasonably be incurred in order to clear the spectrum; and

- any solution should be consistent with existing policy objectives for DTT coverage after DSO, and the process should aim to minimise the impact on viewers of broadcasts from the existing DTT multiplexes.

4.12 We propose that any plan to clear DTT from channels 61 and 62, as well as the implementation of that plan, should meet these criteria. We have developed these criteria in the light of discussions about potential risks with the parties most affected by the proposed changes, including multiplex operators, broadcasters, Digital UK and Arqiva, the transmission company.

4.13 Particular concerns were raised by these stakeholders over implications for viewers, especially the elderly and the vulnerable, who tend to be least well equipped to deal with changes such as these. As well as the more obvious concerns and risks relating to DSO, DTT coverage and cost, more practical issues were also flagged, together with views on how to manage these (e.g. ensuring effective control and governance arrangements for implementation). We also discussed the DTT migration criteria and how these could be applied in practice, as well as funding, in general terms. We discuss these issues in greater detail below.

4.14 Overall, we found these discussions positive and constructive, and while a number of issues remain, there appears to be recognition of the benefits to citizens and consumers of clearing DTT from channels 61 and 62.

Question 2. Do you agree that the proposed DTT migration criteria are proportionate and appropriate? If not, please explain why and clearly identify any other criteria you believe should be adopted and why.

Options

4.15 The DTT migration criteria provide a benchmark for testing spectrum-reorganisation options for moving DTT from channels 61 and 62 as well as the manner in which the preferred option could be implemented. The three spectrum-reorganisation options we have examined are set out below. We evaluate them against the DTT migration criteria and consider implementation options as well as the associated costs.

4.16 To understand whether it is possible to clear DTT from channels 61 and 62 while satisfying the DTT migration criteria, we commissioned NGW – now Arqiva (Warwick) – to consider three options. All three options involve channels 39 and 40 as replacements for channels 61 and 62.

4.17 Arqiva's analysis covered the 80 main transmitter stations in a first study[15] and an additional 17 key coastal relays in a second study.[16] Collectively, these 97 stations cover about 95% of UK households and are considered to be the most difficult for which to secure UK assignments due to international coordination requirements. Arqiva's second study also considered notional requirements of neighbouring countries, noting that several of the UK's neighbours have decided or are considering clearing the 800 MHz band (which means that revisions to existing agreements will be needed in any event). In due course, if we decide to clear DTT from channels 61

[15] http://www.ofcom.org.uk/consult/condocs/800mhz/arqiva.pdf
[16] This study focuses specifically on the hybrid option and contains confidential and sensitive information, so we are not publishing it. Its key findings are factored into the analysis later in section 4.

and 62 in the UK, this analysis will need to be further extended to include several hundred other UK relay stations.

4.18 The three options are described below, followed by a summary of our assessment against measures derived from the DTT migration criteria.

UK aerial groups

4.19 The UK's broadcast planning system is based on the assumption that the frequencies used by any one transmitter are grouped within a relatively small subset of UHF Bands IV and V. This has allowed the domestic roof-top aerials used throughout the UK to be similarly grouped, allowing them to have greater gain. This means that the coverage area of each station is extended beyond what would normally be allowed under our international agreements. Any change of frequency for these transmissions should therefore aim to keep within the existing aerial group otherwise the households affected may have to install a new wideband aerial (group W). Table 1 shows the aerial groups used in the UK.

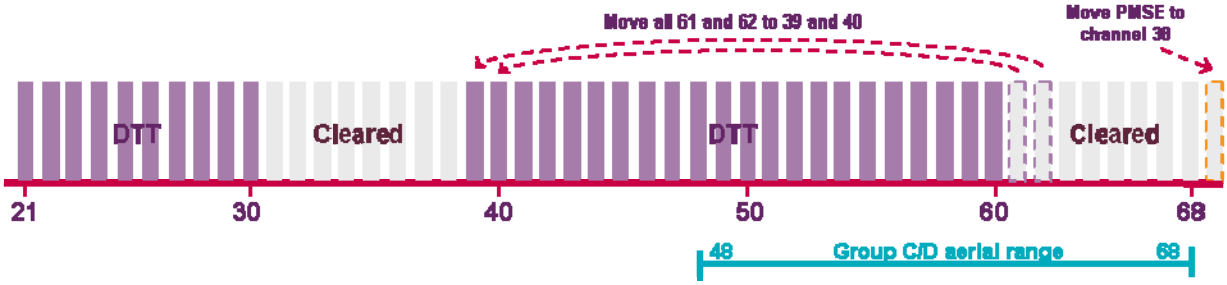
Table 1. UK aerial groups

Aerial group	Channels covered
Group A	21-37
Group B	35-53
Group C/D	48-68
Group E	35-68
Group W	21-68

The one-step option

4.20 This option involves moving all assignments planned for channels 61 and 62 to channels 39 and 40 respectively (see figure 4).

Figure 4. The one-step option

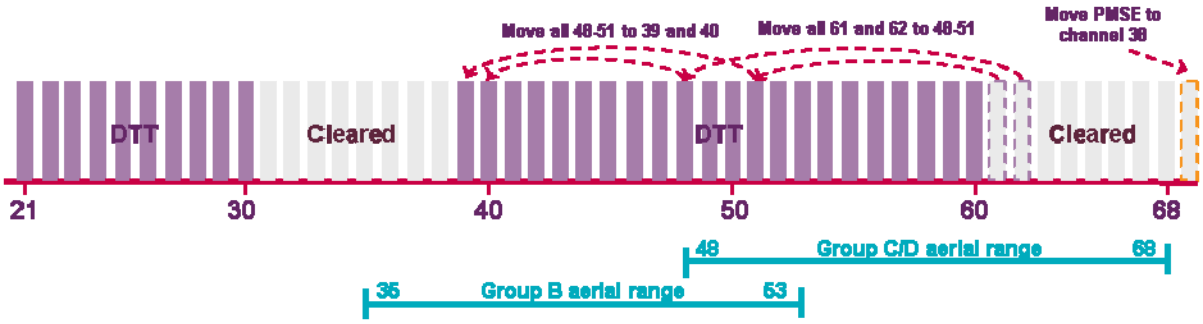


4.21 In the current DSO spectrum plan, 23 of the 80 main stations have PSB or commercial multiplex assignments in channels 61 or 62. Four of these stations use both channels 61 and 62. Most stations using channels 61 or 62 require households to have group C/D aerials for optimum reception, so moving DTT assignments to channels 39 and 40 also moves them out of the notional range of group C/D aerials (channels 48-68) and into the group B aerial range (channels 35-53). This would require replacement or adjustment of a potentially large number of household aerials. There are some coverage effects for PSB and commercial multiplexes (see table 2).

The two-step option

4.22 This option involves moving all assignments planned for channels 61 and 62 to channels 48 and 51, with assignments planned for channels 48 and 51 moved to channels 39 and 40 respectively (see figure 5).

Figure 5. The two-step option

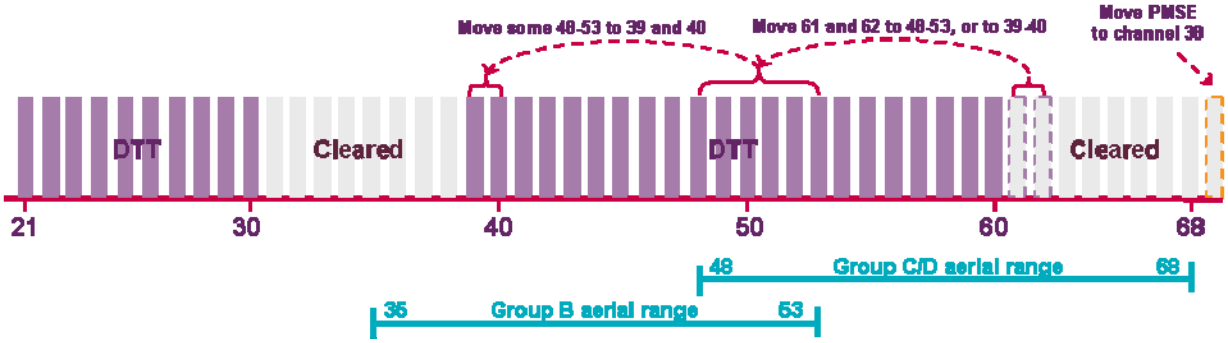


4.23 In the current DSO spectrum plan, 33 of the 80 main stations have PSB or commercial multiplex assignments in channels 48, 51, 61 or 62. 15 of these stations have two multiplexes affected by the changes. The two-step option uses channels 48 and 51 because they fall within the overlap between the group B and group C/D aerial ranges. Thus, to a large extent, the two-step option fixes the problem of households being moved out of aerial group. However, four stations – Dover, Huntshaw Cross, Mendip and Whitehawk Hill – remain out of group even after these changes, meaning some changes to household aerials would be required. There are some coverage effects for PSB and commercial multiplexes (see table 2).

The hybrid option

4.24 This option involves a similar approach as the two-step option but allows a wider set of channels (48-53) to which assignments in channels 61 and 62 would be moved on a station-by-station basis (see figure 6). Some assignments are also moved directly from channels 61 and 62 to channels 39 and 40.

Figure 6. The hybrid option



4.25 The hybrid option keeps the vast majority or all households within aerial group. It affects more sites than the one-step option (and marginally more than the two-step option), but, due to the smaller frequency change, the changes are less complex and difficult to implement. Eight of these stations have two multiplexes affected by the changes. There are some coverage effects for PSB and commercial multiplexes (see table 2).

Assessment

4.26 The third DTT migration criterion – consistency with existing policy objectives for DTT coverage after DSO and minimising the impact on viewers of broadcasts from existing DTT multiplexes – is the most pertinent to the assessment of spectrum-reorganisation options. The other criteria – implementation and funding – are independent of the spectrum-reorganisation options and therefore are excluded from this assessment.

4.27 We have adopted four quantitative measures to aid our assessment of the three options against the third DTT migration criterion:

- change to post-DSO PSB multiplex coverage;
- change to post-DSO coverage by all six multiplexes;
- the number of household aerial changes required; and
- the number of household receiver retunes required.[17]

4.28 Table 2 summarises the estimated performance of each option against the measures above. As with all planning exercises of this nature, there is a margin of error in the analysis, in this case of ±0.2%. The analysis is based on a preliminary plan, and significant extra planning work is needed to confirm these numbers.

4.29 Aerial group is a key determinant of the potential impact of a particular spectrum-reorganisation option on households. As noted above, UK aerials are either wideband (i.e. they receive signals broadcast in channels 20-68) or specific to a particular group. We are able to estimate the theoretical maximum number of households affected by calculating how many households receive signals from particular transmitter(s). However, this is likely to be a substantial overestimate because many group-specific aerials will receive services broadcast in adjacent frequencies. Therefore, we need to estimate the real number of households affected. We are able to do this by applying a methodology developed by our predecessor the Independent Television Commission that estimates which channels a given aerial will receive and by making certain assumptions about the number and type of aerials in use. Both the nominal and real estimates for affected aerials are included in table 2 below.

[17] DTT receivers need to be retuned after a frequency change to ensure all available services can be accessed. Retuning usually takes a few minutes and is performed by the viewer.

Table 2. Summary of assessment of spectrum reorganisation options

Measure	One step	Two step	Hybrid
Estimated change to post-DSO PSB multiplex coverage	-0.2%	-0.2%	+0.01%
Estimated change to post-DSO coverage by all six multiplexes	-0.5%	-0.3%	-0.29%
Estimated number of household aerial changes required	4.5m (nominal) 0.2m (real)	1.1m (nominal) 0.1m (real)	0 (nominal) 0.01m (real)
Estimated number of household receiver retunes required	7m	10m	11m

Note: coverage estimates for the one- and two-step options may understate coverage impacts as no provision is made for potential revisions to neighbouring countries' spectrum plans. Coverage estimates for the hybrid option do make provision for changes to neighbours' spectrum plans.

Note: estimated household retunes may overstate the impact, possibly by as much as 30%, because many households do not view television via DTT and so would not be affected at all.

4.30 The one-step option is initially attractive because it is the simplest, with the fewest network-infrastructure changes and a relatively small number of potential household retunes. However, the predicted PSB- and commercial-multiplex coverage losses, taken together with the estimate of a very large number of affected household aerials potentially needing replacement (as a result of falling out of aerial group C/D because of the large frequency shift) represents a significant and material adverse impact on viewers.

4.31 The one-step option affects the smallest number of transmitter stations. However, again due to the large frequency shift from channels 61 and 62 to channels 39 and 40, it also has the largest number of transmit-antenna changes, which are the most complicated, susceptible to weather conditions and difficult to implement while DSO is under way. There would therefore be obvious advantages if this work could be integrated with DSO. This issue is discussed in more detail in paragraphs 4.49-4.52.

4.32 The two-step option addresses some of the household-aerial issues of the one-step option as using channels 48 and 51 keeps households in their current aerial group. This also reduces the number of transmit-antenna changes required, therefore reducing cost and implementation difficulty. The two-step option has a similar level of predicted coverage loss for PSB and commercial multiplexes and a higher number of household retunes required.

4.33 The hybrid option is conceptually the most complex but, by optimising the one- and two-step options, minimises potential coverage losses and household-aerial changes. To this extent, the hybrid option performs very well. Although it requires a larger number of changes to network infrastructure than the one- or two-step options, these are relatively simpler.

4.34 The most significant impacts for viewers is the need for them to retune DTT receivers. Retunes were also required for existing DTT users when DSO was implemented in the Scottish Borders during 2008. The experience there was that a significant proportion of calls to the help centre related to retuning. The lessons learned from Scottish Borders DSO will obviously help improve the information provided to viewers on retuning for DSO elsewhere in the UK (e.g. to place greater emphasis on the need to retune in DSO-related communications and guidance in

resources available to viewers). This should, in turn, improve viewers' understanding of the retuning process.

4.35 We therefore believe that viewers will become more comfortable with the retuning process as DSO rolls out. Nevertheless, it will be vital to manage the process carefully both to minimise the number of rescans (see below on implementation) and to ensure information is available and accessible. This will be particularly important for elderly and vulnerable viewers, for whom it will be necessary to coordinate with the DSO Help Scheme to ensure adequate support is in place. Clear and effective communications about any further retunes required to move DTT from channels 61 and 62 will be crucial (see below). One element of communicating these changes to viewers could be to include reference (e.g. with details or a link to further details) to a further change in DSO-related communications.

4.36 When assessed against the DTT migration criteria, we believe the hybrid option is, on balance, the strongest. It requires the smallest number of remedial changes to household aerials, and although it requires a greater number of changes to the network infrastructure, it requires the fewest changes to transmitter antennas (the most difficult changes). The relatively higher number of household retunes is an issue that will require careful management but one that should reduce in materiality as viewers learn more about the retuning process through DSO. The two-step option remains a credible alternative to the hybrid option, but the combination of coverage reductions and a comparatively higher required level of household aerial changes detracts from its attractiveness. The one-step option remains credible but with the further disadvantage of a larger number of household-aerial problems.

Question 3. Do you have views on the options identified and our assessment of them? Do you believe there are other, superior options, and, if so, why? Do you agree that the hybrid option is most consistent with the DTT migration criteria?

Potential for further DTT multiplexes

4.37 Clearing the 800 MHz band will not prevent its use by broadcasting following a service- and technology-neutral award. However, we expect that the outcome of international negotiations will include limits on the power that can be used in the band in areas of the UK that could cause interference in neighbouring countries. In practice, this is likely to make it difficult to use the 800 MHz band for high-power broadcasting in important parts of the UK.

4.38 We have therefore considered whether the use of spectrum below channel 61 could be optimised to accommodate further DTT multiplexes offering wide coverage across the UK. To this end, we asked Arqiva to investigate the scope for accommodating further DTT multiplexes in the lower band, in particular channels 31-35 and 37.

4.39 This was not done with a view to specifying how the spectrum should be used but instead to help ensure the best possible options are available for all potential new uses. This particular pattern of use is just one of several possible outcomes of the award of the lower band of cleared spectrum (which might be supplemented with interleaved spectrum if necessary).

4.40 Arqiva's work indicated that greater DTT use of the lower band could be possible through a creative spectrum plan using a combination of single-frequency networks (SFNs) and multi-frequency networks. Coverage would be subject to spectrum and network design.

Option for implementation

4.41 DSO is a complex change-management programme that will affect virtually every UK household. DSO also has to be coordinated with several neighbouring countries. If a decision is taken to clear channels 61 and 62, we believe the revised spectrum plan should be implemented in a manner consistent with the objectives set out in section 3 and earlier in this section. It will therefore be necessary to develop the implementation plan for moving DTT from channels 61 and 62 with DSO in mind and to test the implementation plan against the DSO implementation schedule to avoid or minimise potential impacts on DSO. This should be done while minimising impacts on viewers, the costs associated with the changes and the opportunity cost of delaying the award of the cleared spectrum.

4.42 As with DSO itself, establishing robust and effective project-control and -governance arrangements with appropriate safeguards will be very important in aligning the interests and incentives of key parties and minimising adverse impacts and risk. Proposing implementation options in this consultation document is the first step in what we would expect to become a major programme of work. We expect to develop these plans further during the consultation period through dialogue with the stakeholders most affected and in the light of consultation responses.

Timing

4.43 The timing of any clearance of DTT from channels 61 and 62 is an important issue in terms of both the availability of the cleared spectrum for new services and its impact on DSO. This is of particular importance because the planning and procurement for DSO, which has been under way for several years, is well advanced, so any attempt to integrate clearance with DSO would require careful management.

4.44 We set out above that clearing DTT from channels 61 and 62 should not result in any material adverse effects on DSO. We now consider how the necessary broadcast-infrastructure changes could be implemented. We have identified three timing options, all of which are compatible with the three spectrum-reorganisation options outlined above. But prior to considering the timing options, it is helpful to review how DSO is being implemented. Specifically, five elements of DSO are pertinent to implementing a decision to clear DTT from channels 61 and 62:

- **spectrum planning**. This includes planning the UK assignments and securing international agreement. This task is carried out by the Joint Planning Project (JPP), an Ofcom-chaired group in charge of the UK spectrum plan for DSO. It underpins (and must precede) all later planning and implementation stages;

- **regional systems design**. Relay analysis ensures there is a robust and workable network design. This process is coordinated by Digital UK and the transmission operators. Each regional design takes six months to complete;

- **regional rollout planning**. This includes an assessment of the dependencies between transmitter groups to determine a workable ordering of the regional rollout of DSO. This process is coordinated by Digital UK and involves the transmission companies and broadcasters. The last regional rollout plan, B15, took nine months to complete and was a refinement of an earlier plan. An entirely new plan to account for clearing DTT from channels 61 and 62 might take a year;

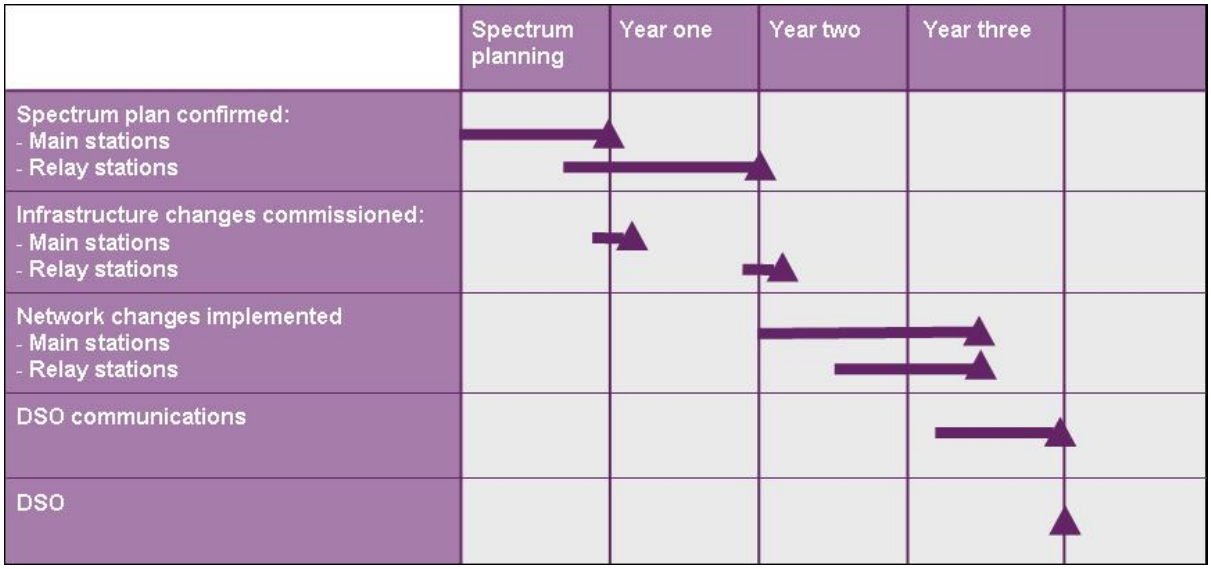
- **broadcast infrastructure**. This includes main- and relay-station transmitter and antenna equipment. The procurement process can commence once the spectrum plan and the regional systems design is confirmed. Indicative lead times for DSO

from the point an order is made are three years for main transmitters and two years for relay transmitter stations;[18] and

- **communications**. Digital UK starts the process of communicating in a region 14 months before DSO and announces the exact DSO dates to viewers between 12 and eight months before DSO. These communications may commence before all of the broadcast-infrastructure changes are finalised though not before there is a high level of confidence in the completion date.

4.45 Preparations for DSO are being conducted on a regional basis across the UK. Figure 7 illustrates the scheduling and lead times for a hypothetical region.

Figure 7. DSO scheduling and lead times for one hypothetical region.



4.46 These timescales mean that preparatory works are already in train for all sites through to the end of the programme. One consequence of the DSO implementation plan is that any subsequent substantive variations to the spectrum plan now could result in significant cost and/or timing consequences for DSO. This is discussed further in table 3.

4.47 Long lead times for main-station infrastructure changes are due in part to contingency for favourable weather conditions, on which transmit antennas ("air works") are particularly reliant.

4.48 We identified three implementation timing options. Table 3 describes these and assesses each against the three DTT migration criteria introduced earlier (particularly the effect on DSO), cost effectiveness and spectrum opportunity costs.

[18] Lead times will vary depending on the nature of the changes required (e.g. they may be shorter if no transmitter antenna works are required).

Table 3. Assessment of options for the timing of implementation

Option	Description	Assessment	Impact on timing
Recast DSO	Pause DSO until a revised spectrum plan is finalised. Then recast the DSO plan (engineering, communications and rollout) to incorporate that plan	Fully integrating the new spectrum plan with DSO would reduce duplication of effort (engineering, communications etc.) as well as potential disruption to viewers In practice, because a significant number of the preparatory works (in particular modifications to the broadcast infrastructure) for DSO are already underway in the majority of regions, there is likely to be limited benefit from recasting DSO at this stage. Implementing at this stage could have potentially negative side effects for DSO, viewers and the availability of cleared spectrum alike These side effects result principally from a delay to DSO while spectrum plans are revised (by late 2009 at the earliest for main stations) then followed by revisions to procurement/installation schedules, which are highly likely to disrupt DSO, delaying completion. This would also delay access to cleared spectrum. Uncertainty and delay could also be disruptive and confusing for viewers	**DSO** Likely to be delayed by up to 18 months, meaning that DSO would complete in final regions in mid-2014 **800 MHz band** Would be available when DSO was completed in mid-2014
Post-DSO implementation	DSO to take place as planned, completing in late 2012 DTT is then cleared from channels 61-69 retrospectively from late 2012	Prioritising the completion of DSO minimises potential risk to DSO rollout and the risk of consumer confusion In practice, this approach may be too cautious and could lead to greater negative impacts for viewers (e.g. a higher number of retunes and minor coverage changes), higher costs (works duplicated unnecessarily), greater impact on DTT and a delay to the availability of the cleared spectrum	**DSO** Would be completed by the end of 2012 as currently scheduled **800 MHz band** Implementation likely to take 18 months to two years, so expected to be completed in mid- to late 2014

Option	Description	Assessment	Impact on timing
DSO-integrated implementation	DSO to take place as planned, completing in late 2012 Actively seek to integrate clearing DTT from channels 61 and 62 with DSO where this is feasible	Although DSO is only beginning to take place now, many of the infrastructure changes have already been made (or committed to), reducing the benefits of a full recast. Equally, implementing post-DSO misses efficiency opportunities and increases direct and indirect costs as well as spectrum-opportunity costs Although, for the reasons set out above, opportunities for integration with DSO may be limited to later-switching regions, these opportunities remain worth pursuing for two key reasons: • they could reduce extra cost and minimise impacts on viewers without materially adversely affecting DSO; and • they could ensure DTT assignments in channels 61 and 62 are cleared within the minimum possible timeframe. However, it would be necessary to establish a robust framework for deciding how and where integration is optimal. This framework should serve to prioritise opportunities that expedite clearing DTT from channels 61 and 62. It would also have to account for pressures on resource and the risk to DSO	**DSO** Would be completed by the end of 2012 as currently scheduled **800 MHz band** Integrating implementation with DSO where possible would bring forward completion and so is expected to be completed in late 2013. Spectrum would be available from the beginning of 2014

4.49 In implementing any of the three spectrum-reorganisation options discussed earlier in this section it will be necessary to balance different policy objectives, specifically the risk of a material adverse effect on DSO, potential disruption to viewers, direct and indirect costs and delayed access to spectrum. In practice, it is not possible to decide at this point in time the extent to which clearing DTT from channels 61 and 62 could be integrated with DSO. Decisions on whether changes to particular sites should be integrated with DSO would need to be taken on a site-by-site basis when the necessary analysis had been completed. So, in assessing implementation-timing

options we aim to establish broadly how to proceed. This will then provide a basis for a subsequent, more detailed analysis on a site-by-site basis of how to implement the changes.

4.50 At face value, **recasting DSO**, incorporating the new spectrum plan within the DSO timetable, has major benefits, including reduced cost and, in theory, less impact on viewers (as fewer household retunes would be required). However, while this would have been a highly credible option two or three years ago, we believe that the preparation and rollout of DSO is now too far advanced for many of the theoretical benefits to be realised. There are also significant side effects and risks to this option. **Post-DSO implementation** also has some theoretical attractions, principally the very low risk to DSO. However, it is likely to unnecessarily increase the potential impact on viewers, increase implementation costs and impose higher spectrum opportunity costs.

4.51 It appears to us that most or all of the realisable benefits of **recasting DSO** are also achievable by **DSO-integrated implementation** and, when assessed against the DTT migration criteria, with much less cost and risk. We believe that carefully integrating implementation with DSO provides the best opportunity to minimise costs, disruption to viewers and any delay to use the cleared spectrum while avoiding uncertainty to DSO and without materially adversely affecting it. Clearly, it would be necessary to establish a robust decision-making framework and processes as well as develop appropriate governance and ensure the incentives of the various parties are aligned.

4.52 We propose, therefore, to implement the hybrid spectrum-reorganisation option integrated with DSO under a framework that accounts for the different policy objectives and risks.

Question 4. Do you have views on the implementation-timing options identified and our assessment of them? Do you agree that DSO-integrated implementation is most consistent with the DTT migration criteria? If not, why not?

Programme control and governance

4.53 While the process of clearing DTT from channels 61 and 62 is not expected to be as complex as the implementation of DSO, we do expect the two processes will have some issues in common. This includes the need to ensure that viewers continue to get access to the full range of existing DTT services throughout the transition process. We also recognise that the implementation of clearing channels 61 and 62 will be complex and require careful and robust project management and oversight and that it is vital that viewers are provided with appropriate advice and help throughout the process.

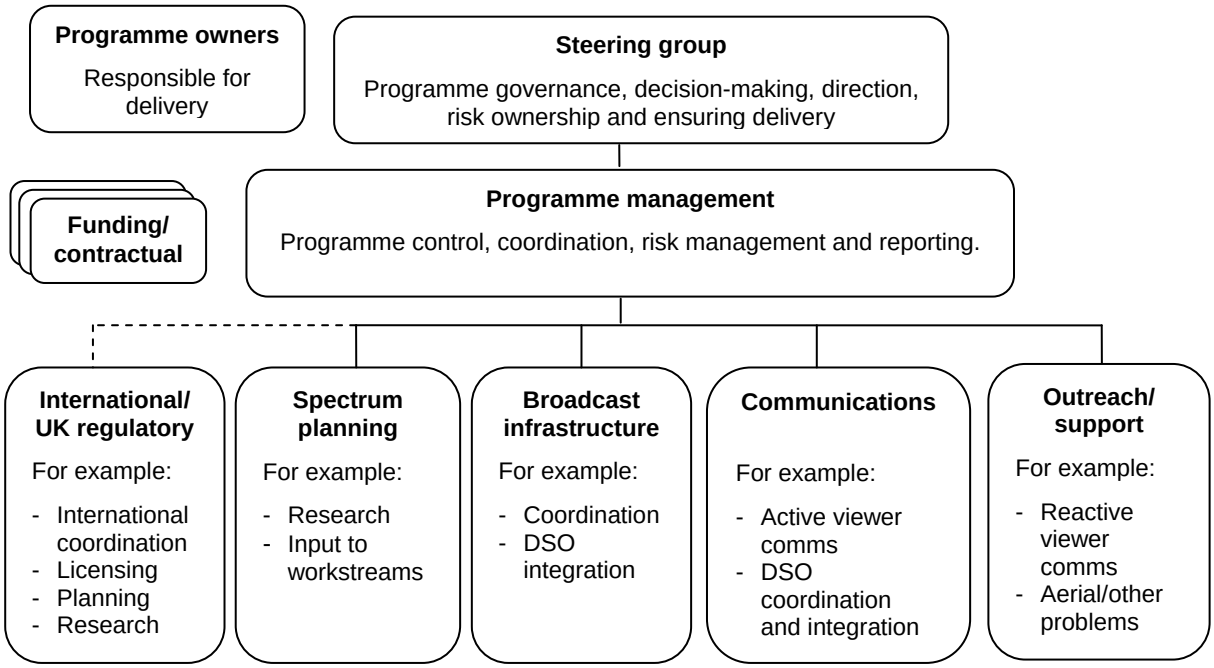
4.54 Hence, we believe that strong programme control and governance will be very important to successfully implementing the clearance of DTT from channels 61 and 62. Also, although there may be a common objective of implementing in a way that minimises any adverse impacts on DTT and viewers, there may also be conflicting views over how best to achieve that objective. Therefore, effective coordination (including with DSO activities) and alignment of incentives for the principal parties would be particularly important, as would systems and safeguards for spotting and addressing issues as they arise.

4.55 We believe that a clearly scoped, well designed and appropriately resourced programme with clear objectives, a strong mandate and clear lines of accountability

will be necessary. We also believe that the parties with most at stake should have a central role in, and responsibility for, driving and ensuring the success of this programme. We believe this is important to protect the interests of citizens and consumers. It will also be necessary to ensure budgetary accountability reflects these arrangements.

4.56 Figure 8 illustrates one possible programme structure, where the governance and control function is exercised through a steering group comprising the principal affected parties. The programme structure should be common to the spectrum reorganisation and timing of implementation options. Those parties – the programme owners – would have specific obligations (e.g. licence and/or contractual commitments) for delivery. Programme- and contract-management functions will be necessary to coordinate the various implementation activities. The funding source(s) and distribution mechanism(s) touched on in section 3 and below will affect how the contract-management function interacts with other implementation tasks. Each of the broad workstreams will have subsidiary activities of its own, with some examples given below.

Figure 8. Illustrative programme structure



4.57 The programme will have to be appropriately resourced in terms of both funding and access to specialist resources. However, it will also be important that resource demands of this work do not materially adversely affect DSO. We believe that the work should be coordinated wherever possible to mange this risk and to avoid duplication of effort. In particular, we expect there is scope for tensions over access to limited spectrum-planning and engineering resources. However, our initial assessment of work peaks for DSO and clearing DTT from channels 61 and 62 (assuming integration with DSO) suggests that the phasing of planning and engineering workloads is compatible.

Question 5. Do you agree that a programme-control and -governance arrangement such as that outlined above is appropriate?

Costs and funding

Implementation costs

4.58 While the scale of works and the consequent financial cost of the three options discussed above are relatively small compared to DSO, they are still significant. We have identified four broad cost types; each may have several subcategories:

- **spectrum planning**. This covers work initiated by us or other parties, including developing and refining the spectrum plans in preparation for negotiations with neighbouring countries. We expect that the bulk of this work will be overseen by JPP. This activity will peak when very detailed planning work is undertaken to accommodate relays and rebroadcast links but is expected to continue as required to adjust the base plan through to the completion of implementation;

- **infrastructure reengineering**. This is required where and when changes to broadcast infrastructure arise from changes to the UK's digital dividend and from anticipated increases in interference from neighbouring countries as a result of more intensive use of the spectrum. It will first involve reviewing the DSO implementation plan in the light of the revised spectrum plan to establish where there is scope for integration and to integrate with the DSO implementation plan as appropriate. Where this is not possible, a detailed programme of infrastructure changes will need to be prepared and costed;

- **communications and support**. We anticipate that it will be necessary to communicate with the large number of households that will need to retune DTT receivers. We also anticipate that a certain amount of support will be required; and

- **programme management**. We have assumed that there will be additional costs associated with policy/strategy development, planning, programme management and communications management. The activities and commitments for each organisation are likely to change across the period.

4.59 Our preliminary cost estimate for implementing the hybrid option is £85-185m (NPV), as shown in table 4. The costs provided here are based on one particular scenario – the hybrid spectrum-reorganisation option with DSO-integrated implementation – and therefore should be considered to be illustrative only. They are based on our preliminary analysis, have not been independently scrutinised and are not supported by formal estimates. Implementation costs will be affected by the spectrum plan agreed with neighbouring countries (e.g. the extent to which changes to infrastructure will be required) and the extent to which implementation can be integrated with DSO and communications.

Table 4. Range of costs for DSO-integrated implementation of the hybrid option

	Lower bound	Upper bound
Total estimated cost	£85m	£185m

4.60 As well as the cash costs associated with the four activities outlined above, we have also made some provision for non-cash costs associated with households retuning DTT receivers. We assume 11m household retunes each taking up to 15 minutes to complete, equating to a total of around £15m (NPV). These costs are included in the range of costs above.

4.61 The lower cost bound is based on a benign scenario with the minimum possible level of change to broadcast infrastructure and where relatively low-key communications to stakeholders suffice. The upper cost bound assumes a considerably worse-case scenario involving a much more significant volume and complexity of works. We also assume that much more intensive communications and support activities will be required together with higher spectrum-planning and project-management costs.

4.62 The estimates above are gross costs prepared for planning purposes. They do not net off costs that may also occur in the base case where DTT is not cleared from channels 61 and 62 in the UK. This means that the benefits of proceeding as calculated in the impact assessment are likely to be understated.

Question 6. Do you agree that the four cost categories adequately capture the costs associated with clearing DTT from channels 61 and 62? Are there any costs that do not appear to have been accounted for in any of these categories?

Schedule of works and cost profile

4.63 For context, our initial view of the potential profile of work for each of the four cost categories is as follows:

- **spectrum planning**. We expect the bulk of these costs would fall in 2009 and 2010 as spectrum plans for main and relay stations are developed, though costs will continue to be incurred at a reduced level throughout 2011, 2012 and 2013;

- **infrastructure reengineering**. We expect these costs would begin to be incurred from 2010, when initial works orders are placed, and to continue through to a peak in 2012/2013, when we expect that the bulk of the network engineering works will be undertaken;

- **communications and support**. We expect a relatively low level of activity in the initial years, consisting largely of planning and coordination with DSO-related communications to the extent appropriate, with communications and support activities ramping up in 2012 and 2013; and

- **programme management**. We expect these costs would begin to be incurred from late spring 2009, when the programme-management and governance structures will be established and planning undertaken, continuing through to managing network changes and communications in 2012 and 2013.

4.64 Based on the work profile above, we believe the bulk of the costs will begin to be incurred in 2010, peaking in 2012 and 2013. Costs for 2009 are likely to be focused on spectrum planning and establishing the programme. We expect to scope these plans further during the consultation period through dialogue with the stakeholders most affected and in the light of consultation responses. We expect to have a clearer view of the work plan, cost estimates and cost profile by spring 2009.

Question 7. Do you agree that our cost profile is a reasonable basis for planning the capital expenditure for clearing DTT from channels 61 and 62?

Funding

4.65 As noted in section 3, we are discussing this matter with the Government. If we decide to proceed with our proposal to clear DTT from channels 61 and 62, we will publish details of any funding arrangements later this year.

Summary

4.66 This section has provided context for the role that DTT is expected to play in the medium term in the UK, proposed DTT migration criteria that we believe should be satisfied in clearing DTT from channels 61 and 62 and assessed options for moving those assignments. It has also assessed options for implementation, outlined potential programme-management and -governance arrangements and identified the key workstreams. Finally, it has outlined our view of the main cost categories, initial cost estimates and our initial view on the profile of the work. In summary:

- certain criteria relating to DTT coverage, DSO and existing users of the 800 MHz band should be satisfied when clearing DTT from channels 61 and 62;
- we believe the hybrid option is the strongest of the three spectrum-reorganisation options considered;
- the hybrid option should be implemented after DSO but take advantage of opportunities to integrate with DSO where these exist in order to minimise subsequent impacts on viewers and unnecessary rework or delay;
- a clearly scoped, well designed and appropriately resourced programme with clear objectives, a strong mandate and clear lines of accountability should be established to implement the changes; and
- the programme will require appropriate systems, principles and criteria for determining who is eligible for funding, the amount and how this should be paid.

Section 5

Moving PMSE from channel 69

Introduction

5.1 Section 3 considered the benefits and costs of clearing the 800 MHz band. In this section, we set out how we propose to move PMSE from channel 69 to alternative spectrum if we proceed with our proposal to clear the 800 MHz band following this consultation.

PMSE use of channel 69

5.2 Channel 69 is the only channel available on a UK-wide basis for wireless-microphone users in UHF Bands IV and V. It has been allocated for use by wireless microphones and audio links for a number of years as a result of restrictions on its use in the UK to avoid interference to services in continental Europe. Licences are granted either on a coordinated basis (whereby frequencies within the channel are assigned on an exclusive, short-term, location-specific basis, ensuring freedom from interference) or for shared use (whereby defined frequencies within the channel can be used in any location at any time but without the same certainty of quality).

5.3 Approximately 1,700 PMSE users are currently licensed to use channel 69 in the UK. These account for most wireless-microphone licensees.

5.4 Wireless-microphone users attach great importance to the use of channel 69 because it offers three key characteristics not afforded by any other spectrum allocated for this use:

- the ability to accommodate the use of at least eight (to date analogue) microphones;
- relative freedom from interference; and
- UK-wide coverage.

5.5 Wireless-microphone users also place great value on channel 69 because it is adjacent to interleaved spectrum in channels 67 and 68. Channels 67 and 68 are currently used for analogue terrestrial television but not heavily so. This means they afford microphone users access to the 24 MHz in channels 67-69 on a near-UK-wide basis.

5.6 For these reasons, a significant stock of equipment in the UK can tune to channel 69.[19]

[19] Sagentia estimated in its report of 13 December 2006 on the use of UHF spectrum for PMSE in the UK that 95% of new wireless microphones sold and 50% of professional users' equipment are for use in channel 69 (see www.ofcom.org.uk/consult/condocs/ddr/ reports/report_sagentia.pdf).

Channel 69 in the DDR

What we said in the DDR statement

5.7 In the DDR statement, we noted the importance that PMSE users placed on having access to high-quality, UK-wide spectrum. At that time, we decided we would therefore award channel 69 to a band manager who would be charged a licence fee based on administered incentive pricing (AIP). The band manager would be able to recover its costs, including the licence fee, from users of its spectrum.

5.8 In keeping with one of our four key objectives for the band manager award – to avoid undue disruption to PMSE users – we proposed setting AIP at a conservative level and phasing it in over a period of time where necessary. This would allow PMSE users to adjust to any increases in licence fees that would materially impact on their ability to provide services to their customers.

What we said in the digital dividend award-design consultation documents

5.9 We noted in the cleared award consultation document that channel 69 in isolation is of limited value to PMSE users because touring companies, who generally use channel 69, also require access to channels 67 and 68. We subsequently discussed this issue in greater depth with PMSE stakeholders. During these discussions, we were informed that a number of users do attach great value to having access to contiguous spectrum offering interference-free, UK-wide coverage for at least eight wireless microphones.

5.10 We further noted in our consultation document on the detailed design of the band manager award, published on 31 July 2008,[20] that the lower bound for the opportunity cost of channel 69, assuming its use as a single isolated channel, could be £2.8m per year if this were based on the existing cellular spectrum tariff unit for GSM use of the 900 MHz band. If spread equally among the 608,000 assignment days in channel 69 in 2004/05, this would already result in a uniform fee of about £4.61 per assignment day, significantly higher than the existing fee of 8p per day for an annual fixed-site indoor wireless-microphone licence. However, the value of channel 69 if liberalised for use for mobile communications could be even higher, and a more realistic estimate of the opportunity cost would take into account how this channel could in future be combined with the adjacent cleared spectrum. We continue to expect this would lead to a significantly higher opportunity cost estimate, reinforcing the desirability of identifying a suitable alternative for PMSE users.

We have subsequently discussed alternatives with PMSE stakeholders

5.11 Our recent meetings with PMSE stakeholders have helped us to understand the specific issues facing users in relation to their continuing use of channel 69. This has assisted our assessment of a suitable long-term alternative to this channel. These meetings have also helped us to better understand the implications for moving PMSE use to alternative spectrum. We are grateful to stakeholders for their willingness to engage so constructively with us.

[20] www.ofcom.org.uk/consult/condocs/bandmngr/condoc.pdf.

Possible alternatives to channel 69

It is important we identify a suitable long-term alternative

5.12 It is important that we identify an alternative to channel 69 that offers not only comparable utility for wireless microphones (in terms of capacity and freedom from interference) but also allows the band manager being established through the DDR to fulfil its proposed obligations to PMSE for the duration of these obligations (i.e. until 2018).

We have identified a number of possible alternatives

5.13 We have identified a number of possible alternatives from internal analysis, meetings with stakeholders and responses to consultation documents. These are outlined below.

Interleaved spectrum only

5.14 This is a possible alternative due to the technical similarities it shares with channel 69 and its existing extensive use for wireless microphones and availability of equipment across the UK.

Channel 38

5.15 This was put forward as a possible replacement by a number of stakeholders, including the Joint Frequency Management Group (JFMG), which grants PMSE licences under contract to us; the British Entertainment Industry Radio Group (BEIRG); the Professional Light and Sound Association; Vodafone; and T-Mobile.

FDD duplex split

5.16 As part of ongoing work in CEPT on least restrictive technical conditions for non-mandatory harmonisation of the 800 MHz band, a plan for its use by FDD mobile services has been proposed. This is only one of a number of possible uses of the 800 MHz band, but it is attracting considerable commercial and regulatory interest.

5.17 The present version of the plan involves the creation of a 12 MHz centre gap at 820-832 MHz (i.e. centred on channel 65) between the uplink and downlink frequencies. If this configuration is the eventual outcome of an award of the 800 MHz band, it is likely that any use of this spectrum would need to be low power, making wireless microphones a suitable candidate. If this is the pattern of use across much of Europe, it would offer the opportunity to realise economies of scale for equipment manufacture.

5.18 However, there are significant uncertainties about whether this pattern of use will be the outcome of awards of the spectrum both in the UK and in other European countries. Uses of the 800 MHz band other than FDD mobile services are possible, and the final pattern of use is not likely to be known for some considerable time. In the UK, this is unlikely to be until the cleared award has been completed, and even thereafter the pattern of use may change. Even in other countries that take a more *dirigiste* approach to spectrum management, based on command and control, it is unlikely that regulatory decisions on awards will be taken for many months or possibly some years.

5.19 It is also possible that other new uses seeking access to such a centre gap will emerge. It is worth noting that, over time, there has been increasing interest in use of the centre gaps in other spectrum used for FDD mobile services.

5.20 This possible alternative was identified in responses to the band manager consultation document by T-Mobile and Vodafone.

Channel 70 (862-870 MHz)

5.21 We identified the possibility of greater licence-exempt use of this channel – albeit in the interests of community rather than professional wireless-microphone users – in the DDR statement. We consider that an assessment of its wider suitability should be part of any comprehensive analysis.

872-876/917-921 MHz

5.22 We identified this possible alternative as it is currently part of our future awards programme and may share some of the characteristics of channel 69. It was also identified by mobile network operators in responses to both our consultation document on the further spectrum access for PMSE, published on 20 June 2007,[21] and the band manager consultation document.

1785-1800 MHz

5.23 This spectrum has been allocated for use by digital wireless microphones for a number of years although it is not currently used. It was identified as a possible (albeit unsatisfactory) alternative by BEIRG in its response to the band manager consultation document.

Assessment of possible alternatives

5.24 We have assessed whether any of these options offer a realistic alternative to channel 69 for PMSE. The considerations that we have taken into account in this assessment are:

- **technical**. Could the spectrum be used without interference by wireless microphones? How many microphones could use it? Would microphones interfere with adjacent users?

- **coverage**. Could the spectrum be used by wireless- microphones across the UK? How close would it be to other spectrum usable by microphones? When would the spectrum be available for use by microphones? and

- **economic**. What other uses of the spectrum would be displaced by wireless-microphones? How valuable would they be to citizens and consumers? What would the likely costs for PMSE users be?

Question 8. Do you agree that these are the most appropriate criteria to assess which spectrum is the best alternative to channel 69 for PMSE?

5.25 In assessing possible alternatives, we must strike a balance between all three criteria. For example, if one alternative offers very close technical and coverage substitutability for channel 69 but has a high opportunity cost, we might conclude that

[21] www.ofcom.org.uk/consult/condocs/pmse/pmse.pdf.

the cost of precluding alternative uses of that spectrum outweigh the benefits to PMSE users. Conversely, where spectrum has a low opportunity cost but does not offer a close match to the utility of channel 69, there would be little point in proposing it as an alternative for PMSE.

5.26 For the purposes of our assessment, we looked first at the technical and coverage characteristics of each possible alternative. Where an alternative clearly did not meet those criteria, we decided not to consider it further and so did not assess the economic implications of PMSE use. For those options we believed were realistic technical and coverage alternatives to channel 69, we looked in more depth at the economic implications of awarding them to the band manager.

Technical and coverage analysis

Interleaved spectrum only

5.27 Wireless microphones, in-ear monitors and talkback devices are designed and manufactured to use interleaved spectrum because their low-power, low-density nature means they can take advantage of the geographic "white spaces" that occur between terrestrial television transmitters.

5.28 One of the effects of DSO will be a reconfiguration of the interleaved spectrum and its availability for PMSE users. We published a statement about this on 16 January 2008 that suggested availability was expected to increase after DSO in most locations of high demand but there were a limited number of locations where it would be problematically low.[22] We are now refining that assessment in light of the DTT-protection approach proposed in the geographic-interleaved consultation document and confirmed for the first awards, covering the Manchester and Cardiff areas, in the statement published on 29 October 2008.[23] Initial indications are that this delivers a marked improvement in the quantity of available interleaved spectrum. We expect to publish a further statement with our refined assessment in the near future.

5.29 While the interleaved spectrum as a whole will provide sufficient capacity to support eight wireless microphones per channel without interference, there are challenges to its offering UK-wide coverage. This is because of the combined effect of its inherent geographic constraints and the inability of most analogue wireless microphones to tune over a range of more than 24 MHz. This range would not be sufficient to provide a channel set that offers UK-wide coverage using a single set of equipment.

5.30 However, as it becomes clear that more interleaved spectrum can be used by wireless microphones after DSO, the coverage of certain tuning ranges is also improving, with some possibly approaching UK-wide coverage. There is also evidence that equipment able to tune across more than the standard 24 MHz range does exist, and such equipment could therefore feasibly be deployed to exploit the new configuration of interleaved spectrum in the future.

5.31 With this in mind, we considered that interleaved spectrum alone could be a possible alternative to channel 69, and we therefore went on to assess the economic implications of its use as such.

[22] www.ofcom.org.uk/consult/condocs/ddr/statement/statement2/statement.pdf.
[23] www.ofcom.org.uk/consult/condocs/notice524/.

Channel 38

5.32 Radioastronomy is the main use of channel 38, which is currently available for use by wireless microphones on a secondary, non-interference basis. This means it already offers near-UK-wide coverage for PMSE.

5.33 In the cleared award and band manager consultation documents, we explained that UK radioastronomy would stop using channel 38 during 2012. As a result, we considered that this spectrum would generate the most value to society by being included in the cleared award. We further proposed that PMSE should continue to have access until 2012, when new services would begin operating.

5.34 We also noted that radioastronomy used channel 38 in the Netherlands and there were no known plans for this to stop. As a result, there is a continuing need to ensure the UK protects Dutch radioastronomy from interference, meaning that channel 38 will remain suitable only for low-power uses (e.g. PMSE) in much of the UK.

5.35 Once radioastronomy in the UK stops using channel 38, the geographic coverage of this channel for wireless microphones should become fully UK-wide as opposed to near-UK-wide as at present. This would make channel 38 a much closer alternative to channel 69 than it is at present.

5.36 One of the key benefits to PMSE of channel 69 is its adjacency to channels 67 and 68. These are lightly used for analogue terrestrial television and so offer good coverage of the UK for wireless microphones in their own right. When combined with channel 69, the quantity of available spectrum for PMSE use in most locations is significant. Although subject to further technical consideration, our current planning models suggest DTT is similarly likely to use channels 39 and 40 relatively lightly under the hybrid option. As a result, PMSE could enjoy access to spectrum in the 24 MHz tuning range of channels 38-40 very similar in quantity to that currently available in channels 67-69. Moreover, if DTT emerges as a use of any of channels 31-37 as a result of the cleared award, this could add to the availability of adjacent or nearby interleaved spectrum.

5.37 We therefore consider that the closeness of the technical and coverage characteristics of channel 38 make it a possible alternative to channel 69. As a result, we went on to assess the economic implications of its use as such.

5.38 We do need to caveat our technical assessment of channel 38 in one respect. This is because we will not know how adjacent cleared spectrum, particularly channel 37, will be used until after the cleared award has taken place. We do know that DTT can be used in an adjacent channel to PMSE in controlled circumstances. But we are now considering in more detail the impact of DTT on PMSE and will also assess likely interference between other potential uses and PMSE to help us determine the specific technical conditions of PMSE use of channel 38 and so minimise the risk of harmful interference to new services in channel 37. An approach involving a small guard band may prove appropriate in relation to channel 38.

5.39 This is consistent with the approach taken at present for PMSE use of channel 69 and analogue terrestrial television in channel 68. JFMG generally avoids assigning frequencies at the lower end of channel 69 – the first 200 kHz being particularly lightly used – because of the risk of harmful interference into broadcasting.

5.40 We intend to publish the details of our technical analysis in the spring. In the meantime, we are working on the assumption that channel 38 will be available for

PMSE use on a basis comparable to channel 69. More complete information will be available as a result of work in CEPT, which is due to report in the summer.

FDD duplex split

5.41 The technical work on the CEPT FDD band plan is still ongoing and not due to finish until June 2009. Part of this work will assess whether PMSE could use the duplex split free from harmful interference and, if so, how much of the spectrum would be available. We have undertaken a preliminary analysis, whose results were inconclusive. A more robust assessment is needed to be definitive on the utility of this spectrum for PMSE.

5.42 More significantly, we do not think this spectrum can be considered a viable alternative to channel 69 for PMSE because we will not know whether it will even exist for a considerable period. We have therefore not assessed the economic implications of its use.

Channel 70

5.43 Wireless microphones can currently use 2 MHz of this channel (863-865 MHz) on a licence-exempt basis. We are exploring in CEPT whether there is scope to increase the amount of spectrum available for PMSE, but we are clear that this would not be on an exclusive basis. There is also little likelihood that all 8 MHz of channel 70 will become available in the foreseeable future due to difficulties sharing with existing uses, primarily short-range devices.

5.44 We do not therefore consider channel 70 to represent a realistic alternative to channel 69 for PMSE, and we have not assessed the economic implications of its use.

872-876/917-921 MHz

5.45 These bands are adjacent to spectrum used by GSM base stations operated by Vodafone and O_2. Our analysis suggests there is a significant risk wireless microphones using these bands would cause harmful interference to those base stations. This situation does not improve if the adjacent 2×2 MHz used by the Ministry of Defence (at 870-872/915-917 MHz) is included in the analysis. With that in mind, we do not see 872-876/917-921 MHz as a viable alternative to channel 69 for PMSE and have not assessed the economic implications of its use.

1785-1800 MHz

5.46 This spectrum is allocated for use by digital wireless microphones in Great Britain only (i.e. excluding Northern Ireland, where it was awarded in 2007 on a service- and technology-neutral basis in parallel with a similar award in the Republic of Ireland). The spectrum at 1785-1795 MHz is available on a coordinated basis.

5.47 Digital technology has not yet been extensively adopted by PMSE users as a whole. Some representatives have indicated that they view its performance characteristics as inadequate to meet the needs of professional productions, citing latency as a particular concern. However, we have become aware that large theatrical productions are increasingly using digital wireless microphones in UHF Bands IV and

V with high reported performance standards.[24] We will shortly publish an independent consultants' report on the potential for more efficient spectrum use by wireless microphones that considers this issue. Nonetheless, we are mindful that there is little to no equipment able to use the 1785-1800 MHz band and consider that some development time would be required to bring such equipment to the market. We note, too, that there is no nearby spectrum that could also be exploited by wireless microphones using this band.

5.48 We consider that its isolation and lack of UK coverage make this spectrum an unviable alternative to channel 69, and we have not assessed the economic implications of its use.

Summary of technical and coverage analysis

5.49 Our analysis suggested two realistic alternatives to channel 69 for PMSE from technical and coverage perspectives:

- interleaved spectrum only; and
- channel 38.

Question 9. Do you agree with our technical and coverage analysis of the possible alternatives to channel 69 for PMSE?

Economic assessment

5.50 Our second consultation document on the detailed design of the band manager award, which we expect to publish early in the spring, will assess the likely opportunity cost of the spectrum we have proposed to award to the band manager. This assessment will be a key input into our proposals for the AIP-based licence fee that we will charge the band manager and, accordingly, the prices its customers will pay. Our economic assessment of the realistic alternatives to channel 69 for PMSE draws on our work to date on this issue

Interleaved spectrum only

5.51 In our band manager consultation document, we suggested low-power business mobile radio was a suitable alternative use of interleaved spectrum to PMSE. We conservatively estimated a possible lower bound for the opportunity cost based on this use might be at least £900k per year. Further work for the second band manager consultation document suggests the figure is higher, in the region of £1.6m per year.

5.52 We recognise that this alternative to channel 69 for PMSE would entail the greatest potential for disruption to users because of the need for wireless microphones able to tune across more than 24 MHz. It is likely that such equipment would require a significant period of time for testing and development before it could be brought to the market – at least three years according to the PMSE Pro User Group's response to the PMSE consultation document.[25] If these timescales were broadly accurate, there would be a real danger that new equipment would not be available to a large number of PMSE users in the timescales we are envisaging for clearing channel 69 (see below).

[24] For example, see www.orbitalsound.co.uk/sales-radio-mics-zaxcom.cfm.
[25] www.ofcom.org.uk/consult/condocs/pmse/responses/ProUserGroup.pdf.

5.53 It is also worth recalling our conclusion in the DDR statement that we should allow licence-exempt use of the interleaved spectrum by cognitive devices as long as we were satisfied that this would not cause harmful interference to licensed uses, including PMSE. We will publish a consultation document with our proposals on this issue in the near future.

Channel 38

5.54 Our work for the second band manager consultation document suggests the opportunity cost of channel 38 to be in the region of £122k per year. This is based on the value that might otherwise be realised if it were used for DTT in Wales and Northern Ireland.

5.55 The opportunity cost of channel 38 is of a relatively low magnitude at present. If the Netherlands cleared radioastronomy from this spectrum, the restrictions on its use in the UK would likely be relaxed. If this happened, there could be more alternative uses (e.g. a DTT multiplex with UK-wide coverage using an SFN), with a potentially higher economic value. We would in general expect to reflect this in the AIP-based licence fee charged to the band manager and thus in the fees it charged its customers in the longer term. This said, we are not aware of any plans for radioastronomy to stop using channel 38 in the Netherlands.

5.56 In terms of costs to PMSE users, channel 38 is noteworthy in two respects:

- the existing ability of wireless microphones to use this spectrum across almost all of the UK means there are no absolute barriers to beginning the move from channel 69 at an early date; and

- In the US the Federal Communications Commission has proposed requiring all wireless-microphone use of UHF Band V above 698 MHz to cease at DSO following the recent auction of its digital dividend in the 700 MHz band.[26] If implemented, this will mean equipment will be restricted to using spectrum below channel 50. As channel 38 sits within this range, it may be possible for the UK market to benefit from economies of scale with the United States, so reducing equipment costs.

Summary of economic assessment

5.57 Our economic assessment indicates that using interleaved spectrum only for PMSE has a higher opportunity cost than channel 38. However, uncertainties are associated with both alternatives to channel 69:

- interleaved spectrum only would require equipment development that is unlikely to be compatible with the timescales we envisage for clearing channel 69; and

- the opportunity cost of channel 38 will increase if radioastronomy ceases to use it in the Netherlands.

Question 10. Do you agree with our economic assessment of the realistic alternatives to channel 69 for PMSE?

[26] http://hraunfoss.fcc.gov/edocs_public/attachmatch/FCC-08-188A1.doc.

Summary

5.58 Table 5 summarises our assessment of all the possible alternatives to channel 69 for PMSE.

Table 5. Assessment of possible alternatives to channel 69 for PMSE

	Technical	Coverage	Economic	Conclusion
Interleaved spectrum only	Equipment designed and manufactured to share with terrestrial television	Existing equipment does not tune over sufficient bandwidth to fully replicate capacity in channel 69	Relatively low opportunity cost	
Channel 38	Subject to further technical work to confirm viability for PMSE use	Available now and will be UK-wide during 2012	Low opportunity cost but might increase if radioastronomy use ceased in the Netherlands	
FDD duplex split	Unclear until later in 2009 how much spectrum would be free from harmful interference	Availability only known as a consequence of the cleared award	N/A	N/A
Channel 70	Currently unable to share with existing use by short-range devices	Available UK-wide now	N/A	N/A
872-876/917-921 MHz	Likely to be impaired by mobile interference	Available UK-wide now	N/A	N/A
1785-1800 MHz	Unclear how much spectrum would be free from mobile interference	Not available in Northern Ireland	N/A	N/A

Strong  Weak

The leading alternative is channel 38

5.59 Each of the realistic alternatives has merit as a future source of spectrum for wireless-microphone use, depending on users' particular needs. However, on balance, we consider that channel 38 is the best alternative to channel 69 for PMSE:

- it is the closest in technical terms, both in its own right and in terms of adjacency to interleaved spectrum, so it would offer almost identical utility for wireless microphones;

- it is already available for and used by wireless microphones, so there will be no period of technical development to bring equipment to the market; and

- it will have a low opportunity cost – and, hence, ultimately price for PMSE users – for the foreseeable future.

Question 11. Do you agree that channel 38 is the best alternative to channel 69 for PMSE?

Providing early certainty to wireless-microphone manufacturers and users

5.60 In meetings with PMSE stakeholders, wireless-microphone manufacturers have explained that the recent uncertainty about the future use of channel 69 for PMSE has led to a marked decrease in sales as users have decided to wait for clearer information before committing to long-term purchases. We fully recognise the difficulties that manufacturers face, not least in the current difficult economic climate.

5.61 We believe this points to deciding the alternative to channel 69 as soon as possible rather than, in particular, delaying until the existence of a usable FDD duplex split is known following the cleared award. Although the technical availability of channel 38 is itself subject to confirmation, we can offer this within a relatively short timescale, helping to minimise disruption to PMSE users.

5.62 Of course, an early decision would not preclude wireless-microphone users electing to exploit other, lower-cost spectrum of equal utility (perhaps including the FDD duplex split) in due course.

5.63 Subject only to technical confirmation in the spring, we therefore propose to award channel 38 to the band manager on the same terms as would have applied to channel 69 (i.e. for an indefinite term subject to revocation after a period of notice given by us).

Question 12. Do you agree that we should award channel 38 to the band manager on the same terms as would have applied to channel 69?

Timing

There is little benefit to clearing PMSE from cleared spectrum before DSO

5.64 Throughout the DDR, PMSE stakeholders have argued that they should retain their existing access to the whole of UHF Bands IV and V until DSO ends in the UK. They believe the benefits would be twofold:

- it would allow sufficient time for an orderly migration of PMSE from the cleared spectrum; and

- it would ensure a sufficient stock of suitable equipment was available for use for the London 2012 Olympic Games and Paralympic Games.

5.65 We have previously concluded that new uses of the cleared spectrum should be permitted from the point of DSO in a region, subject to the necessary rights having been awarded and our having given PMSE users six months' notice in the upper band.[27] We sought views in the cleared award consultation document on extending the notice period in the upper band to 12 months, extending this notice period to include the lower band and deferring the start date for rights to use the cleared spectrum in London until after the 2012 Olympic Games and Paralympic Games.

5.66 Responses from likely bidders in the cleared award suggest they would not roll out new services in the cleared spectrum until it was available across the UK. The one possible exception to this remains channel 36, which will be cleared of use by aeronautical radar during 2009 and so will be available for new use across the UK from the point of its award. We therefore propose to maintain existing PMSE access to the cleared spectrum until DSO is completed in the UK in late 2012 (with the exception of channel 36, for which we would give 12 months' notice for PMSE use to cease).

Question 13. Do you agree with our proposal to maintain PMSE access to channel 36 on 12 months' notice to cease and to the rest of the cleared spectrum (channels 31-35, 37 and 61-69) until DSO is completed in the UK in late 2012?

There may be scope to allow PMSE use of the 800 MHz band during 2013

5.67 There may be benefits in allowing wireless microphones to continue to access at least some of the 800 MHz band until the end of 2013 given that channels 61 and 62 are unlikely to be cleared of DTT and available for new uses until then. However, access to the whole band would prevent early use by new licensees. Under our existing award proposals, it would be for those licensees to determine the use of the 800 MHz band during 2013 before all the spectrum was cleared. There is also the potential for PMSE use of channels 63-69 to disrupt use of the band by other technologies (e.g. TDD). We have not estimated the potential opportunity cost but believe that it could be significant. We do not think we need to take a position on this now but will keep it under review.

Moving PMSE from channel 69

The principal cost is modifying existing equipment and purchasing new

5.68 Moving wireless microphones from channel 69 to channel 38 will require existing equipment to be modified and/or new equipment to be purchased. PMSE stakeholders have argued that they will need financial assistance given that the timescales involved are less than the typical 10-year lifecycle of existing equipment.

5.69 At this initial stage, we believe the level of such financial assistance to which PMSE users may be entitled should be based on the lower cost of either modifying equipment or replacing it, the latter based on the residual equivalent value of existing equipment and not the cost of buying new equipment. This avoids the situation where public money is used to buy new equipment that would have replaced old equipment with little remaining usable life anyway.

5.70 For the purposes of assessing claims, our working assumptions for possible criteria to be satisfied for initial consideration as to entitlement are that:

[27] www.ofcom.org.uk/consult/condocs/pmse/statement/statement.pdf.

- we would only consider assistance for equipment purchased before publication of this consultation document (i.e. 2 February 2009);
- claimants would need to hold a licence to use channel 69 valid before publication of this document;
- the equipment would need to be capable of tuning to channel 69 but not channel 38; and
- the full lifecycle of equipment from the date of its original purchase is 10 years.[28]

It is difficult to accurately assess the scale of funding

5.71 It is not easy to accurately assess the overall level of funding that could be required to meet reasonably incurred costs as more than one piece of equipment may be used under a single licence. We have therefore estimated upper and lower ranges at this stage on the basis of the evidence currently available to us.

Lower end of the range

5.72 For the lower end of the range, we have used Sagentia's December 2006 report, which suggested that:

- there were 58,000 wireless microphones in the UK, with a total replacement cost of £29.8m;
- 95% of these microphones would tune to channel 69 and are assumed not to be able to tune to channel 38; and
- 22,000 (38%) of these microphones were licensed for use and 36,000 (62%) unlicensed; so that
- the maximum lower cost would be £29.8m × 95% × 38% = £10.8m; and
- since, on average, wireless microphones eligible for funding will be halfway through their lifecycle in January 2009, a realistic lower cost may be in the order of £5m.

Upper end of the range

5.73 For the upper end of the range, we have used estimates from PMSE stakeholders that the value as new of the relevant wireless microphones in the UK is nearer £100m and not £29.8m. This suggests the maximum upper cost would be £100m × 95% × 38% × ½ = £18m.

Conclusion

5.74 Overall, we believe the level of funding required to move wireless microphones from channel 69 to channel 38 is plausibly in the range of £5-18m.

Question 14. Do you agree with our approach to determining eligibility for, and our assessment of the level of, funding to move PMSE from channel 69?

[28] This is consistent with the PMSE Pro User Group's response to the PMSE consultation document.

Timescales

5.75 Recent discussions with professional PMSE representatives have suggested three years would be a plausible period for users to modify or buy equipment to use channel 38 given it is already available for and used by wireless microphones. We recognise that moving PMSE from channel 69 would still be a challenging exercise, and we are ready to support users through this process where we can.

5.76 A three year process culminating by late 2012 to coincide with the end of DSO would need to start by the end of 2009 at the latest. Again recognising the desirability of providing early certainty to PMSE users, we will seek to agree terms with the Government with a view to making funding available to those eligible as soon as possible. We will also take into account responses to this consultation document and other relevant factors.

5.77 We will publish a more detailed description of how we intend to take forward the issue of funding later in the year.

Question 15. Do you agree that three years is long enough for PMSE to move from channel 69?

Summary

5.78 This section has set out how PMSE uses channel 69 and its treatment in the DDR to date. It has identified and assessed possible alternatives from technical, coverage and economic perspectives and proposed a leading option. Finally, it has considered continued PMSE access to the cleared spectrum, the date and timescales for moving from channel 69 and how funding might be made available. In summary:

- we believe channel 38 is the best alternative to channel 69 for PMSE;
- PMSE should have continued access to most of the cleared spectrum until DSO ends in the UK in late 2012, and there might be merit in access to some of the 800 MHz band during 2013;
- financial assistance should be extended to existing licensees for channel 69 whose equipment can use this spectrum and based on the lower cost of either modifying that equipment or replacing it; and
- a three year period for assistance is plausible but still challenging.

Section 6

Securing the UK's interests in international negotiations

Introduction

6.1 This section addresses the international negotiations we propose to seek to ensure the minimum constraints are imposed on the use of the UK's digital dividend. A key issue is whether to maintain our current GE06 assignments in the cleared spectrum or to negotiate new assignments with neighbouring countries (e.g. tailored toward two-way mobile use of the upper band) without precluding other uses. Some of our neighbours are already seeking to negotiate with us as part of their own digital dividend considerations. We therefore need to determine our strategy for those negotiations. Consistent with our statutory duties and the proposals set out in this document, we will seek to negotiate international transmission rights that are likely to secure the greatest benefits for UK citizens and consumers.

6.2 We expect international negotiations could take up to a year to conclude, but high-level agreement on main GE06 assignments could be achieved by the end of 2009. This timetable is aggressive, its delivery predicated on satisfactory agreements with Belgium, France, Ireland and the Netherlands. Nevertheless, we will be able to maintain flexibility to reflect stakeholder responses to this consultation document as appropriate.

GE06

6.3 Under GE06, the UK has rights to operate up to eight DTT multiplexes in channels 21-68 of UHF Bands IV and V. GE06 included only the main high-power UK transmitter stations as a minimum threshold of 250 Watts was set. In each location, six channels of retained spectrum will be used for the six DTT multiplexes that are planned to operate after DSO. The remaining two channels are in the cleared spectrum. There are no international coordination agreements in place for using channel 69.

6.4 Under GE06, neighbouring countries also secured DTT assignments that they are expected to adopt as part of their DSO programmes. The UK is currently negotiating bilaterally with Belgium, France, Ireland and the Netherlands to finalise the detailed mutual implementation of GE06 and also to coordinate the UK's lower-power relays, which were not included in the plan.

6.5 To permit two-way mobile use of the 800 MHz band with minimal restrictions, DTT assignments in that band will need to be renegotiated. Changes to GE06 can only be made by mutual agreement with countries within coordination range. Because of this, there is an opportunity to reorganise existing GE06 assignments where there is a common need among several neighbouring countries.

Options for the UK

Maintain our DTT assignments under GE06

6.6 If the UK maintains its GE06 assignments with no changes, we will still need to engage with countries that do wish to change their assignments to enable two-way mobile use of the 800 MHz band. This is in order to protect our own assignments and their associated coverage and to get agreement for UK relays not covered by GE06.

6.7 As more European countries clear the 800 MHz band, channels 21-60 will be used more intensively for broadcasting, which will result in requests to export higher levels of interference into the UK. This might result in a loss of multiplex coverage in the UK. Arguably, the UK should not agree to any changes to GE06 that result in any coverage losses. But in this scenario, the UK still has to coordinate with neighbouring countries to obtain agreement for relays after DSO. There is likely to be only one opportunity for joint collaborative reorganisations of the main GE06 assignments.

Renegotiate new international assignments

6.8 As explained in section 4, to move DTT from channels 61 and 62 to channels 39 and 40, the UK must agree changes to GE06 with neighbouring countries on an equitable basis. Changes to the UK's GE06 assignments will affect those neighbouring countries, which may need to change their own assignments as a result, which in turn could affect their immediate neighbours, and so on across Europe. Thus, not just bilateral but multilateral engagement may be necessary to agree general principles for negotiating changes to GE06. In the run-up to RRC-06, the UK participated in multilateral negotiations in the North Sea Group, also comprising Belgium, France, Ireland and the Netherlands with Germany and Luxembourg as interested observers. This could be reinstated by mutual agreement. The UK also participated in one of the larger multilateral groups centred around the western/southwestern part of Germany to coordinate changes where the effects rippled across large geographic areas.

Conclusion

6.9 We believe that renegotiating the UK's DTT assignments under GE06 is not only desirable but unavoidable. The UK will come under increasing pressure to do so from neighbouring countries who have signalled their intent to clear the 800 MHz band. France, in particular, has set herself aggressive timetables for agreeing new assignments to allow two-way mobile use of this spectrum.

6.10 We believe it prudent to plan on the basis of entering into new negotiations with our neighbours to seek the most efficient transmission rights for the UK's digital dividend. France has publicly stated she would like to award her digital dividend for two-way mobile services by the end of 2009. This means agreement (at least in principle) on international assignments for the 800 MHz band must be in place in the same timeframe. We believe this is attainable but aggressive, and much depends on our ability to successfully conclude negotiations with neighbouring countries.

6.11 With this timeframe in mind, we believe it may be possible to conclude international negotiations for main UK sites to use the lower band of cleared spectrum in a year. In the next section, we set out the timetable for the cleared award, building into it the time we expect it will take to conclude those negotiations. We then discuss the issues we will consider in 2009 as a result of our proposals to clear the 800 MHz band.

Section 7

Next steps

Introduction

7.1 This section considers the impact of our proposals to clear the 800 MHz band on the timetable for the cleared award. It also sets out the further steps that we need to take to clear the 800 MHz band and the possible implications for auction design and packaging for the cleared award.

7.2 Our original timetable, set out in the cleared award consultation document, envisaged the award taking place in summer 2009. We have revised this to take account of the proposals in this consultation document and important new events since June 2008, notably the decisions by an increasing number of European countries to identify the 800 MHz band as their digital dividend and the need to enter international negotiations with our international neighbours.

7.3 The cumulative effect of these developments is that, as events currently stand, we expect to be in a position to hold the cleared award in 2010.

Recap on the June 2008 timetable

7.4 At the time of the cleared award consultation document, we set out a best-case timetable for the award taking into account the timelines of the various international negotiations and policy and technical processes that must precede it. We estimated that we could release an information memorandum and draft regulations in the spring of 2009 and then start the award process itself in summer 2009.

7.5 This timetable is no longer achievable, especially given the amount of time it will take to renegotiate international agreements. Securing international coordination rights to use the spectrum is a fundamental step toward the cleared award. Potential bidders will need to know the transmission rights – coverage and power – that the UK and our neighbours have in order to take a view on the relative value of the spectrum. Our view is that international negotiations should reach a certain level of clarity (i.e. agreement on the main transmitters) before we hold the cleared award. In addition, there will need to be a reasonable degree of certainty regarding the arrangements to be made to clear the 800 MHz band before an award can be held. We set out next steps below.

Next steps

7.6 As a result of our proposals to clear the 800 MHz band, we envisage a series of further steps that we, together with key stakeholders, will take over the next 12 months. These fall into two related but distinct categories:

- steps to clear the 800 MHz band; and
- steps to progress the cleared award.

7.7 We discuss each of the categories below.

Next steps to clear the 800 MHz band

7.8 As set out in sections 4 and 5, we propose to take forward a range of detailed practical arrangements for clearing DTT from channel 61 and 62 and PMSE from channel 69. A large part of this will be continuing work with stakeholders to refine our plans and to gain a better understanding of the costs of moving both DTT and PMSE.

7.9 To enable the clearance of DTT from channels 61 and 62, we will enter negotiations with neighbouring countries. As explained in section 6, these could take up to 12 months to conclude, though it may be possible to reach earlier agreement on main transmitter sites akin to GE06.

7.10 In summary, we expect to progress the work as follows:

- during the next few months, we will start coordination negotiations with our neighbours. We will also continue discussions with stakeholders on the practical arrangements needed to clear channels 61 and 62. In particular, we expect to undertake further analysis of the opportunities for integrating clearance with DSO;

- in the summer, we expect to be in a position to make a decision, taking into account responses to this consultation document, on our proposals to clear the 800 MHz band. We anticipate issuing a statement on that decision;

- if we do decide to proceed with our proposals, then around the same time we would expect to commission an implementation programme and publish further details of that plan;

- we hope to be able to bring international negotiations to a conclusion in respect of main transmitter sites by the end of 2009; and

- also by the end of the year, we anticipate that the contractual and other practical arrangements associated with clearing DTT from channels 61 and 62 will largely be in place.

Next steps to progress the cleared award

7.11 Alongside the work on clearing the 800 MHz band set out above, we expect to continue work on technical and policy issues relating to the cleared award, taking into account responses to cleared award consultation document.

Structure of the digital dividend awards

7.12 Our strategy for awarding the digital dividend was set out in the DDR statement. This strategy is unchanged by the proposals in this consultation document. Our approach remains one based on creating as much flexibility as possible for users to decide how spectrum is used while preventing harmful interference and ensuring that the UK meets its international obligations.

7.13 This approach maximises the potential uses of the spectrum and imposes the minimum restrictions on spectrum use. We consider that this strategy is likely to generate significantly more value for citizens and consumers over time than taking a command-and-control approach, in which the regulator would pick certain preferred uses or users and prevent or prohibit others.

7.14 We also continue to think that promoting competition and innovation should be central to the design of the digital dividend awards and that well designed awards should create major opportunities for more competition and innovation in the communications sector.

7.15 We do, however consider that there are some issues about the sequence and structure of the digital dividend awards that will need to be addressed if we change the configuration of the UK's cleared spectrum as proposed in this consultation document. These concern:

- the timing of the award of channel 36;
- the case for awarding the upper and lower bands of cleared spectrum either together or separately; and
- the case for holding the combined geographic-interleaved award alongside or separate to the cleared award(s).

7.16 On the first of these issues, we have considered again whether to award channel 36 with the rest of the cleared spectrum (in an award that is likely to be in 2010 – see below) or to seek to award it earlier. The latter might be possible as channel 36 may not form part of the same set of international negotiations as the rest of the cleared spectrum.

7.17 We have, however, reached the same view as we held before, namely that if we award channel 36 with the rest of (at least) the lower band, this is likely to lead to the most efficient outcome and that this is in the interests of citizens and consumers. Our view takes into account the nature of likely demand for channel 36 and the fact that other channels in the lower band (with the exception of channel 38) could be substitutes and/or complements to channel 36. We think that awarding channel 36 on its own ahead of the rest of (at least) the lower band would not take into account these factors and therefore risk creating a very inefficient outcome.

7.18 In relation to the other issues identified above regarding the structure of the digital dividend awards, we expect to carry out further analysis as part of our wider programme of work on the awards. We expect to set out views in summer 2009.

TLCs

7.19 We are continuing our work to develop suitable TLCs for the cleared spectrum. In order to do this, we have been contributing to the work in CEPT and expect to provide further input during 2009. CEPT's final report is due to be delivered in June 2009. The satisfactory conclusion of this work is key to our ability to design and hold the cleared award.

Spectrum packaging, auction design and other licence conditions

7.20 In the light of the conclusions of CEPT's work, our proposals to clear the 800 MHz band and responses to the cleared award consultation document, we will undertake further work to develop further proposals for spectrum packaging, auction design and other licence conditions relating to the cleared award. We expect to publish a consultation document setting out this thinking in summer 2009.

Conclusion on the likely timetable for the cleared award

7.21 There remains some uncertainty regarding the timetable for the cleared award. The timetable is affected by a number of processes not completely within our control, including the outcome of European policy and technical discussions, international negotiations and putting in place suitable arrangements to clear the 800 MHz band. However, we believe we can progress the work on the award during 2009 and, given other satisfactory developments, believe it should be possible to hold the auction in 2010.

7.22 The key next step will be a consultation document setting out further proposals for the detailed design of the cleared award. We expect to publish this in summer 2009. Following that consultation, we anticipate it is likely to be necessary to publish a further, probably narrower consultation document focusing on technical and more detailed aspects of the award design in winter 2009. A statement, information memorandum and draft regulations would follow in 2010, allowing the award to proceed later that year.

Annex 1

Responding to this consultation

How to respond

A1.1 We invite written views and comments on the issues raised in this document, to be made by 5 p.m. on 20 April 2009.

A1.2 We strongly prefer to receive responses using the online web form at http://www.ofcom.org.uk/consult/condocs/800mhz/howtorespond/form as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see annex 3) to indicate whether or not there are confidentiality issues. This response cover sheet is incorporated into the online web-form questionnaire.

A1.3 For larger consultation responses – particularly those with supporting charts, tables or other data – please email ddr.cleared@ofcom.org.uk, attaching your response in Microsoft Word format, together with a consultation response cover sheet.

A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation.

DDR Cleared-Award Project Team
Spectrum Policy Group
Riverside House
2a Southwark Bridge Road
London SE1 9HA

A1.5 Note that we do not need a hard copy in addition to an electronic version. We will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.

A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together in annex 3. It would also help if you can explain why you hold your views and how our proposals would impact on you.

Further information

A1.7 If you want to discuss the issues and questions raised in this consultation or need advice on the appropriate form of response, please contact Kalpesh Brahmbhatt on 020 7783 4526.

Confidentiality

A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, please specify what part and why. Please also place such parts in a separate annex.

A1.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.

A1.10 Please also note that copyright and all other intellectual property in responses will be assumed to be licensed to us to use. Our approach on intellectual property rights is explained further on our website at www.ofcom.org.uk/about/accoun/disclaimer/.

Next steps

A1.11 Following the end of the consultation period, we intend to publish a statement in summer 2009.

A1.12 Please note that you can register to receive free mail updates alerting you to the publications of relevant Ofcom documents. For more details, please see www.ofcom.org.uk/static/subscribe/select_list.htm.

Our consultation processes

A1.13 We seek to ensure that responding to a consultation is as easy as possible. For more information, please see our consultation principles in annex 2.

A1.14 If you have any comments or suggestions on how we conducts our consultations, please call our consultation helpdesk on 020 7981 3003 or email us at consult@ofcom.org.uk. We would particularly welcome thoughts on how we could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumers, who are less likely to give their opinions through a formal consultation.

A1.15 If you would like to discuss these issues or our consultation processes more generally, you can alternatively contact Vicki Nash, Director Scotland, who is our consultation champion:

Vicki Nash
Ofcom
Sutherland House
149 St. Vincent Street
Glasgow G2 5NW

Tel: 0141 229 7401
Fax: 0141 229 7433

Email vicki.nash@ofcom.org.uk

Annex 2

Our consultation principles

A2.1 We have published the following seven principles that we will follow for each public written consultation.

Before the consultation

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

During the consultation

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

A2.4 We will make the consultation document as short and simple as possible. We will try to make it as easy as possible to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

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

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

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

After the consultation

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

Annex 3

Consultation response cover sheet

A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses in full on our website: www.ofcom.org.uk.

A3.2 We have produced a cover sheet for responses (see below) and would be very grateful if you could send one with your response. (It is incorporated into the online web form if you respond in this way.) This will speed up our processing of responses and help to maintain confidentiality where appropriate.

A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore, we would encourage respondents to complete their cover sheet in a way that allows us to publish their responses upon receipt rather than waiting until the consultation period has ended.

A3.4 We strongly prefer to receive responses via the online web form, which incorporates the cover sheet. If you are responding via email, post or fax, you can download an electronic copy of this cover sheet in Word or RTF format from the consultations section of our website at www.ofcom.org.uk/consult/.

A3.5 Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details or job title to remain confidential, please provide them in your cover sheet only so we do not have to edit your response.

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

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

Nothing	☐	Name/contact details/job title	☐
Whole response	☐	Organisation	☐
Part of the response	☐	If there is no separate annex, which parts?	

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

DECLARATION

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

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

Name Signed (if hard copy)

Annex 4

Consultation questions

The costs and benefits of clearing the 800 MHz band

Question 1. Do you agree that clearing DTT from channels 61 and 62 and PMSE from channel 69 to align the upper band of cleared spectrum in the UK with the emerging digital dividend in other European countries is likely to further the interests of citizens and consumers to the greatest extent?

Moving DTT from channels 61 and 62

Question 2. Do you agree that the proposed DTT migration criteria are proportionate and appropriate? If not, please explain why and clearly identify any other criteria you believe should be adopted and why.

Question 3. Do you have views on the options identified and our assessment of them? Do you believe there are other, superior options, and, if so, why? Do you agree that the hybrid option is most consistent with the DTT migration criteria?

Question 4. Do you have views on the implementation-timing options identified and our assessment of them? Do you agree that DSO-integrated implementation is most consistent with the DTT migration criteria? If not, why not?

Question 5. Do you agree that a programme-control and -governance arrangement such as that outlined above is appropriate?

Question 6. Do you agree that the four cost categories adequately capture the costs associated with clearing DTT from channels 61 and 62? Are there any costs that do not appear to have been accounted for in any of these categories?

Question 7. Do you agree that our cost profile is a reasonable basis for planning the capital expenditure for clearing DTT from channels 61 and 62?

Moving PMSE from channel 69

Question 8. Do you agree that these are the most appropriate criteria to assess which spectrum is the best alternative to channel 69 for PMSE?

Question 9. Do you agree with our technical and coverage analysis of the possible alternatives to channel 69 for PMSE?

Question 10. Do you agree with our economic assessment of the realistic alternatives to channel 69 for PMSE?

Question 11. Do you agree that channel 38 is the best alternative to channel 69 for PMSE?

Question 12. Do you agree that we should award channel 38 to the band manager on the same terms as would have applied to channel 69?

Question 13. Do you agree with our proposal to maintain PMSE access to channel 36 on 12 months' notice to cease and to the rest of the cleared spectrum (channels 31-35, 37 and 61-69) until DSO is completed in the UK in late 2012?

Question 14. Do you agree with our approach to determining eligibility for, and our assessment of the level of, funding to move PMSE from channel 69?

Question 15. Do you agree that three years is long enough for PMSE to move from channel 69?

Impact assessment

Question 16. Do you agree that with our analysis of the key impacts of our policy options? Are there any other key impacts we should assess?

Annex 5

Impact assessment

Introduction

A5.1 The analysis presented in this annex and the consultation document as a whole represents an impact assessment, as defined in section 7 of the Communications Act 2003.29

A5.2 You should send any comments on this impact assessment to us by 20 April 2009. We will consider all comments before deciding whether to implement our proposals.

A5.3 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best-practice policy-making. This is reflected in section 7 of the Communications Act, 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. However, as a matter of policy, we are committed to carrying out and publishing impact assessments in relation to the great majority of our policy decisions. For further information about our approach to impact assessments, see the guidelines "Better policy-making: Ofcom's approach to impact assessment," which are on our website at www.ofcom.org.uk/consult/policy_making/guidelines.pdf.

A5.4 This impact assessment summarises analysis in the rest of this consultation document and is organised as follows:

- first we outline our objective for the DDR as a whole and two subsidiary objectives the policy options examined in this impact assessment seek to meet. These serve to establish the criteria against which we evaluate the impacts of the alternative policy options;
- we then summarise our approach to this assessment and the policy options examined in it, beginning with the base case of retaining the scope of the cleared award set out in the DDR statement and the cleared award consultation document, then outlining the alternative policy options of clearing DTT from channels 61 and 62 and/or clearing PMSE from channel 69;
- we then set out the key assumptions we have made in evaluating the impacts of these policy options, including –
    - the assumed environment of international constraints that will affect the availability and hence value of the spectrum concerned;
    - the market-demand scenarios we have used in quantifying the potential economic impacts of the policy options; and
    - the specific valuation assumptions we have adopted to quantify the economic impacts of the policy options under these different spectrum-availability and demand scenarios;

[29] www.opsi.gov.uk/acts/acts2003/pdf/ukpga_20030021_en.pdf.

- we then set out our assessment of the impacts of the policy options in the context of the three key evaluation criteria we have used to assess them; and

- finally we draw these conclusions together to identify our preferred policy option and set out how we propose to evaluate its effects.

The citizen and/or consumer interest

A5.5 The digital dividend is of very significant value to citizens and consumers, not just in the UK but also in other European countries. Spectrum Value Partners estimated in March 2008 that allocating at least some spectrum in UHF Bands IV and V to mobile communications would generate €63-165bn (NPV over 20 years) for the European economy[30] .

A5.6 It is therefore in the interests of citizens and consumers that the UK's digital dividend is configured and awarded in a way that is most likely to maximise the total value to society generated by using the spectrum over time. This is our objective for the DDR. In achieving this, we must have regard both to specific circumstances in the UK – including current and planned uses of this and adjacent spectrum – and evolving plans in other European countries and at the EU level.

Objective for the DDR

A5.7 This consultation document has set out our consideration of the spectrum to be included in the cleared award. In particular, we have considered whether there is a net benefit to society in amending our previous proposals in order to clear DTT from channels 61 and 62 (which previously would have been interleaved capacity) and PMSE from channel 69 (which previously we had decided to omit from the award)

A5.8 In assessing the different policy options available, we have borne in mind our objective for the DDR as a whole, as set out above, and two subsidiary objectives the policy options examined in this impact assessment seek to meet:

- minimising disruption to existing and planned authorised users of the 800 MHz band; and

- ensuring the timely and orderly award of the cleared spectrum.

Policy options

A5.9 To secure these objectives, we have identified four primary policy options, described in more detail in paragraphs A5.22-A5.39. These are:

- **option A** – the base case of continuing with our current proposals;

- **option B** – clearing DTT from channels 61 and 62 and including the spectrum in the cleared award;

- **option C** – clearing PMSE from channel 69 and including the spectrum in the cleared award; and

[30] www.spectrumstrategy.com/Pages/GB/perspectives/Spectrum-Getting-the-most-out-of-the-digita-dividend-2008.pdf.

- **option D** – clearing all three channels and including the spectrum in the cleared award.

Types of impact assessed

A5.10 Our assessment entails examining the potential impacts of the alternative policy options (options B, C and D) relative to the base case (option A) in terms of the three objectives identified above.

A5.11 To identify the impact of the policies on the total value to society the cleared award is likely to generate, our assessment includes both quantitative economic and qualitative elements. For the quantitative economic assessment, we have modelled the key value impacts of spectrum being awarded under the policy options. Annex 6 provides an overview of this modelling work and presents its outputs. A summary of our approach is set out in the next section.

A5.12 Our assessment has also included consideration of the potential impacts on specific groups of stakeholders. Some of these are included, in aggregated form, in the quantified economic analysis, while others are less easy to quantify. Following the aggregated economic analysis, we provide a qualitative description of both types of impact on specific groups of stakeholders. For this purpose, we have identified the following groups that are likely to be particularly affected by the different spectrum awards implied by the alternative policy options:

- viewers of DTT carried by the existing six multiplexes after DSO;
- the associated DTT service providers – broadcasters, multiplex operators and the transmission network owner;
- licensed PMSE users;
- users of new services that are likely to be deployed in the digital dividend;
- new spectrum licensees and providers of these new services; and
- citizens generally.

A5.13 Finally, we set out the results of our assessment of impacts against the other two objectives: minimising disruption to existing and planned authorised users of the 800 MHz band; and ensuring the timely and orderly award of the cleared spectrum.

Summary of our approach to the quantified economic assessment

A5.14 Our quantified assessment examines the economic value associated with the different policy options. We have defined economic value to include both producer and consumer surplus. We have not explicitly included broader social value within the quantified assessment. Broader social value can arise when social benefits (e.g. enabling greater participation in a civil society) are not reflected in the valuations placed on spectrum in consumer and producer surpluses.

A5.15 We consider that including explicit estimates of broader social value in the quantified assessment would not change its key conclusions. While the alternative policy options may entail some loss in broader social value from DTT, the impacts would be limited as our analysis implies only limited changes in service coverage. Furthermore, any such losses could be offset by any increase in broader social

value from the improved access to affordable mobile-broadband services that the alternative policy options would facilitate. The net changes in broader social value, were they to be quantified, are therefore unlikely to be great. In contrast, we have estimated the economic value from clearing the channels to be very significant. Therefore, including broader social value would be unlikely to affect our policy conclusions.

A5.16 To compare the policy options, we have adopted a range of plausible assumptions in relation to consumer demand for different possible uses of the spectrum. This has allowed us to identify a broad range of economic values for the spectrum concerned. We then compare the total economic value that might be generated by using the spectrum under the different policy options, netting off the costs of implementing them.

A5.17 Overall, we think our assessment of the net economic benefits of the alternative policy options is likely to be conservative. In particular, our estimates do not quantify the likely additional value for users of mobile communications services generated by the greater potential of the 800 MHz band and stronger competition. In reality, this additional value could prove to be substantial. However, given the complexity of the analysis required (especially in relation to mobile communications) and the substantial net benefits identified, we do not believe this added complexity is necessary to arrive at the policy option that, in our view, best meets our objectives.

A5.18 Furthermore, our results could overestimate the benefits that would be available in the base case (option A) without clearing the 800 MHz band. This is because, in specifying the base case, we have assumed that there would no material adverse effects from additional incoming interference in the lower band of cleared spectrum that could arise as a result of neighbouring countries' decisions. In practice, such an assumption may prove to be unrealistic, thereby potentially increasing the benefits associated with the alternative policy options (although our modelling does not assume adverse effects from additional incoming interference in these policy options either).

A5.19 Nevertheless, our quantitative assessment of the net economic benefits of the proposed policy option could prove to be overstated, with particular risks in two areas:

- the value generated by mobile communications services could be lower than we have assumed in our demand scenarios. We consider this risk to be low given the recent evidence of strong demand for mobile broadband. Further, even with relatively low demand for mobile communications services, there are still likely to be material net benefits from clearing the 800 MHz band given that the reduction in value to DTT is limited (as the opportunity to deploy two additional UK-wide multiplexes in cleared spectrum is retained) while the additional benefits from mobile communications are still substantial; and

- the economic costs of clearing the band could be greater than we have assumed, although, in developing our implementation cost estimates for this assessment, we have sought to adopt relatively conservative assumptions.

A5.20 Notwithstanding our generally conservative approach, the economic case for option D is, in our view, very strong, although it must of necessity rely on a range of assumptions about future outcomes – including future service demand and the outcomes of future international negotiations – to which some risk and uncertainty

must always be attached. Consequently, we have also stress-tested our assessment by considering a less-favourable demand scenario with high demand for DTT combined with relatively low demand for mobile services. There are still net economic benefits from option D under this scenario, such that it would still be the preferred policy option under these assumptions.

A5.21 We set out the specific assumptions we have made in specifying the four policy options for this quantitative analysis. The next section describes the assumptions made for the base case (option A). The section after that describes the assumptions made for the three alternative policy options (options B, C and D).

Option A: base case of continuing with our current proposals

A5.22 In the DDR statement, we decided to award channels 31-37, 39-40 and 63-68 by auction in a single "cleared" award. In the cleared award consultation document, we also proposed including channel 38 and the interleaved capacity in channels 61 and 62 in this award, with all licences being UK-wide in scope.

A5.23 We proposed this award scope for the following key reasons:

- the international rights negotiated at RRC-06 allow transmissions by both broadcasting and mobile communications networks in the cleared spectrum;
- the UK's DSO plan enabled channels 31-35, 37, 39-40 and 63-68 to be cleared, and channels 36 and 38 could also be cleared in the UK on similar timescales;
- channels 61 and 62, while planned for use by DTT in the UK under GE06 and the DSO plan, were identified in WRC-07 as being attractive for mobile communications use, and accordingly interleaved capacity in these channels could be of potential value for such use;
- given the existing UK-wide use of channel 69 by PMSE, we decided to award this channel to the band manager with obligations to those users; and
- given the complementarities and substitution possibilities between spectrum at different UK-wide frequencies within the cleared award, a single auction would be the most efficient way to assign the spectrum, enabling bidders to avoid the significant aggregation risks otherwise inherent in separate auctions.

A5.24 Because GE06 enabled the cleared spectrum to be used in a variety of ways, we proposed to offer licences with a range of alternative TLCs in the auction. This approach would maximise the opportunities for licensees with similar networks to use the spectrum efficiently in adjacent spectrum. Where the efficient auction outcome implied that licensees with different network types would be located in adjacent spectrum, we proposed the use of guard bands to ensure the neighbours concerned were protected from harmful interference from each other.

A5.25 We also proposed a clause in all licences to protect existing DTT users, and we proposed that all awarded licences would be tradable and (other than TLCs) not contain restrictions on use – i.e. a technology- and service-neutral award.

A5.26 Respondents to the cleared award consultation document broadly endorsed our proposals for including the interleaved capacity in channels 61 and 62 in the cleared award, although a number of them suggested that the award would be inefficient unless DTT were cleared from these channels, given ongoing European

consideration of harmonising the whole 800 MHz band for mobile communications use. Similarly, respondents agreed with our proposal to include channel 38 in the cleared award despite the impact that existing international restrictions on high-powered use in much of the UK would have on its value.

A5.27 A number of respondents pointed out that excluding channel 69 from the cleared award would potentially lead to an inefficient outcome. They suggested a number of alternative frequencies that would meet the needs of PMSE users at lower economic and financial cost.

A5.28 Most respondents endorsed our proposal to offer UK-wide licences and accepted the need for flexible but effective mechanisms to protect existing DTT and for guard bands to separate licensees with TLCs of different types, although a number again emphasised the need to align these with the least restrictive technical conditions being developed in CEPT. Concerns were expressed at the potential complexity introduced into the auction design by sustaining the flexibility for licences with different TLCs to be awarded across the cleared spectrum, but solutions proposed focused on simplifications enabled by changing the spectrum within the cleared award.

A5.29 Having considered these responses, we consider that the scope of the cleared award as currently proposed still constitutes a realistic baseline against which to assess the impacts of changing the spectrum to be auctioned. However, we have reviewed the potential timing for an award of this scope in our base case for two main reasons:

- since the cleared award consultation document was published, a number of countries, notably France, have announced their intention to enable use of the 800 MHz band for mobile communications. This will require new international coordination within the existing framework of GE06 in any event. For example, the UK's existing assignments enable high-powered transmissions from the UK that could impair neighbouring countries' use of the band for mobile communications, while more intensive use of the lower band by neighbours for DTT under GE06 could increase the levels of interference experienced by users of this spectrum in the UK. We have also yet to agree terms with all neighbours for new use of channel 36;

- a number of respondents suggested we should not finalise our cleared award proposals until the range of technical work being undertaken in CEPT has concluded. This is now scheduled for June 2009. If we did not finalise our proposals until then, and allowing for the time needed to finalise the details and make regulations for the cleared award following a further consultation on award design, it is unlikely that the cleared award could now be held before spring 2010 in any event.

A5.30 Accordingly, we have defined our base case (option A) for this assessment as being the spectrum assignment that could occur as a result of a spring 2010 cleared award of the same scope as proposed in the cleared award consultation document. Because of the potential impact of neighbouring countries' plans, the impact of international constraints on the value of the UK spectrum concerned could be greater than assumed in the DDR statement, even with no changes to GE06. Further, some of the associated agreements for relays under GE06 have not yet been concluded with our neighbours and may in practice be difficult to conclude

with no impact on assumed spectrum values. However, as noted above, we have conservatively discounted such potential negative impacts on the base case.

Alternative policy options: changing the spectrum in the cleared award

A5.31 To fully to align the upper band of cleared spectrum with the 800 MHz band increasingly being made available by other European countries, channels 61, 62 and 69 would all need to be cleared of their current planned uses and included in the cleared award. The impacts of clearing these channels would fall on two distinct sets of users:

- viewers of DTT planned to use channels 61 and 62 after DSO; and
- PMSE users of channel 69.

A5.32 The impacts on the users concerned are substantially independent, hence it may in principle be possible to achieve some of the benefits of aligning the UK's upper band of cleared spectrum with the digital dividends of other European countries while avoiding some impacts by only changing some of the spectrum concerned.

A5.33 We have therefore assessed the impacts of three alternative policy options for changing the spectrum in the cleared award, each involving distinct sets of avoidable costs and associated benefits (relative to the base case, option A):

- **option B** – moving DTT from channels 61 and 62 to channels 39 and 40 under the hybrid option described in section 4 and including the spectrum in the cleared award;
- **option C** – moving PMSE from channel 69 to channel 38 as described in section 5 and including the spectrum in the cleared award; and
- **option D** – combining options B and C to clear all three channels and including the spectrum in the cleared award.

A5.34 A variant of options C and D would be to award a licence for channel 38 with a delayed commencement date in the cleared award to enable PMSE users to use this spectrum while the band manager is required to meet their reasonable demand, together with an assurance that suitable spectrum would continue to be made available to them in the long term. However this variant does not affect the basic policy decision in relation to clearing the 800 MHz band and so has not been separately analysed in this impact assessment.

A5.35 The key benefits of all three alternative policy options are focused on the more efficient use of the upper band of cleared spectrum. As indicated in section 3, these include harmonisation (allowing manufacturers to realise greater economies of scale, reducing prices for network and handset equipment), fewer restrictions on spectrum use if we can renegotiate existing international agreements satisfactorily, more valuable spectrum suitable for mobile services when demand for mobile broadband is increasing rapidly and increased competition as the availability of more spectrum suitable for mobile services helps to support a more competitive market, yielding lower prices, higher quality and greater choice. The results of our quantified economic assessment of these benefits are set out in paragraphs A5.61-A5.68.

A5.36 The impacts on DTT stakeholders (viewers, broadcasters and their suppliers) of implementing option B or D are set out in detail in section 4 and summarised in paragraphs A5.93 and A5.94. The impacts on PMSE users of implementing option C or D are set out in detail in section 5 and summarised in paragraph A5.95 below.

A5.37 In addition to these impacts, options B and D would potentially delay the time when the affected spectrum in the upper band can be brought into UK-wide use. In the cleared award consultation document, we proposed that this would be toward the end of 2012, following the completion of DSO. The proposed approach to clearing channels 61 and 62 described in section 4 is designed to limit the risks to DSO and the costs of implementation while still making spectrum available with limited delay.

A5.38 Striking this balance in practice will require careful management of the various impacts and risks, including those associated with international negotiations. It is possible that, as an outcome of this process, the optimum timing to make channels 61 and 62 available for new uses is still relatively close to the end of DSO in late 2012. However, for this assessment, we have assumed that clearing channels 61 and 62 would delay the availability of these channels for new uses for a year, to the end of 2013. This builds in appropriate allowance for the related processes of international coordination and clearance of channels 61 and 62 following DSO.

A5.39 There is also a balance to be struck between minimising the costs and impacts on PMSE users of clearing channel 69 on the one hand and limiting any delay to making the spectrum available for new uses on the other. In practice, this is an area where the timing of clearing channels 61 and 62 could affect the optimum timing for clearing channel 69. If the delay in clearing channels 61 and 62 is not great, there could be a stronger case for aligning the availability of the whole 800 MHz band. A greater delay to clearing channels 61 and 62 could imply a stronger case for making the capacity enabled by clearing channel 69 available earlier. For this assessment, we have assumed that, with the exception of channel 36, only the availability of spectrum affected by clearing channels 61 and 62 is delayed by one year after the base case. More exact timings will need to be considered when the plans for DTT have been further developed. We discuss a range of related timing issues in section 7.

Key governing assumptions in evaluating impacts of alternative policy options

Options for changing international constraints

A5.40 The value of spectrum in the cleared award is materially affected by international constraints on transmissions. Currently, these constraints are primarily defined by GE06.

A5.41 For the base case (option A), we have assumed in this assessment that no material changes to GE06 would be agreed, with only minimal renegotiation of existing agreements undertaken, thereby sustaining the ability for the UK to deploy both broadcasting and mobile communications networks in the upper band of cleared spectrum. Even though this renegotiation outcome might not in practice be realistic, as noted above, it serves to maximise the value of the upper band for broadcasting uses in the base case. It is therefore conservative for the purposes of this impact assessment. That is, the net benefits from clearing the 800 MHz band would be even greater with a more realistic assumption about the extent of changes to GE06.

A5.42 We have assumed that implementing any of the three alternative policy options (options B, C and D) will require more material aspects of these arrangements to be renegotiated with neighbouring countries, as described in section 6. Although one conceptual option for changing these international arrangements would be to seek the minimum changes required for the UK alternative policy option concerned, such an approach may well be neither realistic nor desirable in practice as the best approach to implement the alternative policy options. This is because:

- the existing GE06 assignments no longer align with our neighbours' plans. For example, France has announced its intention to allocate the 800 MHz band to mobile broadband, which would be best achieved by renegotiating GE06 for all this spectrum (and adjusting the existing DTT assignments below channel 61). Regardless of UK policy, an approach of minimal renegotiation may therefore be difficult to sustain; and

- the existing GE06 assignments do not provide an envelope that would maximise the value of UK spectrum under the alternative policy options. While the existing high-power assignments in the upper band of cleared spectrum would enable medium-power mobile communications transmissions in the UK, they were not negotiated with this purpose explicitly in view. Given that neighbouring countries will now have that purpose, it may be in the UK's best interest to negotiate a compatible solution if the spectrum concerned aligns more with our neighbours.

A5.43 We have therefore assumed for this assessment that, consistent with implementing any of the three alternative policy options, the following changes to GE06 would be agreed with neighbouring countries:

- rights to use the 800 MHz band would be renegotiated to facilitate mobile communications in both the UK and at least our most significant neighbours in interference terms – France and Ireland; and

- DTT assignments below channel 61 would be renegotiated to sustain, as far as possible, the opportunity for two new DTT multiplexes with UK-wide coverage to be deployed in the UK (as currently enabled by GE06).

A5.44 The timing attached to such negotiations is not certain. On one hand, France has announced her intention to make the 800 MHz band available from the end of DSO, planned for 2011. This would be facilitated by expedited renegotiations of GE06 with affected neighbours, including the UK. On the other hand, a number of potentially affected countries have yet to announce any plans and/or timetables for a digital dividend of their own. For the purpose of this assessment, we have assumed that the international negotiations required to support awards of the 800 MHz band in the UK and France can be concluded by 2010, consistent with the latter's plans.

A5.45 In turn, this international timing will affect the timing of the UK cleared award. Even with expedited international negotiations, a range of frequencies and countries is potentially affected, such that the negotiations could take longer than assumed in the base case (i.e. allowing a spring 2010 award). For the purposes of this assessment, we have therefore assumed a six-month delay to the award, to autumn 2010, would occur as a result of the more significant renegotiation of GE06 required to enable the alternative policy options. In practice, the delay to the award could be greater, either as a result of some negotiations taking even longer or due to other award-preparation requirements.

Spectrum-demand scenarios

A5.46 The spectrum in the cleared award will not (apart from channel 36) be available on a UK-wide basis until the end of DSO (and potentially later if the spectrum in the award is changed). Further, we are assuming in this assessment that the award itself will not occur before 2010. These timings mean that considerable uncertainty still attaches to the future economic values of the spectrum under different award permutations.

A5.47 For the purposes of this assessment, we have reflected these external uncertainties by considering a range of demand scenarios described in annex 6. For each demand scenario, we have explored the impact of the alternative policy options on the relative demands from the three most likely uses of cleared spectrum: mobile communications, DTT and MMS.

A5.48 Clearly, in principle, a very large number of such plausible demand scenarios could be assembled given the number of uncertainties concerned. We have, however, identified two specific scenarios we consider likely to encapsulate the most plausible outcomes:

- **scenario 1 – strong demand for mobile communications**. This scenario involves strong consumer demand for mobile communications and weak demand for other services; and

- **scenario 2 – strong demand for all services**. This scenario involves strong demand for the spectrum for all of mobile communications, DTT and MMS.

A5.49 We have also tested the policy options against more extreme demand scenarios. The main demand scenario we have used to stress-test our analysis is the following:

- **scenario 3 – strong demand for DTT**. This scenario involves strong demand for DTT and relatively weak demand for mobile communications and MMS.

A5.50 We consider scenario 3 to be much less likely than scenarios 1 and 2. This is because, on the one hand, there is evidence of increased demand for mobile broadband (see annex 6), while, on the other hand, the effective capacity of the spectrum retained for DTT for the existing six multiplexes is likely to increase in the coming years due to technological developments. Nevertheless, we do not regard such a scenario as being implausible.

A5.51 We do not explicitly consider PMSE demand in our quantified economic impact analysis of the alternative policy options. This is because we assume that the minimum spectrum required to meet the needs of PMSE users would be available in all policy options and, while some options and demand scenarios could give rise to additional spectrum suitable for low-power use, this additional spectrum would have relatively low value and hence would not materially affect the policy choice.

Economic-valuation assumptions

A5.52 We have undertaken analysis to quantify the total changes in economic value that would occur as a result of spectrum awarded under each alternative policy option under each market scenario examined. The approach we have used is similar to that adopted for the economic analysis we undertook in reaching our policy

conclusions in the DDR statement but using updated assumptions about the potential economic value of spectrum in different uses.

A5.53 The assumptions used are set out in more detail in annex 6. The key assumptions are that:

- spectrum would always be awarded to one or more of four uses – mobile communications, the provision of additional DTT multiplex capacity, MMS and PMSE. While there are other possible uses, research evidence for, and responses to, previous consultation documents suggest these are among the most likely given the constraints assumed for the spectrum concerned;

- mobile communications use is valued in an FDD configuration. While TLCs suitable for TDD networks would also be made available for bidders in the cleared award, TDD use of most spectrum would displace potential FDD use given the nature of the international constraints we assume. This displacement would only occur if TDD use was of higher value. In these cases, the adoption of FDD (the focus of CEPT's work to date) for this impact assessment would provide a floor to the value of spectrum in mobile communications use;

- the FDD value of spectrum is assumed to reflect its opportunity cost in terms of transmission cost savings for deploying Long-Term Evolution (LTE) relative to networks at a higher plausible frequency for LTE – 1800 MHz, as discussed in annex 6. Responses to previous consultation documents have suggested that LTE is a plausible commercial technology for deployment in the 800 MHz band. Alternative FDD technologies could also be deployed in the spectrum – by a future FDD variant of WiMAX technology, for example, as the technology involved in WiMAX and LTE is sufficiently similar that we consider our analysis of benefits applies to either technology given the level of confidence that we are seeking in this analysis;

- the value of spectrum used by DTT is estimated on a similar basis to that set out in the DDR statement, with our analysis updated to reflect more recent assessments of future service demand together with the assumed revisions to GE06 implied by the alternative policy options. These could effectively preclude the economic deployment of high-power DTT networks in the upper band of cleared spectrum and alter the marginal values of spectrum in the lower band;

- the value of spectrum used by MMS is also estimated on a similar basis to that set out in the DDR statement. Some of the parameters have been updated to include data on currently deployed nascent mobile TV services at 2.1 GHz and the result of the L-Band auction; and

- as noted in paragraph A5.51 above, we have assumed that the value generated by PMSE is constant under all policy options.

A5.54 In addition to these underlying values, the modelling that we describe in annex 6 has sought to reflect the potential impact of international and other constraints on the use of particular spectrum in the policy options examined. The most important impacts reflected in the analysis are:

- the value for mobile communications use of cleared spectrum being aligned to the CEPT FDD plan for the 800 MHz band. This is expressed in terms of a value reduction in non-harmonised deployments;

- the amount of spectrum needed to deliver high-coverage DTT multiplexes;
- the broad impact of the geographic UK constraints implied for interleaved spectrum as an outcome of international negotiations; and
- the impact on licence values for different spectrum of the protection provisions proposed for existing UK DTT and continental radioastronomy.

Results of quantified analysis

Assumed spectrum-award outcomes

A5.55 Our quantified economic analysis involved valuing possible spectrum-award outcomes that would be consistent with each demand scenario analysed for the base case and then considering and valuing the award outcomes that might emerge under each of the three alternative policy options for the same demand scenario. While there is, in practice, a wider range of award outcomes that could be consistent with our demand scenarios, those we selected were intended to be appropriate to estimate the net economic benefit range for our policy options.

A5.56 For this purpose, plausible award outcomes for the base case were first developed for each demand scenario. In most respects, these were broadly consistent with the packaging assumptions in our cleared award consultation document. The basis and assumptions used for our assumed award outcomes are set out in annex 6. In the alternative policy options, the CEPT FDD plan for the 800 MHz band is used for award outcomes in those scenarios where the demand for harmonised spectrum suitable for mobile communications is assumed to be high enough. The award outcomes for the lower band of cleared spectrum were posited for each policy option and market scenario, as set out in annex 6.

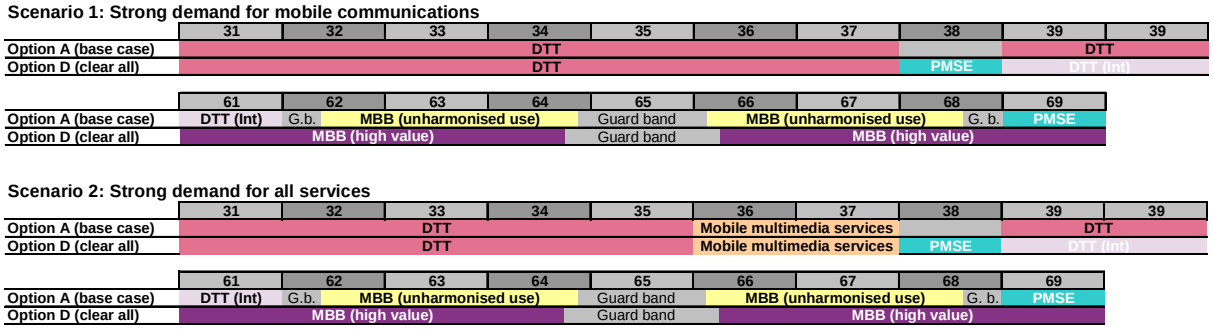
A5.57 In **scenario 1**, the strong assumed demand for mobile communications results in the upper band of cleared spectrum being used for mobile communications in all policy options. These outcomes would reflect sustained growth in the demand for fast, high data-rate mobile communications. Demand for spectrum for providing mobile services is assumed to be sufficiently high that relevant bidders would acquire available spectrum even if it were not aligned with that in other European countries.

A5.58 This would be combined with a longer-term reduction in relative demand for additional DTT capacity, given that this could be made available on the existing multiplexes in the interim and the potential limits to the growth of the platform in the longer term.

A5.59 In **scenario 2**, where there is competing demand for all three uses, demand for MMS is assumed to be sufficiently strong to create a business case for two dedicated SFNs using cleared spectrum in the lower band. The remaining spectrum is shared between DTT and mobile communications. In this scenario, demand for MMS therefore partially substitutes for DTT uses as an outcome of the auction.

A5.60 Figure A1 summarises the resulting “band plans” for these two main demand scenarios. For both scenarios, the band plans are shown for the base case (option A) and the alternative policy option D of clearing all of channels 61, 62 and 69. A full set of the band plans assumed in the analysis is given in annex 6.

Figure A1. Summary of band plans for scenarios 1 and 2



Economic impacts of alternative policy options

A5.61 These band plans, or potential outcomes from the cleared award, were each valued as briefly described above and set out in more detail in annex 6. The impact of the alternative policy options (relative to option A, the base case) was then estimated by subtracting the values associated with option A from the values associated with options B, C and D respectively.

A5.62 We also included the economic costs of implementing the policy options concerned in our quantified assessment. These are described in sections 4 and 5 respectively. These implementation costs are relatively small when compared to the potential economic benefits to citizens and consumers that improved spectrum allocation could bring.

A5.63 The resulting net incremental economic effects of each policy option under the more likely market scenarios, relative to the base case, are summarised in table A1. This shows the result of combining the higher-value demand scenario with the lower end of the range of implementation costs (and *vice versa*) to provide a range for the net economic benefits of the policy options.

Table A1. Net economic benefits compared to base case of existing award scope (£m)

	Strong demand for mobile communication services; low implementation costs	Strong demand for all services; high implementation costs
Option B: clear channels 61 and 62 only		
Change in value from DTT	-80	-400
Change in value from mobile communications	2,000	2,000
Change in value from MMS	0	-200
Implementation costs	-85	-185
Total incremental benefits of option B	**1,800**	**1,200**
Option C: clear channel 69 only		
Change in value from DTT	-20	0
Change in value from mobile communications	800	800
Change in value from MMS	0	-200
Implementation costs	-5	-18
Total incremental benefits of option C	**800**	**600**
Option D: clear channels 61, 62 and 69		
Change in value from DTT	-80	-400
Change in value from mobile communications	3,200	3,200

	Strong demand for mobile communication services; low implementation costs	Strong demand for all services; high implementation costs
Change in value from MMS	0	-200
Implementation costs	-90	-203
Total incremental benefits of option D	**3,000**	**2,400**

All figures are present values in 2009 prices of economic benefits (producer plus consumer surplus) over the relevant evaluation period, as set out in annex 6. Total incremental benefits are rounded to the nearest £100m. The cumulative difference between services may not match the specified difference due to rounding.

A5.64 It can be seen that a net improvement in the economic value of cleared spectrum is implied in all three alternative policy options (options B, C and D) relative to the base case (option A). In both demand scenarios, the greatest improvement arises under option D, when all three of channels 61, 62 and 69 are included in the cleared award.

A5.65 Under a reasonably wide range of plausible demand outcomes, our modelling therefore suggests the net total economic benefits of clearing all three channels, relative to the base case (option A), are in the order of **£2.4-3bn**.

A5.66 As set out in annex 6, positive benefits from clearing all three channels also arise under more extreme demand scenarios. Even under scenario 3 – high demand for DTT and relatively low demand for mobile communications – there are nevertheless still material net economic benefits of clearing all three channels, of the order of £0.5bn.

A5.67 We therefore conclude that clearing all three channels is likely to bring the greatest benefit under a wide range of possible market circumstances.

A5.68 It should be noted that timing effects have been included within the economic impacts quantified in this analysis. Hence:

- the initial term for all awarded licences is assumed to be the same (until 2026) in all policy options, with the value of the proposed indefinite licences represented by some additional use thereafter in the case of FDD and MMS use and with delays in spectrum availability being represented by consequent reductions in present value; and

- for channel 36 specifically, which can be brought into use for an SFN before the end of DSO, the impact of delay is represented by the effect on present value of the assumed delay in the cleared award under the policy options.

Other economic benefits of option D

A5.69 Our conclusion that clearing all three channels results in significant net economic benefits is strengthened by the fact that our analysis is conservative, in the sense that it will tend to underestimate the net economic benefits arising from this policy option. In particular, our modelling is conservative in that it does not capture all the benefit of increased spectrum use for mobile communications services, as

discussed further below. In reality, this additional value could prove to be substantial. However, given the complexity of the analysis required and the substantial net benefits that are nevertheless identified, we do not believe this added complexity was necessary to support our assessment of the policy alternatives.

A5.70 As noted above, the estimated value of mobile communications was based on the likely cost savings to operators of providing "4G" services with harmonised 800 MHz spectrum using LTE networks compared to providing the same services using higher-frequency spectrum. However, in addition to these operator cost savings, there are likely to be economic benefits we have not quantified, including enabling freeing up higher-frequency spectrum for alternative uses.

A5.71 Potentially the most important additional economic benefit from using the spectrum for mobile communications is that it would probably facilitate more intensive competition in the provision of mobile communications services in the longer term. The efficient delivery of high data-rate services to consumers is likely to benefit from the increased availability of suitable harmonised spectrum with sufficient contiguous bandwidth at appropriate frequencies. Harmonised 800 MHz spectrum for mobile services is particularly useful for the provision of such services, including for delivering mobile broadband through LTE and WiMAX. Networks with access to such spectrum may have a competitive advantage over those with access only to other, significantly higher frequencies. More intensive competition is likely to lead to greater benefits to consumers in terms of lower prices, higher quality and greater choice as well as drive up operator efficiencies and accordingly greater economic value overall.

A5.72 Policy option D significantly increases the availability of the relevant harmonised 800 MHz spectrum, as illustrated in the above band plans. There is no such harmonised spectrum available in the base case. For all demand scenarios, there is significantly more paired harmonised 800 MHz spectrum for mobile communications services available if channels 61, 62 and 69 are cleared. Hence, where access to the 800 MHz band delivers a competitive advantage, the significantly greater availability of harmonised spectrum when the whole 800 MHz band is cleared would be likely to lead to more intensive competition in the provision of mobile services.

Impacts on different stakeholders

A5.73 Our analysis strongly suggests that the aggregate economic impacts of the alternative policy option to clear all three of channels 61, 62 and 69 are significant. We have also examined how these and other impacts would be felt by different types of stakeholder. In paragraph A5.12, we identified six broad groups of stakeholder likely to be particularly affected by the policy options that we have considered. We now assess the likely impacts on each of these stakeholder groups.

Future viewers of DTT broadcasts

A5.74 Our proposals involve little adverse impact to viewers of broadcasts via the existing DTT multiplexes in the longer term after DSO, as it is proposed to sustain essentially the same coverage levels under all policy options. Indeed, particularly given our policy proposal to require a measure of interoperability for new licensees of digital dividend spectrum seeking to provide UK-wide, national, regional and/or local services via new DTT multiplexes, there remain good prospects that existing DTT viewers will see significant enhancements in the range of broadcast services available via the Freeview platform over time as a result of the digital dividend. For

example two additional high-coverage national multiplexes are still enabled by our policy proposals, consistent with the basis on which the international framework for the digital dividend was originally negotiated under GE06.

A5.75 Nevertheless, some viewers of existing DTT broadcasts will probably experience short-term detrimental impacts from the changes proposed in this document in the shape of retuning, as described in paragraph A5.93. In the longer term, after DSO, there will be two potential impacts on viewers of the DTT platform (relative to the base case).

A5.76 The first is that the proposed renegotiation of international constraints to facilitate mobile communications in the upper band (channels 61-69) will increase the relative attractiveness of this spectrum for non-DTT use, and hence the likelihood that this spectrum will be used to deliver alternative services. In turn this means that less spectrum in aggregate could be used in the delivery of national DTT services. Depending on the outcomes of both the international negotiations and the digital dividend awards, this might potentially have impacts on the range and/or the technical quality of additional DTT programming (through additional national multiplexes) that the available spectrum could support in the future.

A5.77 A second, related, type of impact could be on viewers of new regional and local programming via the DTT platform that the release of the digital dividend is likely to support. The revised proposals might imply increased use of the geographic interleaved spectrum to provide sufficient coverage capacity for national DTT multiplexes. This could affect our detailed packaging proposals in the forthcoming awards of geographic interleaved spectrum, on which we consulted last summer. In addition, the outcome of forthcoming international coordination negotiations could adversely affect the coverage of some geographic interleaved assignments. In combination, these factors could mean that less spectrum is available for the provision of local DTT services and/or for a regional/sub-national DTT multiplexes in some locations than we had indicated in our cleared award consultation document: there will probably not be sufficient spectrum, under our revised proposals, to enable all such services to be provided in all parts of the UK.

A5.78 Both impacts have been taken into account in our quantified economic assessment. Nevertheless, many such impacts are capable of being mitigated through careful planning of the affected spectrum: for example, we anticipate that, following further detailed investigation, there is now likely to be even more spectrum suitable for local or national DTT broadcasting in Scotland than anticipated in our cleared award consultation document.

DTT service providers

A5.79 As noted above, the proposal to clear channels 61 and 62 and include cleared channel 69 in the award will increase the attractiveness of the spectrum in channels 61-69 for non-DTT use. This may mean that bidders in the award will have a higher willingness to pay for this spectrum compared to what it was under the previous proposals. This could have two impacts on future DDT service providers.

A5.80 One is that these service providers, if they are to be successful in the award, may have to bid and pay higher amounts than they might need to have done under the previous award proposals (other things being equal). The second is the amount of spectrum used to provide DTT services as an outcome of the award could be less than it might have been (as the revised proposals increase the likelihood of the

upper band being used to provide non-DDT services). In such a scenario there would be fewer opportunities for these service providers to expand their output, as there could be tighter spectrum capacity constraints on such opportunities.

A5.81 In addition, existing DTT service providers could also experience some short-term detrimental impact from the multiplex re-organisation required to clear channels 61 and 62, involving their participation in a carefully-organised programme of stakeholder communications (including viewer communications) as well as interfaces with their key suppliers (including the transmission network provider). The implementation costs concerned have been taken into account in our quantified economic assessment. We discuss these impacts on existing providers further below.

PMSE users

A5.82 PMSE users overall are expected to benefit from the changes proposed in this document (relative to the implications of the base case assumption of including channel 69 in the BM award) in the longer term.

A5.83 Channel 69, together with other spectrum awarded to the BM, had previously been identified as being sufficient to meet the ongoing needs of PMSE users for UHF spectrum. With our revised proposals, channel 69 would be replaced by channel 38 after DSO. Therefore, alternative spectrum, of comparable capacity, will be made available for these users on a national basis. Because channel 38 cannot be used for higher power alternative services in the UK (at least in the short-medium term), its use will entail substantially lower opportunity costs, in the region of £100,000 a year in this timeframe. This will be reflected in the AIP licence fees paid by the band manager, and hence in significantly lower costs paid by future PMSE users to access the spectrum than access to channel 69 would have implied. As noted above, these beneficial impacts on PMSE users have not been included in the quantified economic assessment.

A5.84 However, in the short term, there are likely to be transition costs involved for PMSE users in obtaining suitable equipment to use channel 38 more rapidly than efficient equipment replacement cycles would dictate. These transition costs have been taken into account in the quantified economic assessment. We discuss these short-term impacts on existing PMSE users further below.

Users of new services which are likely to be deployed

A5.85 Users of new services are expected to experience substantial positive impacts from the changes proposed in this document. The revised proposals may enable the provision of new and innovative services, in increased volumes, compared to the previous proposals, with a particular focus on wider opportunities to access fast mobile data communications at lower cost, and with more sustainable and effective competition between the suppliers concerned. The consumer benefits concerned have been taken into account in the quantified economic assessment.

A5.86 These benefits will flow both to consumers of the services directly, but also to citizens more generally, as wireless communications form an important tool in meeting wider policy objectives to ensure that all parts of the UK, and different stakeholders, have access to the digital technologies that will be available in the coming years, hence preventing the emergence of “digital divides”. The widespread availability of wireless communications will improve the opportunities to meet emerging public policy aspirations such as universal access to broadband. As noted

above, the impact of the policy proposals on broader social values has not been explicitly included in the quantified economic assessment.

A5.87 It is also likely that many of the users who are likely to benefit from the policy proposals will, over time, also be the same individuals identified above as viewers of existing DTT services, particularly as the technologies used to deliver digital broadcast services continue to converge with other communications technologies, and "bundling" of retail broadcast and communications products (e.g. through "triple-play" and "quad-play" tariffs) becomes standard for a wider range of consumers. On this basis, most individual consumer groups in different parts of the UK are likely to be net beneficiaries of the proposals in this document.

The new spectrum licensees and service providers

A5.88 The new spectrum licensees and associated service providers will, in general, benefit from the changes proposed in this document, as the availability of harmonised spectrum will enable a wider range of businesses to explore the opportunities presented and exploit the economies of scale that should be associated with European-wide availability of receiving equipment. The producer benefits concerned have been reflected in our quantified economic assessment. In addition, our spectrum award proposals remain suitable for different technologies and business models, and will enable and facilitate trading between licensees in response to market developments following the award.

A5.89 As noted above, the exception to this general position would be if future demand for new DTT services resulted in auction prices rising as a result of the reduced capacity available for these services (albeit that sufficient capacity suitable for two new UK-wide multiplexes and a range of geographically-specific multiplexes will be still be available).

Citizens generally

A5.90 Citizens are in general expected to experience positive impacts from the changes proposed in this document, as indicated by the expected net welfare benefits of £2-3 billion identified in the quantified economic analysis above. As well as being of direct benefit to those citizens who are also consumers, the availability of new services at lower cost is also likely have to have wider economic benefits via the ways in which products and services can be delivered more efficiently in the economy.

A5.91 A further broader impact on citizens may arise in connection with the widespread provision of broadband services across the UK. While the majority of broadband connections in the UK are currently provided over wired access connections, the availability of fast and affordable mobile broadband services to complement wired solutions will be assisted by these policy proposals. Accordingly there is the prospect of using wireless access technologies to assist in enabling the geographic universality of provision (e.g. in harder to reach areas where such solutions are more effective than wired alternatives) as well as ensuring that citizens and consumers can use broadband on the move. The availability of cleared spectrum that would be suitable for national mobile broadband networks could complement the geographic interleaved spectrum in this respect.

Analysis of disruption impacts on existing spectrum users

A5.92 Two groups of stakeholders will be potentially disrupted by the policy proposals in the short term: DTT viewers and suppliers, and PMSE users.

A5.93 The shorter term impacts on existing DTT viewers and suppliers were discussed in section 4. They can be summarised as follows:

- around 11m viewers would need to retune their receiving equipment after DSO, in order to continue the same signals from the existing six multiplexes. We have estimated that the economic value of this additional viewer disruption could be around £15m. In addition there is a risk of a much smaller number of existing viewers (expected to be under 100,000) potentially needing to adjust their aerials;

- to implement the required changes to ensure that existing planned coverage from the existing six multiplexes is sustained, a programme of works, potentially costing £100-200m, will need to be undertaken, and managed in such a way that it does not disrupt existing DSO activities.

A5.94 Existing DTT suppliers (including broadcasters and the transmission network provider) will need to be actively involved in the transition programme to ensure timely reallocation of the frequencies after DSO at minimum disruption to the viewers, and hence underpin the continued enhancement of the platform. We have set out in section 4 that this smooth transition will need to be appropriately managed in the relevant period (2009-2013), with a structure which preserves incentives to achieve the frequency reallocation at least cost to society.

A5.95 The shorter term impacts on PMSE users were discussed in section 5. They can be summarised as:

- some of the licensed wireless microphone users of channel 69, which currently use equipment which cannot retune to channel 38, will need to replace their existing equipment before the end of DSO, when the channel could become unavailable for its existing use;

- while some of these users would be expected to replace their equipment in any event, others would be required to replace their equipment early, with the existing equipment having little resale value. The value of such stranded equipment could be in the region of £5-18m, depending on the exact size, age distribution and replacement costs of the equipment population affected;

- accordingly, for such users, we propose to consider funding assistance (to the extent of any legal entitlement) to facilitate the early equipment replacement that will be required by the proposed regulatory change, with the assistance being made available over the period 2010-2012.

A5.96 We consider that, providing the details of the necessary transition arrangements can be developed and implemented on a timely basis, there are unlikely to be material net adverse consequences on existing spectrum users during the transition period.

Risks to orderly and timely award

A5.97 We have consistently placed much weight in the DDR on the need to ensure that spectrum is made available to the market in a timely manner, to ensure that services are provided to citizens and consumers as soon as possible. This general approach ensures that the costs to society associated with the unnecessary delay of the provision of such services, which could be very significant, are minimised.

A5.98 Therefore it is important to consider the relative delays implied by each policy option to making spectrum available via an award. However, in doing so, it is also important to ensure that the process adopted to implement the preferred option is orderly, such that it does not undermine the efficiency of the award of the spectrum, and hence risk reducing the benefit to society that could be derived from it.

A5.99 In this context, it important to recognise that, even if we were to continue with the existing (base case) scope of the award, there is now likely to be a significant delay in awarding it from the timescale set out in the summer 2008 cleared award consultation. This is primarily due to the international developments that have occurred since that document was published (which we highlighted at that time may transpire). Therefore, when assessing the additional impact of alternative policy options on delay, we need to start from a base case where the award is likely to be delayed to 2010 in any event.

A5.100 We currently assume that the additional delay to the award associated with the options to reorganise the upper band would be of the order of a few months (we have assumed six for modelling purposes), meaning that the award timing itself need not significantly delay the bringing into use of the spectrum (except for channel 36) after DSO. Further details of our latest timing assumptions are set out in section 7.

A5.101 Clearing channel 61 and channel 62 will require the re-organisation of some of the existing DTT multiplex frequencies, which would in turn have potentially more complex implications for the international negotiations, as they affect the lower band (including a number of important relay assignments). Because these negotiations would be unlikely to conclude until 2010, the consequent award of spectrum would need to be delayed. Failure to adjust the award timetable in this way would risk spectrum being awarded without the international envelope within which licensed transmissions could occur being fully defined, risking inefficient auction outcomes.

A5.102 Similarly, because a key benefit of the proposed policy is to increase the availability of harmonised spectrum in the upper band in the UK, it will be important not to award the spectrum before the shape of the harmonised environment has been fully considered at technical level by CEPT. The European Commission has mandated CEPT to do this by summer 2009, enabling associated UK TLCs to be developed for a 2010 award. We therefore propose to consult in detail on the licence conditions concerned later this year, as set out in section 7.

A5.103 Based on this timetable, we believe that an orderly process for awarding the spectrum can be maintained, while minimising the delay in the bringing the spectrum concerned into use.

A5.104 To achieve the timely changes to existing DTT frequencies, we have set out for comment in section 4 potential governance arrangements for a delivery programme, which would begin work in 2009 and oversee the changes required in the period to

2013. This programme, which would operate in parallel to DSO, would be overseen by the main stakeholders affected, including broadcasters, the transmission network provider, us and the Government.

Overall conclusions from comparison of policy options

A5.105 Drawing the above assessments together, we conclude that there is a high probability that a policy aimed at negotiating suitable revisions to GE06 to enable the replacement of channels 38-40 by channels 61, 62 and 69 in the cleared award will deliver significant value to society over time, with positive net impacts on most affected stakeholder groups. Although this option would also result in some shorter term disruption for existing users of the spectrum, these effects are likely to be limited and can be addressed by making suitable transitional arrangements available for the stakeholders concerned.

A5.106 Further, although the implementation of this policy option will introduce some incremental delay in bringing into use the spectrum included in the cleared award, this delay is likely to be limited. Similarly, although there is a possibility that the international negotiations may extend the process of award preparation by up to a year, such negotiations are more likely to be successful if undertaken in a coordinated manner with our neighbours, with similar aspirations to make best use of the digital dividend on a timely basis.

Future evaluation of the actual impacts of the preferred option

A5.107 Our preferred policy option is therefore to include channels 61, 62 and 69 in the cleared award. Full *ex post* evaluation of the key economic benefits that actually arise from this policy will be difficult to undertake. This is because the relevant benefits concern the efficient utilisation of spectrum after DSO, when the actual impacts (relative to the previous proposed scope of the cleared award) will be very difficult to assess. This is of particular relevance where the award outcome, and any subsequent reallocation of spectrum via the secondary market, would be difficult to posit with confidence for the base case.

A5.108 Nevertheless we propose to evaluate the shorter term effects of our proposed policy using the following criteria:

- our ability to make spectrum available in the cleared award that aligns both to the least restrictive technical conditions and the harmonised plan for the upper band being developed by CEPT;
- our ability to negotiate bilateral changes to GE06 with affected neighbours which preserve, as far as possible, the ability to use UK spectrum to maximise economic benefits for citizens and consumers;
- the derivation and delivery of a detailed plan to change the frequencies used by the existing DTT multiplexes after DSO with minimum risk to DSO itself, and subject to this at minimum disruption to existing licensees;
- the inclusion in the band manager award of frequencies suitable for PMSE use, including national use at UHF, sufficient to meet users' demand for spectrum at reasonable cost; and
- subject to the above, our ability to proceed with the auctions of cleared and interleaved spectrum with the minimum of delay, consistent with an orderly

process, including the award of geographic interleaved spectrum licences suitable for local TV in line with DSO timescales.

A5.109 As set out in section 7, it will not be possible to evaluate even a number of these shorter term impacts until 2010, given the intervening work which must first be accomplished. We nevertheless propose to provide an interim update on progress towards these objectives in our detailed consultation on award packaging and auction design in the autumn.

Question 16. Do you agree that with our analysis of the key impacts of our policy options? Are there any other key impacts we should assess?

Annex 6

Economic modelling

Introduction

A6.1 This annex provides an overview of the economic modelling work we have undertaken to inform our assessment of the economic value of the four options are set out in the impact assessment in annex 5:

- Option A (the base case): continuing with a cleared award based on the spectrum configuration in our Summer 2008 consultation but with an award date of Spring 2010[31];
- Option B: clearing channels 61 and 62 and including these as cleared frequencies in the award alongside the other frequencies (with the exception of channels 39 and 40);
- Option C: including channel 69 in the cleared award alongside the other frequencies; and
- Option D: a combination of both option B and C

A6.2 The incremental values outlined in this annex are not an indication of likely auction proceeds. We discuss the reasons for this later in this annex.

Methodology overview

A6.3 The economic value that the digital dividend spectrum can provide is dependent on two main demand factors and two main supply factors.

A6.4 For demand these are:

- consumer demand for services that may use digital dividend spectrum (potential DDR services); and
- the alternative ways of delivering the service without using digital dividend spectrum.

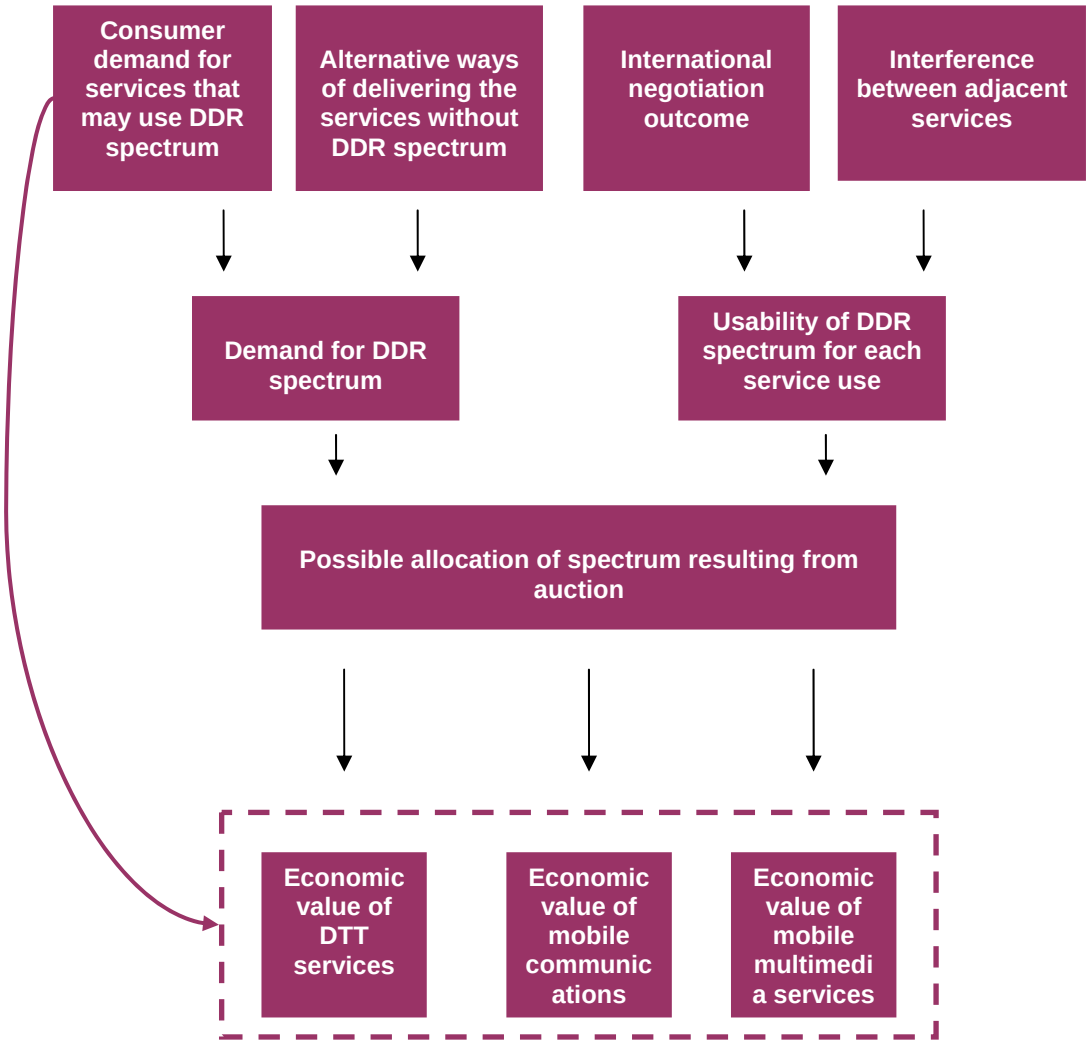
A6.5 For supply these are:

- the usability of digital dividend spectrum for each potential service. This has two components:
  - the international negotiation outcome assumed; and
  - interference between adjacent services
- how much spectrum each potential service wins in the cleared digital dividend award

[31] http://www.ofcom.org.uk/consult/condocs/clearedaward/

A6.6 Figure A2 below provides an overview of our modelling approach and shows how these factors fit into it.

Figure A2: Overview of modelling methodology



A6.7 From the demand for digital dividend spectrum and its usability for each potential service, we have made assumptions about the allocation of spectrum that may result from the auction.

A6.8 We have then sought to estimate the economic value associated with those allocations. These valuations are affected by the assumed demand from consumers for the underlying services. We have modelled economic values for three services:

- DTT services;
- mobile communications;[32] and
- MMS.

[32] We use the term 'mobile communications' in a generic way, to refer to two-way voice and data services offered over cellular networks.

A6.9 As discussed further below, there is considerable uncertainty over consumers' demand for services that may use digital dividend spectrum. We have therefore considered a range of different demand scenarios and focus in this annex on three specific demand scenarios.

A6.10 For each of the three demand scenarios, we consider the interaction with the four policy options that influence the usability of the spectrum for different service types. We therefore consider twelve different spectrum allocation scenarios and valuations.

A6.11 In the rest of this annex, we discuss the various aspects of the modelling in more detail. We cover:

- our approach to assessing what demand scenarios to model;
- usability of the digital dividend spectrum for each potential service;
- timing assumptions;
- spectrum allocations resulting from the assumptions about supply and demand for digital dividend spectrum;
- other key modelling assumptions;
- DDT service model;
- mobile communications service model;
- MMS model;
- treatment of delay; and
- results from the modelling.

Approach in assessing what demand scenarios to model

A6.12 There is considerable uncertainty attached to the future economic value of the spectrum. There are three main sources of uncertainty:

- **General economic uncertainty:** The effects of the recent global economic upheavals, and the severity and duration of a downturn in the UK economy, are very difficult to predict. While the spectrum released by DSO will remain of significant economic value in the period after 2012, the impacts on consumers' and citizens' values for specific applications (and hence bidders valuations at auction) are correspondingly difficult to estimate. This uncertainty is likely to persist regardless of the exact timing of the auction.
- **Uncertainty within specific communications markets:** While the general economic climate will overshadow demand, there is additional uncertainty in specific markets. For example, the market for MMS is still in its infancy, with a variety of business models using a variety of technologies still under development. There is a wide range of projections for the future evolution of mobile communications services following recent explosive growth. The speed of take-up of HD services on the DTT platform and the growth of other TV platforms will affect the DTT platform in the future. There is great uncertainty

over how the different methods of delivering "TV content" will act as substitutes and complements. This interrelationship is difficult to model explicitly but has been taken into account when assessing the plausibility of different scenarios; and

- **Technology uncertainty:** The rapid growth in the scope and diversity of mobile communications devices is spurring rapid further development of new standards and capabilities in the industry, including next generation mobile technologies such as LTE (capable of faster access to the internet at speeds comparable to fast fixed-line DSL broadband). However, standards for LTE at 800 MHz have yet to be developed. Their future adoption and use remains uncertain. In some mobile markets there are also benefits in the harmonised use of technologies across national borders, but there remains some uncertainty over the extent to which UHF spectrum that has historically been used for broadcasting will in practice be fully harmonised in Europe.

A6.13 We have therefore sought to capture a wide range of underlying demand assumptions within our demand scenarios. We expect this wide range to capture the plausible range, but we have not attempted to model the absolute lowest or highest value possible for each service. Previous models attempted to provide a conservative estimate of the economic value of the digital dividend spectrum, and we believe the current approach is broadly consistent with this aim.

A6.14 The first two demand scenarios capture what we consider the most plausible outcomes:

- **Scenario 1 - Strong demand for mobile communications** – this scenario involves strong consumer demand for mobile communications and low demand for other services; and

- **Scenario 2 - Strong demand for all services** – this scenario involves strong demand for the spectrum for all of mobile communications, DTT and MMS.

A6.15 We have also considered less likely demand scenarios. In particular, we consider the following scenario:

- **Scenario 3 - Strong demand for DTT only** – this scenario envisages strong demand for DTT and relatively weak demand for mobile communications and MMS.

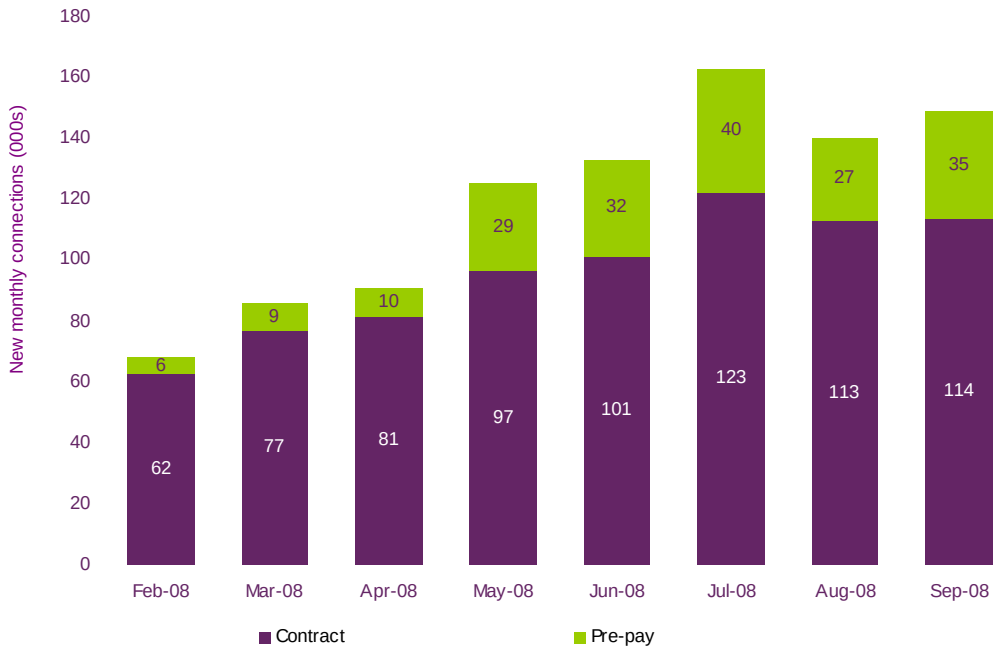
A6.16 For each of these demand scenarios, we have made detailed assumptions in the individual service models that specify in more detail how we interpret them[33]. We discuss these more detailed assumptions in the sections describing each of the individual service models.

A6.17 One reason we regard Scenario 3 as less likely is that it assumes weaker demand for mobile communications. This is in contrast to recent evidence of strong growth in demand for mobile broadband. We have reported on the increased demand

[33] A service model takes the inputs specified in paragraph A6.1 and estimates the incremental economic value that one particular potential service derives from using digital dividend spectrum.

through dongles in a number of recent publications[34]. Figure A3 illustrates this trend by showing the strong growth in new mobile broadband connections.

Figure A3. New consumer mobile broadband connections



Source: GfK retail data.

A6.18 Our most recent research finds that around 9% of households claim to have a mobile broadband connection. This is equivalent to over 2 million connections.

Usability of digital dividend spectrum for each service use

A6.19 Each of the four policy options affects both:

- the most efficient outcome from renegotiating GE06 that will be required; and
- the availability of spectrum in the cleared award.

A6.20 As set out in annex 5 and shown in table A2, we make a number of assumptions about the outcome of the GE06 renegotiation for the four policy options.

Table A2. International negotiation outcomes assumed

Policy option	International negotiation outcome assumed
A – base case	Minimal renegotiation to GE06
B, C, D – clearing some or all of 61,62 and 69	GE06 renegotiated to allow mobile use of upper band

A6.21 Tables A3 and A4 below outline the maximum possible spectrum in the cleared award that could technically be deployed for DTT and mobile communications

[34] See section 5.1.5 of Ofcom, "The Communications Market 2008" (www.ofcom.org.uk/research/cm/cmr08/cmr08_2.pdf) and section 3.99 of Ofcom, "Mobile citizens, mobile consumers" (www.ofcom.org.uk/consult/condocs/msa08/msa.pdf).

(using FDD technologies) under each of the four policy options.[35] This does not mean that we have assumed the spectrum will be used in this way. That will also be affected by the relative demand for the spectrum from the different services. We do not include MMS in this table, because we assume there is no significant variation in the spectrum usability for MMS between policy options.

Table A3. Maximum spectrum availability for DTT

Policy option	Effect on DTT		
	Lower band	Upper band	Potential services deployed
A	High power use permitted	High power use permitted	Up to 2 multiplexes with over 90% household coverage in-group
B, C, D	High power use permitted	High power use limited to areas far away from coastal regions	Up to 2 multiplexes with over 90% household coverage out of group

A6.22 As explained in the later section on the mobile communications model we have modelled deployment of mobile communications services using FDD technologies in the upper band. Our modelling and feedback from previous consultations suggests that use of FDD in the lower band is less likely than in the upper band. Given these assumptions, table A4 shows the maximum mobile communications spectrum using FDD technology available for each policy option.

Table A4. Maximum spectrum availability for paired FDD mobile communications (in MHz, excluding interleaved)

Policy option	Unharmonised upper band	Harmonised upper band
A	30	0
B	30	40
C	30	20
D	60	60

Timing Assumptions

A6.23 We modelled each of the services on an annual basis for simplicity. Modelling services on any time period less than a year was expected to add complexity while providing little extra information, given the inherent uncertainty in the services being modelled. Where appropriate a simple adjustment was made to annual values as discussed in the treatment of delay section.

A6.24 We have assumed spectrum is always used from the beginning of a calendar year. The timing assumptions on this basis we have made for both the award and when the spectrum is usable are shown in table A5 below

[35] Operators may choose to supplement cleared award spectrum with additional new or existing spectrum holdings.

Table A5. Effect of policy options on timing assumptions

Policy option	Award date	Earliest use of channel 36	UK-wide use of lower band	UK-wide use of channels 61-62	UK-wide use of channels 63-68	UK-wide use of channel 69
A	Q2 2010	2011	2013	2013	2013	N/A
B	Q4 2010	2012	2013	2014	2013	N/A
C	Q4 2010	2012	2013	2014	2013	2013
D	Q4 2010	2012	2013	2014	2013	2013

A6.25 Spectrum availability affects the time at which consumers may start using mobile communications networks. However, some of the network can be built (and in some cases tested) before the spectrum is available for use. This means that some of the cost savings from using low frequency spectrum accrue during the period when the network is being built but is not in use. We have assumed that spectrum availability does affect the time at which MMS and DTT services are available. We discuss the reasons for this in the treatment of delay section.

Spectrum allocations

A6.26 For each combination of demand scenario and policy option, we have developed assumptions about the allocation of spectrum that may result from the cleared spectrum award. Other possible outcomes might reasonably be assumed. However, we consider our set of assumptions on spectrum allocation to be plausible outcomes. We have checked our assumed spectrum allocations to ensure that they are consistent with the values resulting from the individual service models. However, other auction outcomes are possible and our assumptions are in no sense our preferred outcome.

A6.27 Below we set out our assumptions about the allocation of spectrum. For each of the three demand scenarios we set out the assumptions we have made for the four policy options.

Scenario 1 – Strong demand for mobile communications

A6.28 When there is strong consumer demand for mobile communications and relatively weak demand for other services, we assume spectrum allocations that have the following features:

- There is sufficient demand for DTT services such that operators deploy only two additional commercial multiplexes that rely only minimally on interleaved spectrum. There is insufficient demand for a third commercial multiplex using interleaved spectrum.
- Demand for mobile communications is strong enough that we assume unharmonised use of the upper band, but harmonised use of spectrum occurs when we clear channels 61-69. We assume that other operators are able to afford to deploy networks at higher frequency if there is insufficient 800 MHz spectrum, albeit at a higher cost.
- Demand for mobile TV may be strong, but this can be met through users watching TV using different methods (via the BBC iPlayer etc) so a dedicated network is assumed not to be deployed.

A6.29 Figure A4 shows the assumed band plans for the different policy options.

Figure A4. Assumed band plans for different policy options with demand scenario 1

	31	32	33	34	35	36	37	38	39	40
Option A (base case)	DTT							low power	DTT	
Option B (clear 61 & 62)	DTT							low power	DTT (int.)	
Option C (clear 69)	DTT							PMSE	DTT	
Option D (clear all)	DTT							PMSE	DTT (int.)	

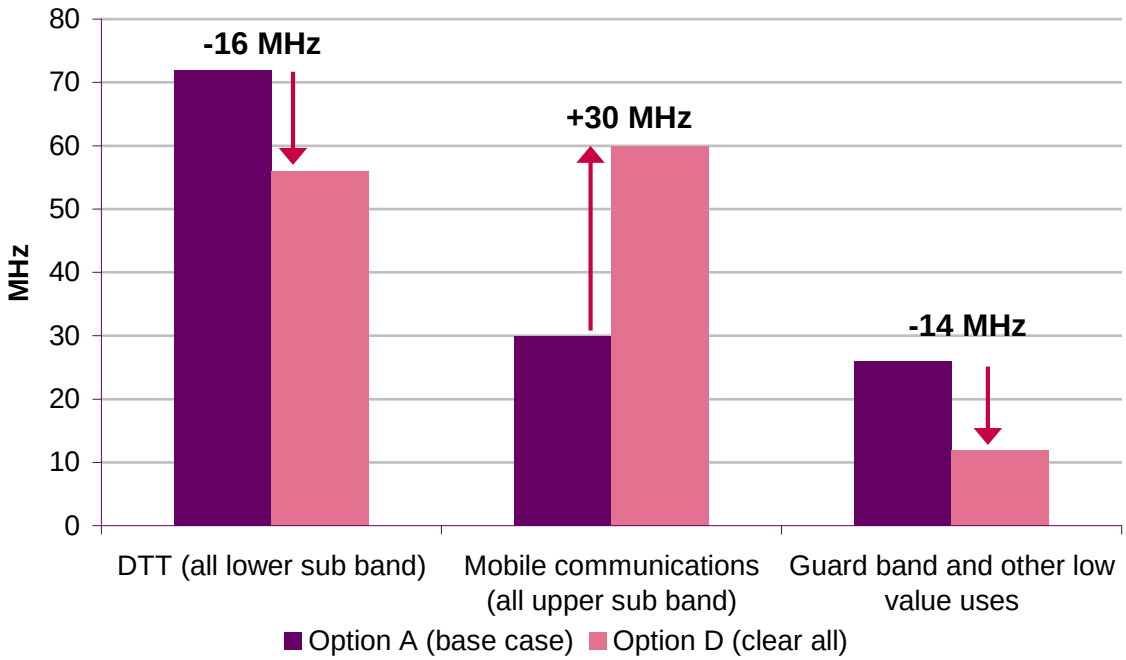
	61	62	63	64	65	66	67	68	69
Option A (base case)	DTT (int.)	G.b.	Mob (int)	Mob. (unharmonised use)	Guard band	Mob. (int)	Mob. (unharmonised use)	G. b.	PMSE
Option B (clear 61 & 62)	Mob. (high value)			Mob. (low value)	Guard band	Mob. (high value)		G. b	PMSE
Option C (clear 69)	Mob. (low value)			Mob. (high value)	Guard band	Mob. (low value)			Mob. (high value)
Option D (clear all)	Mob. (high value)				Guard band	Mob. (high value)			

DTT (int): Spectrum that is shared with the operators of the existing six multiplexes and used for new DTT services
Mob: Spectrum for mobile communications services
Mob (int): Unharmonised interleaved spectrum
Mob (High value): Harmonised spectrum subject to no constraints
Mob (Low value): Harmonised spectrum subject to some constraints

A6.30 In our modelling, we have drawn finer distinctions than are illustrated in the band plan above. For example, we have made more distinctions between different types of mobile communications deployment than shown in the band plans.

A6.31 Another way of showing the impact of the policy options on the different services is to consider the amount of nationally available spectrum assumed for different services. Figure A5 compares the outcomes for policy option A and policy option D for demand scenario 1, excluding interleaved and PMSE spectrum.

Figure A5. Changes in spectrum use with demand scenario 1 (excl. interleaved & PMSE)



A6.32 Clearing all three channels results in a significant increase of 30 MHz in the amount of spectrum used for mobile communications (excluding interleaved spectrum). In this scenario the value of unharmonised spectrum to mobile communications is sufficient for unharmonised deployment to occur in policy option A. There is also a smaller,16 MHz reduction in the use of spectrum for DTT.

Scenario 2 – Strong demand for all services

A6.33 When there is strong demand for the spectrum for all of mobile communications, DTT and MMS, we assume spectrum allocations that have the following features:

- there is sufficient demand for DTT services that up to two additional multiplexes may be deployed using largely cleared spectrum, although one of the multiplexes may require some interleaved spectrum. There is sufficient demand for DTT services such that a third additional multiplex may be deployed using interleaved spectrum. The number of multiplexes actually deployed may be less than this (or may have limited coverage) if MMS demand is strong enough to use up significant amounts of lower band spectrum;
- the demand for mobile communications is similar to scenario 1 above; and
- demand for stand-alone mobile TV services is strong enough that dedicated networks are required, as other networks cannot provide the quality or quantity of data that users would demand at the same price.

A6.34 Figure A6 shows the assumed band plans for the different policy options.

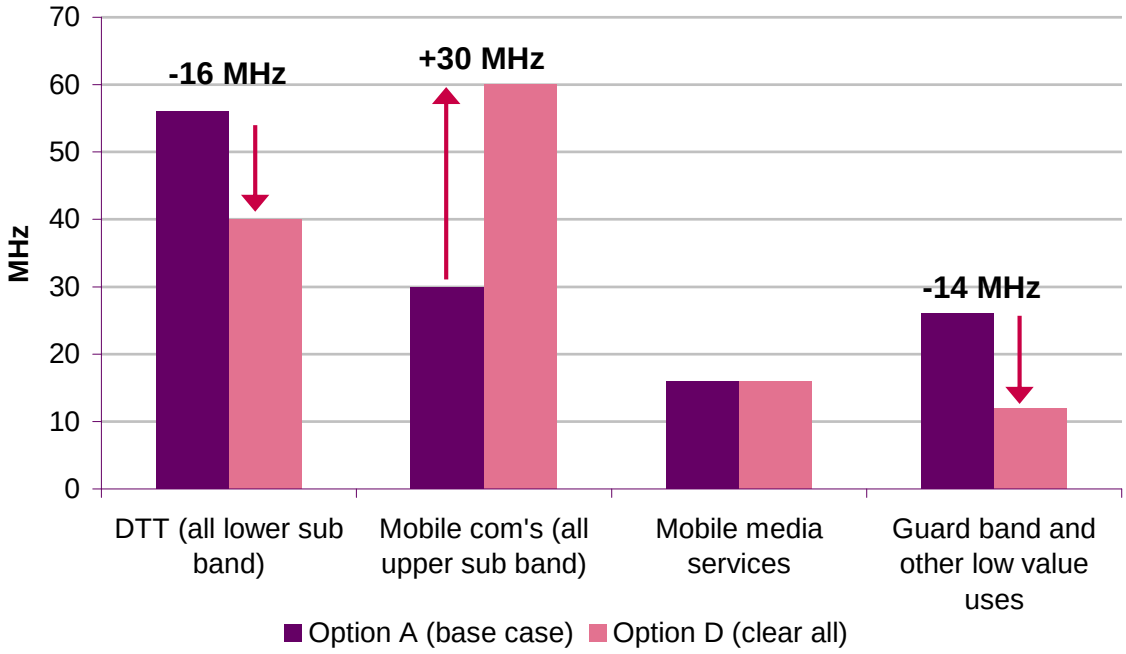
Figure A6. Assumed band plans for different policy options with demand scenario 2

	31	32	33	34	35	36	37	38	39	40
Option A (base case)	DTT					Mobile multimedia services		low power	DTT	
Option B (clear 61 & 62)	DTT					Mobile multimedia services		low power	DTT (int.)	
Option C (clear 69)	DTT					Mobile multimedia services		PMSE	DTT	
Option D (clear all)	DTT					Mobile multimedia services		PMSE	DTT (int.)	

	61	62	63	64	65	66	67	68	69
Option A (base case)	DTT (int.)	G.b. Mob (int)	Mob. (unharmonised use)		Guard band	Mob. (int)	Mob. (unharmonised use)	G. b.	PMSE
Option B (clear 61 & 62)	Mob. (high value)		Mob. (low value)		Guard band	Mob. (high value)		G.b.	PMSE
Option C (clear 69)	Mob. (low value)		Mob. (high value)		Guard band	Mob. (low value)			Mob. (high value)
Option D (clear all)	Mob. (high value)				Guard band	Mob. (high value)			

A6.35 Figure A7 compares the outcomes for policy option A and policy option D for demand scenario 2.

Figure A7. Changes in spectrum use with demand scenario 2 (excl. interleaved & PMSE)



A6.36 In this demand scenario, MMS secures two channels (16 MHz) in the lower band in both policy options. In policy option D, when all the three channels are cleared, mobile communications secures 30 MHz more spectrum in the upper band. DTT again loses 16 MHz in this scenario.

Scenario 3 – Strong demand for DTT only

A6.37 When there is strong demand for DTT and relatively weak demand for mobile communications and MMS, we assume spectrum allocations have the following features:

- there is sufficient demand for DTT such that two additional commercial multiplexes would be rolled out using cleared spectrum, although multiplexes may rely on some interleaved spectrum, with a third commercial multiplex deployed using interleaved spectrum;
- demand levels for mobile communications are lower so if operators had access to 800 MHz spectrum they would roll out a limited number of sites. As a result, unharmonised use of the upper band is not economically efficient or commercially viable, so does not occur in policy option A (the base case). In policy option D, when we clear channels 61, 62 and 69, the use of upper band spectrum for mobile communications is both economically efficient and commercially viable; and
- demand for MMS services is lower, such that it is not profitable for firms to roll out any dedicated MMS networks using digital dividend spectrum.

A6.38 Figure A8 shows the assumed band plans for the different policy options.

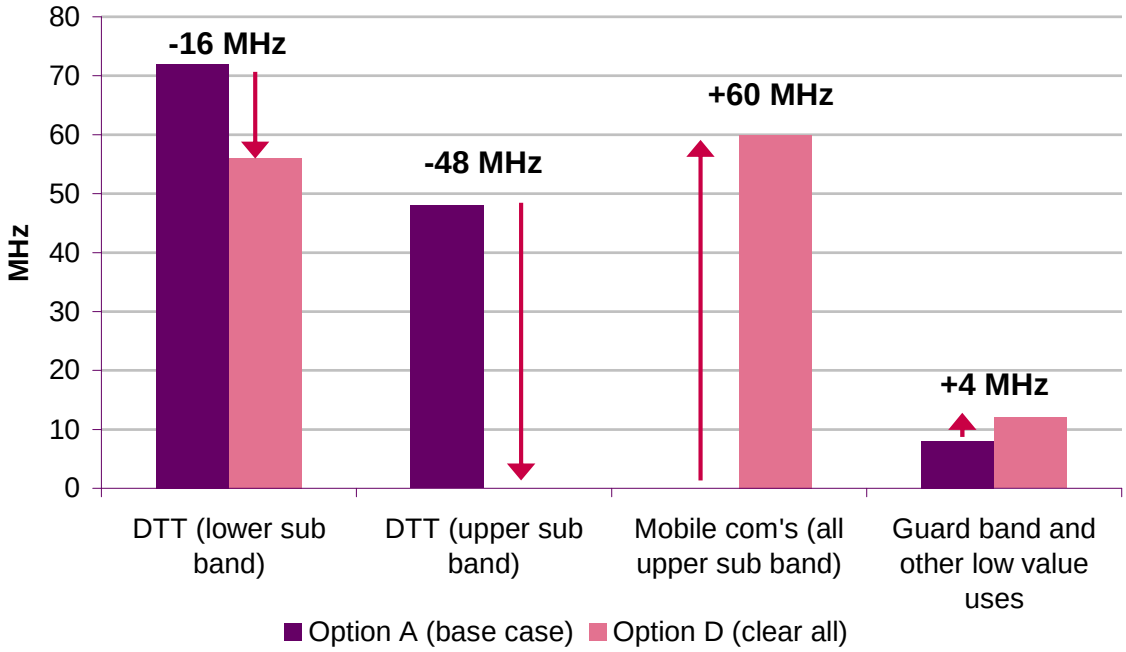
Figure A8. Assumed band plans for different policy options with demand scenario 3

	31	32	33	34	35	36	37	38	39	40
Option A (base case)	DTT							low power	DTT	
Option B (clear 61 & 62)	DTT							low power	DTT (int.)	
Option C (clear 69)	DTT							PMSE	DTT	
Option D (clear all)	DTT							PMSE	DTT (int.)	

	61	62	63	64	65	66	67	68	69
Option A (base case)	DTT (int.)		DTT						PMSE
Option B (clear 61 & 62)	Mob. (high value)			Mob. (low value)	Guard band	Mob. (high value)		G.b.	PMSE
Option C (clear 69)	Mob. (low value)			Mob. (high value)	Guard band	Mob. (low value)			Mob. (high value)
Option D (clear all)	Mob. (high value)				Guard band	Mob. (high value)			

A6.39 Figure A9 compares the outcomes for policy option A and policy option D for demand scenario 3.

Figure A9. Changes in spectrum use with demand scenario 3 (excl. interleaved & PMSE)



A6.40 In scenario 3, mobile communications does not secure any spectrum when we do not clear 61, 62, or 69. DTT secures all of the available spectrum in the upper and lower bands. In contrast, when all three channels are cleared, mobile communications has 60 MHz, most of the upper band. By renegotiating GE06, there will be more restrictions on DTT use of the upper band whilst there will be less restrictions on mobile communications use of the same spectrum

A6.41 Scenario 3 is a less likely scenario than has been modelled in previous work. We have included this scenario for completeness but we consider it unlikely, for the reasons given earlier.

Other key modelling assumptions

Guard bands and auction design assumptions

A6.42 In developing our assumed band plans, we have assumed guard bands that are consistent with the cleared award consultation document with one exception. This is that we assume there is no guard band between MMS and new DTT. We are undertaking ongoing work to assess the way in which existing DTT services will be protected from interference. We have assumed that although there may be an initial 5 MHz guard band between MMS and new DTT services, secondary trading allows DTT use adjacent to MMS to occur. The loss in coverage for a new DTT service would be of the order of 1-2% with no guard band. We have assumed that in scenarios where there is high demand for the upper and lower bands, it is unlikely that MMS and DTT operators would leave the guard band unused.

A6.43 Additionally we have assumed:

- **no aggregation or threshold risks in the auction**. Some of the band plans assume that significant amounts of interleaved spectrum are required to increase the coverage of DTT multiplexes. We assume that multiplex operators would be able to acquire this after the cleared award auction.

- **renegotiation of GE06 does not materially affect the amount of interleaved spectrum**. Renegotiation of GE06 in all policy options will necessarily affect the specific frequencies and usability of interleaved spectrum. We have assumed that this will not be a large net effect between policy options in aggregate.

Discounting and related assumptions

A6.44 In all our modelling, we have used:

- the Treasury's social discount rate of 3.5% to discount costs and benefits; and
- a time period from 2009 to 2026 in considering costs and benefits. The end date of 2026 was chosen as this aligns the end date of existing and potential new DTT services. Services may have economic value beyond this end-date, but the proposed initial licences are for this duration. This assumption may prove to be unrealistic but provides a conservative estimate of the benefit.
- All results shown as present values in 2009 pounds sterling.

Economic values not indication of auction proceeds

A6.45 The economic values 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 and not just the value which auction bidders might be able to realise;
- the producer value we have modelled is the total producer value, rather than the producer value generated by the potential bidder alone;
- the producer value generated by a potential bidder is the maximum they should be willing to bid in an auction. The design and rules of the auction and market circumstances at the time of the award will determine the amount a bidder will have to pay (i.e. auction proceeds). Auction proceeds may be only a proportion of the producer value of the winning bidder; and
- as noted above, real future values have been discounted at 3.5% and private sector bidders will discount future values at their own opportunity costs of capital.

Services not modelled

A6.46 There are a number of services (that have been modelled in previous DDR work) have not been modelled explicitly for the purposes of this consultation. In particular, we have not modelled PMSE and local TV.

A6.47 As discussed in section 5, we expect that the usability of spectrum made available for PMSE use will be similar between the alternative policy options.

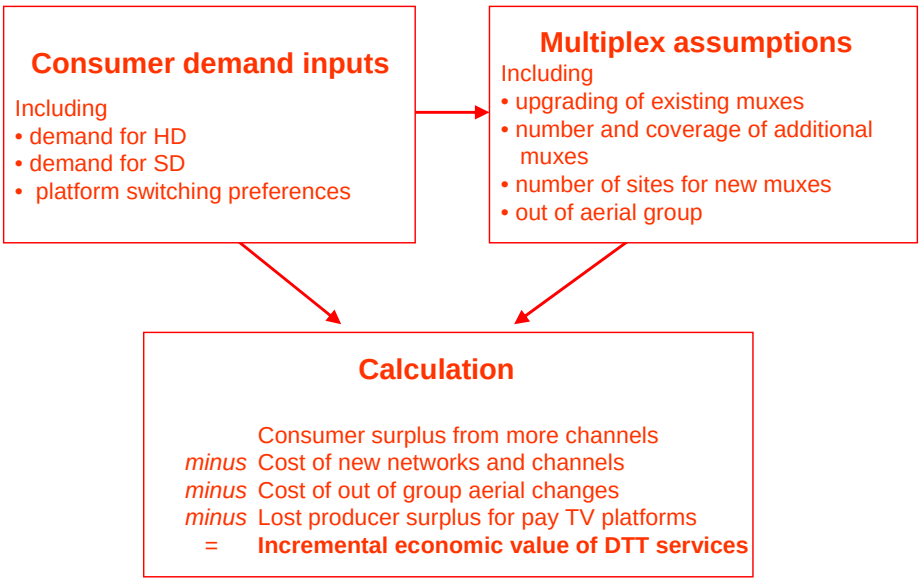
A6.48 The total value of local TV is dependent on the amount and usability of interleaved spectrum that is available. There may be changes between policy options in the amount of spectrum in individual areas, but we do not expect the net effect between policy options to be significant in aggregate.

A6.49 We have not explicitly modelled low power use in channel 38, as the economic benefit of using this channel for other uses is likely to be low relative to the size of the benefits of our preferred policy option.

DTT model

A6.50 Figure A10 below gives an overview of our approach to modelling the economic value from DTT services using the digital dividend cleared spectrum. We make assumptions about consumers' tastes for Standard Definition (SD) and High Definition (HD) television. Partly informed by these, we make assumptions about the technologies used and on existing and future multiplexes and the way in which future multiplexes will be deployed. We then estimates the incremental value that DTT viewers would derive from new DTT multiplexes, less various costs, such as the costs of building new networks and the ongoing running costs of the channels on them.

Figure A10: Outline of DTT Model structure



A6.51 The key inputs that affect the incremental value of the use of digital dividend spectrum for DTT are:

- **demand for HD**. This has two components:
  - How widespread is the desire for HD. We assume that between around 30% and 60% of homes obtain material value from watching HD content.
  - How much HD-equipped consumers value content in HD over SD. We assume that when consumers watch HD content, they value it around 20-30% more than somebody who watches it in SD. We have used a slightly more aggressive range than in the future of DTT consultation, which used a range of 15-25%[36].
- **demand for SD**. This also has two components:

[36] The objective of the future of DTT consultation was to find a conservative value in intervening to upgrade multiplex B. In this consultation, we wish to make a conservative estimate of the alternative policy options and hence we have erred to slightly increase the value of digital dividend spectrum to DTT.

- level of interest in a high number of SD channels; and
- how much viewers who have HD sets value watching channels that are exclusively in SD.

- **how many existing multiplexes are upgraded to DVB-T2/MPEG4.** This is relevant because it affects the future capacity of the existing multiplexes and hence the economic value of new multiplexes. We have incorporated the policy decision to enable the upgrade of Multiplex B to DVB-T2/MPEG4.[37]

- **whether new multiplexes are in SD or HD**. The value that consumers place on channels provided via the new multiplexes will depend if they are broadcasting HD or SD channels.

- **the coverage of new multiplexes**. The coverage of new multiplexes depends on:
  - the amount of cleared and interleaved spectrum used for each multiplex; and
  - the international interference environment. Initial studies suggest that under policy options B, C and D a multiplex using three channels may have up to 90% of households covered. Previous analysis suggested that in policy option A, coverage of 90% of homes may require at least four UHF channels.

- **the amount of interleaved spectrum needed to supplement coverage using cleared channels**. In certain circumstances, multiplexes using cleared channels may wish to add in interleaved spectrum either to provide in-group coverage or to boost coverage. We assume that each of the policy options does not affect the overall demand for interleaved spectrum, but may affect the resulting coverage of the seventh and eighth multiplexes.

A6.52 Our assumptions about the number of DTT multiplexes required to serve consumer demand change as we move through scenarios 1 to 3. This is to reflect an assumed increase in demand for SD and HD services. We assume:

- **Scenario 1**. Consumer interest in watching DTT is relatively weak. For example the proportion of homes interested in watching services in HD reaches around 30% by 2020, and they have a 15% increase in value from watching services in HD. Consumer interest in additional SD channels is such that only one existing multiplex has upgraded to DVB-T2/MPEG 4.

- **Scenario 2** Consumer interest in watching DTT is stronger than in scenario 1. For example, the proportion of homes interested in watching services in HD is around 60%, and they have a 30% increase in value from watching services in HD by 2020. Homes that watch channels in HD still enjoying watching SD channels so that by 2020 up to three existing multiplexes have upgraded to DVB-T2/MPEG 4.

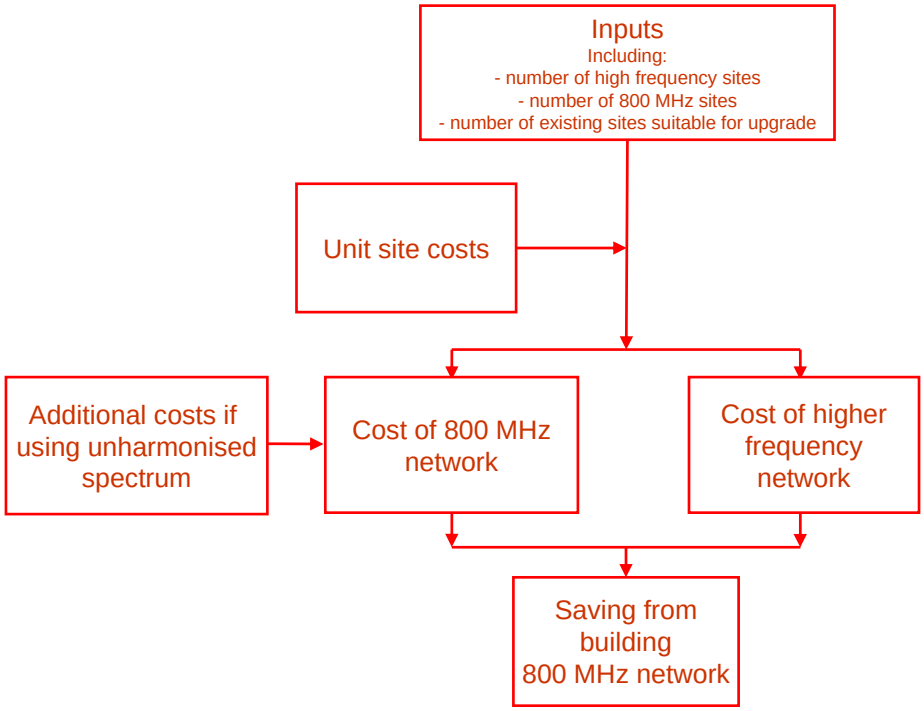
- **Scenario 3** As per scenario 2, but consumer interest in additional SD channels is assumed higher than in scenario 2.

[37] www.ofcom.org.uk/consult/condocs/dttfuture/dttfuture.pdf.

Mobile communications model

A6.53 We have modelled the economic value from mobile communications by comparing the cost of rolling out a network using the 800 MHz spectrum with the cost of doing so at a higher frequency. Figure A11 gives an overview of the approach. The costs are lower with 800 MHz spectrum because fewer transmission sites are required at lower frequency to deliver the same service.

Figure A11. Outline of mobile communications model structure



A6.54 There is considerable uncertainty around which technologies operators will use to deploy future mobile communication services. It is not clear if operators will use TDD (such as WiMAX) or FDD (such as LTE or HSDPA) technologies.

A6.55 We have chosen to model the use of LTE technology. We have not done this because we favour that technology over another, but because LTE in the 800 MHz band is a plausible candidate given that some of its standards are being developed. The beneficial propagation characteristics of digital dividend cleared spectrum would also apply to other mobile communications technologies such as WiMAX. If we had modelled another technology, we anticipate that it would also have shown significant savings from using 800 MHz spectrum relative to using other higher frequency spectrum.

A6.56 As the alternative higher frequency, we used 1800 MHz. If we had compared 800 MHz with 2.6 GHz, we expect the frequency benefit of 800 MHz (and hence cost difference) would have been larger. We assume that the propagation characteristics of 2100 MHz spectrum would be similar to 800 MHz spectrum. We note that not all operators will have access to 1800 MHz spectrum or other high frequency band, but that this approach offers a conservative estimate of value difference.

A6.57 We undertook some limited modelling of LTE-type services in order to understand the relationship between site numbers using 2 x 10 MHz for an 800 MHz network

and those using 2 x 10 MHz for an 1800 MHz network[38]. The modelling made assumptions that were broadly consistent with the approach taken in our considerations of liberalisation of mobile spectrum. In the absence of definitive standards for LTE in 800 MHz, we adopted reasonable assumptions based on standards for other bands.

A6.58 Our modelling suggested that for reasonable technical and service parameters the ratio of sites with 1800 MHz compared to 800 MHz was between 2 and 3.7.[39] Greater indoor coverage or peak data rate would tend to result in the ratio being at the higher end of this range. However, if the number of sites at 1800 MHz is very high then it may be too expensive or impractical[40] to deploy an LTE network at this frequency. In these cases, the absolute size of the cost advantage of 800 MHz is unlikely to be a good indicator of its economic value and instead the impact of potential quality differences would need to be considered in a full evaluation. We have not modelled 1800 MHz networks that require very high numbers of sites.

A6.59 Other inputs that have a significant impact on the economic value of mobile communications include:

- **The consumer demand for mobile communications.** If operators choose to offer services provided with 800 MHz spectrum to a limited coverage area, then the absolute cost advantage that 800 MHz spectrum provides will be lower.

- **The cost of using unharmonised spectrum.** As discussed in section 3, there are costs to FDD operators in using spectrum that is not harmonised with the rest of Europe. This therefore represents a further cost advantage to using harmonised 800 MHz spectrum.

A6.60 The assumptions in each of the three demand scenarios as are follows:

- **Scenario 1**. The cost of using unharmonised 800 MHz spectrum is high, but deployment is assumed given the high demand. Up to three existing operators are assumed to obtain spectrum in the 800 Mhz band. The 800 MHz network is able to provide a service that can offer either:

  - peak data rates higher than that which could be provided using HSDPA; and/or

  - data volumes that could not be easily supported using HSDPA technology.

- **Scenario 2**. As per scenario 1

- **Scenario 3**. LTE networks are rolled out that can offer both the same capacity and peak data rates as HSDPA networks. LTE technology is not used to its full potential, and operators use the spectrum to supplement existing networks. Operators using either low- or high-frequency spectrum roll out a smaller network.

A6.61 In this assessment we have made no explicit assumption regarding:

[38] "1800 MHz band" means the 1710-1785 MHz and 1805-1880 MHz bands
[39] This result is similar to the results obtained for existing technologies.
[40] Our timeframe of assessment in this consultation is longer than in our mobile liberalisation consultation, and we have therefore used a slightly different limit when looking at the practicality of network deployments.

- the total amount of spectrum in the 900 MHz [41]band that is usable for next generation mobile;

- how much spectrum each operator holds in the 900 MHz band;

- which operators win access to the 800 MHz band; or

- how much spectrum each operator holds in the 1800 MHz, 2100 MHz and 2.6 GHz bands.

A6.62 The cost differences are supposed to be illustrative rather than specify a plausible or preferred outcome.

A6.63 We have not attempted to model the commercial incentives of specific potential operators. We have done this for three reasons:

- it is not appropriate to assume the outcome of liberalising the 900 MHz band. Our assumption that up to three operators require 2 x 10 MHz using sub-1 GHz is consistent with a range of outcomes such as:

    - a scenario where there is very heavy use of 900 MHz for 3G and GSM so that it is difficult for incumbent operators to clear this spectrum;

    - a scenario where in the long term at least 2 x 10 MHz of contiguous sub 1 GHz spectrum is required; or

    - LTE technology in the 900 MHz band is not available on a similar timescale to the 800 MHz band.

- existing mobile communications operators have different legacy amounts of spectrum and may have different demand for 2.6 GHz and 800 MHz spectrum; and

- existing and new operators will have different business models and may wish to offer different services.

A6.64 We have not modelled the value of a new firm entering the mobile communications market. We have done this for the following reasons:

- it is not clear what spectrum requirements, and other network investments a new firm would require in order to be able to be able to compete in the mobile communications market;

- this would also require us to assume the outcome of the 2.6 GHz auction; and

- new firms would have no existing networks to upgrade and may place a high value on new or additional spectrum.

A6.65 Modelling a new firm could have given an aggressive valuation of digital dividend spectrum for mobile communications use.

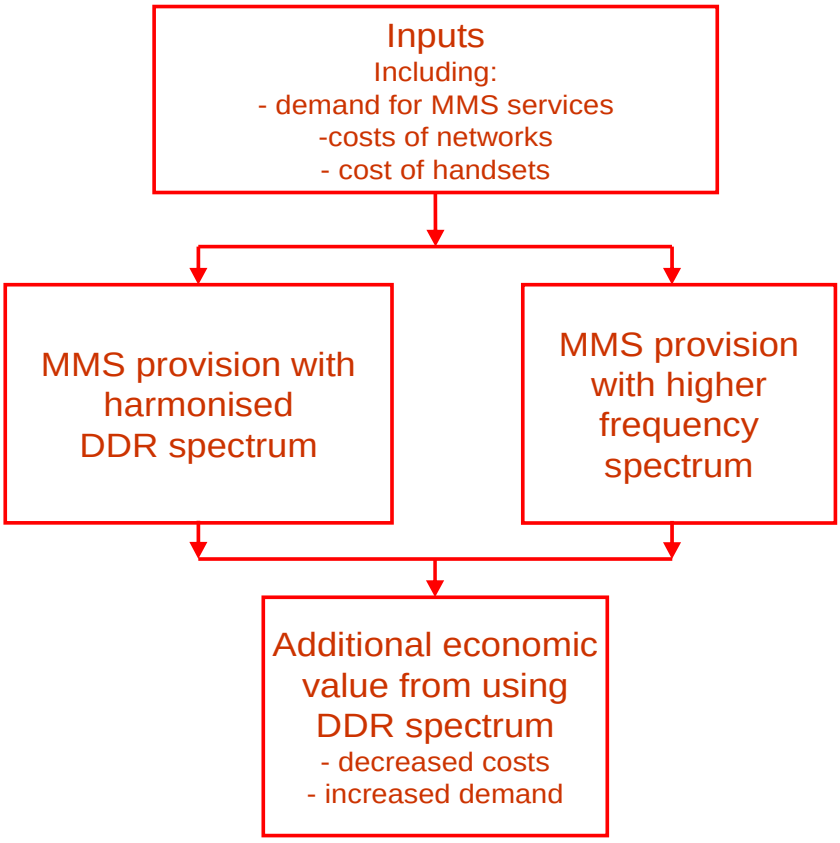
[41] "900 MHz band" means the 880-915 MHz and 925-960 MHz bands.

MMS services model

A6.66 We have modelled the economic value from MMS services by estimating the additional economic value that a dedicated national service using digital dividend spectrum could provide relative to provision using higher frequency spectrum. We use the term MMS services to refer to services that are provided on dedicated broadcast-type networks.

A6.67 Figure A12 below gives an overview of the model structure.

Figure A12. Outline of MMS model structure



A6.68 There are two aspects of potential additional economic value that may result from using digital dividend spectrum to provide MMS services, compared to other potential spectrum bands:

- decreased costs:
  - an EU-wide frequency standard has been agreed for MMS to operate in UHF spectrum (using DVB-H technology). If the UK uses EU-wide harmonised spectrum, the costs of handsets is assumed to be lower as development costs are spread across the entire EU rather than just the UK market; and
  - a smaller number of sites would be needed with the digital dividend spectrum compared to using higher frequency spectrum
- Increased demand, because of better reception capabilities, and due to likely wider variety of handsets if harmonised spectrum is used.

A6.69 For the higher frequency, we assume the MMS services are provided with L-Band spectrum.

A6.70 The assumptions in each of the demand scenarios are as follows:

- **Scenario 1**: demand for mobile TV is not sufficient to support any dedicated MMS networks in digital dividend spectrum.

- **Scenario 2:** there are two MMS networks in the lower band, each using one 8 MHz channel. Consumers place a value on the specific qualities of UHF spectrum, and enjoy cheaper handsets because of European-wide development. One of the channels we assume is used is channel 36. We assumed MMS use in this channel is subject to protecting channel five's analogue core network in the transition period before DSO is completed.

- **Scenario 3:** demand for mobile TV is not sufficient to support any dedicated MMS networks in digital dividend spectrum.

A6.71 In two of the demand scenarios, we therefore assume there is no dedicated MMS network in digital dividend spectrum. In part, this is because since the last consultation the options for mobile TV services that do not require the use of MMS have broadened. For example, three existing mobile phone operators already offer mobile TV over 3G networks.

Treatment of delay

A6.72 For each of the different service uses we have treated the cost of delay in a slightly different fashion. The assumptions for each potential service are set out below.

A6.73 **DTT** - The lower band is assumed available from 1st Jan 2013 in all scenarios. When operators win channel 36 at auction we assume it is not used in any significant fashion before DSO. In policy options B, C, and D, we assume DTT does not win any upper band spectrum in any of the demand scenarios. Delay to the availability of upper-band spectrum does not result in delay to the rollout of DTT services. We have assumed that renegotiations for GE06 in the lower band do not take so long as to push the date of the auction so far as to jeopardise the planning and building of new DTT networks. We do not assume that any operator would use cleared spectrum pre-DSO.

A6.74 **Mobile communications** - We assume that the delay in the usability of some spectrum from 2013 to 2014 does not have a significant impact on the cost of building the network. We expect that operators may build part of the network before the spectrum is cleared for use so that a degree of network testing can occur. We expect that there will not be widespread existence of LTE 800 handsets before 2013. There may be some delay to the existence of services to a limited market. As we have only modelled the cost difference between low and high frequency networks, the quantifiable cost of delay will be minimal.

A6.75 **MMS** - We assume that MMS can be deployed in channel 36 as soon as is practical after the auction and that MMS in all other channels cannot commence until after DSO. For modelling purposes we have assumed that a network in channel 36 is fully operational by 2011 and in all other channels by 2013. This would require very rapid rollout for an operator that is using channel 36. We modelled MMS services on an annual basis so to obtain the cost of a 6-month delay to the use of channel 36

for MMS services we halved the cost of a full year's delay. This is likely to overstate the cost of delay.

Results

A6.76 Table A6 shows the incremental value for each service, for each demand scenario and policy option.

A6.77 We also include the costs of clearing the channels, to give the net economic benefit of the different policy options. The size of the implementation costs is largely independent of the underlying demand assumptions of scenarios 1, 2 and 3. We have assumed low implementation costs in scenario 1 and high implementation costs in scenario 2 to obtain a low to high range for the most likely outcomes. Scenario 3, which we see as a less likely scenario, also assumes high implementation costs.

Table A6. Net incremental value per service use (£m)

	Scenario 1	Scenario 2	Scenario 3
Option A: Baseline (i.e. do not clear channels)			
Economic value of DTT	2,100	2,400	3,600
Economic value of Mobile Broadband	1,200	1,200	0
Economic value of MMS	0	1,600	0
Cost of Clearance	0	0	0
Total economic value	**3,300**	**5,200**	**3,600**
Option B: Clear channels 61 and 62 only			
Economic value of DTT	2,000	2,000	3,100
Economic value of Mobile Broadband	3,200	3,200	900
Economic value of MMS	0	1,400	0
Less costs of clearing channels 61 & 62	-85	-185	-185
Total economic value	**5,100**	**6,400**	**3,800**
Option C Clear channel 69 only			
Economic value of DTT	2,100	2,400	2,900
Economic value of Mobile Broadband	2,100	2,100	600
Economic value of MMS	0	1,400	0
Less costs of clearing channel 69	-5	-18	-18
Total economic value	**4,100**	**5,800**	**3,500**
Option D: Clear channels 61, 62 & 69			
Economic value of DTT	2,000	2,000	3,100
Economic value of Mobile Broadband	4,400	4,400	1,300
Economic value of MMS	0	1,400	0
Less costs of clearing channels 61, 62 & 69	-90	-203	-203
Total economic value	**6,300**	**7,600**	**4,200**
Incremental benefit of Option B vs. Option A	**1,800**	**1,200**	**200**
Incremental benefit of Option C vs. Option A	**800**	**600**	**(100)**
Incremental benefit of Option D vs. Option A	**3,000**	**2,400**	**600**

Numbers may not sum due to rounding. We have rounded the value of individual services and the total economic value to the nearest £100m.

A6.78 Table A6 shows that in each of our three scenarios, policy option D always provides the highest net economic value. It is also true that option D provides higher economic value than option B, which provides higher economic value than C.

A6.79 The assumed international renegotiation of GE06 in policy options B, C and D results in a loss of value from potential new DTT services in these policy options. However, when that negotiation has taken place, policy options C, B and D provide increasing amounts of spectrum that can be used by mobile communications. This will be the case unless there is no demand for nationally available 800 MHz spectrum for mobile communications.

A6.80 Of the three demand scenarios, the preferred policy option D offers the smallest incremental benefit in scenario 3. In this scenario, there is no demand by mobile communications for unharmonised use of the upper band. This is because there is relatively low demand for this spectrum as operators cannot afford to sustain unharmonised use of the spectrum. Through clearing channels 61-69, the value of the spectrum to DTT is decreased and the value to mobile communications is raised. This occurs as the spectrum is now more suited to mobile communications use than before.

Annex 7

Glossary of abbreviations

CEPT	European Conference of Postal and Telecommunications Administrations
DDR	Digital Dividend Review
DSO	Digital switchover
DTT	Digital terrestrial television
DVB-H	Digital Video Broadcast – Handheld
EPG	Electronic programme guide
EU	European Union
FDD	Frequency-division duplexing
GE06	Geneva 2006
GHz	Gigahertz
HSDPA	High-Speed Downlink Packet Access
ITU	International Telecommunication Union
ITU-RR	International Telecommunication Union Radio Regulations
JPP	Joint Planning Project
kHz	Kilohertz
LTE	Long-Term Evolution
MHz	Megahertz
MMS	Mobile multimedia services
NPV	Net present value
PMSE	Programme-making and special events
PSB	Public-service broadcasting
RRC-06	Regional Radio Conference 2006
SFN	Single-frequency network

TDD	Time-division duplexing
TLCs	Technical licence conditions
UHF	Ultra-High Frequency
WiMAX	Worldwide Interoperability for Microwave Access
WRC-07	World Radiocommunication Conference 2007