



1200 EIGHTEENTH STREET, NW
WASHINGTON, DC 20036

TEL 202.730.1300 FAX 202.730.1301
WWW.HARRISWILTSHIRE.COM

ATTORNEYS AT LAW

January 17, 2008

Ex Parte

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street, SW
Washington, DC 20554

Re: Unlicensed Operation in the TV Broadcast Bands, ET Docket No. 04-186

Dear Ms. Dortch:

As the Commission is no doubt aware, the United Kingdom's Office of Communications (Ofcom) recently concluded that it will authorize unlicensed use of the television white spaces by cognitive radio devices after the digital television transition.¹ The White Spaces Coalition² enthusiastically endorses this decision, a copy of which is attached. Ofcom's plan is substantially similar to the proposal the Coalition has advocated throughout this proceeding: in short, reap the benefits of unused spectrum in the television bands by authorizing white space devices on an unlicensed basis, and utilize spectrum sensing technology that complies with overarching technical parameters to avoid interfering with incumbent users.

Ofcom recognized, as the Coalition has long advocated, that unlicensed use will best bring about geographically disparate medium-range applications, such as mesh networks and rural broadband, and will better serve consumers by encouraging more innovation and competition than licensed use.³ And, as the Coalition has long advocated, Ofcom concluded that cognitive sensing would best provide the flexibility needed to use the white spaces, while protecting incumbent users from interference.⁴

¹ See Digital Dividend Review: A Statement on our Approach to Awarding the Digital Dividend, Ofcom, ¶ 1.34 (Dec. 13, 2007) ("Ofcom statement").

² The White Spaces Coalition's members include Dell, Inc., Google, Inc., Hewlett-Packard Co., Intel Corp., Microsoft Corp., Palm, Inc., Philips Electronics North America Corp., and TDK Corp.

³ *Id.* ¶ 1.36, 6.18, 6.19. See Comments of Dell Inc., Google, Inc., The Hewlett-Packard Company, Intel Corp., Microsoft Corp., and Philips Electronics North America Corp. (filed Jan. 31, 2007) at 22-24 ("Coalition FNPRM Comments").

⁴ Ofcom Statement ¶ 6.26.

Ofcom also shares the Coalition's views on implementing spectrum sensing. Specifically, Ofcom intends to specify operating parameters with which spectrum-sensing devices must comply and then carefully certify the final consumer devices.⁵ While Ofcom noted that cognitive technologies are still in development,⁶ it also observed that the results of the first OET tests on prototype white space devices confirm the possibility of spectrum sensing.⁷

Finally, Ofcom proposed to allow licensed wireless microphones and unlicensed spectrum-sensing white space devices to share the white spaces, with the understanding that a cognitive device would avoid a frequency on which a wireless microphone was then transmitting.⁸ In addition, Ofcom said it would continue to reserve Channel 69 for licensed wireless microphone use.⁹ This is, in essence, the same as the Coalition's proposal for white space devices to avoid transmitting on frequencies that are in use by a wireless microphone and to additionally set aside channels 2-20 for wireless microphone use.

In sum, Ofcom's plan for the United Kingdom's white spaces is in many ways identical to the Coalition's recommendations in this proceeding. The concept of using white spaces for spectrum-sensing unlicensed wireless devices originated in the United States. The British Government has now adopted that concept. The Coalition urges the Commission to likewise adopt that concept and authorize spectrum-sensing devices on an unlicensed basis so that the public in the United States can reap the same benefits as the public in the United Kingdom.

Sincerely yours,

/s/ Scott Blake Harris

Scott Blake Harris

Enclosure

⁵ *Id.* ¶ 6.29.

⁶ *Id.* ¶ 6.16.

⁷ *Id.* ¶ 6.29.

⁸ *Id.* ¶¶ 6.24, 8.39.

⁹ *Id.* ¶¶ 1.43, 7.82.



Digital Dividend Review

A statement on our approach
to awarding the digital dividend

Statement

Publication date: 13 December 2007

Contents

Section	Page
Foreword	1
1 Executive summary	3
2 Introduction	12
3 International developments	19
4 Our duties and our objective for the DDR	24
5 How to identify if a market led approach is right for the DDR	29
6 Licence exemption and an innovation reserve	42
7 Licensed use of the digital dividend	51
8 The digital dividend awards	84
9 Award timing	94
10 Other issues	100
11 Next steps	107
Annex	Page
1 Glossary of abbreviations	109

Foreword

This statement sets out one of the most important decisions we have ever made: how to award the spectrum freed up by digital switchover (DSO)—the digital dividend—for new uses. This has been the focus of our Digital Dividend Review (DDR) since it was launched two years ago.

This decision matters for several reasons:

- spectrum is an essential input in the modern world. Its use underpins 3% of the UK's gross domestic product (GDP) and generates wide reaching benefits for citizens and consumers. But spectrum is a scarce resource, so how it is managed is a critical issue;
- the spectrum presently used by analogue terrestrial television is exceptional because it can readily be used to provide high bandwidth services over long distances and into buildings; and
- the opportunity to put this spectrum to new use does not arise often. Analogue television has been its main use for many decades, under a framework that dates back to 1961.

Most of the spectrum used for analogue television has already been set aside for digital terrestrial television (DTT) at DSO: 256 MHz out of a total of 368 MHz. This will allow a major expansion of the capacity and coverage of DTT.

Our main task in the DDR has been to decide how to release the remainder of this spectrum. This could be put to new uses as varied as mobile broadband, mobile television, more DTT and new “cognitive” wireless services.

Under the Communications Act 2003, our duties are to further the interests of citizens and consumers and to secure the optimal use of spectrum. Our objective for the DDR is to award the digital dividend in a way that maximises the total value to society from its future use. This includes value both to citizens and to consumers. It is expressly not our aim to raise revenue for the Government.

We published proposals for consultation in December 2006. These set out a market led approach, moving away from the command and control regime of the past. Instead of the regulator deciding who could use spectrum, how and for what, we favoured giving users the flexibility to decide how spectrum should be used and the ability to change that use over time as technologies and needs change. This is likely to generate greater value for citizens and consumers.

We also recognised that markets do not work perfectly. We set out proposals to address issues faced by smaller users in particular, like the programme making and special events (PMSE) sector and potential operators of local television.

Our proposals generated over 750 responses and a lively debate. Many stakeholders supported a market led approach, but others called on us to intervene. We had requests to reserve spectrum for many different uses and users, for a range of different reasons. There was particular concern about the prospects for DTT services in high definition (HD) and more generally about how broader social value would be delivered within a market led approach. We also received comments on our proposals for PMSE and local television. The timing of the award was a key issue for many respondents: some argued for it to be brought

forward, others for delay. Separately, both the Government and the House of Commons Select Committee for Culture, Media and Sport declared their support for a service and technology neutral auction of the digital dividend.

Since consultation, we have undertaken a significant body of new work:

- we have conducted a separate, detailed consultation on spectrum access for PMSE;
- we have published detailed proposals to upgrade the DTT platform by using new technologies. These will enable a richer and more varied set of services, including HD, without needing extra spectrum;
- we have conducted more market research, responding to comments on our methodology. The new research nonetheless came to similar conclusions, with no single service commanding overwhelming support from citizens and consumers; and
- we have conducted further analysis, including economic modelling and technical analysis, of a wide range of issues.

In light of all the evidence available, we have concluded that we should take a market led approach to awarding the digital dividend. This means that, with one important exception, we will auction the spectrum in a way that allows users to decide how the spectrum should be used and creates the maximum flexibility and opportunities for different technologies and services.

We have carefully considered arguments for reserving spectrum for a variety of particular uses, but we have not found them compelling. Giving spectrum to one use will deny it to others. It will also tend to reduce flexibility and blunt incentives. We recognise that many services can provide broader social value, but we do not think that support via implicit subsidies in the form of spectrum is necessary to realise this. Explicit support through direct funding is more transparent and can achieve a better outcome.

The exception to our market led approach is for PMSE, which already uses interleaved spectrum on a large scale. This is an extremely diverse community, and we do not think it would be able to take part effectively in an auction, creating a serious risk of market failure. We will therefore hold a beauty contest to award a package of interleaved spectrum to meet PMSE users' needs.

This statement marks the end of the first phase of the DDR. But another, equally important phase is to come: the detailed design of the award process and the licences. Promoting competition and innovation will be at the heart of our work, and we will look carefully at how to encourage entry and guard against the risk of anticompetitive behaviour. Our experience suggests that, if spectrum auctions are well designed, they can be powerful tools for creating a more competitive landscape.

We thank all stakeholders for their engagement in the DDR to date and look forward to working closely with them in the months to come.

David Currie
Chairman

Ed Richards
Chief Executive

Section 1

Executive summary

Introduction

- 1.1 Demand for spectrum is growing quickly, fuelled by rapid innovation in wireless technologies and consumers' appetite for mobility. Wireless services are now widely available at low cost, to the benefit of both individuals and society as a whole.
- 1.2 But spectrum is a scarce resource, so the way it is managed and used is an important issue for advanced economies around the world. One of our key duties is to secure the optimal use of spectrum in the interests of the UK's citizens and consumers.
- 1.3 In the DDR, we have considered how we should award some of the most valuable spectrum likely to be released for new uses over the next 10 to 20 years. Consultation has been an essential element of our work, and our proposals generated over 750 responses from a wide variety of stakeholders expressing a wide range of views.
- 1.4 This statement sets out our answer to the fundamental question of whether we should intervene in awarding the digital dividend by favouring certain uses or users or whether we should take a market led approach, allowing the market to determine who should use the spectrum, how and for what.

The digital dividend

- 1.5 Analogue terrestrial television is currently the primary use of 368 MHz of spectrum in the UK. This represents just under half of the most useful spectrum available. Analogue television will cease when DSO ends in 2012.
- 1.6 The Government decided in 2003 that 256 MHz of this spectrum should be reserved for DTT at DSO. DTT is many times more efficient than analogue television, so many more services can be provided to viewers even while using less spectrum.
- 1.7 The Government's decision means that, at DSO, there will be a major expansion of the coverage and capacity of DTT. DTT will be universally available throughout the UK for the first time. In parallel, the capacity of the six DTT multiplexes will grow by at least 20%, enabling a wider and richer range of services without extra spectrum.
- 1.8 The Government also decided in 2003 that the 112 MHz that will be cleared of analogue television should be released for new uses. This cleared spectrum, with a few adjacent frequencies, forms the core of the digital dividend.
- 1.9 The way that DTT operates means that there is also a large amount of spare capacity within the 256 MHz reserved for it. This can be made available for new uses that will interleave (i.e. share) successfully with broadcast transmitters. This capacity is known as interleaved spectrum.
- 1.10 We have considered the future of both cleared and interleaved spectrum as part of the DDR. Together, they constitute the digital dividend.

- 1.11 The fundamental reason why this spectrum is so important is its physical characteristics: an exceptionally attractive combination of capacity (bandwidth) and coverage (signals travel further and penetrate buildings more readily). This, in turn, means that it can be used for a very wide range of potential new services. These include additional television services delivered through DTT (whether in standard definition—SD—or HD), local television, new types of mobile broadband, mobile television, wireless home networks and many more.
- 1.12 This diversity of potential use makes the digital dividend exceptional in our spectrum awards programme.

Our objective

- 1.13 Our objective for the DDR is to maximise the total value to society that using the digital dividend generates over time. To this end, we have been rigorous in seeking to look at all potential sources of value. This includes the value that each of us derives as a consumer of new services. Critically, it also includes the value that communications services can create for society more widely through their potential for contributing to broad social goals like inclusion and promoting informed democracy.
- 1.14 This comprehensive approach meets our principal duty, which is to further the interests of citizens and consumers. It is also an approach we have applied consistently, so we have looked at citizen and consumer interests in relation to all the likely uses of the digital dividend, from mobile broadband to more DTT, mobile television and beyond.
- 1.15 Our work has already stretched over two years. It has included two major rounds of market research, using a variety of techniques to discover the opinions of citizens and consumers on the options for using this resource. It has also included extensive technical research and detailed economic analysis and modelling. Finally, it has included careful consideration of consultation responses and analysis of multiple policy options.
- 1.16 It is emphatically not our objective to award the digital dividend so as to maximise revenue for the Exchequer. Given our duties, this is not a consideration that we take into account.
- 1.17 In parallel with the DDR, our extensive work on public service broadcasting (PSB) has helped to identify potential threats to the delivery of public purposes in broadcasting in a timely way and contributed to a wider debate about potential solutions. These will be considered in our second PSB Review. And our ongoing work on access and inclusion is seeking to ensure citizens across the UK have access to services such as broadband Internet access and mobile telephony.

The strategic choice

- 1.18 The DDR consultation document, published on 19 December 2006,¹ said that we faced a strategic choice in the approach that we took to awarding the digital dividend. We summarised this as a choice between taking a market led approach and an interventionist one.

¹ www.ofcom.org.uk/consult/condocs/ddr/ddrmain.pdf.

- 1.19 Under a market led approach, we would release the spectrum in a way that would allow the widest possible range of technologies and services to be deployed. We would leave it to the market to decide how the spectrum should be used and create flexibility for users to change the use of spectrum over time, reflecting changes in technology and the preferences of citizens and consumers.
- 1.20 Under an interventionist approach, we would limit the way that the spectrum could be used through regulation. We would select particular uses or users, reserving spectrum for them and excluding others.
- 1.21 We noted that, historically, spectrum has been managed in a very interventionist way, with detailed regulation controlling who could use spectrum, for what and how. Spectrum policy has been used to pursue many different objectives, including the delivery of social policy goals, by gifting spectrum as an alternative to funding. But we observed that, as scarcity increased, spectrum management was changing around the world, with more emphasis on market mechanisms and flexibility for users and less resort to regulation.
- 1.22 We said that we had a clear presumption in favour of a market led approach and that this reflected our wider strategy for spectrum management: reducing regulation and making more use of market mechanisms. But we also recognised clearly the risk of market failure: the risk that markets might not deliver the best outcome for citizens and consumers in all circumstances.
- 1.23 We said that the key question for this phase of the DDR was whether intervening to control the use of the digital dividend was the best way of maximising total value to society. We set out a clear analytical framework for addressing this question, according to which we would consider both the potential benefits and the potential costs of intervening. And we identified two major types of cost: the opportunity cost created by displacing other uses and users and the long term effects of reducing flexibility in spectrum use and blunting incentives for efficiency.
- 1.24 We invited views on whether this was the right analytical approach, and we included an initial analysis of many arguments that had been put to us about the need to intervene.
- 1.25 In preparing this statement, we have again examined thoroughly the choices that we face and our analytical framework for assessing them. We conclude that the strategic choice we have identified remains valid and that the analytical framework we have used is robust.
- 1.26 We also think it is right to retain our presumption against intervening to limit the use of spectrum and in favour of a market led approach. In rapidly changing and converging markets, we think that the market is better placed than the regulator to determine the best uses of spectrum, including the digital dividend.
- 1.27 We have applied our analytical framework in detail to a wide range of potential uses and looked at many different options for intervening. We now turn to these.

The case for particular uses

- 1.28 Many stakeholders have suggested to us that we should ensure the digital dividend is used for particular uses or by particular users. Their proposals have included PSB in HD, local television, mobile television, wireless broadband in rural areas, public safety services, healthcare, education, community development, and providing new

services for people with disabilities. We have also had many representations that we should protect the existing use of interleaved spectrum for PMSE, particularly wireless microphones.

- 1.29 The breadth of these proposals reflects the status of spectrum as a basic input into the economy, akin to capital or labour, which can be used in a vast array of ways in downstream products and services.
- 1.30 We have examined the case for intervening by looking at arguments common to several cases and considering in detail those potential uses that we think are most plausible.
- 1.31 Our analysis has identified two broad types of concern that are potential sources of market failure. These are:
- the costs of coordination. Some types of spectrum use involve large numbers of small users who act largely or wholly independently of each other. It can be very costly for these users to coordinate their demand for spectrum so that its value can be tested through market mechanisms against other uses and users; and
 - the potential existence of broader social value. Some uses of spectrum can bring value to society (e.g. encouraging greater participation in civil society) that goes beyond what individual consumers might be willing to pay for a service.
- 1.32 We have also identified two points that are particularly relevant to the case for intervening on the grounds of broader social value:
- the need to look at all the possible ways of intervening and to consider whether allocating spectrum is the best mechanism; and
 - the need to think about all the possible ways of delivering this value, including not just the digital dividend but other spectrum bands and wireless services and the whole range of wired communications.
- 1.33 Our conclusions are set out below. We deal first with the scope for authorising use of the digital dividend on a licence exempt basis, which avoids the need for individual licences, and then with possible licensed uses.
- 1.34 **We propose to allow licence exempt use of interleaved spectrum for cognitive devices.** Some licence exempt uses are able to coexist successfully with higher power licensed uses. Cognitive radio is a new technology that can detect spectrum that is otherwise unused and transmit without causing harmful interference. It has the potential to support a wide range of uses, including high speed always on broadband. It is particularly suited to operating in interleaved spectrum, where significant capacity is often unused at any one location at least some of the time.
- 1.35 We see significant scope for cognitive equipment using interleaved spectrum to emerge and to benefit from international economies of scale. But use of equipment in the UK will need to protect licensed users of this spectrum, including DTT and PMSE, against harmful interference. We will not allow cognitive equipment to use interleaved spectrum until we are satisfied on this point.
- 1.36 We think that allowing licence exempt cognitive use of interleaved spectrum is likely to be justified. Allowing access in this way will overcome the coordination problem they would otherwise face while imposing limited costs on other potential uses. We

also think it is likely to encourage more innovation and competition in the provision of services, promoting the interests of citizens and consumers.

- 1.37 **We have decided not to set aside any of the digital dividend exclusively for licence exempt use.** The opportunity cost of setting aside spectrum just for licence exempt use would be high, and the additional benefits would be limited given the prospects for cognitive access to interleaved spectrum and the fact that large amounts of spectrum are already available for licence exempt use in other bands.
- 1.38 **We have decided not to hold back spectrum as an innovation reserve.** We have considered this idea carefully since the consultation but concluded that the arguments against it are strong.
- 1.39 Holding spectrum back would impose large costs on citizens and consumers now by reducing the availability of new services. It would also not be a good way of promoting innovation, not least as there would be significant uncertainty over when we should make the spectrum in the reserve available. It would only be beneficial if a high value use of the digital dividend emerged after the award and could not access the spectrum. This is not impossible, but we think it unlikely, not least given that our proposals for cognitive access to interleaved spectrum and allowing licensees to trade spectrum and change its use minimise this risk.
- 1.40 We see technological change in this area as continuous and indefinite. We do not think there will be a “eureka” moment at which the right future use of spectrum will become clear. We think the best way of promoting innovation is to award spectrum, not reserve it, and to pay particular attention to doing so in a way that will encourage new entry and new uses.
- 1.41 **We have decided to reserve most of the available interleaved spectrum to meet the needs of PMSE users.** PMSE is an existing use of interleaved spectrum. It comprises a large and diverse community of businesses, community organisations and individuals. We think that PMSE users would find it difficult to coordinate a bid for access to spectrum, and we think there is a high risk of market failure as result. However, with a careful transition, they can move to accessing spectrum via market mechanisms in the future.
- 1.42 We will award a single package of interleaved spectrum to a licensee that will act as a band manager. To help PMSE users with the transition to market mechanisms, we will use criteria designed to ensure that the band manager’s interests are aligned with those of PMSE users. The band manager will pay a charge for the spectrum based on Administered Incentive Pricing (AIP) and will be able to earn revenue by charging its customers for access. But regulation will ensure that it has to meet reasonable demand from PMSE users on fair, reasonable and non-discriminatory terms. So long as these obligations are met, the band manager will be able to allow others to make use of its spectrum.
- 1.43 **We have decided that channel 69 should continue to be available for PMSE use throughout the UK on a licensed basis.** We will also promote greater licence exempt use of channel 70 for PMSE, in the interests of community users.
- 1.44 These decisions close the separate PMSE consultation that we launched in June 2007. Shortly we will also publish detailed information on the availability of interleaved spectrum for PMSE after DSO.

- 1.45 **We have decided to award geographic packages of interleaved spectrum suitable for local television, but we will not restrict their use to this service.** We have found some interest in the use of the digital dividend for local television among viewers (through our market research²) and potential operators. But we think that if we release only UK wide packages of interleaved spectrum, local television operators would find it difficult to coordinate a bid. We will respond to the demand that we have identified by packaging some spectrum in geographic lots, based on main transmitter sites serving major towns and cities and areas where local television operators are already providing an analogue service.
- 1.46 We have identified around 25 possible locations across the UK where there is enough evidence of demand to justify offering such packages. We will be willing to consider other locations if there is persuasive evidence of demand. We will offer one or two packages in each location. Each package should allow, for example, the operation of a low power DTT multiplex carrying several SD channels.
- 1.47 We have considered arguments made by some local television operators and community media organisations for intervening more extensively, to reserve spectrum exclusively for local television and to award it by beauty contest. We have concluded that further intervention is not justified. It would have a high opportunity cost, displacing other potential users who could also generate high value for society. It would not ensure that local television is economically viable, and it would reduce incentives to use spectrum efficiently. We also think that other delivery mechanisms, such as broadband, might be an attractive alternative for delivering social goals.
- 1.48 These geographic packages of interleaved spectrum will be auctioned. We plan to begin with the first regions where DSO will take place: Border, Granada, West Country and Wales. We aim to hold the first awards by the end of 2008.
- 1.49 **We have decided not to reserve spectrum to provide more DTT services in SD.** The Government reserved almost 70% of the spectrum released by ceasing analogue television for DTT in 2003, before Ofcom took on its responsibilities. A number of stakeholders have pressed us to allocate more spectrum to DTT so that additional capacity will be available for SD services. Some service providers with public policy goals (e.g. Teachers TV, the Community Channel and NHS Direct) have linked this to the difficulty they face in accessing the capacity they would like on DTT multiplexes.
- 1.50 We recognise that a number of broadcast services, not just PSB delivered by organisations like the BBC, can deliver important public goals. We do not, however, think that allocating additional spectrum is an appropriate response to the issue identified. This is because it would displace other uses and users of the spectrum, including new uses that might be more innovative than additional SD services. This could impose a high cost on society. This is particularly so given that new technologies are likely to increase the capacity of the existing DTT multiplexes and hence allow more services to be provided without using additional spectrum that is in high demand for other uses. We also think that intervening in spectrum allocation is not the right way to address difficulties organisations like these may face in accessing multiplex capacity. This is first and foremost a matter of funding and choices about the best way to reach audiences.
- 1.51 We will, however, consider the role that services like these can play in delivering broader social value in our second PSB Review.

² www.ofcom.org.uk/radiocomms/ddr/documents/research07.

- 1.52 **We have decided not to reserve spectrum for DTT services in HD.** Many organisations and individuals pressed us during the consultation to set aside much or all of the digital dividend to provide DTT services in HD. They argued that, unless we intervened by reserving spectrum, PSB services would not be available in HD on DTT. They said that this would lead to a decline in the value and competitiveness of DTT and that this, in turn, would undermine the future of PSB.
- 1.53 The DDR consultation document observed that enough capacity would be available on the DTT platform at DSO to offer HD services without needing extra spectrum and that this could be done without having to reduce the number of other services available. Our confidence in this view has grown over the past year. We published detailed proposals on 21 November 2007 for upgrading the DTT platform to introduce new technologies on one of the six multiplexes.³ This will allow HD services to be offered as DSO is rolled out, starting in the Granada region in late 2009 or early 2010—substantially earlier than would have been possible using the digital dividend.
- 1.54 Given that there are several options for offering HD services using the 256 MHz of spectrum already reserved for DTT, we do not consider that there is a case for allocating more spectrum to achieve the same goal.
- 1.55 **We have decided not to reserve any of the digital dividend for other services, such as mobile broadband and mobile television. But we will package the spectrum in a way that enables the widest possible range of uses, including additional DTT multiplexes as well as new mobile services.**
- 1.56 We think that mobile broadband could generate significant value for citizens and consumers, but we do not see a case for reserving any spectrum exclusively for this use or for other applications like mobile television.
- 1.57 We will, however, package cleared spectrum to enable the widest possible range of uses, in particular to meet potential demand for spectrum for additional DTT multiplexes, for mobile broadband and for mobile television. We regard these as likely uses of cleared spectrum. We have seen evidence of interest from both citizens and consumers (through our market research) and from potential service providers.
- 1.58 We also propose to offer a package of interleaved spectrum in a way that could enable a wide range of new uses, including mobile broadband or extra DTT. This would comprise channels 61 and 62, which are adjacent to the upper cleared spectrum.

Award process and timing

- 1.59 **We have decided to auction cleared spectrum.** This reflects our view that an auction is the fairest and most transparent way to award rights to use spectrum and that it is superior to a beauty contest. We think that market mechanisms are the most effective tool available to encourage efficient use of spectrum and should be used unless there is a compelling case to the contrary.
- 1.60 **We have decided to auction channel 36 alongside cleared spectrum.** Channel 36 is different because it is currently used for ground based aeronautical radar, a use that will cease at the end of March 2009. Channel 36 will therefore be available UK wide before other cleared spectrum, which will only be fully vacated when DSO ends in 2012. We will allow early use of channel 36 that does not materially degrade

³ www.ofcom.org.uk/consult/condocs/dttfuture/dttfuture.pdf.

analogue television services operating in adjacent channels. We have also considered whether to award channel 36 before the rest of the digital dividend, but there are many options for using this spectrum that would involve combining channel 36 with other frequencies. Auctioning channel 36 separately could impose very large costs by making it difficult to realise these options. We also see few advantages to a separate auction, which would, at best, advance the award by a few months.

- 1.61 **We have decided to auction the packages of interleaved spectrum, except for the package with PMSE obligations, which we will award by beauty contest.** We have concluded that, in this latter case, an auction would not be appropriate. Qualitative criteria—notably the technical and managerial ability to meet the needs of PMSE users—will be required to select the band manager, and the intervention required to allow these users to move to a market led approach to spectrum access reduces the benefit of an auction. We recognise that this level of intervention in the use of interleaved spectrum creates risks to the long term efficiency with which it is used. We will mitigate these by charging the band manager AIP, creating an incentive to use the spectrum more efficiently.
- 1.62 **We have decided to award the digital dividend as soon as possible.** This will allow citizens and consumers to benefit from new services with minimum delay. We consider that the auction of cleared spectrum could be held in the first half of 2009 but that some of the geographic packages of interleaved spectrum suitable for local television and the package with PMSE obligations could be awarded by the end of 2008.

Issues for further consultation

- 1.63 The approach set out above will create new opportunities for the UK communications sector to bring an array of new products and services to citizens and consumers, to deploy new technologies and to create new ways of generating and delivering value.
- 1.64 The significance of this opportunity is immense. Our analysis suggests that the value to citizens and consumers generated by using the digital dividend could be £5-10 billion (net present value—NPV—over the next 20 years). This is not an estimate of auction proceeds.
- 1.65 But there is a great deal more to be done to turn these opportunities into reality. This statement concludes the first phase of the DDR by making decisions on the strategic choice that we identified last year. There is another, equally important phase to come: the detailed design of the awards and the terms of the licences awarded.
- 1.66 During this phase, we will consider in detail how awarding this spectrum can best promote competition and innovation in downstream markets and guard against the possibility of anticompetitive behaviour such as hoarding.
- 1.67 Our experience of spectrum awards suggests that a well designed auction can be a powerful tool for encouraging new entry, new services and new technologies. We will harness experience of spectrum markets around the world to address issues such as the packaging of the spectrum, the options for auction design, the contents of licence conditions and the need for specific measures to protect and promote competition.

International developments

- 1.68 Spectrum management in the UK takes place within international frameworks set both globally and in the European Union (EU). Two recent developments are particularly relevant to the DDR.
- 1.69 First, the World Radiocommunication Conference 2007 (WRC-07) agreed to change the international Radiocommunication Regulations to make spectrum currently used for analogue television more flexible, in particular enabling mobile use.
- 1.70 This has limited direct effect on the UK because agreements with other European countries already give us substantial flexibility. But the indirect benefits of the agreement could be large, opening up the prospect that many more countries will make a digital dividend available for new wireless services. This will help to create global economies of scale for equipment, so reducing prices for UK consumers.
- 1.71 Second, the European Commission has published a Communication on a common approach to the digital dividend in the EU. This recommends identifying common bands that can be optimised by enabling “clusters” of services using a similar type of communications network: broadcasting, mobile multimedia and mobile broadband. These bands would be planned and harmonised in some form at EU level.
- 1.72 We recognise that the UK will benefit if other EU Member States release a digital dividend, particularly if they do so in a broadly similar way. But requiring them to replan the frequencies they are using to deliver DSO would significantly delay this process. Discussions in the EU also need to be concluded quickly so that citizens and consumers can benefit from new services as soon as possible.
- 1.73 We therefore strongly support a non-mandatory approach to harmonising the digital dividend in the EU. This will allow Member States to participate to the extent that they wish while not favouring one use of the digital dividend over others.
- 1.74 We will contribute fully to EU discussions in the months to come. In the meantime, we believe it right to press ahead with the DDR in the interests of bringing benefits to UK citizens and consumers at the earliest possible date.

Next steps

- 1.75 We will consult on the detailed design of the digital dividend awards in spring 2008.
- 1.76 In relation to cleared spectrum and interleaved channels 61 and 62, we hope to publish the information memorandum and auction rules by the end of 2008. The auction itself could take place in the first half of 2009.
- 1.77 In relation to interleaved spectrum, we expect to auction geographic packages in the Border, Granada, West Country and Wales regions by the end of 2008. We expect to award the package with PMSE obligations by beauty contest to the same timetable. Auctions of the remaining geographic packages will follow in 2009.
- 1.78 This timetable is subject to factors outside our control, particularly developments in the EU, and may change during the course of the rest of the DDR.

Section 2

Introduction

Background

- 2.1 Around Europe and the rest of the world, television broadcasting is embracing the digital age. New emerging broadcast technologies and standards mean that the pace of change is increasing rapidly. In the UK, for example, the number of households watching digital television in June 2007 was 85%, compared with 66% two years earlier.⁴ There are now several digital broadcasting platforms available in the UK: satellite, cable, television over broadband and DTT.
- 2.2 In the UK, the Government has decided that analogue television should cease by 2012. This will allow the expansion of DTT to cover as much of the country as analogue covers now. This programme of change—DSO—will have two major consequences. First, there will be an expansion of the number and range of services available via terrestrial television across the UK. Second, a large amount of spectrum—the digital dividend—will become available for new uses.
- 2.3 This is possible because digital technology is more efficient than analogue, carrying much more content in a given amount of spectrum. The move from analogue to digital broadcasting therefore has important consequences for spectrum, which is a scarce resource of great importance to our economy and society.
- 2.4 As well as being one of the fundamental inputs for terrestrial broadcasting, spectrum supports a wide range of different communications services. Access to spectrum is key to innovation and competition in the fast growing information and communications technology (ICT) sector in addition to a wide range of applications in other fields, including defence, transport and science. Wireless technology is increasing in importance given rising demand for communications and entertainment while on the move. The use of spectrum underpins 3% of the UK's GDP and generates benefits worth over £40bn a year, a figure that has grown by about a half in real terms since 2002.⁵ Indeed, this is likely to be an underestimate as it does not take into account the use of spectrum for commercial aviation, public safety, defence or science or directly assess the impact of high levels of innovation associated with many uses of spectrum.
- 2.5 This statement sets out our approach to awarding the digital dividend. This is the largest amount of the most valuable spectrum that is likely to be available in the UK for the foreseeable future.

Terrestrial broadcasting in the UK

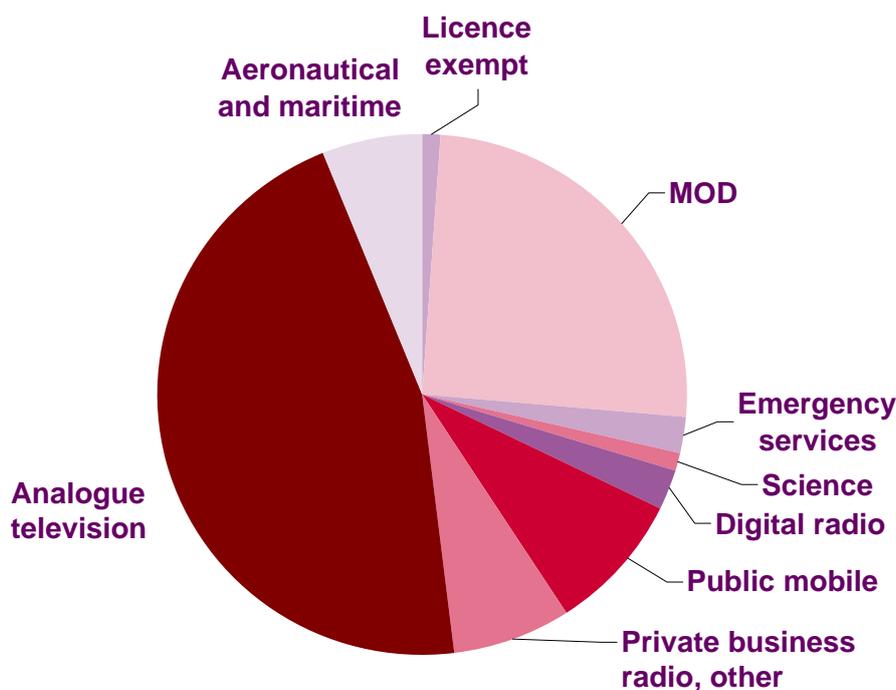
- 2.6 The spectrum generally regarded as being of most value in the UK lies between 200 MHz and 1 GHz. This spectrum is in high demand due to its attractive characteristics. At these frequencies, signals generally propagate well, which means that large areas can be covered at relatively low cost and signals tend to penetrate buildings easily. At the same time, there is sufficient spectrum available for services that require large capacity or bandwidth. This combination of characteristics makes it suitable for the widest range of applications.

⁴ www.ofcom.org.uk/research/cm/cmr07/cm07_print/.

⁵ www.ofcom.org.uk/research/radiocomms/reports/economic_spectrum_use/economic_impact.pdf.

2.7 Figure 1 shows that analogue television is currently the largest single use of this spectrum. It occupies 368 MHz of spectrum between 470 and 862 MHz (Ultra High Frequency—UHF—bands IV and V) and 46% of the total spectrum between 200 MHz and 1 GHz. This capacity is used principally to carry the five main analogue channels, according to a plan largely dating back to 1961. Existing DTT services and some other secondary uses fit in and around this analogue plan. Mobile telecommunications, by contrast, uses only about 70 MHz, less than 9% of the total.

Figure 1. Existing use of spectrum between 200 MHz and 1 GHz



DSO

- 2.8 On 15 September 2005, the Secretary of State for Culture, Media and Sport confirmed that the UK’s analogue television signals would be switched off region by region between 2008 and 2012.⁶ Switching off the analogue signal will allow a reorganisation of all 368 MHz currently used by terrestrial television.
- 2.9 In principle, there exists a wide range of choices about the use of this capacity. For example, the five main analogue television services could be carried on just one DTT multiplex, requiring only 40 MHz. However, important decisions have already been made about the use of most of the spectrum. In particular, the Government decided in 2003 that, at DSO, 256 MHz—more than two thirds—should be assigned to the operators of the six DTT multiplexes operating before DSO.⁷
- 2.10 A substantial amount of spectrum will still become available for new uses following DSO. The Government’s decision provided for this digital dividend. It stated that at least 14 frequency channels—each of 8 MHz, making a total of 112 MHz—would be cleared across the UK. It also noted that spare capacity available in spectrum interleaved with the six DTT multiplexes could be used for additional services and that services such as wireless microphones currently made use of this interleaved

⁶ www.culture.gov.uk/Reference_library/Press_notices/archive_2005/dcms116_05.htm.

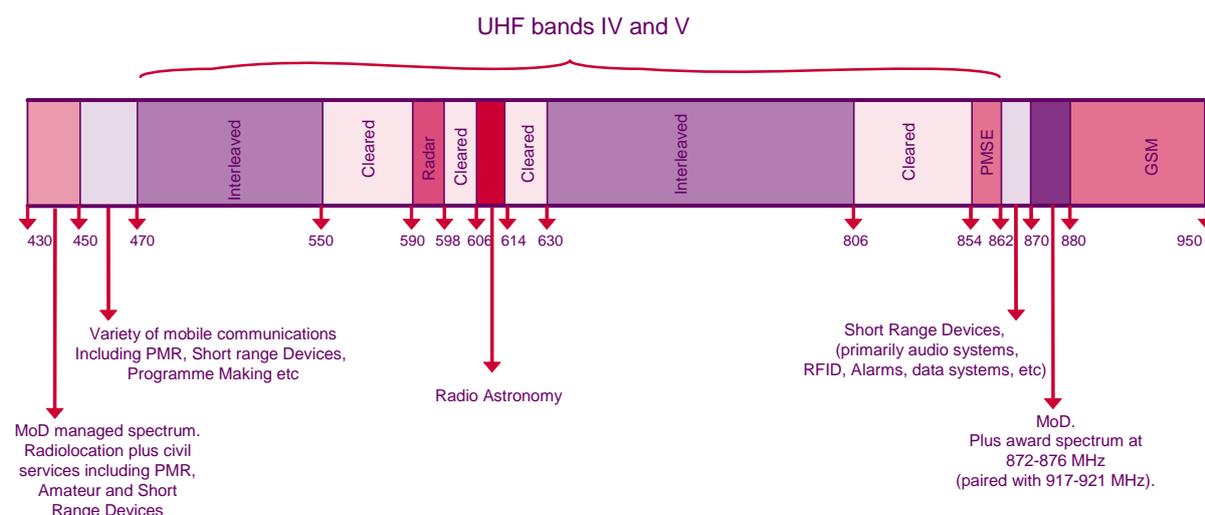
⁷ www.digitaltelevision.gov.uk/publications/pub_spectrum_planning.html.

spectrum. Cleared and interleaved spectrum are explained in more detail later in this section.

The digital dividend

2.11 Figure 2 shows the digital dividend in the context of adjacent spectrum use between 430 and 950 MHz. The principal use above 862 MHz is GSM mobile telecommunications. Smaller quantities of spectrum are used for short range licence exempt equipment and by the Ministry of Defence (MOD). MOD is the principal user below 470 MHz, for a variety of applications including radar. There is also some civil use, including extensive use by private mobile radio (PMR) at 450-470 MHz.

Figure 2. The digital dividend and adjacent spectrum use between 430 and 950 MHz



Different types of spectrum

2.12 Different types of spectrum are available for award as part of the digital dividend. The principal distinction that needs to be made is between cleared spectrum and interleaved spectrum.

Cleared spectrum

2.13 Cleared spectrum will be available for new uses on a UK wide basis. These channels are also used in neighbouring countries and are subject to incoming interference from them. Most of this spectrum will be freed as a direct consequence of DSO, which will release 112 MHz. In the existing plan for this spectrum, these channels are numbered 31-35, 37, 39-40 and 63-68.

2.14 This statement also sets out our approach to other channels in UHF bands IV and V that have potential to be cleared on a similar timeframe, namely channels 36 (currently used for aeronautical radar) and 69 (currently used for PMSE). Channel 38 is mainly used for radioastronomy, and we have no plans to require this use to cease.

Interleaved spectrum

2.15 The digital dividend also includes the interleaved capacity that will be available within the 256 MHz reserved for the six DTT multiplexes. In any one location, only six

channels are used for the preferred DTT service. It is the remaining channels that make up interleaved spectrum (also known as white space). In principle, these are available for alternative uses, although some channels will be required for transmitter relays and some locations are capable of receiving two or even three DTT services, each using a different set of six channels. The identity of these channels will change from location to location, and the extent to which they can be used will depend heavily on how they are used to carry DTT elsewhere. But in any given location, it can be a large amount of spectrum. Similar capacity but with a different pattern of frequency availability exists at present within the spectrum used for analogue television.

2.16 Figure 3 shows these different types of spectrum in the context of the wider use of UHF bands IV and V. It gives both channel numbers and the frequencies for each channel. For example, channel 21 occupies 470-478 MHz, while channel 36 occupies 590-598 MHz. For simplicity, this statement will generally refer to spectrum by channel number. Where appropriate, it will refer to both channel numbers and frequencies.

Figure 3. Channel numbers and frequencies for UHF bands IV and V

Channel Frequency (MHz)	21	22	23	24	25	26	27	28	29	30	31	32
	470-478	478-486	486-494	494-502	502-510	510-518	518-526	526-534	534-542	542-550	550-558	558-566
	33	34	35	36	37	38	39	40	41	42	43	44
	566-574	574-582	582-590	590-598	598-606	606-614	614-622	622-630	630-638	638-646	646-654	654-662
	45	46	47	48	49	50	51	52	53	54	55	56
	662-670	670-678	678-686	686-694	694-702	702-710	710-718	718-726	726-734	726-742	742-750	750-758
	57	58	59	60	61	62	63	64	65	66	67	68
	758-766	766-774	774-782	782-790	790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854
	69											
	854-862											

	Cleared spectrum		Aeronautical radar		Programme-making and special events
	Interleaved spectrum		Radioastronomy		

Matters addressed by this statement

Our approach to awarding the digital dividend

2.17 In general, we prefer a market led approach to awarding spectrum, allowing users flexibility to determine how it is used. This is the position set out in our Spectrum Framework Review (SFR),⁸ and it is the approach we have taken to the rest of our spectrum awards programme.

2.18 The wide range of potential uses for the digital dividend distinguishes it from other awards. Potential uses that we have identified or that have been suggested to us include:

- mobile television and other types of mobile video and multimedia;
- extending existing DTT coverage;

⁸ www.ofcom.org.uk/consult/condocs/sfr/sfr2/sfr.pdf.

- new DTT channels aimed at a UK market in either SD or HD;
- new DTT channels aimed at local markets (i.e. local television);
- wireless microphones and applications for PMSE;
- other low power applications, like hubs to distribute content around the home or using ultra wideband (UWB) technologies;
- broadband wireless applications, which could be mobile, and other mobile voice and data services;
- services using satellite communications;
- emergency and public safety services;
- cognitive radio;
- community radio;
- digital radio;
- communication with medical professionals and educational institutions;
- amateur and/or university use;
- new services for people with disabilities;
- international and cross border uses (e.g. an international emergency channel);
- digital public service teletext to match the analogue service; and
- user created networks (e.g. employing mesh technology).

2.19 This list is not exhaustive, and rapid changes in technologies, services and applications in the communications sector mean that new uses of the digital dividend will continue to emerge.

2.20 Given this wide range of potential uses, we have to consider carefully our objective for awarding the digital dividend in the light of our duties and whether the best way to meet that objective is to pursue a market led approach or whether we need to intervene. This assessment is particularly important given that many of the potential uses might deliver broader social value as well as value to consumers and producers.

2.21 Where we identify that a market led approach will not meet our objective, we consider that the market will fail. Therefore, in the context of the DDR, we define a market failure to be when:

a well designed auction of rights to spectrum that is subject to only the minimum constraints on use would not achieve an efficient outcome—that is to say, the holding and exploitation of spectrum by the users and for the uses that generate maximum value for society over time.

2.22 To inform our market failure assessment, we have constructed a framework to analyse the services that we believe are most likely to use the digital dividend and the potential sources of value that these services could bring to citizens and consumers. We have called this a total value framework. Applying this framework helps us to assess whether there are significant risks that a market led approach to awarding the digital dividend would not meet our objective (i.e. market failure would occur) and, if so, whether total value would be higher if we intervened to control the future use of this spectrum.

The decisions we have made

2.23 The fundamental question for this statement is whether we should take a market led approach to awarding the digital dividend or adopt an interventionist approach. We consulted on this and other issues addressed in this statement between 19 December 2006 and 20 March 2007.

2.24 Our proposals generated over 750 responses, among the highest number to a consultation we have ever received. We published a summary of these on 29 May 2007.⁹

2.25 We have decided that a market led approach to awarding the digital dividend is generally most likely to meet our objective. However, in relation to PMSE use of this spectrum, we believe that intervention is justified. We have therefore decided to award a package of this spectrum to a band manager via beauty contest with obligations safeguarding its continued use by this sector.

2.26 We have also identified a risk of coordination problems preventing local television operators from bidding effectively for spectrum. As a consequence, we have decided to auction geographic packages of interleaved spectrum in specific locations that match the pattern of demand for local television. These packages will be suitable but not reserved for use by local television.

2.27 Other key decisions that we have taken are:

- to propose to allow access to interleaved spectrum by cognitive radio on a licence exempt basis;
- not to set cleared spectrum aside for licence exempt use or as an innovation reserve; and
- not to award channel 36 ahead of cleared spectrum but to allow access as soon as its current use is cleared.

Issues on which we will consult in the spring

2.28 We have not made decisions about most aspects of detailed award design. This includes technical constraints, usage rights and obligations, packaging and competition issues as well as the implications of major forthcoming events (e.g. the London Olympics and the Glasgow Commonwealth Games) and the position of the Crown Dependencies. We will consult on these issues in spring 2008.

⁹ www.ofcom.org.uk/radiocomms/ddr/condocsummary/ddrsummary.pdf.

Structure of this statement

2.29 This statement is structured as follows:

- section 3 looks at relevant developments in the EU and the rest of the world and at WRC-07 and considers their implications for the DDR;
- section 4 sets out how we have interpreted our relevant duties in formulating our spectrum management strategy in general and our objective for the DDR in particular. It also explains the total value framework that we have used to help us evaluate whether we are meeting that objective;
- section 5 considers how we should go about answering the strategic question of whether following a market led approach to award the digital dividend will meet our objective for the DDR or whether we should depart from this by intervening to determine how the spectrum is used (i.e. an interventionist approach) in order to maximise total value;
- section 6 considers the extent to which we should make the digital dividend available by licence exemption rather than by licensing specific rights of use. It also considers whether we should hold back some of the spectrum as an innovation reserve;
- section 7 considers whether a market led approach to awarding the digital dividend is likely to lead to market failure for likely licensed uses. It explains our sources of evidence, including the results of expanded and updated market research. It then considers the merits of intervention for each likely licensed use;
- section 8 sets out our decisions on implementing the digital dividend awards, in particular the mechanisms for releasing the spectrum;
- section 9 sets out our position on the timing of the digital dividend awards;
- section 10 considers other issues on which we will consult further; and
- section 11 sets out the next steps in the DDR.

2.30 The annexes to this statement often repeat points made in the statement itself. This is not only unavoidable but to some extent desirable given that similar issues were raised in response to a number of different questions. We have also sought, where possible, to provide a comprehensive and accessible account of our analysis.

Section 3

International developments

Introduction and summary

3.1 There are important international dimensions to the use of spectrum. This section looks at relevant developments in the EU and the rest of the world and at WRC-07 and considers their implications for the DDR. It concludes that we will continue to engage at all levels to promote market led harmonisation.

The EU

Regulatory framework for electronic communications

3.2 The EU has important powers and responsibilities regarding spectrum management. At a general level, it provides a regulatory framework for electronic communications, including provisions on the use of spectrum. This framework is set out in detail in legislation that was adopted by the European Parliament and the Council of Ministers in 2002.¹⁰ This was incorporated into UK law by the Communications Act.¹¹ Annex 6 contains a more detailed discussion of our obligations relevant to spectrum management under this framework.

3.3 Under the Radio Spectrum Decision,¹² the Commission can adopt Decisions governing spectrum use. This can be done in the interests of ensuring effective policy coordination and, where appropriate, harmonised conditions for spectrum use in the internal market. These Decisions are binding on Member States and can only be adopted by the Commission with the support of a qualified majority of them, convened as the Radio Spectrum Committee (RSC). We represent the UK at RSC under direction by the Government.

3.4 The Radio Spectrum Policy Group (RSPG) works in parallel with RSC and also draws its membership from Member States. Again, we represent the UK under direction by the Government. RSPG's role is to give strategic advice to the Commission on major questions of spectrum policy. It does this by adopting Opinions, which are not binding but can have significant influence as they represent the prevailing view of Member States. RSPG Opinions adopted thus far that are relevant to the digital dividend include:

- Opinion on wireless access policy for electronic communications services (WAPECS) (a more flexible spectrum management approach).¹³ Adopted on 23 November 2005, this proposes the use of the WAPECS concept—technology and service neutrality and authorisation conditions that do not distort competition, with the aim of ensuring the effective and efficient use of spectrum—to facilitate the provision of converged services and to foster innovation and growth;
- Opinion on the introduction of multimedia services in particular in the frequency bands allocated to the broadcasting services.¹⁴ Adopted on 25 October 2006, this

¹⁰ http://ec.europa.eu/information_society/policy/ecomm/current/index_en.htm.

¹¹ www.opsi.gov.uk/acts/acts2003/pdf/ukpga_20030021_en.pdf.

¹² http://eur-lex.europa.eu/LexUriServ/site/en/oj/2002/l_108/l_10820020424en00010006.pdf.

¹³ http://rspg.groups.eu.int/doc/documents/opinions/rspg05_102_op_wapecs.pdf.

¹⁴ http://rspg.groups.eu.int/doc/documents/opinions/rspg06_143_final_rspg_opinion_multimedia_services.pdf.

addresses licensing, limiting constraints and obligations to the minimum necessary, the suitability of several spectrum bands and several actions that could be considered at a European level to facilitate the introduction of multimedia services within Europe; and

- Opinion on EU spectrum policy implications of the digital dividend.¹⁵ Adopted on 14 February 2007, this addresses the possibility for harmonising parts of the digital dividend in Europe, points out various difficulties and calls for a mandate to be given to the European Conference of Postal and Telecommunications Administrations (CEPT) to study the issue.

3.5 The Communications Committee (COCOM) assists the Commission in carrying out its executive powers and provides a platform for information exchange on market developments and regulatory activities. Member States must take utmost account of Commission Recommendations that have been endorsed by COCOM. One Recommendation that it is considering relates to authorisation conditions for six WAPECS bands, including UHF bands IV and V. UK representation is led by the Department for Business, Enterprise and Regulatory Reform.

The EU framework review

3.6 On 13 November 2007, the Commission published proposals to amend the legislation defining the EU regulatory framework.¹⁶ Reforming spectrum management to increase flexibility and greater use of market mechanisms is a central plank of the proposals. The Commission intends that service and technology neutrality should be the norm, with exceptions to avoid harmful interference, protect public health, ensure sharing of spectrum or meet general interest objectives. Member States would be required to permit spectrum trading in certain bands identified by the Commission, with the ability to introduce trading more widely if they so wished. And the Commission proposed that pan-European authorisations to use spectrum be considered by a new European Electronic Communications Market Authority.

Commission Communication on the digital dividend

3.7 On 13 November 2007, the Commission also published a Communication on a common approach to the use of the digital dividend in the EU.¹⁷ It invites Member States to facilitate the introduction of new services by working together and with the Commission to identify common spectrum bands in the digital dividend that can be optimised by creating “clusters” of services using a similar type of communications network:

- unidirectional high power networks (i.e. mainly for fixed broadcasting services). This spectrum would be subject to national management;
- unidirectional medium to low power networks (i.e. typically for mobile multimedia services and newer forms of converged broadcasting and communications services). This spectrum would be subject to national management, combined with optional EU coordination; and

¹⁵ http://rspg.groups.eu.int/doc/documents/opinions/rspg07_161_final_op_digdiv.pdf.

¹⁶ http://ec.europa.eu/information_society/policy/ecommm/tomorrow/index_en.htm.

¹⁷ http://ec.europa.eu/information_society/policy/ecommm/doc/library/proposals/com_dd_en.pdf.

- bidirectional low power networks (i.e. typically for fixed and mobile broadband access services). This spectrum would be subject to EU harmonisation on a flexible basis.
- 3.8 The Communication concludes by indicating that the Commission will prepare the required measures to reserve and coordinate the common bands at EU level. Our award of the digital dividend and the future use of this spectrum will need to comply with any mandatory EU measures.
- 3.9 We welcome the opportunity to debate this very important issue at European level, including consideration of the benefits that a common approach to the use of this spectrum could bring. However, we believe that three key issues must be taken into account if these benefits are to be maximised:
- discussions in the EU about pan-European measures need to be concluded quickly—more quickly than consideration of the Commission’s framework review proposals. This will ensure that European citizens and consumers can benefit from new, innovative and competitive services worth billions of euros—including those that the Commission has said are desirable for supporting its i2010 strategy¹⁸—as quickly as possible;
 - Member States should not have to replan the specific frequencies they are using to introduce DTT. These were agreed across International Telecommunication Union (ITU) Region 1—Europe, the Middle East and Africa—in Geneva in 2006 after substantial negotiation. A major replan of the Geneva 2006 Agreement (GE-06) would seriously threaten DSO in Member States; and
 - Member States are at very different stages of DSO and have very different digital dividends. Given this, it will be extremely difficult, if not impossible, to mandate a common solution for the whole of the EU. Any such measure would be inconsistent with GE-06 and seriously disrupt plans for DSO in many Member States. We therefore strongly support a non-mandatory and non-exclusive approach, allowing Member States to participate to the extent that they wish while not favouring any one service over another. This could encourage and facilitate greater cooperation and consistency over time.
- 3.10 The technical detail in the Communication and the identification of common bands is based on work undertaken by Task Group 4 (TG4) within CEPT. TG4 operates under a mandate from the Commission to study technical considerations regarding harmonisation options for the digital dividend. TG4 is due to submit its final report to the Commission around the end of 2007. This will be discussed by RSC in 2008.
- 3.11 The key conclusions culminating from TG4’s work are that:
- harmonising a sub-band in a way that enables two way mobile applications (including uplinks) is feasible from a technical, regulatory and administrative point of view provided that it is not made mandatory or exclusive; and
 - the preferred sub-band is the upper part of UHF bands IV and V and should include, as a minimum, channels 62-69 (798-862 MHz). We note that while channels 63-68 are cleared spectrum in the UK’s digital dividend, channels 62 and 69 are not. Section 8 sets out our decisions on implementing the award of these channels.

¹⁸ http://ec.europa.eu/information_society/eeurope/i2010/index_en.htm.

3.12 Annex 7 contains further details about TG4 and the work supporting its conclusions.

The rest of the world

Europe

3.13 In some European countries—including Belgium, the Czech Republic, Italy and Spain—little or no digital dividend has been identified. These countries do not currently plan to use UHF bands IV and V for services other than broadcasting (both DTT and mobile television).

3.14 Other countries have recognised the value of this spectrum for non-broadcasting applications and are considering how to use and release any digital dividend. Finland's Government established a national working group in March 2006 to prepare proposals for doing so. French telecommunications regulator ARCEP publicly consulted in July 2007 seeking views on the use of the digital dividend in France and highlighting the need to make a sub-band of UHF bands IV and V (as identified by TG4) available for mobile uses.¹⁹ Sweden's Infrastructure Minister commented on 6 November 2007 that the key issue was how much spectrum should go to television and how much could be used for mobile services such as mobile broadband.²⁰

United States

3.15 In the US, analogue television will cease on 17 February 2009. A mix of legislative and regulatory action has released a digital dividend of 108 MHz in the 700 MHz band. 24 MHz of this has been set aside for public safety, and 22 MHz has already been auctioned to allow new commercial uses such as mobile television.

3.16 The Federal Communications Commission (FCC) will auction the remaining 62 MHz for a mixture of commercial and public safety services, beginning on 24 January 2008.²¹ While this band does not align directly with cleared spectrum in the UK's digital dividend, it is sufficiently close to create economies of scale for equipment designed to operate in both the UK and US markets.

Other countries

3.17 DSO in Japan will release the 48 MHz between 722 and 770 MHz. The release of 12 MHz between 710 and 722 MHz is also being considered. This spectrum may be awarded by technology neutral auctions. DSO in Korea will free up the 54 MHz between 752 and 806 MHz. The future use of this spectrum has yet to be decided.

3.18 Some countries, including Australia and South Africa, have expressed interest in realising a digital dividend but have not yet identified how much spectrum, if any, will be released. Others, including Brazil, China, India and New Zealand, are still at an early stage in planning DSO.

WRC-07

3.19 Global coordination of spectrum use is undertaken within the ITU, a United Nations agency with a mission to maintain and extend international cooperation for the improvement and efficient use of telecommunications of all kinds. The ITU holds a

¹⁹ www.arcep.fr/uploads/tx_gspublication/consult-divid-num-130707-eng.pdf.

²⁰ www.thelocal.se/9022/20071106.

²¹ http://wireless.fcc.gov/auctions/default.htm?job=auction_factsheet&id=73.

World Radiocommunication Conference every three to four years to review and, if necessary, amend the Radiocommunication Regulations—an international treaty governing how spectrum is shared globally—to reflect the changing needs of various wireless services and applications. WRC-07 took place from 22 October to 16 November 2007.

- 3.20 WRC-07 considered providing for future mobile systems, known in the ITU as International Mobile Telecommunications (IMT). It considered several proposals to add a primary mobile allocation to UHF bands IV and V, with a non-exclusive identification for IMT. The outcome included a primary mobile allocation in Region 1 for 790-862 MHz (channels 61-69). This comes into effect from 17 June 2015.
- 3.21 WRC-07 also extended existing provisions of the International Frequency Table to IMT in this band for the period up to 2015 for a number of countries, including the UK. Table 1 summarises the overall result.

Table 1. Timeline of ITU mobile allocation in the band 790-862 MHz

Now	Footnote 5.316: primary mobile allocation for various countries including the UK, the Netherlands, and France (830-862 MHz only). Lesser status with respect to other countries.
1 January 2009	Footnote 5.316A: extension of provisions to many more Region 1 countries but not Belgium or Ireland.
17 June 2015	Primary mobile allocation in Region 1 subject to the application of procedures from GE-06.

- 3.22 Because European signatories to GE-06 have agreed that assignments for DTT can be used for other services as long as they cause no greater interference, we already had flexibility to enable mobile use of the digital dividend in the UK before WRC-07. However, the focus of attention at WRC-07 and the identification of common bands in many countries should help to provide economies of scale that can drive down equipment costs and facilitate the take-up of new services, providing indirect benefits to the UK.

Conclusion

- 3.23 This section has considered developments relevant to the DDR:
 - in the EU;
 - in other countries; and
 - at WRC-07.
- 3.24 We will continue to contribute to the work of TG4 and other technical bodies. We plan further work to establish licence conditions suitable for two way mobile applications as well as other uses, and we will study further the viability of two way mobile use of interleaved spectrum.
- 3.25 We will also engage fully and constructively in EU discussions about the digital dividend and explore how to promote market led harmonisation with other international bodies and stakeholders.

Section 4

Our duties and our objective for the DDR

Introduction and summary

- 4.1 This section sets out how we have interpreted our relevant duties in formulating our spectrum management strategy in general and our objective for the DDR in particular. It also explains the total value framework that we have used to help us evaluate whether we are meeting that objective.

Legal framework

- 4.2 We make decisions within a framework defined in EU and UK law. This sets out overarching general duties, which apply across all our functions, to further the interests of citizens in relation to communications matters and to further the interests of consumers in relevant markets, where appropriate by promoting competition. Below these general duties sit three broad groups of specific duties. One group relates to securing the optimal use of spectrum, a second to our responsibilities for broadcasting and a third to the provision of electronic communications services (ECS). A summary of these statutory duties can be found in annex 6.
- 4.3 Our task is to apply these duties in the DDR to determine how best to exercise our functions. Where our duties conflict with each other, the principles of good regulation guide us to take proportionate, transparent, evidence based and balanced decisions.

Applying our spectrum duties

- 4.4 Our spectrum duties focus on securing the optimal use of spectrum. Leaving spectrum unused will not fulfil this duty.
- 4.5 As in all cases where spectrum is available for award, it is highly relevant to look at potential uses of the digital dividend. Section 2 explained that the wide range of such uses sets this apart from other awards.
- 4.6 As discussed in more detail in this statement, we consider that this points to an approach to awarding the digital dividend that gives a wide variety of competing uses and users an equal opportunity for access both immediately and over time.

Applying our broadcasting duties

- 4.7 Our broadcasting duties include:
- securing the availability throughout the UK of a wide range of television and radio services which (taken as a whole) are both of high quality and calculated to appeal to a variety of tastes and interests; and
 - having regard to the desirability of promoting the fulfilment of the purposes of public service television broadcasting in the UK.
- 4.8 We consider that, with the spectrum reserved for DTT and the availability of other spectrum and fixed networks, PSBs and commercial broadcasters have sufficient capacity to fulfil the first of these duties. We consider that the spectrum reserved for DTT (almost 70% of the amount used for analogue television) is sufficient to fulfil the

second. We particularly note that this spectrum currently supports more than 40 SD services, many of which are PSB channels, as well as interactive and radio services. This represents a major increase in the range of content, and in the volume of content provided by PSBs, over the five services available via analogue television.

- 4.9 We recognise that PSB needs to continue evolving to achieve reach and impact in an all digital world. Our extensive work in this area (including our first PSB Review,²² our review of children's programming,²³ our New News, Future News report²⁴ and our financial review of Channel 4²⁵) has identified potential threats to the delivery of public purposes in broadcasting and contributed to a wider debate about potential solutions. At present, the evidence is insufficient to conclude that more PSB DTT services are necessarily the best way to achieve the goals of maintaining and strengthening the quality of PSB in future or that the PSBs are unduly disadvantaged in securing additional DTT capacity, even if that is the best option. This analysis is supported by the terms of reference for our second PSB Review, which argues that a much wider set of possible long term solutions for PSB should be considered.²⁶
- 4.10 We therefore conclude that we do not need to intervene in the award of the digital dividend to favour certain users or uses in order to meet our broadcasting duties. Section 7 nonetheless takes into account the broader social value associated with different broadcasting services in applying our total value framework.

Applying our ECS duties

- 4.11 Our ECS duties include securing the availability throughout the UK of a wide range of ECS and having regard to the desirability of encouraging broadband availability and use throughout the UK.
- 4.12 We consider that there is already sufficient spectrum, in combination with fixed networks, to fulfil these duties. This is enhanced by our programme to extend the liberalisation and tradability of spectrum use and by a number of initiatives promoting increased broadband availability and use throughout the UK, both of which have grown.²⁷ Our ongoing work on access and inclusion is examining the extent of availability of ECS such as broadband Internet access and mobile telephony and looking at the options available for addressing any gaps identified. Finally, we note that the scope of universal service will be the subject of a Commission Communication in mid-2008.
- 4.13 We therefore conclude that we do not need to intervene in the award of the digital dividend to favour certain users or uses in order to meet our ECS duties. Section 7 nonetheless takes into account the broader social value associated with different ECS in applying our total value framework.

Our spectrum management strategy

- 4.14 Historically, regulators approached spectrum management in an interventionist way. They decided who could use spectrum, the services they could provide and the technologies they could use. We rejected this approach in the SFR, instead favouring

²² www.ofcom.org.uk/consult/condocs/psb3/psb3.pdf.

²³ www.ofcom.org.uk/tv/psb_review/childprog/.

²⁴ www.ofcom.org.uk/research/tv/reports/newnews/newnews.pdf.

²⁵ www.ofcom.org.uk/tv/psb_review/c4review/c4review/statement.pdf.

²⁶ www.ofcom.org.uk/tv/psb_review/psb_2review/psbreview2.pdf.

²⁷ www.ofcom.org.uk/research/cm/broadband_rpt/broadband_rpt.pdf.

market mechanisms to allow users more flexibility in determining spectrum use and to accommodate the increasing demand for spectrum. A market led approach entails:

- allowing spectrum to be traded between users;
- liberalising spectrum by imposing as few constraints as possible on its use and removing existing restrictions limiting use to certain services or technologies; and
- awarding spectrum through service and technology neutral auctions or, where spectrum is already licensed, introducing AIP to ensure that licence fees provide incentives to use spectrum efficiently by reflecting its value.

4.15 We believe that this approach will:

- promote efficient spectrum use by allowing it to be transferred to, and used by, those who value it most highly;
- promote competition by increasing the availability of spectrum for use in the most valuable services; and
- facilitate innovation as new providers enter the market to offer new services.

4.16 These characteristics of a market led approach all tend to bring positive benefits to citizens and consumers and are therefore consistent with our duties. They are also directly relevant to our objective for the DDR.

Objective for the DDR

4.17 Taking account of our duties and our spectrum management strategy, and as set out in the DDR consultation document, our objective for the DDR is to maximise the total value to society that using the digital dividend is likely to generate over time. It is emphatically not our objective to award the digital dividend to maximise revenue for the Exchequer. Given our duties, this is not a consideration we take into account.

The total value framework

4.18 The DDR consultation document summarised the key elements of total value that are relevant to consumers and citizens. These are respectively:

- consumer value. This includes the value we derive as consumers when we engage in markets by using goods or services. This is derived from serving consumer interests in relation to both access to and participation in markets; and
- broader social value. This includes the value we derive as citizens from goods or services. This is derived from the provision of and access to goods or services that meet social goals.

4.19 Access to and use of services can therefore generate both consumer value and broader social value.

Consumer value

4.20 There are well established techniques for assessing consumer value. These involve assessing the benefits consumers gain from consuming goods and services over and above what they have to pay for them (commonly referred to as consumer surplus).

Broader social value

- 4.21 Broader social value can be thought of as a form of externality (i.e. spillover effect) that affects us as citizens. When services that meet broader social goals (e.g. universal access to telecommunications or PSB) are provided and consumed, this generates broader social value.
- 4.22 To understand better how the different uses of the digital dividend might generate broader social value, we have identified the following elements:
- access and inclusion (e.g. value derived from universal access and facilitating access to public services);
 - quality of life (e.g. value derived from providing access to services that improve quality of life by promoting work/life balance or family life);
 - belonging to a community (e.g. value derived from allowing people with similar interests to communicate and/or participate in the local community);
 - educated citizens (e.g. value derived from services with educational content or child oriented services);
 - cultural understanding (e.g. value derived from services that reflect and strengthen cultural identities or promote diversity and understanding of other cultures);
 - informed democracy (e.g. value derived from services that provide information facilitating democratic debate); and
 - social bads, including negative value derived under any of the elements above.
- 4.23 The DDR consultation document set out a number of ways in which broader social value generated by particular uses of the digital dividend might be assessed. It noted that we would use the following three methods:
- quantitative market research that assessed the value citizens and consumers attached to these uses, including trade-offs based on their importance to society;
 - deliberative market research to assess citizens' preferences for different possible uses of the spectrum; and
 - an assessment by an academic in this field, Dr Damian Tambini.
- 4.24 A more detailed discussion of broader social value and its measurement can be found in annex 2 to the DDR consultation document.²⁸

Assessing total value to society

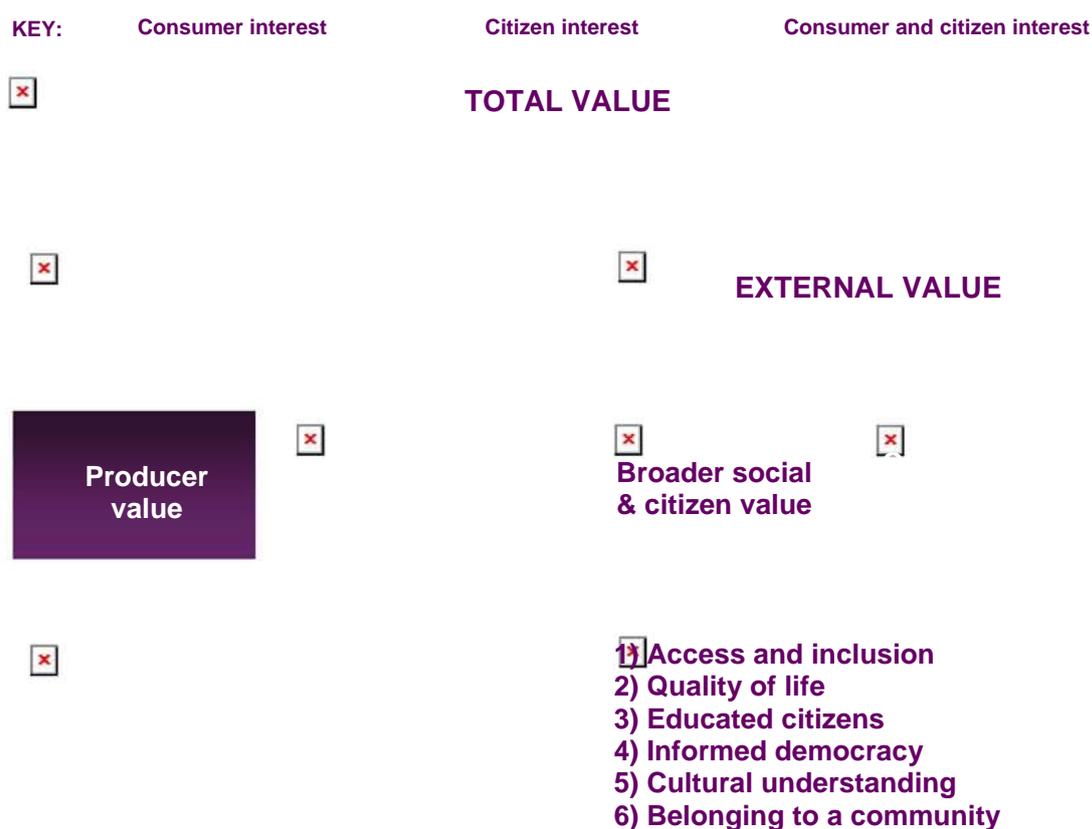
- 4.25 Combining consumer value and broader social value with two other sources of value, producer value and other externalities, gives the total value of producing and consuming a particular good or service. Figure 4 illustrates this. In deciding how to award the digital dividend, we must consider the potential value to society of different uses of the spectrum. We use this total value framework to do so. We are particularly

²⁸ www.ofcom.org.uk/consult/condocs/ddr/ddr_annexed.pdf.

concerned with assessing broader social value and the extent to which it differs across uses or is unrelated to the private value generated by a use. When this happens, there is a risk that a market led award could result in a socially suboptimal outcome (i.e. one in which total value is not maximised due to market failure).

4.26 It is important to stress that, in applying this framework throughout the DDR, we have sought to ensure that we assess the incremental effect on total value of using the digital dividend. This means looking at effects over and above those of other services already available and other options for delivery.

Figure 4. The total value framework



* Producer value should be taken into account owing to the knock-on effect of innovation on consumer (and, in some cases, citizen) value. However, consideration might need to be given to the weight given to producer value relative to consumer and citizen value.

Conclusion

4.27 This section has considered:

- how we have interpreted our relevant duties in formulating our spectrum management strategy in general and our objective for the DDR in particular; and
- the total value framework that we have used to help us evaluate whether different approaches to awarding the digital dividend would be likely to meet that objective.

Section 5

How to identify if a market led approach is right for the DDR

Introduction and summary

- 5.1 This section considers how we should go about answering the strategic question of whether following a market led approach will meet our objective for the DDR or whether we should depart from this by intervening to determine how the spectrum is used (i.e. an interventionist approach).
- 5.2 We have answered this question by starting with a market led approach and considering whether there are reasons why this might fail to maximise total value. Where we find the potential for market failure, we consider the range of options we have for remedying this. These include options consistent with a market led approach (i.e. which help the market to work) and options that involve moving to an interventionist approach. Our approach weighs up the costs and benefits of not intervening against the costs and benefits of intervening (taking into account the opportunity cost of the intervention and the potential for regulatory failure to increase this). This trade-off allows us to identify whether the total value generated by using the digital dividend is likely to be greater if we intervene and hence depart from our market led approach.
- 5.3 We also explain how our total value framework applies to decisions about licence exempting the digital dividend.
- 5.4 This section focuses on the factors we take into account when conducting our assessment. Sections 6 and 7 apply this approach to decide:
- whether we should set aside spectrum for licence exempt use; and
 - whether we should adopt a market led approach for potential licensed uses of the digital dividend.
- 5.5 Our approach to answering this strategic question was first set out in the DDR consultation document. This section addresses responses on its suitability.
- 5.6 This section therefore considers the following issues:
- how our approach to answering the strategic question involves trading off the costs and benefits of a market led approach and an interventionist approach;
 - how markets can deliver total value;
 - how markets can fail and our approach to assessing the importance of this issue; and
 - what options are available to remedy market failure and how the likelihood of regulatory failure can be reduced.

Consultation responses

- 5.7 The DDR consultation document sought comments on our analysis of the choice between a market led approach and an interventionist approach to awarding the digital dividend. We received 260 responses (167 from individuals) on the desirability of a market led approach and 138 (77 from individuals) on the risk of market failure. Views were deeply polarised. Annex 4 sets out responses in detail.
- 5.8 A number of respondents, from all sectors, did not regard the choice as starkly between one approach or the other. Some noted licence exemption as a third approach. Some recognised the Government's role in funding public services that require spectrum, albeit with varying degrees of confidence that this would happen. Others supported our proposals for a market led approach and recognised a need to intervene in the event of market failure but noted that intervening might have unpredictable effects.
- 5.9 In general, telecommunications and ICT organisations, along with some public bodies, supported a market led approach. Mobile network operators (MNOs) and mobile equipment manufacturers restated the benefits of taking a common approach across Europe and noted that EU harmonisation measures could affect use of the digital dividend. The Ofcom Spectrum Advisory Board (OSAB) echoed both views.
- 5.10 Our Advisory Committee for Northern Ireland (ACNI) generally supported the market led approach. So did the Ofcom Consumer Panel (OCP), while looking to us to set out clearly how we would rectify the possible outcome that the broader social value of a service was not being maximised in the marketplace. Our Advisory Committee for Scotland (ACS) and our Advisory Committee for Wales (ACW) had more concerns about an exclusively market led approach, whereas our Advisory Committee for Older and Disabled People (ACOD) saw a need to promote access for non-commercial service providers.
- 5.11 PSBs, certain manufacturers, some other organisations and a large number of private individuals argued for spectrum to be reserved for specific uses such as DTT services in HD. Generally, these respondents did not consider a market led approach to be appropriate, for a wide range of reasons including:
- the unsuitability of auctions for realising broader social value. Some respondents proposed reserving spectrum for social use, others imposing obligations on auction winners to set aside capacity for such use, yet others providing bidder credits for those generating broader social value;
 - the need to allocate spectrum to particular services (e.g. those generating broader social value) even if specific assignments were subsequently auctioned; and
 - an inability to take part in an auction, notably on the part of PMSE users, who considered themselves typically to be small and under-resourced.
- 5.12 Other respondents raised a wide range of market failure issues which they thought we needed to consider. Annex 4 sets these all out.

Our response

- 5.13 We agree that the potential for market failure requires very careful consideration. The analytical approach we set out in this section is the way in which we do this. We think

this approach is sufficiently broad to capture all important sources of market failure and allow us to reach a reasoned judgment on the need to intervene.

5.14 Many responses about our approach to assessing whether to intervene fit into one of the following common themes:

- questions about whether a market led approach can really be used to deliver value to society. These comments raised concerns about the suitability of public funding for delivering broader social value and suggested alternative approaches (e.g. reserving spectrum), which respondents considered preferable;
- comments about the range of market failure issues we should consider and questions about whether our approach captured all these; and
- recognising the need to be careful when intervening as this can have unexpected effects.

5.15 We have taken the consultation responses into account in assessing whether we should adopt a market led approach or an interventionist approach. We explain below our approach to this assessment and why we think it is the right one. Our response to the three themes above can be found as follows:

- we address questions about whether a market led approach can work and the suitability of alternative approaches to delivering broader social value first in discussing how markets can deliver total value (paragraphs 5.31-5.38) and second in assessing the different intervention options available for resolving market failures (paragraphs 5.59-5.70);
- when setting out the framework we use to identify market failures (paragraphs 5.39-5.47), we explain why we think this is broad enough to capture all important market failure risks; and
- in considering what to do when markets fail (paragraphs 5.48-5.58), we show how our approach takes account of the potential for intervening to have undesirable effects.

5.16 We have noted the comments that we should not characterise licence exemption as a form of intervention. We agree that there are approaches to licence exemption that allow markets to play a role (e.g. using general licence exempt allocations rather than application specific allocations so the market can determine which licence exempt applications should make use of the available spectrum). However, in deciding whether to licence exempt the digital dividend, we believe that our total value framework is still appropriate:

- licence exemption decisions are required because of market failures—namely transaction costs—that prevent a large number of individual users of low power applications from aggregating their demand effectively;
- these uses are also often characterised by incentives to free-ride. Individual users typically do not reduce the usability of the available spectrum for other users (i.e. they do not create harmful interference for other licence exempt users and in some cases can share spectrum with licensed uses without causing interference), and each individual user represents only a small amount of the overall demand for this use. These two factors, when combined with the practical

difficulties involved in excluding users able to purchase consumer equipment, can provide strong incentives for free-riding if this use were to bid for spectrum;

- in these situations, our total value framework is a useful way to implement our economic value test from the SFR, which we consider to be the appropriate approach to these decisions. Additionally, this approach helps us to recognise the importance of considering regulatory failures when making licence exemption decisions, as with other forms of regulatory decision; and
- this approach is consistent with our duties under EU and UK law in relation to licence exemption. When uses do not create harmful interference, they will be subject to the market failure risks identified above. Additionally, when this situation is present, the most appropriate regulatory response is clearly to exempt the use from licensing but in the most flexible manner possible (i.e. using general rather than application specific allocations).

5.17 We also acknowledge the concerns raised by some respondents about the need to promote harmonisation. Section 3 explained how our approach to awarding the digital dividend is consistent with market led harmonisation of spectrum use across the EU and elsewhere in the world.

Trading off a market led approach and an interventionist approach

5.18 Our approach to the strategic question facing the DDR is to trade off the costs and benefits of a market led approach and an interventionist approach as both have advantages and disadvantages. At the heart of this assessment is a consideration of potential market and regulatory failures. Before considering the merits of the two different approaches, we first define market and regulatory failures.

5.19 In the context of the DDR, we would consider a market to have failed if:

a well designed auction of rights to spectrum that is subject to only the minimum constraints on use would not achieve an efficient outcome—that is to say, the holding and exploitation of spectrum by the users and for the uses that generate maximum value for society over time.

5.20 Regulatory failure can be thought of as the counterpart of market failure. A regulatory decision would have failed if:

a well designed regulatory intervention fails to achieve the benefits expected or causes unintended additional costs, which result in the decision failing to generate maximum value for society over time.

5.21 At a high level, the benefits of a market led approach are that it reduces the risk of regulatory failure, while the costs are that it may be subject to market failure. The merits of an interventionist approach are the reverse: if it works, it could remove any market failure, but this comes at the price of the risk of regulatory failure.

5.22 To understand the trade-off between these two approaches, it is important to consider the likelihood and significance of both market and regulatory failures in awarding the digital dividend.

5.23 Our work before publishing the DDR consultation document identified that there were two market failure issues particularly relevant to awarding the digital dividend. These are:

- transaction costs, driven by the need for some users to coordinate in order to bid for spectrum. Where a large number of users need to aggregate their demand in order to bid for spectrum, this can result in transaction costs that artificially depress the amount they are willing to bid. Transaction costs may be a problem if spectrum is auctioned in packages significantly larger than the amount demanded by some of the individual users; and
- the presence of externalities, which are driven by the presence of broader social value generated by the potential uses of the digital dividend. Our work identified that many such uses generate value over and above their value to consumers and producers. This extra value accrues to us as citizens and is referred to in our total value framework as broader social value. It is therefore of great importance that our assessment of market failure takes a sufficiently broad view of value to society, including the benefits we all enjoy as citizens as well as consumers.

5.24 We also conducted detailed work to assess how significant regulatory failures might be. This suggested that regulatory decisions to reserve the digital dividend for potential uses would be particularly prone to regulatory failure. This is because of the uncertainty over the best use of this spectrum both now and in the future, the lack of information available to us and the potential for regulatory decisions about use to have undesirable effects on the incentives for spectrum efficiency. These issues are resolved by a market led approach because:

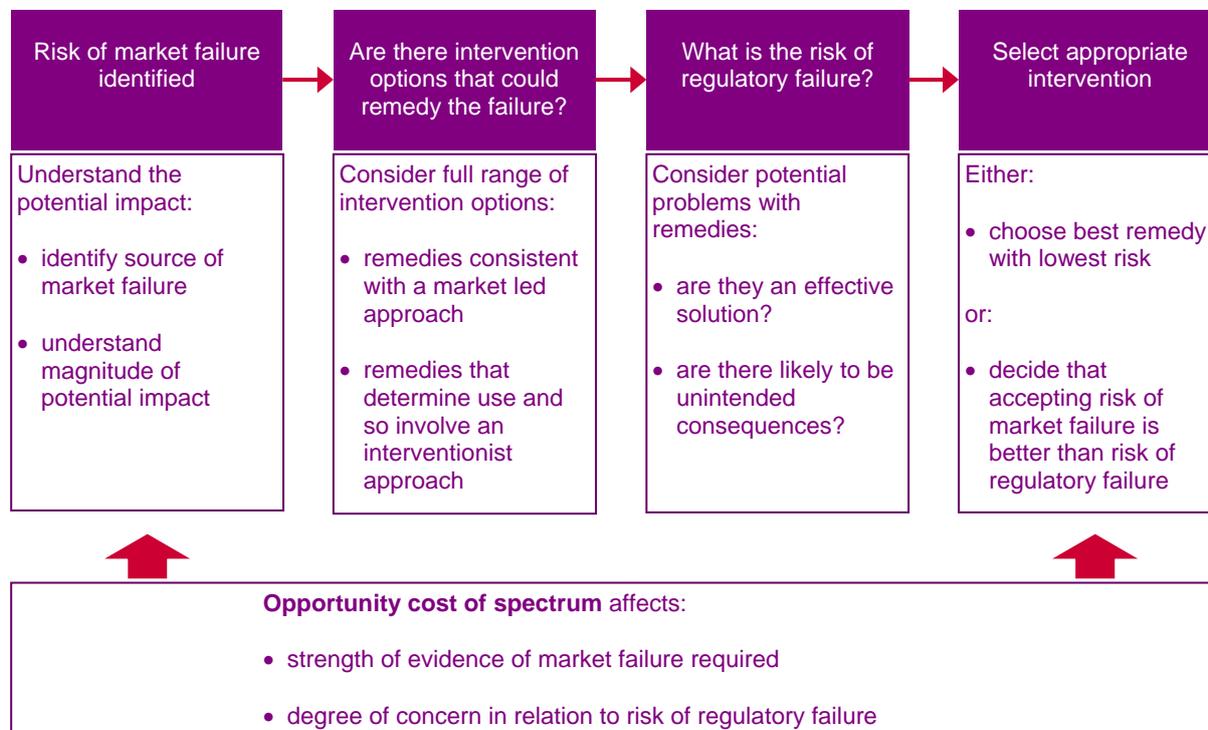
- where there is considerable uncertainty over which uses are likely to generate the highest value, market mechanisms can help to ensure that the spectrum is used by those who value it the most. This is because markets can act as an information discovery mechanism. Markets allow the superior information held by participants to be revealed and combined in order to identify those who have the highest value;
- market mechanisms also help to resolve uncertainty. This is because they reveal information by showing participants how much a resource is worth to others. This can help to resolve uncertainty. For example, if market mechanisms show that all my competitors are willing to pay more for the resource than I am, unless I understand the reasons for this, it might suggest that my valuation of the resource is too low; and
- information about value and flexibility of use give users strong incentives to get the most out of the spectrum they own and hence to ensure efficient use in the longer term and promote innovation. This may include, for example, changing the use to which spectrum is put and/or trading spectrum with other potential users. The ability to make these changes and to be flexible in responding to unforeseen changes quickly is particularly important for promoting efficient spectrum use in the longer term.

5.25 In considering how best to trade off the risks of market and regulatory failure, we have carefully considered the range of regulatory remedies available to resolve market failures. The reason for this is that, in some situations, remedies can resolve market failures without completely departing from a market led approach. This type of remedy is hence less prone to regulatory failures. Our work on the range of regulatory remedies is set out later in this section and in annex 2, but for now we point out that this work identified some remedies consistent with a market led approach. Hence, when trading off the costs and benefits of a market led approach and an interventionist approach, we take into account whether there are regulatory remedies that could be used under a market led approach and might therefore result

in a better overall outcome when market failure is present than taking an interventionist approach.

5.26 Figure 5 sets out the approach we have taken to pulling these different considerations together.

Figure 5. Approach to trading off market led and interventionist approaches



5.27 The use of trade-offs in assessing whether to intervene needs to be kept in mind when interpreting our decisions. For example, when we reach a conclusion that intervening is not justified in relation to the presence of broader social value, this does not mean that the presence of broader social value is unimportant. To illustrate this, consider that our work has identified that many (if not all) potential uses of the digital dividend generate broader social value as well as high levels of private value. If we are to intervene to set aside spectrum, the types of question we might need to ask ourselves are:

- should we pick universal access to more DTT services in HD when this might mean we lose the opportunity of universal access to mobile broadband? or
- should we reserve interleaved spectrum for local television when this might mean that we lose the opportunity of a multiplex that could offer capacity to other socially valuable content?

5.28 Therefore, when deciding to intervene, we are not deciding between some broader social value or none. We are deciding whether we are likely to get even more value by intervening than we would without.

5.29 The remainder of this section provides further information on:

- how we identify and assess market failures; and

- how we identify intervention options that can resolve market failures and assess the risk of regulatory failure with these options.

5.30 But first, the presence of broader social value generated by some potential uses of the digital dividend was raised by some respondents to the DDR consultation as a reason why a market led approach should not be adopted at all. In response to these concerns, we explain how, in principle, markets can deliver many different sources of value.

How markets can deliver total value

5.31 To understand when markets might fail and how this problem can be resolved, it is important to understand the role markets can play in delivering total value.

5.32 Markets can be thought of as a mechanism for assisting decision making. They reveal information, more accurately and quickly than a regulator could. For parties to make efficient choices in a market, they need to have all the relevant information. When this is combined with other factors which are important for well functioning markets, such as defined rights of ownership²⁹, decision makers will have strong incentives to use the information provided by the market to trade off the costs and benefits of the decisions they are making efficiently.

5.33 Making these choices efficiently can deliver both high consumer value and value for citizens. This will be the case when services important to us as consumers are also highly valued by us as citizens. There is often a strong correlation between consumer and citizen value. For example, mobile services are highly valued by consumers and, as our market research indicates, by citizens, too. This is why, in assessing market failures, we are interested in different relative levels of broader social value. Where all services generate broader social value and this is similar in proportion to the private value they generate, we would expect a market to result in a good outcome for citizens as well as consumers.

5.34 In some cases, there may not be a strong correlation between citizen and consumer value. This does not mean that markets cannot work. Citizen value can be thought of as a form of externality. If this effect is captured in decision making, a market can still arrive at efficient decisions. The existence of broader social value in some activities is a fundamental reason for the existence of government and its power to fund those activities through taxation. So the presence of externalities is not specific to the digital dividend or spectrum management but is, rather, a much wider issue at the heart of public policy.

5.35 If the provision of funding is tied to an obligation to deliver a socially desirable outcome, the body in receipt of this funding can engage in a market to acquire resources with all the information and incentives it needs to make efficient choices.

5.36 There are many examples of public services (e.g. the NHS and state education) whose existence is a response to the existence of broader social value. As a general rule, these services are expected to acquire the inputs they need at market prices. The regime for funding these services recognises this: it is generally on a transparent

²⁹ There are a variety of factors which are generally required for a well functioning market, in addition to those mentioned in this discussion, other factors which are relevant include effective competition, and institutional arrangements which promote trust between transacting parties. Further discussion of the factors required for well functioning markets can be found in "Reinventing the Bazaar: The Natural History of Markets" by John McMillan, published in June 2002 by W. W. Norton & Company.

and explicit basis, through transfers of money rather than resources in kind like land, labour or equipment.

- 5.37 The alternative to allocating resources in a market is for decisions to be made centrally (e.g. by the government). This is what happens in a command economy in respect of the economy's resources as a whole. It is widely accepted that command economies face significant difficulties in making efficient choices precisely because they lack the information and incentives that market forces can bring.
- 5.38 Overall, we believe that using market mechanisms to make decisions about using the digital dividend is likely to bring benefits and will deliver total value as long as any external effects, such as the presence of broader social value, are either of a similar scale across different potential uses or reflected in the decisions made by those bidding for spectrum.

When markets might fail

- 5.39 As mentioned earlier, we define a market failure in the context of the DDR to be a situation in which a well designed auction of the spectrum does not result in those acquiring it generating the highest total value from its use.
- 5.40 Given this, we believe that our approach is sufficiently broad to capture all important risks of market failure. For example, we believe that all of the market failure risks that respondents identified as relevant considerations for the award of the digital dividend would result in one (or more) elements of total value not being maximised.
- 5.41 The outcome of this assessment was the identification of two types of market failure likely to be particularly relevant to that award. These were transaction costs and externalities. We set out below the considerations we take into account when identifying these market failures and assessing how significant they might be.

Transaction costs

- 5.42 If participating in a market led approach to awarding the digital dividend (i.e. transaction costs) is too costly or complex, some types of user may not take part. For example, some types of use involve a large number of individual users, each using a small amount of spectrum independently of others. If these users took part in a market led award, either they would need to coordinate their demand or someone would need to do it for them. This could be very costly, making it uneconomic for them to participate.
- 5.43 Transaction costs are relevant to low power uses that could access spectrum on a licence exempt basis. These uses will face further difficulties in accessing spectrum through a market because of incentives to free-ride. This is because their use of spectrum is in some respects non-rivalrous (i.e. it might not prevent others from using the spectrum) and may also in practice be difficult to prevent (e.g. if equipment is widely available). These are characteristics of uses that are suitable for licence exemption as they do not interfere with each other. When this is the case, each user would face an incentive not to contribute to an aggregate bid for spectrum. This is because they would be able to use the spectrum even if they did not bid, and they will not expect their own decision to have any significant impact on the aggregate bid. Because all users are incentivised to act in this way, the result is that the aggregate bid will be significantly lower and hence will fail to reflect the value of this use.

- 5.44 To understand how significant this type of problem might be, we have identified the types of use that would in principle be exposed to this type of market failure. These are low power uses, local television, PMSE and DTT. To assess the severity of the problem, we considered the nature of the coordination task involved and whether there is any evidence of prior coordination between relevant bodies. For example, demand for multiplex capacity on the DTT platform is already aggregated by multiplex operators. This would tend to suggest that coordination between broadcasters and multiplex owners to express demand for spectrum for additional DTT capacity should be feasible. The DDR consultation document identified that transaction costs, particularly coordination failures, are relevant to two potential uses of the digital dividend: PMSE and local television. Section 7 discusses coordination failures in relation to these two services in detail. Section 6 discusses the potential for low power uses to access the digital dividend.

Externalities: broader social value

- 5.45 Where spectrum is awarded under a market led approach (e.g. by auction), bids represent prospective users' valuations of it. Users with the highest valuation will acquire the spectrum as they will be willing to pay the most. As mentioned above, even when broader social value is present, this will result in an efficient outcome if spectrum users' willingness to pay is correlated with total value. In other words, this will be the case when the ranking of different users' bids is the same as the ranking of total value (i.e. the highest bid is from the use that yields the highest value for society).
- 5.46 This relationship is likely to hold when services highly valued by consumers are also highly valued by citizens. When this is not the case or some services generate disproportionately higher levels of broader social value than others, a market would not be expected to result in an efficient outcome.
- 5.47 We must therefore consider where market failure might arise because of the presence of broader social value. To understand the significance of this issue, the only credible options for us to take is to assess whether there is evidence that some uses generate differing levels of broader social value. Where this is the case, we then need to consider whether this is likely to result in differences in the ranking of willingness to pay for spectrum relative to total value across the potential uses of the digital dividend. Annex 2 discusses this issue and our approach to assessing whether this relationship holds across the likely uses of the digital dividend.

Identifying what to do when markets fail

Identifying options for intervention

- 5.48 To identify whether intervening is appropriate, we start by identifying the range of options likely to be effective in resolving the particular market failure at issue. This is because there is no one intervention option that can resolve all forms of market failure. We go on to consider which, if any, of these interventions might be justified given the magnitude of the market failure. This involves assessing the opportunity cost of the intervention and the risk of regulatory failure. Only when the benefits of resolving the market failure are greater than these costs might intervention be justified.
- 5.49 We have considered a wide range of options for resolving market failures. Annex 2 explains these, provides indicative examples of how the interventions might work and discusses their merits. Some of these interventions are consistent with a market led

approach, while others involve increasingly significant departure from it and hence are interventionist approaches to resolving market failures.

Opportunity cost

- 5.50 If spectrum is used for one service, it is generally not available for others. One potential exception to this rule may be technologies that avoid interference (e.g. cognitive technologies, discussed in section 6). This lost opportunity is a real cost that we need to take into account. The opportunity cost is the value of the opportunity being denied to other uses or users.
- 5.51 For intervention to be justified, the opportunity cost of intervening must be less than the cost of the market failure without intervening. As the benefit of resolving a market failure is often difficult to establish with any degree of accuracy, the assessment of opportunity cost (which is in many cases easier to establish) provides a very important benchmark for assessing market failure. This is because it allows an assessment of whether the uncertain benefits could plausibly exceed the possible opportunity cost.
- 5.52 The assessment of opportunity cost is also a valuable indicator for the assessment of regulatory failures. If the opportunity cost of intervening is relatively low, the impact of regulatory failure is likely to be low. Conversely, when the opportunity cost is particularly high, a thorough consideration of regulatory failure is needed as the impact of getting the intervention wrong is likely to be high.

Regulatory failure

- 5.53 Regulatory failure will arise if we intervene in a manner that prevents maximum value to society being generated by using the digital dividend. Any intervention will have costs and risks of its own. These need to be considered alongside the potential benefits of intervening. Intervening may fail to achieve the benefits expected or have unintended consequences.
- 5.54 These costs can affect the welfare of society in far reaching ways. Interventions that restrict the use of the digital dividend as a way of addressing the risk of market failure would seriously distort choices made by users by reducing their incentive to use the spectrum efficiently. It is important to give users incentives to use spectrum in the most efficient way. Where users do not have such incentives, they are more likely to use too much spectrum relative both to other inputs and to other potential users.
- 5.55 Incentive effects are one example of the ways in which intervention can have a profound impact that is not fully predictable. These can be thought of as a dynamic cost to society. Other examples of dynamic cost include:
- loss of flexibility in spectrum use. Conditions that restrict spectrum use create a barrier to change if circumstances change. Relaxing or removing conditions may require further regulatory decisions, which in themselves can entail a slow and uncertain process, involving vested interests;
 - adverse effects on competition. Setting aside spectrum for a particular use or user can make competition less effective at a variety of different levels. Competition between different platforms may be affected if one operator gains access to spectrum that confers cost advantages or benefits in quality of service not easily replicated by its competitors; and

- adverse effects on innovation. Innovation is an unpredictable process and benefits from innovators experimenting at low cost. By restricting spectrum to a particular use, the opportunity for experimenting at low cost and learning by trial and error could be lost.
- 5.56 A major problem that we face is the difficulty of assessing the effects of intervention. The more difficult this is and the more uncertainty there is, the more likely it is that the intervention will prove mistaken and the greater the risk of undesirable, unintended consequences.
- 5.57 We believe that there is a high degree of uncertainty over the future use of the digital dividend. This stems from:
- the wide range of potential uses and users of the spectrum that can be identified;
 - the fact that many of these potential uses would be new to citizens and consumers;
 - the existence of alternatives to the products and services that could be supplied using the digital dividend;
 - the use of different spectrum for particular services;
 - the development of alternative platforms for delivering particular services, which may use other spectrum or not use spectrum at all;
 - consumer preferences in relation to media consumption; and
 - the high likelihood of further innovation that could affect the possible uses of the digital dividend.
- 5.58 This uncertainty points to caution about intervening in a market led approach to awarding the digital dividend.

Identifying the best option for resolving each type of market failure

- 5.59 As mentioned above, different forms of intervention are best suited to addressing different sources of market failure. If we are to intervene in a market led approach to awarding the digital dividend for reasons of market failure, it is important that we do so appropriately. We now therefore consider the best forms of intervention to resolve the two key market failure risks in the DDR: coordination failures (transaction costs) and the presence of broader social value.

Transaction costs

- 5.60 Three forms of intervention might be effective for transaction costs. These are:
- resolving the failure through auction design and packaging;
 - allowing spectrum use on a licence exempt basis; and
 - reserving spectrum for a particular licensed use.
- 5.61 Appropriate auction design and packaging allow the market failure to be resolved without departing from a market led approach. This option generally works by

changing the characteristics of what is auctioned so that the need to coordinate is removed. As this option allows the market to decide the use to which the spectrum should be put, it is less prone to the regulatory failure risks set out above. This option also allows the market to trade off the benefits of the intervention with the opportunity cost as the use for which the coordination failure has been removed will only gain access to spectrum if the auction reveals that it is the highest value use.

- 5.62 Licence exemption and reserving spectrum for a particular licensed use are more interventionist options. They involve the regulator deciding how the spectrum should be used. However, in some situations, this may be required.
- 5.63 Licence exemption is the appropriate intervention option for resolving coordination problems when there are low power uses that do not cause harmful interference and hence are also likely to be subject to a risk of free-riding as well as facing transaction costs. As this involves the regulator deciding on the use of the spectrum, this type of decision could be subject to a high risk of regulatory failure. However, this can be mitigated. For example, if licence exemption is flexible (i.e. involves general rather than application specific allocations), this can at least allow the market to determine which applications should use the allocation, even though the decision between licence exempt and licensed use is made by the regulator.
- 5.64 Reserving spectrum may be required when the coordination difficulties faced by users requiring licensed spectrum access cannot adequately be removed through appropriate auction design and packaging. As with licence exemption, this type of intervention is likely to be prone to a high risk of regulatory failure. However, there are generally fewer options for mitigating the risk under this option.

Broader social value

- 5.65 The DDR consultation document noted that the best way to generate broader social value is generally for providers to be directly funded to deliver socially desirable outcomes. Intervening in spectrum management is generally not the answer, especially as alternative means of delivering services often exist.
- 5.66 We received many responses that questioned this position and argued that we should intervene by reserving spectrum for particular uses.
- 5.67 Reserved spectrum has, in the past, been used as a substitute for direct funding. However, there are a number of significant disadvantages to using spectrum as a form of funding:
- decisions in relation to funding from taxation rest properly with the Government and Parliament. Funding activities that generate broader social value is a fundamental reason for the existence of government and a function of many other public and private sector organisations;
 - using subsidised inputs (e.g. spectrum) instead of funding can reduce incentives to use resources efficiently. Making one input artificially cheaper than others will generally result in that input being over-consumed; and
 - for the many reasons set out earlier, reserving spectrum for a particular use can be very costly. Not only does it have a significant opportunity cost, but it can also be subject to regulatory failures through, for example, the negative effect it has on the ability to change the use and ownership of spectrum quickly in the future in response to new technological developments.

- 5.68 We continue to believe that direct funding remains the best way to address the risk of market failure caused by the existence of broader social value in awarding the digital dividend. It significantly reduces risks of regulatory failure (e.g. distorting the flexibility of future spectrum use and unintended consequences materialising as a result of intervening). In reaching this decision, we have carefully considered a wide range of other options, such as reserving spectrum and bidder credits. Our analysis of these options, set out in annex 2, has confirmed our original assessment that direct funding is the best option.
- 5.69 The Government has confirmed to us that it has not identified any reason to believe that current financial and institutional frameworks would, in principle, prevent public sector users or other providers of socially valuable services from bidding for access to spectrum at auction. Its view is that current frameworks already provide clear and established processes that allow the need for spectrum to be taken into account when reaching funding decisions, including where necessary through an increase in the funding of such providers of socially valuable applications. This position was set out in a letter dated 10 October 2007 from the Minister of State for Competitiveness to Ofcom's Chief Executive (see annex 10).
- 5.70 Some responses to the DDR consultation document questioned the feasibility of direct funding. Some suggested that institutional issues might impede either its provision or its use. We have given this some thought (our analysis is covered in annex 2), and we will give further consideration to how auction design can help bodies reliant on public funding to take part in an auction of the digital dividend.

Conclusion

- 5.71 This section has:
- set out our analytical approach to assessing whether we should take a market led approach to the award of the digital dividend;
 - explained how our approach identifies market failures that may arise in the award and helps us to identify options for remedying problems that do arise;
 - explained how decisions about licence exemption can be made using this approach;
 - shown how our approach involves consideration of the cost of intervention (i.e. opportunity cost, regulatory failure and the associated cost of unintended consequences); and
 - concluded that our analytical approach to assessing whether a market led approach to awarding the digital dividend is appropriate.
- 5.72 Section 6 applies this approach to the question of licence exempting the digital dividend. It also considers whether we should set aside spectrum as an innovation reserve. Section 7 goes on to apply the approach to the most likely licensed uses of the digital dividend to allow us to conclude whether or not a market led approach is justified given our objective of maximising the total value to society that using this spectrum generates over time.

Section 6

Licence exemption and an innovation reserve

Introduction and summary

- 6.1 This section considers the extent to which we should make the digital dividend available by licence exemption rather than by licensing specific rights of use. It also considers whether we should hold back some of the spectrum as an innovation reserve. The decisions we have reached are as follows.
- 6.2 We propose to allow cognitive equipment to use interleaved spectrum on a licence exempt basis provided it can operate without causing harmful interference to licensed uses.
- 6.3 We are not persuaded that licence exempt applications of a sufficiently high value to displace licensed use of the digital dividend will emerge in the foreseeable future. Therefore, we do not believe it appropriate to set aside cleared or interleaved spectrum for dedicated licence exempt use.
- 6.4 We do not believe that it is appropriate to hold back spectrum as an innovation reserve. This might reduce the total value generated by using the digital dividend because some users might be unable to acquire all the spectrum that they need to offer high value services. There is also unlikely to be a single “eureka” moment when a new use clearly becomes viable. Instead, there will be a series of steady, incremental changes. Finding a trigger point to release the reserve will be difficult, with the possibility that the spectrum might be held for a long time awaiting some better use that might always be imminent. In addition, there are other ways in which we can allow future uses of the digital dividend to provide services highly valued by citizens and consumers.

Licence exemption

- 6.5 The DDR consultation document sought views on whether there were likely low power uses for which we should make the digital dividend available on a licence exempt basis.
- 6.6 We also proposed licence exempting PMSE equipment to use some or all of channel 69. Section 7 considers this alongside the rest of our proposals for PMSE.

Consultation responses

- 6.7 We received 144 responses on licence exempt low power use. Respondents were generally not in favour of setting aside cleared spectrum for licence exempt low power use. These included network providers, broadcasters, manufacturers, MNOs, telecommunications operators, PMSE users and consumer bodies. They thought other uses were more valuable, particularly given that other spectrum is available for licence exempt use.
- 6.8 There was some support from our national advisory committees and some consumer and citizen groups on the grounds that this could foster innovation.

- 6.9 Low power users and community groups supported licence exemption in both cleared and interleaved spectrum due to the increasing number of low power uses, leading to crowding and interference in other bands. They noted that the characteristics of the digital dividend are much better than other available spectrum for these uses.
- 6.10 The 97 responses from individuals were mixed. Those not supporting licence exemption were concerned about interference, particularly to PMSE use of interleaved spectrum, and noted that other spectrum was available for licence exempt use. Those in favour raised the benefits (including broader social value) of potential uses and noted the advantages of future-proofing by setting aside spectrum for licence exempt equipment.
- 6.11 The DDR consultation document did not specifically ask whether we should allow access to interleaved spectrum for cognitive equipment. Nonetheless, certain respondents were strongly in favour of the idea. These included a major software developer, a consumer electronics firm and a network equipment manufacturer as well as open spectrum advocacy groups.

Our response

- 6.12 We have considered licence exempt use of both interleaved and cleared spectrum. We have considered reserving spectrum solely for licence exempt devices and allowing access on a cognitive basis. We have also considered the potential uses to which licence exempt devices may be put and thus the incremental benefit that might be conferred by access to the digital dividend.
- 6.13 These considerations allow us to apply our total value framework in order to assess whether we should set aside spectrum on a licence exempt basis as:
- identifying potential licence exempt uses and assessing their incremental benefit allows us to assess the likelihood and significance of market failure;
 - considering both reserved and cognitive use allows us to assess whether there are interventions that could be effective solutions to this problem. We can then assess the opportunity cost and regulatory risk of these two options; and
 - we can pull these two elements of the analysis together to assess whether setting aside spectrum for licence exempt use is likely to result in higher total value (i.e. whether the incremental benefit of licence exempt uses is likely to exceed the opportunity cost and whether the likelihood of regulatory failures affects this assessment).

Introduction to reserved spectrum and cognitive access

- 6.14 Spectrum can be reserved solely for use by licence exempt devices. With this approach, there is no licensed user. This has historically been the approach taken with most licence exemption. For example, DECT telephones, Wi-Fi and now citizen's band radios all operate in spectrum that is reserved for licence exempt use.
- 6.15 There are also licence exempt devices permitted to operate in spectrum licensed to another use. Harmful interference between the licensed and licence exempt device can be avoided in two main ways:

- the licence exempt device can transmit at a low enough power level not to cause disruption to the licensed use. This is the method employed by UWB technology; and
- the licence exempt device can transmit only when the licensed user is not transmitting. Cognitive access is the ability to detect unused spectrum for this purpose.

6.16 Although cognitive access technologies are still in development, we believe that most licence exempt applications could make use of either reserved spectrum or cognitive access to the digital dividend.

Potential uses

6.17 As discussed in our Licence Exemption Framework Review (LEFR)³⁰, some 18 GHz of spectrum is currently allocated to licence exempt use in the UK. This supports a range of diverse applications, with telemetry services predominantly occupying bands below 1 GHz, broadband wireless communications between 2 and 6 GHz and short range radars and relays at 10 GHz and above. In both the LEFR and the SFR, we explain that our approach to identifying whether further spectrum should be made available for licence exempt use is based on responding to demand and, when so doing, by licence exempting spectrum only when the economic value generated by this use is expected to exceed that of likely licensed uses.

6.18 A number of potential uses of the digital dividend have been mooted for licence exempt applications. Some of those suggested by respondents and proponents of licence exempt use include:

- home networks, including automation and control;
- business networks;
- community and campus networks;
- municipal Wi-Fi;
- Internet connection sharing by multiple households;
- industrial monitoring and automation;
- agricultural monitoring and automation;
- rural broadband provision;
- ubiquitous wireless networks;
- sensor based networks;
- remote patient monitoring and healthcare; and
- an alternative nationwide broadband wireless network.

³⁰www.ofcom.org.uk/consult/condocs/lefr/lefr_statement/lefr_statement.pdf.

- 6.19 Many of these applications would rely not on large scale national network providers but rather on small scale networks deployed in homes or by organisations such as businesses and public sector bodies. This raises the risk of coordination failure if they need to acquire licensed spectrum at auction. Furthermore, these uses may be largely geographically disparate and could be engineered so as not to compete in their demand for spectrum. For example, agricultural, industrial, campus and community networks would tend to operate in different areas and may not therefore be rivals for the same spectrum. When combined with difficulties in excluding users in practice (as many of these uses involve self-deployed networks enabled by consumer equipment), these factors suggest that licence exemption might be the best way to unlock the potential value of these applications. Equipment manufacturers showing interest to date have all indicated a preference for a licence exempt approach.
- 6.20 Most of the applications above could be rolled out using existing licence exempt allocations in the 2.4 GHz and 5 GHz bands, which we believe are not overcrowded. However, there would be a number of advantages to using the digital dividend. It would provide greater range and better propagation for the same power consumption than other spectrum. This would benefit some potential uses by requiring less network infrastructure (e.g. closed circuit television cameras for industrial monitoring). The digital dividend could also provide a similar range to other licence exempt bands with lower power consumption. This could be particularly beneficial in applications such as agricultural monitoring, where devices may have to be battery powered.
- 6.21 The key benefit for these applications of using the digital dividend is likely to be lower costs of deployment. Indicative modelling that we have conducted suggests that the economic value that might be generated by these applications with access to enough of the digital dividend might be in the region of £150-250m (NPV over 20 years)—see annex 8 for further detail. This is an illustrative figure. It only takes into account the uses listed above and assumes that they can all be rolled out using higher frequency spectrum. If these or new applications or services are only viable in the digital dividend, the value may be correspondingly higher. Conversely, if some of the proposed applications do not come into use, the value could be lower.

Use of interleaved spectrum

- 6.22 We consider next whether interleaved spectrum is usable for licence exempt devices, whether low power or cognitive. We consider whether the characteristics of this spectrum make it suitable for this type of use, and we examine the merits both of allowing cognitive access and of a dedicated licence exempt allocation.
- 6.23 Interleaved spectrum is a substantial resource. Analysis suggests that, at any one location, around 100 MHz on average is not being used by DTT and could, in principle, be used by licence exempt devices.³¹ Such spectrum availability would be particularly beneficial for some of the high bandwidth services mentioned above,

³¹ Figure derived through a radio planning model which measured the probable strength of incoming signals in the spectrum reserved for DTT. Where the signal strength was higher than a specific cut-off point, this channel was deemed to be unusable. There are two reasons why this may be a conservative measure. First, it measures outdoor field strengths. If a licence exempt device was being used indoors, a distant DTT signal on a particular channel would be correspondingly weaker. Second, this measure is conducted on a geographic average, so sparsely populated areas on the boundaries between DTT transmitters register as having fewer channels available. Work suggests that if the measure were weighted by population, the amount of available spectrum would be higher.

such as home and business networks, community and campus networks and municipal Wi-Fi.

- 6.24 We have already proposed that PMSE users continue to have access to interleaved spectrum through a band manager. There are other potential licensed uses, such as local television and more DTT. This will mean that some of the available interleaved spectrum is used by licensed services. However, there is still likely to be (potentially significant) capacity available, which could be used by licence exempt devices in many areas, at least for some of the time (e.g. when wireless microphones are not in use).
- 6.25 Given the nature of interleaved spectrum, we do not think that reserving any for licence exempt use would be appropriate. Licence exempt devices without cognitive abilities could not be safely used in the same channel of interleaved spectrum across the UK because DTT and other services would be using them in some locations. Reserving specific channels in interleaved spectrum in specific areas for licence exempt use would also reduce its flexibility and would be expected to result in a lower availability of spectrum for licence exempt devices as it would be difficult to set aside anywhere near as much as 100 MHz without unduly reducing the amount of spectrum available for licensed uses. Therefore, the incremental benefits of reserving spectrum for licence exempt use are likely to be low, and the costs of doing so could be high as this may preclude licensed uses and reduce the flexibility of use of interleaved spectrum.
- 6.26 In contrast, cognitive devices could make flexible use of interleaved spectrum without causing harmful interference to licensed users. This would allow many of the applications set out above to be delivered at a low opportunity cost, resulting in substantial benefits. Other applications and innovations might also be spurred by the availability of a large pool of interleaved spectrum for licence exempt use.
- 6.27 Cognitive use of interleaved spectrum would depend on the development of effective spectrum sensing technology that would avoid transmitting in channels used by licensed services. Devices are being developed by a number of manufacturers, including Microsoft, Motorola and Philips. These companies have each submitted devices to the FCC for testing in the US. These devices are primarily designed to detect DTT and wireless microphone signals and, as such, would be suited for use in interleaved spectrum in the UK.
- 6.28 We therefore propose to allow cognitive technologies to use interleaved spectrum on a licence exempt basis subject to establishing that the probability of harmful interference to licensed users will be low. It is likely that the total value generated would be greater than the opportunity cost of allowing licence exempt cognitive access. The total value would be composed of the private value of foreseen applications, which we estimate to be approximately £150-250m (NPV over 20 years), as well as benefits that would come from innovation and new services. There may also be broader social benefits. Because cognitive devices do not need to be exclusively assigned rights to spectrum and should automatically avoid interfering with licensed services, the opportunity cost should be low.
- 6.29 We would need to specify a number of parameters to which equipment would need to adhere. Early measurements made by the FCC suggest that such spectrum sensing is possible but careful certification might be needed. It may take some years to undertake the work necessary to gain appropriate international harmonisation.

- 6.30 We think that the risk of regulatory failure with this decision is relatively low as we are not preventing licensed uses, but we need to be mindful of the potential for cognitive access to have a negative impact on the future usability of interleaved spectrum when specifying the technical parameters for this use.

Use of cleared spectrum

- 6.31 Reserving cleared spectrum for licence exempt applications is an option. Indeed, this might be the only route to licence exempt use of cleared spectrum at the moment as cognitive use is likely to be complex and hence unachievable on a comparable timeframe, if at all, to the use of interleaved spectrum.
- 6.32 The current development of spectrum sensing technologies required for cognitive radio is primarily focused on detecting DTT and wireless microphone signals. As yet, it is unknown whether cognitive technologies would be able to detect and avoid other potential uses of cleared spectrum. This uncertainty cannot be resolved until it is known which licensed services will be using cleared spectrum.
- 6.33 It is also unlikely that cognitive use of cleared spectrum would yield a significant level of incremental access over and above what would be available under our proposals to allow cognitive use of interleaved spectrum. Dense services (e.g. 3G and successor two way services and mobile multimedia single frequency networks—SFNs) are unlikely to leave much unused cleared spectrum for these devices to exploit.
- 6.34 Therefore, we have focused our assessment on the potential benefits of setting aside cleared spectrum for dedicated licence exempt use. As licence exempt cognitive use of interleaved spectrum depends on testing, specification and possibly international harmonisation, some stakeholders have suggested that reserving cleared spectrum for licence exempt use might offer significant advantages:
- it might allow low power applications to be deployed more quickly. Based on our assessment that the value of licence exempt use of the digital dividend lies in the range £150-£250m, an incremental benefit of a few tens of millions of pounds might result from approximately two years' acceleration. However, this is crucially dependent on when working cognitive chipsets come to market. If this is before 2012, there might be no timing advantage to setting aside cleared spectrum;
 - power consumption may be lower in devices that do not have to utilise spectrum sensing technologies. This would particularly benefit battery operated devices. However, the additional power drain associated with cognitive devices is as yet unknown. If the power required for spectrum sensing is low in comparison to overall power requirements, the magnitude of this benefit might be limited; and
 - devices might be cheaper and create larger initial markets if they do not have to incorporate advanced cognitive technology.
- 6.35 However, there are significant disadvantages to setting aside cleared spectrum for dedicated licence exempt use. In particular:
- Microsoft and Philips suggested that three channels of cleared spectrum should be set aside. This is much less than is available through cognitive use of interleaved spectrum. It might not even be sufficient to accommodate certain high bandwidth multimedia applications. This indicates there may be small incremental value from licence exempt applications in cleared spectrum;

- our work suggests that setting aside three channels could have an opportunity cost of up to £1bn (NPV over 20 years). This is likely to be significantly greater than the incremental benefit that we believe would be generated by setting them aside for licence exempt applications;
- a decision to set aside spectrum for licence exempt use is likely to be prone to regulatory failure. This is because it is likely to reduce future flexibility of use of cleared spectrum as it can be difficult to switch spectrum quickly from licence exempt to licensed use if new higher value licensed uses emerge; and
- a degree of international harmonisation of cognitive equipment may be achievable in interleaved spectrum that is not possible to achieve in cleared spectrum. This is important in creating economies of scale and driving both new applications and potential innovation in licence exempt equipment. For example, the most defining factor in the continuing global success of Wi-Fi is the near global availability of the 2.4 GHz band. It is very unlikely that the same three channels of cleared spectrum could be harmonised for licence exempt use even in the EU due to competing demands and patterns of DTT use.

6.36 Overall, it seems very unlikely that the advantages of setting aside cleared spectrum for licence exempt applications exceed those of using it for licensed applications. We have therefore decided that cleared spectrum should not be set aside for licence exempt applications, as this would be unlikely to maximise the total value generated by the use of this spectrum.

6.37 Additionally at this time, we do not propose to allow cognitive use of cleared spectrum. The ability of cognitive devices to work in cleared spectrum is much more uncertain, and there may only be a small incremental benefit in allowing this over and above our proposal to allow cognitive use of interleaved spectrum. This leads us to believe that the associated costs to licensees of cleared spectrum might be too high given the size of the benefits. If, in the future, cognitive devices are developed that can be used in cleared spectrum, these could be used by licensees. Alternatively, as licences will be tradable, licensees could permit cognitive access to their spectrum.

Innovation reserve

6.38 The DDR consultation document invited views on the case for holding back a small amount of the digital dividend as an innovation reserve. This might benefit major technological developments, such as new low power uses, that could find it difficult to access the rest of the spectrum, even if it had been licensed on a flexible basis.

Consultation responses

6.39 We received 203 responses on this issue. Many were in favour of an innovation reserve as there was general concern that a market led approach to awarding the digital dividend could hamper or stifle innovation. However, very little evidence for this was provided.

6.40 Our advisory committees, consumer bodies, community/citizen groups and public bodies were supportive of an innovation reserve but noted that leftover auction lots might leave reserve capacity anyway. Respondents from the devolved administrations were also in favour.

6.41 Some broadcasters, manufacturers and local television operators were also broadly supportive but thought that account should only be given to known technologies to

ensure the best use was made of the spectrum. Concerns were expressed about the length of time spectrum should be held in reserve and the practical difficulties involved in implementing the reserve.

- 6.42 Network and telecommunications providers were not persuaded of the need to hold spectrum back as they generally considered that secondary markets should be able to manage any new future use. They also considered that there would be a high opportunity cost and serious practical difficulties.
- 6.43 OCP proposed that, rather than holding spectrum back solely for innovation, we should consider putting some into a “spectrum bank” as a reserve for uses that have high broader social value but are not provided through the market.

Our response

- 6.44 Both benefits and costs could arise from the creation of an innovation reserve.
- 6.45 The primary benefit would be to provide spectrum if a high value application, unforeseen at the time of the award, were to emerge that could not find available spectrum to use. Such a new use could emerge, although our research indicates that no radically new uses are likely over the next 10 years.³² We have also taken steps to minimise the likelihood that a sufficiently valuable new use would be unable to gain access to spectrum.
- 6.46 A new use with cognitive abilities would be able to take advantage of our proposal to allow licence exempt use of interleaved spectrum.
- 6.47 For a sufficiently valuable new use which required primary licensed access, two routes could allow its realisation through market mechanisms:
- we will release the digital dividend in as flexible a manner as possible. There will be strong incentives for new uses that deliver high value to citizens and consumers to be adopted by existing users; and
 - because of the possibility of trading spectrum, there will be more opportunities to access the digital dividend to launch new services. If the new use is likely to generate more value than existing uses, it should be possible for potential acquirers to make attractive bids. If a socially valuable use requires access to spectrum in the secondary market, direct funding would be the best way to secure it.
- 6.48 The secondary market for spectrum is not yet well established. This is not surprising given that little spectrum is currently tradable. Far more will be tradable by the time the award of the digital dividend is completed thanks to the liberalisation of 2G mobile spectrum, implementation of the Cave Audit programme of reforms to public sector spectrum and the awards of spectrum at L-Band, 2.6 GHz and 10-40 GHz. We expect that this will result in a more active spectrum market that will more readily facilitate changes in ownership.
- 6.49 Concerns have been expressed about anticompetitive activity by licensees (e.g. hoarding) preventing new uses from gaining access to licensed spectrum. Section 10 explains our thinking on this issue.

³² www.ofcom.org.uk/research/technology/overview/techrandd0506/.

- 6.50 The measures set out above reduce the benefits of an innovation reserve. There are also significant drawbacks associated with this idea.
- 6.51 First, there is the problem of deciding when and for what use the innovation reserve should be released. There is unlikely to be a single “eureka” moment when a new use clearly becomes viable. Instead, there will be a series of steady, incremental changes. Finding a trigger point will be difficult, with the possibility that spectrum might be held in reserve for a considerable period because some better use is always imminent. Because the innovation reserve is held, by definition, for a future unforeseen application, even if such an application emerged, it would be impossible to demonstrate that another, even more valuable unforeseen application was not just around the corner. This could hamper innovation as it will result in considerable uncertainty about when the reserve would become available.
- 6.52 Second, the costs of holding spectrum in reserve are likely to be significant. As described above, setting aside three channels could have an opportunity cost of up to £1bn (NPV over 20 years).
- 6.53 Finally, the creation of an innovation reserve from cleared spectrum might distort an award process. With less spectrum available for award, certain kinds of bidder might be disadvantaged. This is more likely to affect new entrants and those wishing to offer high bandwidth services, both of whom might want larger amounts of spectrum than existing users who might only want to add incrementally to their holdings. Thus, creating an innovation reserve might actually have the unintended consequence of preventing new uses and users from gaining access to the digital dividend.
- 6.54 The same considerations would hold for a spectrum bank for socially valuable uses. Section 7 explains how these can acquire spectrum in a market led award. The same approach applies to acquiring spectrum through the secondary market if socially valuable uses emerge after the award. Therefore, we do not believe that setting aside spectrum in this way would be beneficial.
- 6.55 Separately, we are considering how our non-operational licensing regime can better enable services to move from testing and development to full commercial operation.
- 6.56 Although there could be some benefits to an innovation reserve, these appear small in magnitude, difficult to realise and already provided for by other measures that we are taking. Conversely, the associated costs appear high. Therefore, on balance, we have decided not to create an innovation reserve as we do not believe that this would be likely to generate higher total value from the use of the digital dividend either now or in the future.

Conclusion

- 6.57 This section has set out:
- our proposal to allow licence exempt cognitive use of interleaved spectrum, subject to verifying that this use will not cause harmful interference to other users;
 - our decision not to set aside cleared spectrum for licence exempt use; and
 - our decision not to hold back spectrum for an innovation reserve.

Section 7

Licensed use of the digital dividend

Introduction and summary

- 7.1 This section considers whether a market led approach to awarding the digital dividend is likely to lead to market failure for likely licensed uses. It explains our sources of evidence, including the results of our updated and expanded market research. It then considers the merits of intervention for each likely licensed use.
- 7.2 Evidence collected to date suggests some services are more likely to use the digital dividend than others. In addition to our market research, this comprises our own knowledge, consultation responses, technical research and economic modelling.
- 7.3 Given this evidence, we focus our analysis in this section on:
- PMSE;
 - local television;
 - DTT services in SD;
 - DTT services in HD;
 - mobile broadband; and
 - mobile multimedia (mobile television).
- 7.4 After applying our analytical approach to each of these uses, we have decided that:
- PMSE users currently face a market failure risk due to transaction costs and coordination failures that is so severe that we need to adopt an interventionist approach to awarding spectrum suitable for their use. We expect them to be able to access spectrum through market mechanisms in the longer term. We think our approach to awarding spectrum will assist them during this transitional period;
 - local television operators face a market failure risk due to coordination failures and timing issues, but this is best resolved by packaging under a market led approach;
 - providers of DTT services in SD do not face a market failure risk that requires intervening in the award of the digital dividend. However, the provision of socially valuable content will be considered further in our second PSB Review;
 - providers of DTT services in HD do not face a market failure risk that requires intervening in the award of the digital dividend. If there is a requirement for PSB content to be provided in HD in the future to secure broader social value, this can be achieved using the existing spectrum reserved for DTT;
 - providers of mobile broadband do not face a market failure risk that requires intervening in the award of the digital dividend; and
 - no identified market failure risks face providers of mobile television.

7.5 This section first analyses the evidence that we have gathered during the DDR and then, for each of the uses described above, sets out our assessment of market and regulatory failure. Annex 2 contains a more detailed explanation of our reasoning.

Evidence

7.6 The DDR consultation document set out and assembled a number of sources of evidence concerning, among other things, the elements of total value and the issues of market and regulatory failure. It contained first estimates from modelling work of producer, consumer and external values of a number of uses of the digital dividend. It was accompanied by a report summarising the findings of market research undertaken in 2006. We undertook and published initial analyses of external value and market and regulatory failures.^{33/34} And we published technical analysis in the consultation document and separately,³⁵ considering among other things the potential set of uses of the spectrum.

7.7 We have continued to develop our thinking on the total value framework. Our principal sources of evidence are:

- new market research conducted in 2007;
- economic modelling;
- secondary research;
- technical analysis; and
- consultation responses.

7.8 New information from these sources has been used to update the analysis from the consultation document and inform our assessment of whether to adopt a market led approach as set out in this section. Each source of evidence is described below in terms of our work since the consultation and its role in informing the framework and assessing the elements of total value and the issues of market and regulatory failure.

Market research

7.9 The market research published with the DDR consultation document was undertaken to understand better citizen and consumer attitudes to a number of potential uses of spectrum in terms of value to society. These uses were DTT (SD, HD and local television), mobile television, mobile broadband, and wireless home networks.

7.10 The market research sought to:

- improve our understanding of the value to consumers and society of potential uses of the digital dividend, including using qualitative research techniques to explore in greater depth the value to society associated with new DTT, mobile television and mobile broadband services; and
- measure their relative importance and value to consumers and society.

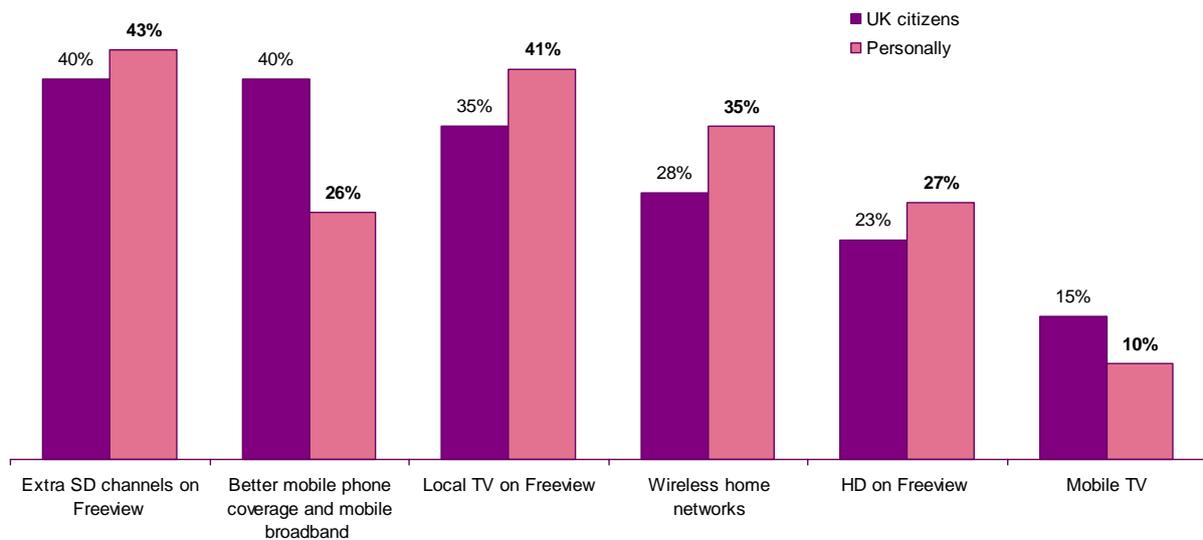
³³ www.ofcom.org.uk/consult/condocs/ddr/report_analysys/annexc.pdf.

³⁴ www.ofcom.org.uk/consult/condocs/ddr/report_analysys/annexe.pdf.

³⁵ www.ofcom.org.uk/consult/condocs/ddr/report_analysys/report_analysys.pdf.

- 7.11 A number of consultation respondents, mainly those arguing for spectrum to be set aside for DTT services in HD, criticised this market research on the grounds that:
- it was out of date, especially given how many HD ready television sets had been sold in the interim;
 - it did not demonstrate technologies (especially HD television) to participants;
 - the show cards used to describe uses of spectrum were not balanced; and
 - other research undertaken for different bodies (e.g. the Freeview HD trial, Digital UK and the Digital Television Supply Chain Group) came to different, more positive conclusions about how much people wanted DTT services in HD.
- 7.12 We consider the market research undertaken in 2006 to be objective and robust. We do not accept the methodological criticisms made by some respondents. Our market research was notable in particular because it assessed citizen and consumer views of the trade-off between different potential uses, unlike most research undertaken by the proponents of a particular use such as DTT services in HD.
- 7.13 We did, however, seek to reflect respondents' concerns as far as we were able when conducting further market research in 2007. This was designed to supplement the research in 2006 by:
- reflecting changes in market conditions since the previous year;
 - providing additional detail by assessing opinion among hard to reach subgroups;
 - demonstrating the most likely potential uses in a fair and balanced way; and
 - exploring a slightly different mix of potential uses of the digital dividend.
- 7.14 Further quantitative and qualitative research was undertaken during summer 2007. The quantitative research was carried out by Ipsos MORI, the qualitative by Opinion Leader Research. The qualitative research involved five deliberative workshops, each consisting of around 20 citizens representative of the UK population. Two workshops were held in London, two in Glasgow and one in Manchester.
- 7.15 We published the results of this market research on 28 November 2007. It provides further insight into citizen and consumer views of, and preferences for, each of the potential uses of the digital dividend, particularly regarding the concept of and attitudes toward broader social value. It demonstrates that some views are reasonably robust over time, and where they are not, we have reconsidered the weight that should be placed on the evaluation of certain uses.
- 7.16 As found in the 2006 quantitative and qualitative market research, the 2007 research shows that no single use commands overwhelming support in terms of the personal or societal value that it generates. Figure 6, taken from the 2007 quantitative research, shows the percentage of participants who ranked each use first or second.

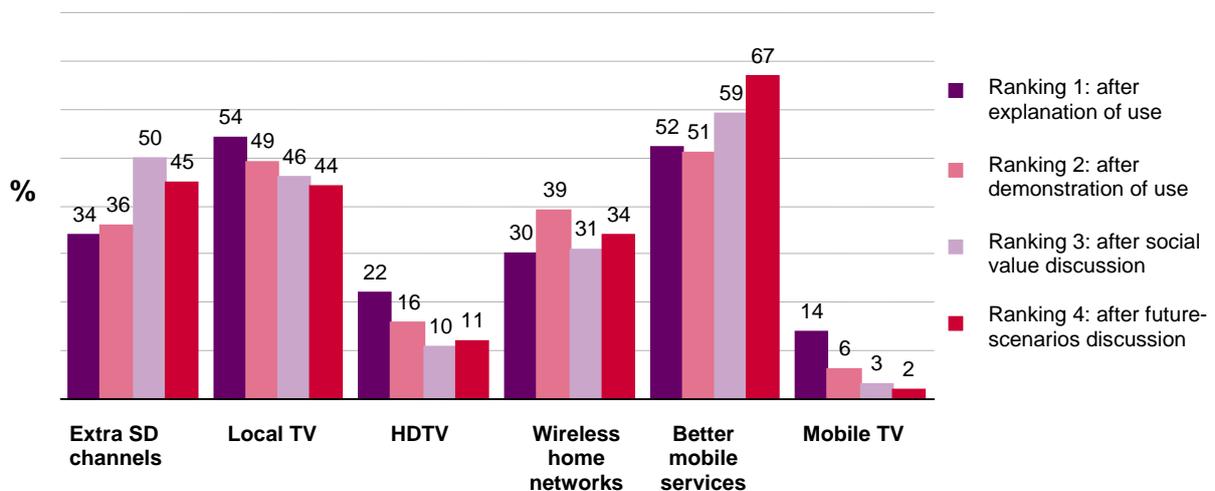
Figure 6. Ranked importance of uses: percentage ranking each use first or second



7.17 All uses were popular with some people. Even mobile television, ranked lowest on average, was rated in the top two from a personal perspective by 10% of participants.

7.18 Figure 7 is taken from the 2007 qualitative research and shows the proportion of participants who ranked each use first or second. It shows how rankings changed over the course of the day when participants considered the value to society of each of the uses. Participants were consistent in their views of which uses had value to society, with DTT services in HD and mobile television receiving low social rankings throughout the day. Improved mobile phone and mobile broadband services started out at a similar level to local television in terms of value to society but were clearly considered to be the most socially valuable of all the uses by the end of the day's discussions. Extra DTT services in SD were also considered to have higher value to society after discussion, ending at a similar level to local television, with wireless home networks falling just behind.

Figure 7. Ranked importance of uses: citizen perspective



Relevance of this source of evidence

- 7.19 The market research is relevant to our assessment of market failures as it helps to inform our consideration of whether some uses generate significantly more broader social value than others. The market research is also relevant to our assessment of the likely demand for spectrum for each of the uses.
- 7.20 Given the nature of this research, including the complex nature of the questions asked, the difficulties respondents face in answering hypothetical questions about new services and the limited sample size relevant to qualitative analysis, the results should be interpreted with care. The results should be considered as broadly indicative of differences in rankings of services rather than as precise estimates.
- 7.21 The market research evidence is also only one part of the story and cannot be relied on in isolation. Such research only reflects opinions at the time it is undertaken. Our assessment of market failure risk must be forward looking. Much of the digital dividend will not be available for new use until 2012—some five years from when the market research was conducted—and is likely to be used for many years after that.
- 7.22 Therefore, while the market research can help to inform our assessment of the relative value of the different uses today, our assessment of the market failure risk needs to predict how this value might evolve over time.

Economic modelling

- 7.23 The economic modelling set out in the DDR consultation document related principally to understanding the elements of total value associated with each potential use of the digital dividend. We worked with consultants to develop models for a number of these uses: mobile television, DTT services in SD and HD, local television, PMSE and mobile broadband. Within this last use, we considered both services based predominantly on the delivery of data (“data-centric”) and services that involve more of a mix of voice and data (“voice and data”). The consultation document referred to these services as mobile broadband and mobile communications respectively. However, as our understanding of mobile services likely to be deployed in the digital dividend has grown, we no longer feel that these descriptions accurately capture the nature of the services modelled.
- 7.24 This modelling allowed us to estimate ranges for producer, consumer and external value.³⁶ Annex 8 discusses our approach to identifying these ranges. Our approach to identifying external value is based on the results of our qualitative and quantitative market research. The assessment of incremental external value should be treated with particular caution. These sources of value are inherently difficult to quantify, and there are a number of reasons why these results may be poor indicators of the actual level of external value. For example, some of the services are new, and hence it would be difficult for individuals to assess their broader social value. In addition, it can be difficult for individuals to appreciate fully the value a service generates for society. However, taking these difficulties into account, this analysis can help us to assess whether there are likely to be significant differences in the relative level of broader social value generated by the different potential uses of the digital dividend.

³⁶ These results are based on the difference in the importance and rankings of services on a societal basis compared to a private basis. It is likely that much of this is due to the presence of broader social value. However, some of this difference could be due to other forms of external effects, such as impacts on the UK economy and competitiveness.

- 7.25 Our modelling also involved developing a wide range of plausible future scenarios and counterfactuals and included work to understand how different combinations of use might affect values for both individual uses and the digital dividend as a whole.
- 7.26 The models take account of the availability of alternative ways of delivering the same services. The values are therefore incremental (i.e. the gain that comes from using the digital dividend rather than some other likely means of delivering the service).
- 7.27 We have reviewed and updated our modelling to take account of market developments. We have revised our findings in some cases, but this has not changed our overall assessment of the value to society of the digital dividend. We have also adapted the modelling to estimate the opportunity costs of forms of intervening. That is, we have developed indicative estimates of the impact on the value of the digital dividend if spectrum were reserved for specific uses.
- 7.28 When considering the results, it is important to keep in mind the difficulties this type of analysis faces. The high level of uncertainty and the complexity of some of the inter-relationships between services mean that this type of modelling can at best provide an order of magnitude assessment of value. The figures presented below should therefore not be interpreted as precise estimates. In particular, it would not be appropriate to compare the value of a service with the opportunity cost of its spectrum use and conclude that it should or should not use spectrum. At best, these results can only be used to provide an indication of whether the value of a service and the opportunity cost of its use of spectrum are of a similar order of magnitude.
- 7.29 Table 2 shows the updated results of our modelling work. Although there have been market developments, these have generally only suggested minor amendments to our estimates of the range of producer and consumer value that might be generated by likely uses of the digital dividend. (Note that these are not estimates of auction proceeds.) This is because our original modelling work was based on a wide range of different potential future scenarios to reflect the uncertainty facing many of the uses.

Table 2. Summary of results of economic modelling by service

Service	Range of producer and consumer value (NPV over 20 years in £bn) ^a	Range of spectrum requirements (total for this service)	Indicative range of external value as a % of producer and consumer value
Mobile multimedia	0.3-3	8-48	Up to 5%
DTT in SD	0.5-3	24-112 ^b	Up to 10%
DTT in HD	1-3.5	24-112 ^b	Up to 5%
Local television	0.05-1	8 ^c	Up to 10%
PMSE	0.15-0.5 ^d	8 (cleared) Up to 256 (interleaved)	N/A
Mobile broadband (data-centric)	1-2.5	30-60	Up to 15%
Mobile broadband (voice and data)	0.5-2	10-64	Up to 15%

a Figures above £1bn are rounded to the nearest £0.5bn.

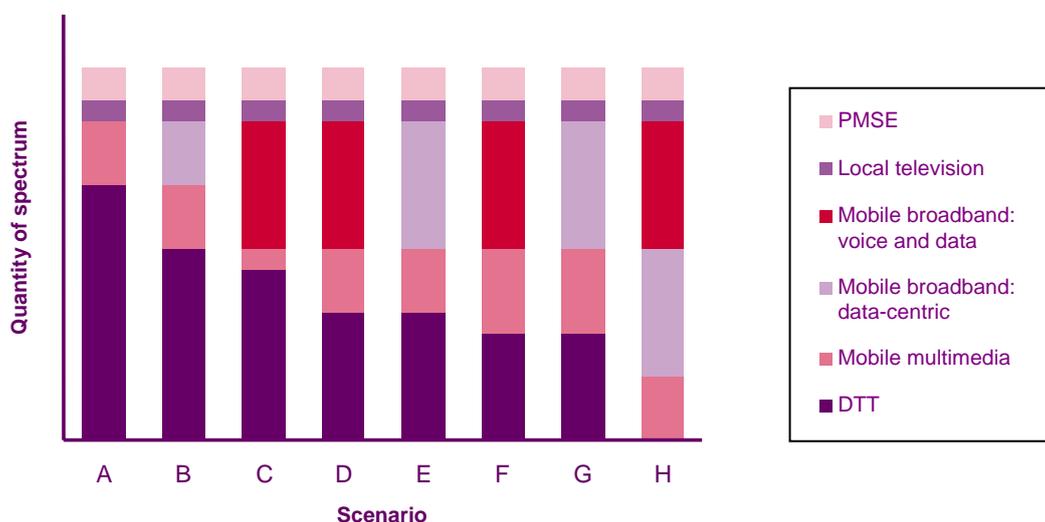
b. Using a multifrequency network.

c. At each location, local television could use either cleared or interleaved spectrum.

d. May understate the true value. Annex 8 discusses the reasons for this.

- 7.30 Annex 8 discusses the market developments reflected in these numbers.
- 7.31 We have also updated our estimates of the aggregate value of the use of the digital dividend. These estimates are based on the aggregate producer and consumer value. This has involved revising our illustrative scenarios to ensure these are consistent with our latest views on the range of likely uses of the spectrum. Figure 8 sets out the new scenarios.

Figure 8. Aggregate value of illustrative combinations of use of the digital dividend



- 7.32 The new set of scenarios reflect some changes. First, the proportion of the digital dividend illustrated as being used by mobile broadband is greater. This is due to a greater confidence that these services could make use of the spectrum and a consequently increased interest from providers of these services. The amount of spectrum illustrated as being used by mobile multimedia services is somewhat smaller in response to a number of consultation responses indicating that a large number of video streams can be carried in a single channel, so market needs might be reduced. Similarly, the spectrum used for DTT is lower in some scenarios, partly due to our proposals to improve DTT capacity within the spectrum reserved for it.
- 7.33 Although there are some substantial changes in some of the combinations comprising the scenarios above, this has not significantly changed the aggregate value figures that were stated in the DDR consultation document. A value to producers and consumers of approximately £5-10bn (NPV over 20 years) is still our best estimate of aggregate value.³⁷ Our analysis of external value suggests that externalities could increase this by up to 10% in total.
- 7.34 Our modelling work has also involved developing illustrative estimates of the magnitude of the opportunity cost of intervening. This requires hypotheses about spectrum use in the absence of intervention. Annex 8 discussed these hypotheses and our approach to modelling opportunity cost more generally.

³⁷ Note that simply summing the individual service by service results will not result in the same aggregate value. This is in part because these results are based on each service acquiring all the spectrum it needs. The aggregate value scenarios take into account that this is not going to be possible in practice owing to excess demand for spectrum. Our approach to assessing the aggregate value of the digital dividend is discussed in annex 8.

7.35 Table 3 describes the ranges of estimated economic value (producer and consumer value) for cleared spectrum. The economic value grows as more channels are removed by intervention. In reality, not all channels have the same value because their use will be subject to different technical constraints.

Table 3. Estimated opportunity cost of removing cleared spectrum by intervening (NPV over 20 years)

Number of channels	1	2	3	4	5	6
Low economic value	£100m	£200m	£400m	£700m	£1bn	£1bn
High economic value	£400m	£700m	£1bn	£1.5bn	£2bn	£2.5bn

7.36 These results indicate that the opportunity cost of one channel is less than one 15th of the aggregate value of the digital dividend. This is for two reasons:

- the aggregate value estimate includes the value of interleaved spectrum as well as cleared spectrum; and
- more importantly, the opportunity cost of one channel is the economic value of the lowest value channel. Therefore, as the number of channels lost through intervention increases, the opportunity cost per extra channel will also tend to increase.

7.37 For interleaved spectrum, we have estimated the opportunity cost by assessing the value that might be lost if some of the most valuable sources of demand are precluded. This work identified that precluding the most valuable uses could have an opportunity cost of up to £400m per channel (NPV over 20 years). However, once demand for two of the high value potential uses is satisfied, the opportunity cost of a further channel falls to a high of £50m per channel.

Relevance of this source of evidence

7.38 Our modelling work plays two roles in our market failure assessment:

- it helps us to understand the magnitude of the total value that might be lost if a market failure were to result in one of the uses not emerging or being significantly constrained; and
- it helps us to understand the magnitude of the opportunity cost involved in intervening. This is because it allows us to assess the value that might be lost if we intervene to facilitate one use of the spectrum at the expense of another. The assessment of opportunity cost is important in helping us to identify how significant a market failure needs to be to justify intervention.

7.39 The estimates of opportunity cost do not give us a guide to the size of potential costs due to dynamic effects such as reduced flexibility and weakened incentives for efficiency. These potential regulatory failures need to be considered in addition to opportunity costs.

Secondary research

7.40 For the DDR consultation document, we commissioned and published research concerning possible external value (meaning broader social value and other external value) that is incremental to, i.e. causally related to, use of the digital dividend. There may be significant broader social value associated with certain potential uses in

general, such as broadcasting, but the relevant question for the DDR is the extent to which use of the digital dividend will result in additional broader social value. The research was intended principally to help us understand whether significant incremental external value existed for any of the uses in ways that differed from private value and producers' willingness to pay for spectrum.

7.41 The research took two approaches:

- top down, using the 2006 market research results to quantify aggregate external value; and
- bottom up, using those results to build up the elements of external value for uses based on categories of broader social value.

7.42 The research also used existing secondary research, principally relevant academic articles and our own reports and studies, as well as interviews with stakeholders.

7.43 The top down approach found only relatively modest differences between private and total values, with no significant differences across the uses studied. The bottom up approach tended to suggest that, although significant absolute broader social value might be associated with some uses (e.g. PMSE, more DTT services in SD and mobile broadband), the incremental broader social value associated with using the digital dividend was relatively modest.

7.44 We have reconsidered the secondary research in the light of the 2007 market research, new evidence and recently published studies. In particular, several relevant academic and other journal articles relating to consumer and citizen interests in broadcasting and communications services have been published. The views and conclusions expressed in them broadly accord with material already considered for the secondary research, so the conclusions remain materially the same.

Relevance of this source of evidence

7.45 The secondary evidence helps to assess the incremental broader social value that might be generated by uses of the digital dividend. This is important in assessing the size of the market failure risk.

7.46 The secondary evidence also helps when predicting how the broader social value generated by some uses might change over time. This is because this research sought to identify the drivers of broader social value associated with each of the services. Hence, consideration of how these drivers might change in the future can provide some pointers for how broader social value might also change.

Technical analysis

7.47 Any new use or user of the digital dividend will have to ensure that its services do not adversely effect the reception of existing licensed services using the spectrum reserved for DTT. Hence, new uses will be subject to a range of technical considerations and constraints, although these will not affect all uses or combinations of use equally because of their varied nature.

7.48 We published several technical reports and analyses alongside and after the DDR consultation document. These set out our initial findings on technical issues, noting, for example, that one way of providing local television—the add/drop option (see

paragraph 7.110) —would potentially be costly.³⁸ Technical analysis also provides useful information to guide the assessment of the total value generated by uses of the digital dividend. For example, for some uses (particularly mobile services), these frequencies allow high coverage at relatively low cost when compared to other suitable frequencies. The technical analysis helps us to understand the magnitude of this advantage when compared to alternative spectrum.

7.49 We have continued to assess technical evidence relating to spectrum use by commissioning further investigation into the compatibility issues between the different types of potential services that might use cleared spectrum. This highlights that the operation of a new service in cleared spectrum can cause interference to other new services (possibly using different technology or network designs) operating in neighbouring channels. However, the technical research shows that this can be mitigated with careful network design and frequency separation.

7.50 The research also suggests that further improvements in the compatibility between different types of use could be gained by adopting better transmission and receiver filter performance compared to what was assumed in the earlier technical reports published with the consultation. The use of these improved filters could also improve the efficient use of cleared spectrum and simplify network deployment.

7.51 The technical analysis that we have carried out since the publication of the DDR consultation document consists of:

- a series of measurements to quantify the impact of interference from a number of potential service types into DTT receivers. This offers an understanding of the performance of real digital receivers in the market today in the presence of interference from a variety of sources;
- a series of measurements to assess how different types of service using the digital dividend may affect the operation of other services. These were carried out using existing equipment where possible to understand the tolerance of each potential type of use to interference from another type of use;
- an international interference assessment to provide an understanding of the potential incoming interference from neighbouring countries operating broadcast services in cleared spectrum and the maximum allowable outgoing interference levels to those countries. Interference levels are plotted geographically on the basis of agreements with each country;
- the feasibility of providing an IMT-2000 mobile voice and data service within UHF bands IV and V. This covers a number of different aspects, including compatibility with DTT, spectrum requirements and potential ways to overcome interference problems through network and antenna design;
- channel 36 issues. This models the potential interference and issues with a potential mobile television service in channel 36 operating before the existing adjacent channel analogue television services switch over to digital;
- an assessment of how the operation of mobile television services using DVB-H could cause interference into analogue PAL television services using an adjacent channel. These measurements were carried out to test the interference tolerance of typical existing analogue television receivers from a new mobile television

³⁸ www.ofcom.org.uk/radiocomms/ddr/documents/tech_tv/.

service and were specifically commissioned to evaluate the use of channel 36 for such services in advance of DSO;

- interference analysis of mobile WiMAX with respect to DVB-H and DVB-T systems. This investigates compatibility when operating a WiMAX service in spectrum adjacent to DTT or mobile television. The report determines the frequency separation and potential for interference between the services;
- an investigation of the availability of assignments within interleaved spectrum that would be suitable for local television at 71 main transmitter sites; and
- a study of PMSE. This looks at technical interference issues for analogue and digital wireless microphones using interleaved spectrum following DSO.

7.52 Further research and analysis is informing a set of technology neutral licence conditions to enable potential uses of cleared and interleaved spectrum to operate without undue interference to or from adjacent uses.

7.53 Annex 9 lists and summarises the technical reports that we are publishing alongside this statement.

Relevance of this source of evidence

7.54 This evidence is relevant to our market failures assessment as it informs our assessment of the likely uses of the digital dividend and hence the uses that need to be assessed in relation to the risk of market failure.

7.55 This evidence also helps to inform our analysis of the opportunity cost of intervening. This is because it provides information about the coexistence of services and hence can inform an assessment of the impact of intervening in favour of one use on the usability of the remaining spectrum for other uses.

7.56 Finally, this evidence also helps us to understand what technical constraints might be required to enable the full range of potential services to operate within cleared and interleaved spectrum. It will help us to prepare our forthcoming consultations on detailed award design.

Consultation responses

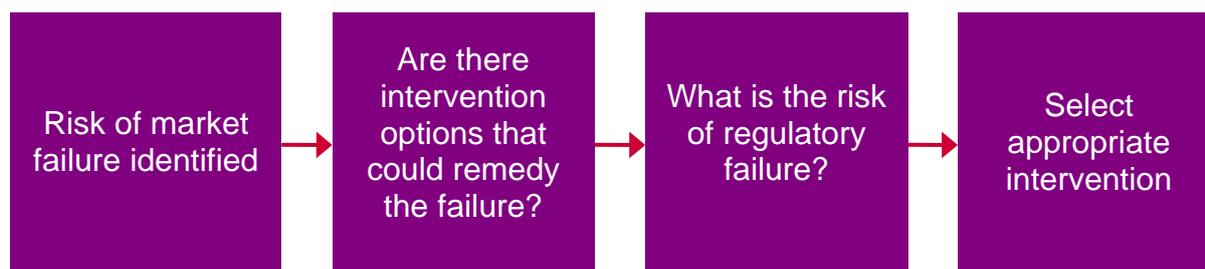
7.57 Many responses to the DDR consultation document commented on the principle or application of our total value framework, particularly concerning broader social value. Some respondents provided new evidence concerning the relative value of different uses of the digital dividend and how these might develop in the future.

7.58 We have carefully considered responses and assessed new evidence. The responses received in relation to each of the market failure assessments are summarised below. Our reapplication of the framework for identifying whether there is a case for intervening takes these into account.

Assessing the case for intervention

7.59 Figure 9 sets out the process we have followed to assess the case for intervening in a market led award for each of the likely licensed uses of the digital dividend.

Figure 9. Process for applying the total value framework



PMSE

- 7.60 PMSE is an existing significant use of interleaved spectrum. It makes a major contribution to the UK's social, cultural and economic well being. It consists of a wide and diverse community, both professional and amateur, including broadcasters, theatres, large event organisers, schools and churches. UHF bands IV and V are used for a number of different PMSE applications, primarily wireless microphones for both professional and community use but also in ear monitors and talkback systems. Channel 69, which is not used for DTT, is also available for PMSE use.
- 7.61 Professional PMSE users are typically broadcasters, commercial theatres and event organisers. They require assured quality of service to guard against interference from other users. They use this spectrum because this is where the equipment in which they have invested operates. Community PMSE users, such as churches, local theatres, pubs and schools, are also driven by their investment in equipment that operates in this spectrum.
- 7.62 The DDR consultation document proposed auctioning interleaved spectrum to promote a flexible market led approach that would not restrict or limit the use of the spectrum. Because we recognised that the transition to accessing spectrum via market mechanisms could pose a significant risk of disruption to PMSE use of this spectrum, we proposed ensuring continued access until at least the end of 2012, when DSO ends. We also proposed making some or all of channel 69 available for use on a licence exempt basis given that community users typically do not require their use to be coordinated with others.
- 7.63 Many respondents argued that a fragmented PMSE sector could not compete successfully at auction and/or that a longer period of transitional access to interleaved spectrum after DSO was needed. They also argued that channel 69 was important for professional users who require coordinated, interference free access across the UK and so should remain available on a licensed basis.
- 7.64 We reflected on these responses and on 20 June 2007 published a further consultation document on future spectrum access for PMSE.³⁹ This recognised that a number of factors could make it difficult for the sector to engage in a market for spectrum access quickly and effectively. It identified four objectives in designing future arrangements for PMSE use of interleaved spectrum:
- avoiding disruption to PMSE users that adversely affects their ability to provide a wide range of services to citizens, consumers and business customers;
 - facilitating the participation of PMSE users in a market led approach to spectrum, particularly to provide them with incentives for efficient use;

³⁹ www.ofcom.org.uk/consult/condocs/pmse/pmse.pdf.

- promoting the optimal use of the spectrum in relation to all potential uses and users over time; and
- avoiding the risks of regulatory and market failure.

7.65 The PMSE consultation document set out six options for how the PMSE sector could access interleaved spectrum in the future. They are summarised in table 4 and explained in more detail below.

Table 4. Options for future PMSE access to interleaved spectrum

Status quo		Transition			No intervention
Option 1	Option 2	Option 3	Option 4	Option 5	Option 6
Status quo	Status quo with AIP	Beauty contest with AIP	Auction with additional safeguards	Auction with DDR safeguards	Auction without safeguards

7.66 Options 1 and 2 are described as status quo because these would involve essentially seeking to replicate the present approach to spectrum access for PMSE from DSO. These arrangements would continue for an indeterminate period, depending on future policy decisions. Under these options, PMSE users would use spectrum specified by us. They would do so via a band manager appointed by us, on terms and conditions specified by us. They would individually hold short term licences, with a maximum length of one year, and they would enjoy little or no security of tenure.

7.67 Option 2 would differ from option 1 through the application of AIP to the spectrum.

7.68 Option 6 is included for completeness only. It would involve auctioning interleaved spectrum with no transitional protection for existing PMSE users. We do not consider that this option meets our objectives. However, it is useful in illustrating the limiting case to the level of intervention.

7.69 Options 3 to 5 are described as transition because they involve a move to a market led approach that is phased over time, at greater or lesser speed and through varying types of measure to achieve that outcome.

7.70 We favoured options 3 and 4.

Consultation responses

7.71 We received 140 responses, most of which expressed concerns over some of our key proposals, in particular the widespread belief among PMSE users that they would be unable to take part in any market led approach to spectrum access.

7.72 The majority of responses, 92 in total, were expressions of support for a submission from the PMSE Pro-User Group, a representative body that set out its own proposals for future licensing of PMSE spectrum use. Annex 3 sets out the detailed responses that we received.

Our response

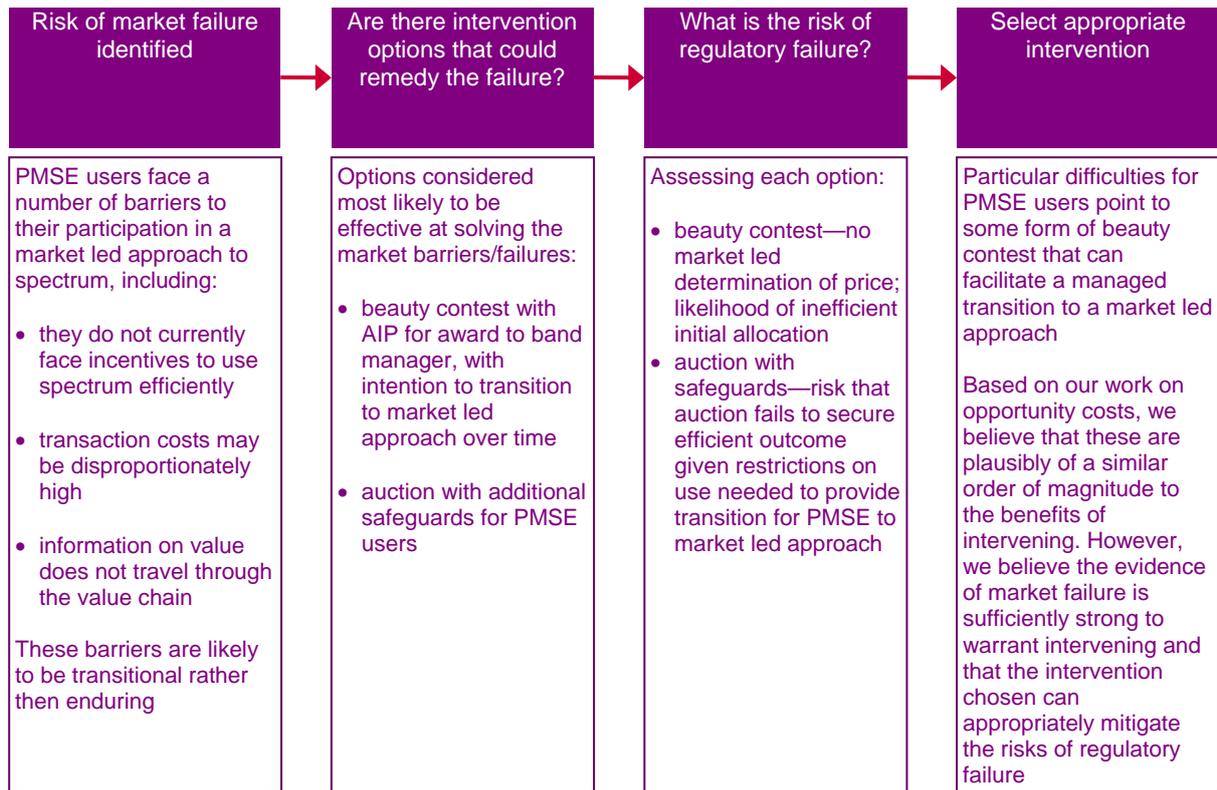
7.73 We continue to believe that we should address the risk of coordination failure currently faced by PMSE and, in doing so, should pay particular attention to how these transitional issues can be overcome, allowing PMSE users to access spectrum via market mechanisms in the longer term.

- 7.74 Our assessment of whether to intervene to resolve this market failure is informed by our assessment of its opportunity cost. Assuming we are able to award some interleaved spectrum in a form suitable for other uses (e.g. local television), our work suggests that the opportunity cost of resolving this market failure is plausibly at most £250m (NPV over 20 years). Annexes 2 and 8 explain our approach to identifying this indicative estimate. This level of opportunity cost is plausibly of a similar order of magnitude to the value that might be generated by using this spectrum for PMSE. Hence, we need strong evidence of the market failure risk in order to intervene and should be mindful of how our method of intervening can reduce regulatory failure risks.
- 7.75 We believe the evidence for market failure is compelling. As explained in our PMSE consultation, there are barriers to PMSE users engaging in a market at this time, and these barriers are sufficiently severe to suggest that a reasonable period of transition would be required to overcome them.
- 7.76 To identify which of the potential options for resolving the transitional coordination failure faced by PMSE users is most appropriate, we have given additional thought to the nature of the solution we need to meet our objectives and how we can mitigate the risk of regulatory failure.
- 7.77 We believe that this solution involves two key elements:
- to prevent undue disruption to PMSE users and provide an appropriate transition to a market led approach, hence avoiding a cliff edge, we need to ensure that prices for spectrum access increase toward market rates gradually and that users' ability to access spectrum is not suddenly reduced; and
 - it is essential that the band manager has flexibility to respond to signals from PMSE users when setting prices and, where appropriate, to promote efficient spectrum use as this will help PMSE users to move to a market led approach and can also reduce the risk of regulatory failure in relation to this intervention.
- 7.78 To ensure that these elements are present in our solution, we have identified that the following will be required:
- the ability to exert some regulatory control over the prices PMSE users are charged during the transition period;
 - the ability to provide PMSE users with some protection in relation to the amount of spectrum they are able to access during the transition; and
 - the ability to ensure that the band manager has incentives to promote efficiency and to assist PMSE users in responding appropriately to market signals.
- 7.79 Given these requirements, our assessment is that the most appropriate option to bring this about is option 3 (a beauty contest with AIP). The benefits of an auction (e.g. option 4) are limited by the regulatory requirements we think are needed to manage the transition period. Annexes 2 and 3 set out the reasons for this. Section 8 sets out how we will implement it in the digital dividend awards. We believe that we can appropriately mitigate the risk of regulatory failure in relation to this intervention by ensuring that the band manager has incentives to promote spectrum efficiency and by ensuring that the transitional protection is time limited.

7.80 There are some practical benefits to choosing option 3 over option 4. It may be easier to extend to PMSE use of spectrum outside the digital dividend than an auction. These bands are different in their nature (many are managed by MOD) and their use (primarily supporting wireless cameras and other video links rather than wireless microphones and other audio links).

7.81 Figure 10 summarises the application of our analytical framework in reaching this conclusion.

Figure 10. Application of our analytical framework to PMSE



7.82 In relation to channel 69, this is heavily used by PMSE users because its availability across the UK allows travelling productions to use the same equipment and the same frequency plan at all venues. We also recognise the importance that PMSE users attach to the higher quality product that can be provided through licensing. We have decided that use of channel 69 should continue on a licensed basis. We will include channel 69 with the rights to be awarded to the band manager. Section 8 nonetheless addresses access to spectrum for users who do not require assurance of such high quality.

7.83 Shortly we will also publish detailed information on the availability of interleaved spectrum for PMSE after DSO.

7.84 Table 5 summarises our application of the total value framework to PMSE. Annex 2 sets this out in more detail.

Table 5. Application of the total value framework to PMSE

Market failure	Case for intervention	Conclusion
Transitional coordination failures	<p>There is real risk of market failure due to coordination difficulties faced by these users during the transition to accessing spectrum via market mechanisms</p> <p>Given the severity of the problem faced and the difficulties PMSE users need to overcome to participate in a market for spectrum access, the most effective remedy involves taking an interventionist approach that restricts the use of spectrum and allows a managed transition to market mechanisms</p>	<p>We should intervene in order to resolve the transitional coordination failures faced by PMSE users</p> <p>This is likely to involve decisions about the use of some interleaved spectrum alongside regulatory intervention to manage the transition process and hence represents an interventionist approach</p>
Community users facing coordination failures	<p>Community users face coordination failures that are likely to be more enduring than those faced by professional users</p> <p>Community users also use spectrum in a way which makes licence exemption a suitable approach to their spectrum access</p>	<p>We should consider what spectrum can be made available for community users on a licence exempt basis</p>

Local television

7.85 Many forms of content deliver broader social value. It is because of this that we have intervened in the past, most notably in the PSB Review and our focus on the provision of content by the BBC, ITV, Channel 4 and Five. In addition to the content provided by the PSBs, other forms of content could deliver broader social value. Local television is one of these. Content focused on communities of interest with a citizenship dimension could be another.

7.86 Our 2003 PSB Review and our Digital Local report,^{40/41} as well as the DDR consultation document, all identified local television as a service with the potential ability to deliver public service benefits (i.e. broader social value). Indeed, Digital Local referred to such services as being capable of creating “significant citizen and consumer benefits” and as “a potentially important element in the future PSB mix.”

7.87 Digital Local identified a number of public purposes, similar to the broader social value categories we identified in our total value framework that might be delivered by local television. These were:

- informing ourselves and others and increasing our understanding of the world through news, information and analysis of current events and ideas, with particular focus on issues relevant to our locality;
- stimulating our interest in and knowledge of arts, science, history and other topics, particularly those relevant to our locality, through content that is accessible and can encourage informal learning;
- reflecting and strengthening our cultural identity, particularly that based on shared local identities, through original programming at local level, on occasion bringing audiences together for shared experiences;

⁴⁰ www.ofcom.org.uk/tv/psb_review/.

⁴¹ www.ofcom.org.uk/tv/psb_review/digital_local/.

- making us aware of different cultures and alternative viewpoints through programmes that reflect the lives of other people and other communities, especially those within our local area; and
 - supporting and enhancing our access to local services, involvement in community affairs, participation in democratic processes and consumer advice and protection.
- 7.88 Local television may be identified as a service likely to serve a closely defined geographic area such as a city, a local authority district or a smaller area (e.g. a neighbourhood or housing estate). It may be operated on a wholly commercial basis, as a not for profit community model or as a combination of both.
- 7.89 Local television is a common element of the television environment in Europe and North America. It has developed because of various factors, including high cable penetration in some countries (Germany and the Netherlands), direct subsidy (Belgium and Germany), relaxed terrestrial licence regimes (Italy and Spain) and mature market consolidation and mergers (Canada and the US).
- 7.90 In the UK, examples of local television include Channel M in Manchester (a commercial operation backed by Guardian Media Group and based on a North American “city TV” formula), MATV in Leicester (a commercial operation targeting the city’s South Asian community) and NvTv in Belfast (a not for profit community model funded by Northern Irish arts, education and training bodies).
- 7.91 All these services are currently broadcasting via analogue terrestrial transmission under Restricted Service Licences (RSLs). Channel M and MATV are also available on other platforms, such as cable and satellite. There are a limited number of cable only operations, including Channel 7, which launched in January 1998 and broadcasts from studios in Immingham onto the Virgin cable network. This service is available to around 70,000 people across north and northeast Lincolnshire.
- 7.92 Most existing and potential local television operators see access to and visibility on the DTT platform as desirable for the future success of their channels. To support this argument, they point to the failure of most previous ventures based solely on cable or satellite television and to the paucity of Internet television examples.
- 7.93 The DDR consultation document identified local television as a likely use of interleaved spectrum. It recognised that demand for that spectrum was likely to come from operators in different locations and that there was a risk of coordination failures preventing them from reflecting their value for spectrum if they had to bid for UK wide licences. We therefore proposed awarding geographic packages of interleaved spectrum, based on main transmitter sites, suitable but not reserved for local television. These packages would be awarded by auction. Subject to further technical research, we suggested that there could be 40 or more, perhaps up to 100 such packages.
- 7.94 The consultation document concluded that it was not necessary to reserve spectrum exclusively for local television to reflect the broader social value that it might generate. The evidence for broader social value was suggestive rather than clear cut, and direct funding was the best way to realise any that did exist.

Consultation responses

- 7.95 In total, we received 244 responses in relation to local television. Although the majority of respondents opposed our proposals to auction interleaved spectrum in packages suitable for local television services, there was almost an equal split between those in favour of more intervention in support of local television (90) and those against (80). Around 20 responses from a wide range of stakeholders, including our advisory committees, broadcasters, telecommunications operators, respondents with an interest in low power use and local television operators plus a small number of individuals, supported our proposals.
- 7.96 Among those who advocated less intervention were proponents of using interleaved spectrum for other services, such as PMSE and DTT services in HD. Others suggested that, because local television has had limited success in the past, there was little demand for local television services and other platforms, such as the Internet, could be used to provide local services. Others suggested that, to reflect the broader social value of local television, a band manager should be used to allocate spectrum for both local television and PMSE. A number of local television operators felt that spectrum should be specifically reserved for local television.
- 7.97 Respondents generally agreed with our assessment of the risk of coordination failures but disagreed with our assessment of the need to reserve spectrum for local television to realise broader social value. They raised a number of specific points:
- many suggested that broader social value was unlikely to be reflected in the bids that local television operators could make at auction;
 - many also felt that we should carry out further work to better determine the broader social value generated by local television and consequently reserve part of the digital dividend exclusively for local television operators;
 - the Community Media Association did not think that our economic arguments were compelling because broader social value is difficult to quantify; and
 - consumer bodies called for broader social value generated by local television to be factored into the auction process. One suggested that this could be done by reserving spectrum for community services via a community band manager, which would allocate spectrum between competing uses such as DTT, community mobile broadcasting and wireless broadband.
- 7.98 Some respondents argued that we should act to ensure that local television is available nationwide and pointed out that this would not be achieved through the use of interleaved frequencies. They called for capacity to be reserved for local television on new or existing DTT multiplexes. Local services would be inserted on the national multiplexes in areas where there was demand using add/drop technology.

Our response

- 7.99 Consultation responses and our 2007 market research both point to there being significant interest in local television. This supports our position that it is important to allow this use to participate in the award of the digital dividend on an equal footing.
- 7.100 It is also clear that local television, as well as many other potential uses, faces a number of challenges. Our economic modelling suggests that the business case for local television on DTT faces some difficulties, for reasons including:

- the cost of delivering high quality content. We understand that this is important if viewers are to watch local services. However, the costs involved are significant. When broadcasting on the DTT platform, these are combined with the high cost of acquiring access to multiplex capacity;
- the degree of competition it faces from other forms of local media; and
- viewer demand for limited local television content. Our market research suggested this could be only an hour or two a day, which will limit the advertising revenues that can be generated and may mean that demand is insufficient to warrant a dedicated television channel.

7.101 At the same time, DTT is by no means the only platform on which local content can be delivered. Digital Local identified the enormous potential of broadband Internet to meet local public service purposes, including through interactivity. It is clear that this potential has not yet been fully realised, but an ever growing number of providers are now using the Internet to provide local news and information, including in video form. These providers include newspapers, local authorities, community groups and some commercial Internet television operators.

7.102 The development of next generation broadband access, with improved technical performance, is likely to make broadband television both more accessible and more watchable in the home. ITV Local has already launched a fully interactive television-type service throughout England and Wales, using linear and on demand services side by side and building on the broadcaster's regional news services for ITV1.

7.103 We recognise the concerns of some in the local television community over the suitability of the Internet as an alternative delivery platform. However, we believe that the role of the Internet in delivering video content is evolving quickly, and by the time the digital dividend spectrum is widely available, the use of this platform in delivering this type of content is likely to be increasingly commonplace.

7.104 In its report on public service content, the House of Commons Select Committee on Culture, Media and Sport considered the value that might be generated by providing local content and the need to support this use to allow it to be provided on the DTT platform. The Committee concluded that:⁴²

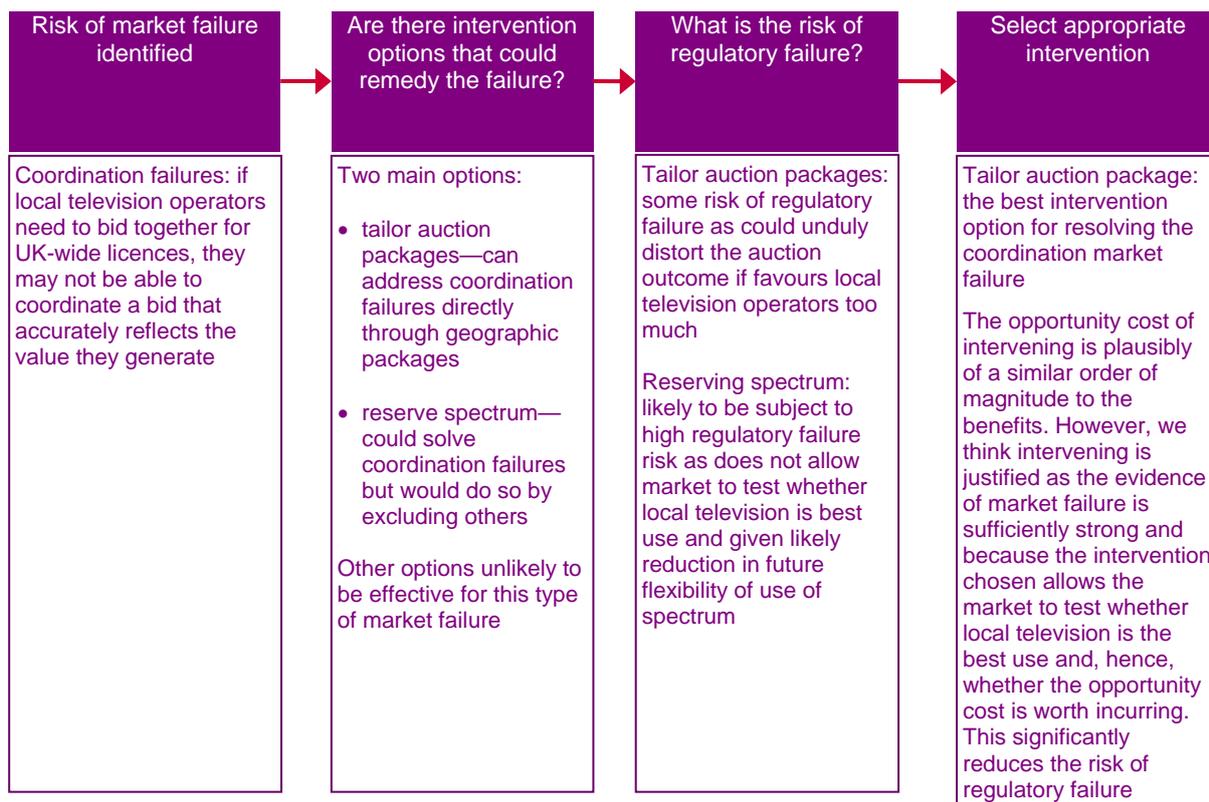
We note the enthusiasm of some witnesses for the potential for local television and the view that the Government needs to take action to support the provision of local content. However, while we do see some value in local content, we are not convinced of the need to intervene to support local television,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

7.105 We have carefully considered the arguments for reserving spectrum for local television, but we have concluded that this would not be an appropriate response for a number of reasons. This does not mean that we think that local content is of low value. We understand that this use could generate significant value. However, there are a number of reasons why we should not intervene in the award of the digital dividend just because of this.

⁴² www.publications.parliament.uk/pa/cm200708/cmselect/cmcomeds/36/36i.pdf.

- 7.106 First, the opportunity cost of local television displacing other uses could be relatively high. As discussed in annexes 2 and 8, our modelling work indicated that this could be as high as £400m (NPV over 20 years). This is plausibly of a similar order of magnitude to the value that could be generated by using this spectrum for local television. When this is the case, we need strong evidence of a market failure risk in order to justify intervening.
- 7.107 Second, while there is evidence of broader social value from this use, this alone is not sufficient evidence of market failure. It is differences in the magnitude of broader social value generated across uses of the digital dividend that is a key driver of market failure. The market research indicated that almost all uses generated broader social value and that the level generated by different uses was comparable.
- 7.108 Third, there are reasons why the incremental broader social value generated by the use of the digital dividend may not be as great as expected. Using the digital dividend rather than alternative on demand delivery mechanisms for local television may not generate the most value for society if viewers' demand is for only one or two hours of programming a day. And delivering local content on other platforms, such as the Internet, may increasingly allow the broader social value of local content to be achieved without access to this spectrum.
- 7.109 Finally, intervening in the award of the digital dividend is unlikely to be a solution to the problems faced by local television operators. Simply reserving spectrum would do little to improve its business case given the high costs involved in producing television content that viewers want to watch and the challenging business model of local television in the UK. Even if spectrum were reserved for local television, we would expect to charge AIP to reflect the opportunity cost of this use. It is likely that a failure by local television to acquire spectrum at auction would be due to that challenging business case. This is the problem that needs to be addressed, and in instances where there is a broader social value case for local television, it is better addressed through direct funding rather than by specifically reserving spectrum.
- 7.110 Under add/drop arrangements, local television operators would agree with a multiplex operator to remove a certain service in an identified area and replace it with the local service. We believe that the use of interleaved spectrum for local television presents a more flexible and credible mechanism for delivering local services. Although we recognise that add/drop is a technically feasible option on either an existing or additional national multiplex, the proposal suffers from a number of fundamental disadvantages that mean that we do not support its implementation:
- the opportunity cost of intervening to reserve one or more slots on a national multiplex is likely to be very high;
 - add/drop requires the transmission of core signal across the network and national coordination of all local television operators. Capacity would remain unused in areas where local services are not viable; and
 - local television operators would need to share the cost of national capacity. This raises significant coordination difficulties similar to those set out above.
- 7.111 We have therefore decided that we should address only the risk of coordination failures faced by local television in bidding for the digital dividend. Section 8 sets out how we will do so in the digital dividend awards. Figure 11 summarises how we have applied our analytical approach to reach this conclusion. Annex 2 sets out the analysis supporting this assessment in more detail.

Figure 11. Application of our analytical framework to local television



7.112 Table 6 summarises our conclusions in relation to each of the key market failure risks considered for local television.

Table 6. Application of the total value framework to local television

Market failure	Case for intervention	Conclusion
Coordination failures	<p>There is evidence to suggest local television operators would face significant transaction costs which would prevent them from effectively coordinating in a bid for UK wide packages</p> <p>This can be resolved via auction design and packaging, which reduces the risk of regulatory failure relative to taking an interventionist approach. This is an important consideration given the potential magnitude of the opportunity cost</p>	<p>Remove coordination problem via packaging</p> <p>Consistent with market led approach</p>
Broader social value	<p>The evidence of incremental broader social value generated by this use of the digital dividend compared to other uses is insufficiently strong to warrant intervening in the award of the digital dividend. This is due not least to the availability of alternative delivery mechanisms (e.g. the Internet) and the magnitude of the opportunity cost and risks of intervention</p> <p>If intervention is required to secure broader social value, the best option is direct funding. This option would not be precluded by a market led approach</p>	No intervention in DDR

Advertiser funding business model	Some respondents suggested that the use of an advertiser funding business model by local television operators results in a market failure Annex 2 sets out our assessment of this. It identifies that there are difficulties with the advertiser funding business model but that these do not constitute a market failure	No intervention in DDR
-----------------------------------	--	------------------------

DTT

- 7.113 The DDR consultation document assessed the potential for market failure to distort the acquisition of spectrum to provide additional capacity on the DTT platform for services in both SD and HD. This involved considering a number of market failure arguments common to both services and some additional arguments relevant only to HD. It led us to propose not intervening in the award of the digital dividend to reserve spectrum for DTT services, whether in SD or HD, but still to ensure that the packaging of spectrum was suitable for use by DTT services.
- 7.114 We received 516 consultation responses, including 443 from individuals, regarding our proposals for DTT. The vast majority of respondents voiced concerns about whether our proposals would preclude DTT services in HD, although a vocal minority of organisations and some individuals supported our proposals for a market led approach in this area. A small minority of responses also specifically sought additional capacity for DTT services in SD.

SD

- 7.115 An important factor that influenced our proposal in the DDR consultation document was the assessment of incremental broader social value that might be generated by additional PSB channels in SD. We did not consider it likely that this would be significant given the amount of existing spectrum already used to deliver PSB channels in SD.
- 7.116 We also identified that there was a risk of capital market failure for the BBC and Channel 4 because of the borrowing restrictions they face.

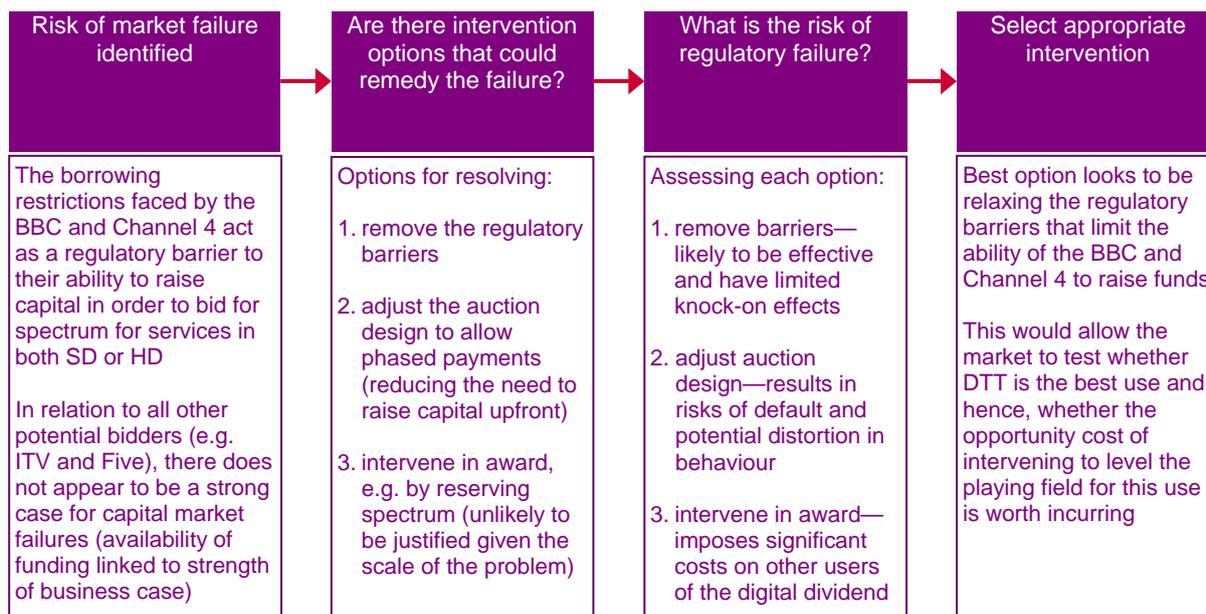
Consultation responses

- 7.117 One of the key themes raised in responses was that we failed to take account of channels that are not PSB in nature but have a community/citizen focus. Respondents argued that our assessment did not consider the incremental broader social value that these channels, which are currently limited in number, could generate. For example, following consultation, we received over 600 emails from individuals asking us to set aside spectrum for Teachers TV.
- 7.118 Responses generally supported our assessment of the capital market failure risk.

Our response

- 7.119 We continue to consider that there is a potential capital market issue associated with the BBC and Channel 4. Figure 12 sets out our assessment of applying the analytical approach to this.

Figure 12. Application of our analytical framework to DTT



7.120 Our conclusion in relation to the capital market issues faced by the BBC and Channel 4 as a result of their borrowing restrictions is that these have the potential to result in a market failure. The best option for resolving these would be to consider if the restrictions should be removed. This issue is a matter for the Government, the BBC and Channel 4.

7.121 In relation to our assessment of broader social value, as indicated above, our earlier analysis focused on using the digital dividend to provide additional PSB channels in SD. We have therefore considered carefully how other, non-PSB channels might generate broader social value and hence whether this should be reflected in our approach to awarding the digital dividend.

7.122 One important piece of additional evidence is our 2007 market research. This sought to identify whether DTT services in SD with a community/citizen focus generated significant broader social value. This work suggested that they could.

7.123 We have considered whether this could result in a market failure in the award of the digital dividend. This analysis identified a number of reasons why we do not believe this market failure risk to be significant and, additionally, why reserving spectrum for this use would not be an appropriate response:

- the risk of market failure faced by this use is not access to spectrum but rather access to multiplex capacity. Given the availability of existing multiplex capacity and the possibility that this will increase over time (see below), it is unlikely that intervening in the award of the digital dividend will generate significantly greater benefits than resolving the market failure in accessing existing multiplex capacity;
- while this use is likely to generate broader social value, it is not disproportionately greater relative to the total value of DTT services in SD than the broader social value generated by a number of other potential uses that it could displace (e.g. local television and mobile broadband). Hence, it is unclear that there is a significant risk of market failure in awarding the digital dividend due to the presence of broader social value generated by this use;

- if the content provided by some providers is of limited duration and/or niche appeal, it might be appropriate to use alternative delivery mechanisms to traditional linear television, such as on demand services downloadable to personal video recorders (PVRs) or via broadband. This may reduce the incremental broader social value generated by using the digital dividend to deliver this service; and
- the points made above all suggest that the market failure risk in relation to this use in the award of the digital dividend is unlikely to be significant. The first and third points also suggest that, if a broader social value market failure were to be a problem, intervention in the form of direct funding, rather than via setting aside spectrum, would be the best option for resolving it. Direct funding could resolve the market failure in relation to existing multiplex capacity and would allow potential content providers to decide between delivering their services on the DTT platform or through alternatives such as the Internet, allowing them to identify the best value outcome for citizens and hence to maximise the total value generated by their service.

7.124 The opportunity cost of intervening to provide an additional DTT multiplex for community/citizen focused content, as discussed in annexes 2 and 8, could be £1-2.5bn (NPV over 20 years). This suggests that we would need strong evidence of market failure to justify action and that we should pay particular attention to encouraging the most effective means of resolving any market failure, such as through funding decisions to acquire more capacity on existing DTT multiplexes.

7.125 We have therefore decided not to intervene in favour of DTT services in SD in the award of the digital dividend. However, we believe it is important to consider the issues faced by such services that generate broader social value. We will do so in our second PSB Review, which is currently under way.

7.126 Table 7 summarises our application of the total value framework to DTT services in SD. Annex 2 sets this out in more detail.

Table 7. Application of the total value framework to DTT services in SD

Market failure	Case for intervention	Conclusion
Capital market failures	There is a risk of market failure in relation to capital market barriers faced by the BBC and Channel 4 The best option for resolving these would be to relax these barriers if justified	This issue is a matter for the Government, the BBC and Channel 4
Broader social value	The evidence of incremental broader social value generated by this use is insufficient to warrant intervening given the high opportunity cost If intervening is required in the future, the first best option would be direct funding. This option would not be precluded by our market led approach	No intervention in DDR

HD

7.127 The DDR consultation document assessed the risk that any of a number of different potential market failures could prevent bidders fully reflecting their valuation of spectrum for DTT services in HD in a market led award. These were:

- capital market failures;
- the existence of broader social value generated by the availability of HD content in general;
- the risk that bidders will not reflect in their willingness to pay for spectrum the potential negative impact on the DTT platform of a failure to acquire spectrum to deliver DTT services in HD;
- the risk that bidders will not reflect in their willingness to pay for spectrum the importance of universally available PSB content in HD for generating broader social value;
- coordination problems; and
- the risk that services funded by advertising will under-represent the total value that they generate.

Consultation responses

- 7.128 As discussed at the beginning of this section, we received a very large number of responses on this issue. Many of the responses also related to our assessment of the risk of market failure for HD.
- 7.129 Many respondents saw a need to reserve spectrum for DTT services in HD to allow a critical mass of five channels to be delivered. PSBs and HDforAll argued that this would not be possible using existing capacity.
- 7.130 A number of respondents argued that the DTT platform would decline if additional spectrum were not made available for DTT services in HD and that spectrum be reserved for this use. In particular, they claimed that HD would be the new broadcasting standard and that the DTT platform would lose audience share to other delivery platforms.
- 7.131 PSBs claimed that they were not capable of acquiring spectrum at auction. They often cited MNOs as having access to greater funds and claimed that the incremental revenue from DTT services in HD, where applicable, would not be sufficient to fund bids. In return, the PSBs stated that they would be willing to accept various conditions (e.g. a requirement to provide near universal access) for the gift of this spectrum.
- 7.132 There were also a significant number of responses from individuals supporting HDforAll and gifting spectrum to PSBs for DTT services in HD. Those critical of our proposals in this area often raised questions about our market research (see below).
- 7.133 However, a number of respondents expressed strong support for our proposal to package the spectrum in a way that would be suitable but not reserved for DTT. This group felt that our arguments for a market led approach were strong and that there was no basis for departure in respect of DTT services in HD. To do so would distort competition, compound the significant intervention of gifting spectrum to the existing six DTT multiplexes and introduce significant opportunity costs (notably by increasing spectrum scarcity for other uses). This group included MNOs, BT, other telecommunications organisations and BSkyB.

Our response

- 7.134 In response to the request to gift further spectrum for DTT purposes, we note that almost 70% of the spectrum released at DSO has already been reserved for DTT. This will bring better coverage, better reception and more free to air channels. Our remit is to consider how best to release the remaining 30% of this spectrum for new uses.
- 7.135 In relation to the capital market failure risk, our assessment is the same as that for DTT services in SD. This is that the capital market failure is a potential risk, and we believe that this is a matter for the Government, the BBC and Channel 4. Table 7 above summarises the application of our framework to this issue.
- 7.136 At the time of the DDR consultation document, there was significant uncertainty about the strength of demand for DTT services in HD. This has lessened to some degree. It seems clearer now that HD will play an important role, with uncertainty instead about the mix of SD and HD content that consumers will demand.
- 7.137 The issue at the heart of the consultation responses is whether the DTT platform is able to deliver services in HD using its existing capacity and, if not, whether the importance of additional spectrum would be reflected in a market led award of the digital dividend. We have looked closely at this, particularly the options for PSBs to increase the capacity of the DTT platform, through both technological improvements and the acquisition of additional spectrum, to deliver new services.
- 7.138 As indicated in our recent DTT consultation document and the announcement by the PSBs supporting our proposals,⁴³ we believe it is credible to deliver PSB content in HD using existing capacity. This is because significant additional capacity—at least 20% more than now—will be created on the DTT platform by DSO. Use of this capacity in combination with technological upgrades provides the opportunity to deliver services in HD, if this is the best use of the capacity. In our consultation, we set out the reasons why we believe the platform would be able to organise itself to move to new technologies if there are benefits from doing so. The market failure risk we identified in the consultation was whether the pace and scale of this upgrade would be optimal. We welcome the announcement by the PSBs in advance of the digital dividend awards as we believe this will allow them and others interested in delivering services over the DTT platform to make a better assessment of their need for additional spectrum.
- 7.139 It is worth noting that our decision to consult on the options for upgrading the DTT platform to new technologies is independent of our work in the DDR. Although there are clear links, we believe upgrading the DTT platform to secure more efficient use of existing spectrum would be justified even if the digital dividend was not available. However, the platform's ability to evolve in the longer term is an important consideration, for both us and industry, when assessing how important additional (digital dividend) spectrum is to the platform. We have therefore taken the recent announcements into account in assessing whether there is a risk of market failure in relation to DTT services in HD that warrants intervening in the award of the digital dividend. This does not mean that when the platform is upgraded, the additional capacity should or will be used for HD. Rather, it means that the upgrade provides the opportunity for HD if the value of this use turns out to be such that it is the best use of this capacity.

⁴³ www.bbc.co.uk/pressoffice/pressreleases/stories/2007/11_november/20/hd.shtml.

7.140 Given the ability of the DTT platform to provide PSB content in HD using existing capacity, in the case where this is the best use of the capacity, we believe that intervention in the award of the digital dividend for this use is not justified. Moreover, we consider that the move to new technologies on the platform will promote a virtuous circle of consumer take-up of equipment that receives services broadcast using those technologies. This will, in time, allow other multiplexes to expand their capacity by moving to these new technologies and hence provide many options for expanding the range of services in HD (and SD) if consumer demand warrants this. If HD does become the standard mode of broadcast, there will be strong incentives for the platform to develop in this way.

7.141 We also note the findings of the House of Commons Select Committee on Culture, Media and Sport in its report on public service content in relation to this issue:

We have continued to listen to the arguments but we fail to see how transmission of extra high definition digital terrestrial television channels delivers sufficient extra public value to justify intervention. In any case, we note that Ofcom and the public service broadcasters have agreed in principle that it is technically possible to transmit up to four channels in high definition within their current allocation of spectrum. We agree that the most appropriate use of the vacated spectrum is best determined by market mechanisms and note that this will still allow the broadcasters the option of purchasing additional spectrum in the market place.

7.142 We consider that the incremental broader social value that might be generated by using the digital dividend to provide additional capacity to the DTT platform for services in HD, above what might already be provided, is likely to be limited. Therefore, given the opportunity cost of intervening in favour of DTT services in HD (this is comparable to the opportunity cost of intervening for SD mentioned above) and the risk of regulatory failure, we have decided not to intervene to set aside spectrum for DTT services in HD. This does not mean that we think that DTT services in HD are not a plausible use of the digital dividend, just that we do not think it is appropriate to intervene to favour this use over others.

7.143 Table 8 summarises our application of the total value framework to DTT services in HD. Annex 2 sets this out in more detail.

Table 8. Application of the total value framework to DTT services in HD

Market failure	Case for intervention	Conclusion
Capital market failures	There is a risk of market failure in relation to capital market barriers faced by the BBC and Channel 4 The best option for resolving these would be to relax these barriers if justified	This issue is a matter for discussion between the Government, the BBC and Channel 4
Broader social value: general	The evidence of incremental broader social value generated by this use relative to others is insufficient to warrant intervening by allocating spectrum additional to the 256 MHz already reserved for DTT	No intervention in DDR

Market failure	Case for intervention	Conclusion
Broader social value: detrimental effects on the DTT platform	The evidence of detrimental effects on the DTT platform is uncertain If there are significant detrimental effects in the future, these could be remedied by using existing spectrum to offer HD services	No intervention in DDR
Broader social value: universal availability of PSB content in HD	A future requirement for universal availability of PSD HD content is possible but not certain There is sufficient capacity within the existing spectrum reserved for DTT to allow this to be provided without further spectrum being allocated	No intervention in DDR
Coordination failures	The coordination problem faced by bidders for spectrum for an additional DTT multiplex to offer HD services are not significant enough to suggest a market failure risk See annex 2 for detailed discussion	No intervention in DDR
Advertiser funding business model failure	The use of the advertiser funding business model by some bidders does not provide significant evidence of a market failure See annex 2 for detailed discussion	No intervention in DDR

Mobile broadband

7.144 Mobile broadband comprises future cellular and Internet access services such as future evolutions of 3G cellular mobile, Mobile WiMAX and the complete family of IMT technologies (previously known as IMT-2000 and IMT-Advanced). Annex 7 sets out recent developments related to these services. In summary, they are as follows:

- our 2007 market research has indicated that improved mobile phone and mobile broadband services generate high value for citizens and consumers;
- our technical analysis indicates that mobile services can, subject to appropriate constraints, operate in cleared spectrum without creating excessive interference to DTT. We are continuing to look at their operation in interleaved spectrum;
- our technical analysis has also indicated that using UHF bands IV and V would substantially reduce the cost of infrastructure to provide mobile broadband services to rural and built up areas compared to using higher frequency spectrum (e.g. 2100 MHz). However, more sites would be required than using 900 MHz spectrum in order to limit interference to neighbouring countries in accordance with GE-06; and
- economies of scale in the mobile equipment market may significantly affect the value to society that can be generated by use of the digital dividend for mobile services. Our work to help realise these is set out in section 3.

7.145 The DDR consultation document considered there to be one potential source of market failure that could prevent mobile broadband bidders from participating at auction on an equal footing. This is the risk that universal access to mobile broadband generates broader social value that is not reflected in bidders' willingness to pay for spectrum. We concluded that the risk of the presence of broader social value resulting in a market failure in the award of the digital dividend is limited and so

proposed to take no action beyond packaging the spectrum in a way that does not preclude mobile broadband use.

Consultation responses

- 7.146 218 responses (172 from individuals and 46 from organisations) specifically addressed this issue. A number of others touched on it in the context of other points.
- 7.147 Approximately a third of individual respondents agreed that we should not preclude mobile broadband use of the digital dividend, while two thirds disagreed. Most of those who disagreed did so because they supported reserving spectrum for other uses (e.g. DTT services in HD and PMSE).
- 7.148 Most of the organisations that responded agreed with our proposals. Some, particularly telecommunications companies, also thought that we needed to achieve EU harmonisation of a sub-band of the digital dividend, thereby securing economies of scale.
- 7.149 The Scottish Executive (now the Scottish Government) and the Welsh Assembly Government both felt that there was a strong case for reserving spectrum for this use. Other groups argued that we should allocate some spectrum for a licence exempt mobile broadband service.
- 7.150 Annex 4 contains a detailed consideration of responses to this issue.

Our response

- 7.151 We are still of the view that the potential for market failure related to mobile broadband in a market led award of the digital dividend is too low to justify intervening in the award. The reasons for this are twofold:
- we believe that the high private value for using the digital dividend for mobile broadband is likely to be correlated with the high broader social value. This means that, while the broader social value will not be directly reflected in bids, those made are likely to be sufficiently reflective of the relative total value of this use when compared to others; and
 - the key market failure risk in relation to mobile broadband seems to be a risk that individual operators' rollout decisions may fail to reflect the broader social value generated by universal access. While the degree of rollout is not independent of the spectrum available, mobile operators are unlikely to require the digital dividend to achieve universal access. If wider access is required in the future, the most effective intervention option to deliver this may be providing operators with direct funding targeted directly at the additional rollout desired. This would be more likely to create incentives for the most efficient delivery of the service than imposing controls on inputs, such as the digital dividend. This is similar to the approach that has been employed by Regional Development Agencies and others to achieve greater availability of fixed broadband services.
- 7.152 We also note that the opportunity cost of intervening in favour of mobile broadband uses is potentially very high. Our modelling work (as discussed in annexes 2 and 8) suggests that this could plausibly be in the region of £1-2.5bn (NPV over 20 years). This suggests that we would need very strong evidence of market failure before deciding to intervene in the award of the digital dividend.

7.153 We also do not accept the argument that we should exclude mobile broadband from the award:

- all the available evidence suggests that mobile broadband is as likely to generate high value for society as other potential uses of the digital dividend, including DTT services in HD. International developments (e.g. at WRC-07 and in the United States) are increasing the plausibility of mobile broadband as a use; and
- as discussed above, we do not accept the arguments for reserving spectrum for DTT services in HD, nor do we accept that intervening is required to restrict mobile broadband use in order to protect PMSE users. Our approach to ensuring that PMSE users have sufficient access to spectrum is discussed above.

7.154 We have therefore decided not to intervene in favour of mobile broadband in the award of the digital dividend. We will ensure that packaging and award design reflect our support for non-mandatory, non-exclusive European harmonisation of a sub-band that can provide economies of scale for equipment.

7.155 Table 9 summarises our application of the total value framework to mobile broadband. Annex 2 sets this out in more detail.

Table 9. Application of the total value framework to mobile broadband

Market failure	Case for intervention	Conclusion
Broader social value	<p>It seems plausible that wider access to mobile broadband may generate broader social value. However, there is insufficient evidence of the need to intervene in the award of the digital dividend to achieve this</p> <p>If intervention is required in the future to achieve wider geographic access to mobile broadband services, the first best option may be direct funding. This option would not be precluded by our market led approach</p>	No intervention in DDR

Mobile television

7.156 The DDR consultation document noted the suitability of UHF bands IV and V for providing mobile television. It noted the suitability of other spectrum, some of which, at L-Band (1452-1492 MHz) and 2.6 GHz, we expect to auction in the first half of 2008. Additionally, mobile multimedia services are already being offered over 3G.

7.157 According to the results of our 2007 market research, consumer interest in mobile television appears to be lower than in other potential uses of the digital dividend, though a significant minority of consumers appear very interested. Additionally, mobile television is a nascent service, so current consumer appeal may not fully reflect the future level of demand, and stakeholders have expressed a high level of interest in using the digital dividend to provide mobile television. There is an interest in acquiring spectrum for this use among those with an established interest in mobile cellular and broadcasting (e.g. MNOs, mobile equipment manufacturers and broadcasters such as BSkyB).

7.158 Our economic modelling indicates that, allowing for a wide variety of assumptions about how services might develop over time and the availability of other spectrum, mobile television is a plausible use of the digital dividend with a potentially high value to society, particularly consumers.

7.159 We have also taken into account the Commission Communication on strengthening the internal market for mobile television, published on 18 July 2007.⁴⁴ This calls on Member States to facilitate the deployment of mobile television, including by making spectrum in UHF bands IV and V available as quickly as possible.

Consultation responses

7.160 A number of respondents stated that mobile television could be provided using other spectrum and so the digital dividend was not critical to its delivery. They nonetheless sought an overall view of spectrum suitable for use by mobile television that would be released by 2012.

7.161 MNOs and mobile equipment manufacturers stated their support for a harmonised sub-band for mobile television, claiming that this would deliver significant economic benefits and kick-start take-up in the UK.

7.162 Ericsson felt that demand for all mobile applications was growing. Nokia felt that the UK risked lagging behind the rest of Europe on mobile television and that the London Olympics were a major opportunity for mobile television. Nokia argued that mobile television's contribution to the economy would be different if it used the digital dividend rather than L-Band. Nokia also argued that mobile television could use interleaved spectrum.

7.163 There was a distinct lack of support for mobile television from individuals who responded. Some raised potential safety concerns about using handheld equipment when driving. Others felt that this was a niche market and pointed to a lack of demand for or interest in services that are already available. RNID also felt that there was no technical need or consumer demand. However, ACOD noted the usefulness of mobile television in social care situations.

7.164 Digital TV Group was looking at deploying low power networks for mobile television and other services where collocation with DTT transmitters is not possible.

7.165 Qualcomm stated that its consumer research had shown high demand for mobile television and that it would need only small packages of spectrum—8 MHz—to deliver it.

7.166 Intellect noted that mobile television might be advertising based rather than pay per view. It thought that our analysis of mobile television fit the experience in Europe.

7.167 Arqiva noted current progress in Finland and Italy and the potential impact of the London Olympics on mobile television. It believed that there was proven demand for this service, pointing to the O₂/Arqiva DVB-H consumer trial as an indicator. It argued that other spectrum would be less efficient than UHF bands IV and V and highlighted that market led harmonisation was already under way throughout Europe for mobile television use of this spectrum.

Our response

7.168 We are still of the view that there are no material market failure risks related to mobile television in a market led award of the digital dividend.

⁴⁴ http://ec.europa.eu/information_society/policy/ecomms/doc/library/communications_reports/mobile_tv/409_en_original.pdf.

- 7.169 No points raised by respondents suggest that our market failures assessment is incorrect.
- 7.170 Responses suggest that there is considerable interest among stakeholders in this use and a belief that delivering mobile television using the digital dividend may generate higher value than using other spectrum. Our economic modelling work takes this assessment into account and also suggests that mobile television is a plausible high value use of the digital dividend.
- 7.171 We have therefore decided not to intervene in favour of mobile television in awarding the digital dividend. We will ensure that packaging and award design reflect our support for non-mandatory, non-exclusive European harmonisation of a sub-band that can provide economies of scale for equipment for this use.
- 7.172 Table 10 summarises our application of the total value framework to mobile television. Annex 2 sets this out in more detail.

Table 10. Application of the total value framework to mobile television

Market failure	Case for intervention	Conclusion
No market failure issues identified	N/A	No market failure concerns

Conclusion

- 7.173 Table 11 summarises the findings of our assessment of whether there is a case for departing from our market led approach to the award of the digital dividend.

Table 11. Summary of assessment of departing from a market led approach

Service	Assessment of key case for intervention	Conclusion
PMSE	<p>There is a transitional risk of a coordination failure for users who require high quality access to spectrum. These are due in part to the significant barriers these users currently face to participating in a market led approach</p> <p>PMSE users who are content to accept lower quality access face further issues. These are best resolved by accessing spectrum on a licence exempt basis</p>	<p><u>Interventionist approach</u></p> <p>Given the transitional coordination failure that results from the barriers these users currently face to participating in a market led approach to spectrum access, we have concluded that we need to reserve spectrum for this use</p> <p>We should also consider whether more could be done to facilitate access for some users on a licence exempt basis</p>
Local television	<p>There is a risk of a coordination failure that would be best resolved through auction design and packaging</p> <p>There is likely to be broader social value generated by the delivery of local content, but the incremental value generated by delivery via the DTT platform is unclear and is unlikely to be sufficient to result in a market failure</p> <p>Given the nature of the content, alternative delivery platforms (e.g. the Internet) may be a more efficient approach to realising the value generated</p>	<p><u>Market led approach</u></p> <p>Using auction design and packaging to resolve the coordination failure is consistent with a market led approach to the award of the digital dividend</p> <p>Direct funding could be provided to support this service in a bid for spectrum if the incremental broader social value warrants it</p>

Service	Assessment of key case for intervention	Conclusion
DTT services in SD	<p>The presence of broader social value generated by additional SD channels of a community/citizen nature does not suggest that there is a market failure that should be rectified through reserving spectrum</p> <p>This is a wider issue that is likely to be better resolved through other means. This could involve acquiring additional capacity on existing multiplexes and/or delivery over other platforms (e.g. the use of PVRs or the Internet) that might be better suited to some of this content</p>	<p><u>Market led approach</u></p> <p>We will consider the wider issues raised by community/citizen channels in the second PSB Review</p> <p>Direct funding could be provided to support this service to acquire more multiplex capacity (and/or spectrum) if this is warranted</p>
DTT services in HD	<p>There is potential for broader social value to be generated by providing PSB content in the future in HD</p> <p>However, this does not constitute a market failure that requires us to intervene in awarding of the digital dividend. It is already expected to be possible to deliver DTT services in HD without extra spectrum. If the situation arises where HD is the universal broadcasting standard (and hence clearly the best use of DTT capacity), the platform will have very strong incentives to evolve in this direction</p>	<p><u>Market led approach</u></p>
Mobile broadband	<p>It is reasonably likely that widespread access to mobile broadband would generate broader social value. However, this is unlikely to result in a market failure in the award of the digital dividend given the strong private incentives potential operators have to acquire low frequency spectrum to provide wider coverage for mobile services at lower cost</p>	<p><u>Market led approach</u></p> <p>If the level of rollout achieved in the future is lower than required from the perspective of broader social value generated by universal access to this service, this can be resolved through targeted direct funding</p>
Mobile television	<p>There are no identified market failure issues for this service</p>	<p><u>Market led approach</u></p>

Section 8

The digital dividend awards

Introduction and summary

- 8.1 This section sets out our decisions on implementing the digital dividend awards, in particular the mechanisms for releasing the spectrum. We conclude that where we do not reserve spectrum for a particular use, the appropriate mechanism for award is an auction.
- 8.2 In practice, this means that we will not intervene in the award of cleared spectrum. These will be auctioned on a service and technology neutral basis.
- 8.3 We will, however, intervene in the award of interleaved spectrum by reserving spectrum for use by a band manager who will have obligations toward PMSE users. We propose to award this spectrum via a beauty contest.
- 8.4 We will also package some interleaved spectrum to address the coordination failures faced by local television operators that we identified in section 7. This spectrum, and our proposed award of channels 61 and 62 where they are available, will be auctioned on a service and technology neutral basis.
- 8.5 This means we propose to hold three distinct awards of interleaved spectrum:
- a beauty contest for a package with PMSE obligations;
 - an auction for geographic packages suitable but not reserved for local television in about 25 locations throughout the UK; and
 - an auction for channels 61 and 62 where they are not being used for DTT.
- 8.6 We expect the award of channels 61 and 62 to be grouped in practice with the award of cleared spectrum.
- 8.7 We will consult on the detailed design of these awards.

Mechanism for award

- 8.8 The DDR consultation document set out our preference for auctions as the most efficient mechanism for awarding the digital dividend under a market led approach and hence the approach that would be expected, in the absence of market failures, to maximise the total value generated by using the digital dividend. This meets our general policy, set out in the SFR, that auctions are the most open, transparent and non-discriminatory method for awarding spectrum. Alternative mechanisms, such as beauty contests (also known as comparative selection), carry the risk of subjective judgements and not awarding spectrum to the user best able to maximise value to society. A well designed auction, with appropriate licence conditions and packaging, should give the market maximum flexibility to determine who uses spectrum, for what and how. This further reduces the risk of regulatory failure and unnecessary intervention inherent in other approaches.

Consultation responses

- 8.9 We received responses from all groups of stakeholders. Views were divided not just between different groups but also between respondents within the same group.
- 8.10 Broadly speaking, organisations such as the MNOs, BSkyB and BT were in favour of auctioning the digital dividend.
- 8.11 The PSBs did not support auctioning the entire digital dividend. Their reasons mainly centred on their ability to deliver their DTT services in HD and their view that more free to air services would bring enormous societal benefits to the UK. The PSBs felt that they would not be able to compete financially with large private organisations (notably the MNOs) in an auction and argued for an appropriate amount of the spectrum to be reserved to operate an additional DTT multiplex reserved for HD. The PSBs had strong support from a wide range of stakeholders, including the Digital Supply Group, Sony and individuals. A number of these argued that the DTT platform would fail if services were not provided in HD.
- 8.12 OSAB supported our proposals but sought assurance that packages would be suitable for a wide range of applications and confer no inherent disadvantage to UK competitiveness. ACNI also agreed with auctioning. OCP felt strongly that the award process should reflect the broader social value of services and urged us to do more work on this. It also proposed that some spectrum be held back in the form of a “spectrum bank” for future uses with high broader social value.
- 8.13 Other concerns raised by respondents stemmed from fears of spectrum hoarding and the perceived inability of some organisations, which pursue purely social goals, to take part in an auction.

Our response

- 8.14 We do not believe that there is sufficient evidence to justify awarding the digital dividend, with the exception of a package with PMSE obligations, by a mechanism other than auction. Our response to the cases for intervention (e.g. for DTT services in HD and local television) is detailed earlier in this statement. This explains why we do not believe it is necessary to depart from a market led approach for any use other than PMSE in order to maximise the total value generated by using of the digital dividend.
- 8.15 Packages suitable for local television could, as discussed below, facilitate national as well as local or near UK wide services. Interleaved spectrum not awarded at auction and not necessary for PMSE could also be made available by the band manager for other uses.
- 8.16 As discussed in section 5, markets are good mechanisms for deciding the optimum use of inputs in the economy, and direct funding is in general a better way of providing subsidies to services that deliver broader social value than gifting inputs like spectrum.
- 8.17 Our approach to auction design will seek to ensure that packages are suitable for as wide a range of services as possible taking into account likely levels of demand. We will pay careful attention to how award design can help to promote competition. Section 10 sets out our views on the importance of considering competition issues when designing the digital dividend awards.

Packaging

Cleared spectrum

- 8.18 The DDR consultation document proposed packaging cleared spectrum on a service and technology neutral basis suitable for any potential use.
- 8.19 It outlined six potential packaging options, from a single lot of 120 MHz to 15 lots each of 8 MHz. These are summarised in table 12. These options assumed UK wide coverage and sought to minimise the effects of interference, both domestic and international, and aggregation risk. They also took account of GE-06 assignments, set in 8 MHz channels, and the potential need for new international agreements.

Table 12. Potential packaging options for cleared spectrum

Lots	Channels
1	31-37 + 39-40 + 63-68
3	31-37 • 39-40 • 63-68
4	31-34 • 35-37 • 39-40 • 63-68
4	31-33 + 63-65 • 34-37 • 39-40 • 66-68
5	31-33 • 34-37 • 39-40 • 63-65 • 66-68
15	31 • 32 • 33 • 34 • 35 • 36 • 37 • 39 • 40 • 63 • 64 • 65 • 66 • 67 • 68

- 8.20 We sought comments on which of these options would be most suitable.

Consultation responses

- 8.21 Taken together, there was no common view among the 86 responses that we received. Many respondents were waiting until further information was supplied and matters of uncertainty (e.g. EU harmonisation) resolved.
- 8.22 More flexibility and packages that permitted optimal aggregation were favoured over a single lot as these provided for the widest range of services from the widest range of providers. Mobile television operators, telecommunications providers and PSBs (once sufficient spectrum for a DTT multiplex was reserved) favoured smaller lots, although they noted the complexity of this approach. Many respondents highlighted competition concerns that might result from a single lot.
- 8.23 Some respondents agreed that cleared spectrum should be packaged in a way suitable but not reserved for mobile broadband. Most organisations and individuals took this view, as did ACOD and ACS. Some, principally the Scottish Executive and the Welsh Assembly Government, argued that spectrum should be reserved for mobile broadband. Electrical retailers and some individuals argued that this use should be excluded because the spectrum should only be used for DTT services in HD. Some individuals also believed that the properties of the digital dividend made it better suited to services other than mobile broadband. OSAB thought that the markets for mobile broadband and mobile television might converge in due course, and ACNI wanted the possibility of all Ireland services to be considered.
- 8.24 The four and five lot options gained more support in general. However, many respondents thought that the options needed to take better account of the suitability of a single 8 MHz channel for mobile television use.

- 8.25 There were some concerns about whether UK wide packages were appropriate. For example, ACNI suggested that a separate approach might be needed for Northern Ireland given a potential lack of bidders and all Ireland spectrum issues.
- 8.26 Consumer bodies and community groups were concerned that our proposals were not suitable for local and community media and broadcasters.

Our response

- 8.27 We remain in favour of auctioning cleared spectrum on a UK wide basis, although we are discussing our proposals with the Irish authorities. We will do this in a way that allows the widest possible range of uses including DTT, mobile television and mobile broadband. This will permit maximum flexibility of use and therefore ensure that the market and ultimately users will decide the best use.
- 8.28 We have made no decisions about the detailed design of the packaging. We will consider this issue in greater detail when consulting on detailed award design.

Interleaved spectrum

- 8.29 The DDR consultation document proposed packaging interleaved spectrum as follows:
- a large number of packages consisting of a single (interleaved) channel that could be used to provide a broadcast-like service at moderate to high power from an individual main station transmitter. These packages would be suitable but not reserved for local television use as there are other potential uses. One or two packages could be made available in each of up to 50 main station areas. This would imply a total of between 50 and 100 such packages. Use would not be limited to such high power broadcast transmissions, but the usage rights would be compatible with this use; and
 - a small number (perhaps one, two or three) of larger packages consisting of the right to use a subset of interleaved spectrum across the whole of the UK while having to protect other services. These packages would be suitable but not reserved for PMSE use, subject to transitional protection for PMSE users to ensure that they could continue to access interleaved spectrum until at least the end of 2012.
- 8.30 Again, we sought comments on which of these options would be most suitable.

Consultation responses

Packaging suitable for local television

- 8.31 The PSBs were generally supportive of our proposals for these packages and did not favour any further action in support of local television.
- 8.32 Within the local television sector, there were broadly two groups of respondent:
- one group felt that interleaved spectrum was insufficient to provide a reasonable level of service since it would not allow UK wide and/or universal service. Instead, the only viable option was the add/drop solution on the DTT platform; and

- another group felt that interleaved spectrum was the best route for providing services but was concerned about how local television operators could secure access. It preferred gifted spectrum to auctions and was not convinced that broader social value could be secured under a market led approach.

8.33 A number of respondents thought that measures might be required to ensure that these packages were used for local television rather than a sub-UK DTT multiplex and to prevent PSBs from bidding. Other respondents proposed changes to the award process to give local television better prospects of acquiring the packages.

Packaging suitable for PMSE

8.34 Responses to our proposals were set out in our PMSE consultation document.

8.35 That consultation document favoured awarding a single package of interleaved spectrum with obligations relating to PMSE use. This reflected users' negative experiences of dealing with more than one service provider prior to 1996 and our own view that dividing the spectrum into separate packages was unlikely to have significant competition benefits, at least in the short term. This was because of restrictions on the tuning range of equipment and/or users' need to access large quantities of spectrum for special events.

8.36 Respondents to the PMSE consultation document again expressed a strong preference for a one stop shop for spectrum use and hence for a single package of interleaved spectrum to be assigned to a band manager. They understood that this would result in a dominant supplier of spectrum for many PMSE applications but hoped to receive protection by virtue of price controls placed on the band manager.

Our response

8.37 Respondents identified a number of potential uses of interleaved spectrum, including:

- local television;
- one sub-UK DTT multiplex;
- PMSE; and
- mobile communications services like voice and data.

8.38 Each of these could make use of cleared and/or interleaved spectrum, although services such as local television and PMSE are better suited to interleaved spectrum.

8.39 Our high level approach to identifying packages of interleaved spectrum has been to assess where there is strong evidence of demand from non-PMSE uses and, where this is the case, to pursue a market led award. We think that remaining interleaved spectrum, for which the current evidence of demand from alternative uses is less strong, should be assigned to the band manager with PMSE obligations. We intend to ensure that the band manager has incentives to promote spectrum efficiency and hence will be able to allow other (non-PMSE) users to access its spectrum so long as reasonable PMSE demand has been met.

8.40 We think this approach to identifying packages of interleaved spectrum appropriately balances the need to provide sufficient spectrum for PMSE users with promoting

spectrum efficiency. Hence, this approach is consistent with our objective for the DDR of maximising the total value generated by using the digital dividend.

8.41 Using this approach, we have decided:

- to award one or two packages suitable but not reserved for local television in about 25 locations with known or likely demand for this use;
- to propose awarding a package of channels 61 and 62, where not already assigned, suitable but not reserved for two way mobile use. This reflects TG4’s preferred sub-band of channels 62 to 69 and the close proximity of channels 61 and 62 to cleared spectrum in the UK; and
- a single package comprising most interleaved spectrum and with obligations relating to PMSE use, to be awarded by beauty contest to a band manager. This will avoid the risk of market failure faced by PMSE users.

8.42 The evidence we used when identifying sources of demand is set out below. In this discussion, we also reflect on the issues raised by respondents.

Packaging suitable for local television and DTT

8.43 These packages will comprise one or two in group channels able to permit broadcasts at sufficient power to be received by most households in the transmitter coverage area. NGW investigated the availability of frequency assignments within interleaved spectrum that would be suitable for local television and DTT at 71 main transmitter sites (see NGW technical report). We anticipate awarding packages in about 25 locations.

8.44 This is less than the 50 locations mentioned in the DDR consultation document but, we believe, reflects reasonable demand for local television. It takes into account the level of population coverage that may be required for this service to be commercially viable as well as areas where local television is already available. We would consider adding further locations identified by potential providers, including community operators, as being of interest. We will consult on the locations in the next phase of the DDR. We intend to invite views on whether to add more sites to, or indeed subtract sites from, this list by inviting those parties interested in providing local television services to provide evidence of demand.

8.45 Table 13 gives an indicative list of these 25 locations. The number of households that it reports as served is likely to overstate the actual coverage that could be achieved as it assumes transmission from the top of the transmitter tower and does not take account of potential interference from other services.

Table 13. Indicative list of packages suitable for local television and DTT

Channel	Main city/county/ surrounding area	Active RSLs	Transmitter	QPSK—max. households served (millions)	64QAM—max. households served (millions)
29	Greater London		Crystal Palace	3.9	2.9
56	Manchester/Liverpool/ surrounding region	Channel M	Winter Hill	3.0	2.6
51	Glasgow/part of Edinburgh		Black Hill	1.4	1.2

Channel	Main city/county/ surrounding area	Active RSLs	Transmitter	QPSK—max. households served (millions)	64QAM—max. households served (millions)
51	Birmingham/West Midlands		Sutton Coldfield	1.3	0.9
56	Newcastle		Pontop Pike	1.2	1.0
45	Yorkshire (Leeds, Doncaster, York)		Emley Moor	1.0	0.7
24	Middlesbrough/York/North Yorkshire	York	Bilsdale	1.0	0.6
29	Southampton/surrounding region		Rowridge	0.8	0.5
55	Leicester	MATV	Waltham	0.8	0.4
52	Part of Edinburgh		Craigkelly	0.7	0.6
51	Cardiff	Capital TV	Wenvoe	0.7	0.5
21	Lincoln/Kingston or Hull		Belmont	0.7	0.3
43	Reading/Newbury		Hannington	0.5	0.2
30	Belfast	NvTv	Divis	0.4	0.3
57	Norwich		Tacolneston	0.4	0.3
49	Cambridge/Northampton/ Peterborough		Sandy Heath	0.4	0.2
55	Bristol		Mendip	0.3	0.2
49	Ipswich/Suffolk		Sudbury	0.3	0.2
49	Oxford	Six TV	Oxford	0.3	0.2
48	Wolverhampton/Telford		The Wrekin	0.3	0.2
57	East Kent		Dover	0.3	0.1
54	Sussex		Heathfield	0.2	0.1
21	Carlisle	Carlisle TV	Caldbeck	0.1	0.1
30	Herefordshire		Ridge Hill	0.1	0.1
48	Londonderry	Channel 9	L/derry	<0.1	<0.1

8.46 As discussed in section 7, we have given further consideration to the option of delivering local television via add/drop. Although we recognise that this is a technically feasible option on either an existing or additional national multiplex, the proposal suffers from a number of fundamental disadvantages that mean that we do not support its implementation. These were set out in section 7.

8.47 Packages will be awarded by auction to the highest bidder, even where there is only one in group channel available. It is, of course, possible that potential local television operators may be outbid by a prospective multiplex operator or other users. However, it is important to note that a single multiplex can carry several video streams, so opportunities for local television may still exist if this happens. Section 7 and annex 2 consider whether there are any market failures that could justify reserving spectrum for local television or preventing other users from bidding for these packages. This assessment has concluded that there are no market failure risks that justify this form of intervention.

8.48 Ideally, we would conduct these awards at least a year before DSO to give successful bidders time to roll out their operations before spectrum becomes available for use. This is not possible for regions where DSO starts in 2008. This

could cause significant problems for existing RSL operators in regions where DSO is relatively early as they cannot transmit in analogue after DSO in their region but might be unable to acquire an assignment enabling digital transmission sufficiently in advance of DSO. There are three such operators:

- the Carlisle RSL operator, located in Border, where the Caldbeck transmitter will undergo DSO in summer 2009;
- Channel M, located in Granada, where the Winter Hill transmitter and its dependent relays will undergo DSO in winter 2009; and
- the Cardiff RSL operator, located in Wales, where the Wenvoe transmitter will undergo DSO for March 2010.

8.49 We plan to award to award these packages sequentially, with the first set of packages in those locations (including the Caldbeck, Winter Hill and Wenvoe transmitters) in late 2008 and the remaining packages at a later date. We believe this is necessary to provide existing RSL operators with sufficient clarity prior to DSO about their options for future spectrum access. However, this approach does have some downsides as it may create aggregation risks for an operator who wishes to offer services in more than one area. We will take this into consideration when deciding whether to award the remaining packages sequentially or simultaneously.

8.50 We acknowledge that varying RSLs to permit digital transmission could help stem the loss of viewers due to increased digital take-up. It could also help local television operators to develop a business case for securing spectrum by allowing them to use their existing licences to test and develop digital transmissions. We will, subject to technical and legal feasibility and international coordination, consider requests to vary existing RSLs to permit digital transmissions until DSO or, in exceptional circumstances, the award of the digital dividend. Short duration or event RSLs for digital transmission will also be available on request, subject to spectrum being available. All technical, planning, capital and operational costs will need to be met by the licensee. For the avoidance of doubt, access to the spectrum for digital transmissions would be purely on a temporary basis and would not create a legitimate expectation of continued use following DSO or, where relevant, the award of the digital dividend.

Packaging suitable for two way mobile

8.51 As set out in section 3, TG4 has identified a preferred sub-band of UHF bands IV and V that could be made available across Europe on a non-mandatory, non-exclusive basis for two way mobile applications. TG4 has concluded that this sub-band should include, as a minimum, channels 62-69 (798-862 MHz). This aligns closely with part of the UK's cleared spectrum, although channel 62 is only available on an interleaved basis and channel 69 is used for PMSE.

8.52 TG4 is currently looking at band plan options, some of which include extending the bottom edge of this sub-band down to channel 58. At the same time, we are investigating the feasibility of two way mobile use of interleaved spectrum. Initial indications are that downlinks are more likely to be feasible in interleaved channels than uplinks. This suggests that frequency division duplexing systems would potentially use interleaved spectrum for downlinks, with uplinks at the top end of the upper cleared spectrum, subject to appropriate technical constraints.

- 8.53 To maximise the potential benefits of harmonised spectrum use within Europe, we propose awarding interleaved channels 61 and 62 on a UK wide basis where they are available at the same time as cleared spectrum (including channels 63-68). We will consult on this proposal in more detail in the next phase of the DDR.

Packaging suitable for PMSE

- 8.54 In developing our proposals in relation to packaging suitable for PMSE, we have given careful consideration to our objectives for this sector, namely the need to:

- avoid disruption to PMSE users that adversely affects their ability to provide a wide range of services to citizens, consumers and business customers;
- facilitate the participation of PMSE users in a market led approach to spectrum, particularly to provide them with incentives for efficient use;
- promote the optimal use of the spectrum in relation to all potential uses and users over time; and
- avoid the risks of regulatory and market failure.

- 8.55 As discussed in section 7 and annex 3, we think these objectives have important implications for the approach we take to awarding this package and the obligations we impose on the band manager.

- 8.56 It is after taking into account the need to balance our objectives that we have decided to award a single package of remaining interleaved spectrum on the following basis (see annex 3 for the analysis completed to support these decisions):

- we will award the remaining interleaved spectrum by beauty contest to a band manager. We will seek to ensure through the beauty contest that its interests are aligned with those of the PMSE sector;
- the band manager will pay AIP as one essential part of developing a market led approach to spectrum access for PMSE users. The band manager will be able to make spectrum available for other uses but only where it is not needed to satisfy the reasonable needs of the PMSE sector;
- the band manager will need to make spectrum available to PMSE users on fair, reasonable and non-discriminatory terms. Annex 3 sets out further details of our initial thoughts on how we might interpret this requirement;
- the requirements to meet reasonable demand on reasonable terms will last until 2018. We believe that the mechanism for awarding the package (see below) greatly diminishes the risk that this date will represent a cliff edge at which PMSE users could lose all their access to interleaved spectrum. We also continue to believe that a decade of protection balances the lifecycle of equipment with the opportunity cost of precluding alternative uses of the spectrum, giving the sector sufficient time to prepare for any change that even a PMSE friendly licensee felt compelled to introduce; and
- the licence will have indefinite duration. We will be able to vary or revoke it after a minimum term for spectrum management reasons. This will enable us to take further steps to protect PMSE users if justified.

- 8.57 Our further work on award design will consider in detail how each of the requirements above will be achieved. Implementing our proposals will necessarily involve answering a number of questions about how the desired level of protection for PMSE users can best be achieved in practice.
- 8.58 In the light of consultation responses, we have decided not to set aside any of channel 69 for licence exempt use. Instead, we will award this for licensed use to the band manager. We will, however, encourage and consider what more can be done to promote greater licence exempt use of channel 70 by PMSE users who do not need the quality of service afforded by licensed use.
- 8.59 We have made no decisions yet about including spectrum outside the digital dividend and currently used for PMSE in the package for award. This is because there are complex issues relating to spectrum usage rights that will require further careful consideration and discussion. We will consider this in detail when consulting on detailed award design.
- 8.60 Separately, we will shortly publish detailed information on interleaved spectrum that is likely to be awarded as part of this package and therefore available for PMSE use in each region after DSO takes place. We have already published our decision to allow temporary PMSE use of channels 63 to 68 in the regions where DSO will take place before the end of 2009, up to the point where new users need access to the spectrum.⁴⁵

Conclusions

- 8.61 We conclude that where there is not a case for reserving spectrum for a particular use, the appropriate mechanism for awarding the digital dividend is by auction.
- 8.62 In practice, this means that:
- cleared spectrum will be awarded by auction. We will do this in a way that allows the widest possible range of uses;
 - we will intervene in the award of interleaved spectrum by awarding a package of spectrum to a band manager with obligations to make this available for PMSE. We will award this by beauty contest;
 - we will auction geographic packages suitable but not reserved for local television in a number of locations; and
 - we propose to auction interleaved channels 61 and 62 on a service and technology neutral basis.
- 8.63 We will consult on detailed award design in the next phase of the DDR.

⁴⁵ www.ofcom.org.uk/consult/condocs/pmse/statement/statement.pdf.

Section 9

Award timing

Introduction and summary

- 9.1 This section sets out our position on the timing of the digital dividend awards. We maintain our preference for awarding the digital dividend as soon as possible so that citizens and consumers can benefit from new services as soon as possible.
- 9.2 We plan to auction geographic packages of interleaved spectrum suitable but not reserved for local television sequentially, starting with packages in the Border, Granada, West Country and Wales regions before the end of 2008. We plan to auction the remaining geographic packages in 2009.
- 9.3 We plan to award the package of interleaved spectrum with PMSE obligations by beauty contest also before the end of 2008.
- 9.4 We will auction channel 36 alongside cleared spectrum because it is both a complement to and a substitute for that spectrum and an earlier award could result in a less efficient use of the digital dividend as a whole. As a consequence, we expect to auction cleared spectrum, channel 36 and (if confirmed) interleaved channels 61 and 62 during summer 2009.

Consultation proposals

- 9.5 We generally prefer to award spectrum as soon as possible because this allows citizens and consumers to receive new services with minimum delay. The DDR consultation document proposed that we do so in this instance. We expected to hold the award at least 16 months after consulting on detailed award design, suggesting late 2008.
- 9.6 The consultation document proposed awarding channel 36 alongside cleared spectrum, assuming that clarity and certainty about rights of use could be achieved in time. We favoured this approach for two reasons:
 - the most efficient use of channel 36 might be in combination with other parts of the digital dividend. Early award of the channel could require participants to bid without certainty that they would acquire other spectrum subsequently. Bidders might consider this risk too great, with the consequence that some uses of value to society might not be realised. This would be an inefficient outcome; and
 - a standalone award of channel 36 could only be held a matter of months earlier than the award of cleared spectrum anyway due to the legal steps necessary to hold an award.
- 9.7 The consultation document sought views on our proposals for timing and invited alternative suggestions with supporting evidence and analysis.

Cleared and interleaved spectrum

Consultation responses

- 9.8 This was a key issue. Some respondents argued for the award to be brought forward, while others suggested delay. Early award of channel 36 to enable the provision of mobile television was a factor for many who supported an earlier timeframe. This is discussed in more detail later in this section.
- 9.9 There was broad support, principally from telecommunications organisations, network providers, our advisory committees and mobile television providers, for our proposals. Some respondents noted the need for certainty in both the UK and the EU. Respondents, such as Microsoft and Philips, who favoured cognitive access noted that such licence exemption could be brought forward provided there was no harmful interference.
- 9.10 Most opposition to our proposals came from PMSE users, who sought additional protection for their spectrum use. They suggested that delaying a decision on channels 63-69 was necessary until more was known about the impact of losing access to the remaining cleared spectrum. The majority of broadcasters, some telecommunications organisations and some consumer bodies also considered that some delay was needed, mainly to take account of EU proposals for the digital dividend, to ensure harmonisation of spectrum bands and to allow sufficient time for analysis and planning by both us and stakeholders.
- 9.11 The high cost of bidding for cleared spectrum at auction in advance of its UK wide availability was also a concern, particularly for smaller organisations and those dependent on public funding. These respondents thought that more time was needed to allow them to secure necessary funding.
- 9.12 The PSBs requested that spectrum be held back until the demand for DTT services in HD could be properly assessed. A large number of individuals supported this view.
- 9.13 A few respondents noted the links between the timing of the award and the timing of DSO. It was thought premature for the former to take place before the first region, Border, completed DSO in 2009. Several respondents, including some MNOs, raised the need for potential sanctions and/or compensation if existing users did not vacate spectrum according to timetable (e.g. if DSO was delayed).
- 9.14 Specific to the interleaved spectrum, some respondents saw value in delaying award until primary users had certainty over their spectrum requirements, providing additional protection for DTT during DSO. It was suggested that this would reduce the likelihood of exaggerated bids.
- 9.15 Finally, some respondents favoured sequential release of some spectrum. They thought that this could assist new entrants and therefore foster competition. It was further noted that regional awards following the DSO timetable would benefit consumers by enabling use of spectrum as soon as it became available. Counter to this view, the higher risks associated with sequential bidding were raised.

Our response

- 9.16 We can award a licence to use spectrum in advance of its becoming available for use. We would simply make clear in the licence that rights of use did not start until

some specified future date. The timing of the digital dividend awards is therefore separate from the timing of the spectrum's availability for use.

- 9.17 Those not in favour of early award noted the uncertainties associated with each of the potential uses of the digital dividend (e.g. because of possible EU harmonisation or uncertain future demand for DTT services in HD). We maintain that it is likely some uncertainty will be associated with some uses at any point in time and that postponing the award would not resolve this problem.
- 9.18 We also believe that delaying the award to confirm whether demand exists for a particular use would skew the process in favour of that use. This would be inconsistent with our service neutral approach.
- 9.19 We consider that our approach to PMSE and DTT services in HD, set out earlier in this statement, deal satisfactorily with the concerns about these uses raised by respondents. We also consider that our decisions on whether to intervene in the award of the digital dividend take appropriate account of the need for some participants to secure direct funding. As indicated in section 7, we will also give further consideration to how auction design can help bodies reliant on direct funding to take part in digital dividend auctions.
- 9.20 A staggered award would have some advantages, but it would also introduce risks for participants who need a combination of packages to deliver their services. They would be in the risky position of having to bid for spectrum that they might not be able to use if they were unable to acquire its complement at a later award.
- 9.21 We believe that arguments supporting delay are outweighed by the arguments to proceed with the digital dividend awards as soon as possible.
- 9.22 The motivation for early award is particularly compelling in regions with existing RSL operators who are seeking early certainty about continuity of service. Three such licensees are of particular concern:
- the Carlisle RSL in Border;
 - Channel M in Granada region; and
 - the Cardiff RSL in Wales.
- 9.23 We plan to auction geographic packages suitable but not reserved for local television in these regions and West Country before the end of 2008. This will give existing RSL operators early certainty about spectrum access after DSO. We recognise that this approach may create aggregation risks for operators who wish to offer services in more than one area. We will take this into consideration in awarding the remaining geographic packages.
- 9.24 We have also stated that, subject to technical and legal feasibility, we will consider requests to vary existing RSLs to permit digital transmissions until DSO or, in exceptional circumstances, the award of the digital dividend.

Channel 36

Clearance

- 9.25 Channel 36 is used in the UK for aeronautical radar. Clearing this use and renegotiating the international agreements that protect it are key barriers to releasing the spectrum for new uses. If these can be overcome, channel 36 could be cleared across the UK before DSO ends in 2012, ahead of the rest of the digital dividend.
- 9.26 Only one radar system, operated by BAE Systems, still uses channel 36. We have given notice that we will revoke its licence to use the channel by 31 March 2009.
- 9.27 At the same time, we are continuing to seek international agreement to use channel 36 for other services. We hope to achieve a degree of certainty with neighbouring countries in the near future and will then look to conclude bilateral agreements.
- 9.28 Taken together, these measures mean that new use of channel 36 in the UK could be possible during the course of 2009.

Consultation responses

- 9.29 23 respondents commented specifically on the timing of the award of channel 36. The majority argued for the channel to be awarded earlier than cleared spectrum.
- 9.30 In general, broadcasters, telecommunications organisations, network providers (including Arqiva) and mobile television operators supported early award, mainly to increase certainty about its use and boost mobile television in the UK. Many respondents saw the London Olympics as a key driver for mobile television and the early award of channel 36 as a key precursor. MNOs generally advocated early award, although some later stated a preference for the channel to be awarded alongside cleared spectrum.
- 9.31 Five opposed early award because of concerns about potential interference to its analogue television service in adjacent channels 35 and 37 from high power mobile multimedia services. Five argued that the award should be delayed if adequate safeguards were not in place.
- 9.32 BT was among the respondents who supported awarding channel 36 with cleared spectrum on the grounds of efficiency of process (so that resources would not be diverted from other awards), the flexibility it would provide to participants and the opportunity for different operators to launch services at the same time. Digital UK also felt that it was sensible to coordinate all the digital dividend awards, including that of channel 36.
- 9.33 A small number of stakeholders raised the prospect of delaying the award in light of any EU harmonisation measures if this would benefit the UK.

Our response

- 9.34 It is important to distinguish between early use of channel 36 (i.e. as soon as it is available and authorised for new use, before DSO finishes in 2012) and early award of the spectrum (i.e. before the award of cleared spectrum).

Early use

- 9.35 We agree that early use of channel 36 would enable earlier investment in network rollout, planning and testing and that services might therefore be provided earlier than would otherwise be the case. We also agree that early use brings with it some potential costs, notably in the shape of the interference concerns raised by Five. We have completed modelling work to estimate the magnitude of these benefits. This is discussed in annex 8 and suggests that three years' earlier use of channel 36 than would otherwise be possible could have benefits in the region of £200-500m (NPV over 20 years).
- 9.36 We also agree that early use brings with it some consequences, notably in the shape of the interference concerns raised by Five. To assess the impact of this, we engaged Aegis and ERA to quantify the possible effect that a densely deployed mobile television network (DVB-H was selected to model this) operating in channel 36 could have on Five's analogue television service operating in channels 35 and 37. We chose mobile television as it is one of the more likely uses of channel 36. While the results are not directly applicable to alternative technologies that can use channel 36, we believe that they provide a reasonable illustration of the potential magnitude of the problem, possibly in a worst case. For example, if channel 36 were used for an additional DTT (SFN) multiplex, we would expect the mitigation strategies available for preventing interference into Five's analogue service to be more effective.
- 9.37 The results suggest that approximately 3% of Five viewers who receive analogue television in these channels could suffer from interference ranging from almost imperceptible to a complete loss of picture, depending on their location relative to a mobile television transmitter. Mitigation techniques could reduce these effects, though not completely. The date at which a mobile television network using channel 36 came into operation is another mitigating factor because, as we approach the end of DSO in 2012, the number of remaining analogue only households will fall considerably. We understand from respondents that it would take two to three years for a phased rollout of a national mobile television network, so full rollout would not be achieved until 2011 or 2012 if channel 36 becomes available in 2009.
- 9.38 We have therefore decided to allow use of channel 36 as soon as it is available and authorised for new services, before DSO ends in 2012, on the condition that any use of this channel prior to 2012 does not materially degrade the reception of Five's analogue television service in this period. We believe that this approach will maximise the total value generated by using channel 36.

Early award

- 9.39 An early award of channel 36 would mean an auction ahead of cleared spectrum. Service providers could use the extra months to prepare their offerings, generating some benefits. We estimate these at up to £50m (NPV over 20 years) for a mobile television operator. (Annex 8 sets out our economic modelling work to support this figure.) However, these benefits are modest and less certain than the benefits of allowing early use.
- 9.40 Early award also involves potential costs. These are also uncertain, but the opportunity cost could be displacing certain uses that require more than one channel. These costs could be very high and adversely affect the efficiency of the award of cleared spectrum as a whole. Therefore, the costs are quite plausibly high compared to the potential benefits. Additionally, given the level of uncertainty, a decision to allow early award of channel 36 could be subject to a high risk of regulatory failure.

- 9.41 We consider the potential benefits of early auction to be too small to justify the risks that this would entail. Hence, we think that the total value generated by using the digital dividend would be higher if channel 36 is awarded at the same time as cleared spectrum.
- 9.42 There is one caveat to this decision. If the award of cleared spectrum is significantly delayed, the benefits of early award of channel 36 are likely to increase. In these circumstances, we would reconsider this issue.

Conclusion

- 9.43 In this section, we concluded that:
- we will auction cleared spectrum and channel 36 at the same time. Our current timetable indicates that this is likely to be in the first half of 2009. We will also propose to auction interleaved channels 61 and 62 at the same time;
 - the early use of channel 36 will be subject to the new licensee not materially degrading Five's analogue television service operating in adjacent channels;
 - we plan to auction geographic packages of interleaved spectrum suitable but not reserved for local television sequentially, beginning in the Border, Granada, West Country and Wales regions before the end of 2008. This is intended to give existing RSLs certainty about their spectrum access after DSO. We plan to auction the remaining packages in 2009; and
 - we plan to award the package of interleaved spectrum with PMSE obligations to a band manager by the end of 2008.

Section 10

Other issues

Introduction and summary

10.1 This section considers other issues on which we will consult further. It sets out the consultation responses we received in relation to:

- technical constraints;
- usage rights and obligations, particularly relating to competition; and
- auction design.

10.2 It also considers three final issues for the DDR:

- the London Olympics;
- multiplex licensing; and
- the Crown Dependencies.

10.3 We will address all of these issues in greater detail when consulting on detailed award design.

Technical constraints

10.4 The DDR consultation document proposed applying only essential constraints on future use of the digital dividend. These were requirements to meet international obligations and to protect uses of UHF bands IV and V that were already planned (e.g. DTT and radioastronomy) from interference. Annex 9 to the consultation document set out these constraints in detail. We sought comments on our analysis.

Consultation responses

10.5 We received 189 responses (133 from individuals) on our analysis of essential constraints and 138 (93 from individuals) on our detailed analysis and proposals regarding technical constraints. These broadly welcomed our recognition of the need to protect existing uses. However, many respondents argued for further detailed assessment of the scope for interference between uses.

10.6 MNOs and mobile equipment manufacturers argued that the risk of interference to DTT from two way mobile services was manageable. They stressed the benefits of identifying a harmonised European sub-band for such services. Some sought the relaxation of protection for radioastronomy in channel 38.

10.7 Broadcasting and PMSE respondents sought greater assurance on protection from interference, particularly the effects of hole punching (where high signal strength causes interference to the reception of a service operating in adjacent spectrum). Both groups doubted the feasibility of sharing frequencies with mobile equipment. Some broadcasters were pleased to see prioritisation given to PSB DTT multiplexes, while professional PMSE users argued for their use of channels 38 and 69 to be protected from adjacent high power users.

- 10.8 Several respondents noted the importance of prioritising DSO over the DDR given that the latter is dependent on the success of the former. The period between the digital dividend awards and the completion of DSO was a particular concern. A range of respondents commented on the uncertainty surrounding the effects of interference on the vast number of differing set top boxes in the market. It was thought that some assistance would be needed to reduce the possible impact on consumers.
- 10.9 Local television operators were unclear about the implications of the proposed constraints for their services. They noted the need for international coordination. ACW and the Welsh Assembly Government stated that they would be disappointed if no assignments suitable for local television could be made available at two of the main transmitters in Wales.
- 10.10 Areas identified by respondents as needing further investigation were:
- allowing licence exempt cognitive use of the digital dividend;
 - protecting broadcasters' rebroadcasting signals;
 - second, third and adjacent channel interference; and
 - the use of SFNs as a way to improve DTT efficiency.

Our response

- 10.11 We have commissioned a suite of technical assessments to consider technical constraints more thoroughly. The results will inform our consultations on detailed award design.
- 10.12 This work has included further investigation into the compatibility issues between the different types of potential services that might use cleared spectrum. This highlights that the operation of a new service in cleared spectrum can cause interference to other new services (possibly using different technologies or network designs) operating in neighbouring channels. However, the technical research shows that this can be mitigated with careful network design and frequency separation.
- 10.13 The research also suggests that further improvements in the compatibility between different types of use could be gained by the adoption of better transmission and receiver filter performance compared to what was assumed in the earlier technical reports published with the consultation. The use of these improved filters could also improve the efficient use of cleared spectrum and simplify network deployment.
- 10.14 Section 7 summarised the different technical reports commissioned and their aim. Annex 9 contains links to more detailed summaries and the full reports.
- 10.15 Section 6 considered options for allowing cognitive use of the digital dividend.

Usage rights and obligations

- 10.16 The DDR consultation document proposed a number of non-technical usage rights and obligations. These were:
- licence terms—indefinite with a minimum term of 18 years (subject to five years' notice of variation or revocation);

- trading—all legal forms to be permitted;
- non-technical usage restrictions—only those necessary to protect against harmful interference, in line with a service and technology neutral approach; and
- service obligations—neither rollout obligations nor use it or lose it conditions, but some relating to PMSE use of interleaved spectrum.

Consultation responses

- 10.17 Of the 112 responses that we received, a small majority favoured additional restrictions to ensure efficient spectrum use and promote diverse, non-discriminatory and inclusive use, particularly on a geographic basis to prevent an increase in the digital divide and for the services offered.
- 10.18 Most broadcasters thought that a minimum licence term of 12-18 years was needed, although other respondents felt that this was too long and that shorter terms were more appropriate to take account of new technologies and to maximise spectrum efficiency. Broadcasters wanted licence terms aligned with those for the six existing DTT multiplexes.
- 10.19 Some community and consumer groups and individuals wanted provisions requiring demonstration of broader social value, to be transferred on any subsequent trade. Most respondents, particularly broadcasters and telecommunications operators, were keen that we formalise any arrangements to reduce interference risks.
- 10.20 The principal concern for many respondents was safeguarding against spectrum hoarding, particularly in light of indefinite licence terms, through use it or lose it conditions. Reasons for this were spectrum inefficiency and the potential impact on innovation and competition. Respondents proposed maintaining a revocation right on public policy grounds, even during the minimum licence term, for this reason.
- 10.21 Many respondents also suggested spectrum ownership caps to promote plurality of ownership and protect against anticompetitive practices, particularly in relation to single ownership of interleaved spectrum.

Our response

- 10.22 We will address issues of licence terms, trading and non-technical usage restrictions in preparing our consultations on detailed award design.
- 10.23 We have carefully considered the best way of ensuring that use of the digital dividend can generate broader social value. This was discussed in sections 5 and 7. In summary, we believe that a market led approach, supplemented by direct funding (where required) to reflect uses of value to society, is best suited to delivering this source of value and to maximising the total value generated by use of the digital dividend.
- 10.24 Competition issues both in the digital dividend awards themselves (e.g. the rules for participation) and in downstream markets that might be affected by the outcome of the awards are a critical consideration for the next phase of the DDR. Promoting efficiency, competition and innovation in spectrum use requires us to pay particular attention to the role that award design and packaging can play.

10.25 A range of mechanisms is available to us to resolve potential concerns, both as part of and after the awards. These include:

- award design and packaging that levels the playing field between incumbents and new entrants (e.g. capping the amount of spectrum an individual bidder can acquire);
- award design that minimises the risk of strategic behaviour by bidders;
- licence conditions that promote efficient use and competition. The DDR consultation document noted that we do not intend to impose any use it or lose it conditions because they are generally unlikely to be justified as a means of securing the optimal use of spectrum. We will nonetheless consider whether any other licence conditions are justified in this case (e.g. to prevent anticompetitive behaviour and/or promote competition); and
- using our powers as a competition authority to investigate anticompetitive behaviour.

10.26 We have not formed a view on the need to apply any such mechanisms to the digital dividend awards. We would only intervene where we believe there is a risk of market failure that would be resolved effectively through intervening.

Auction design

10.27 The DDR consultation document noted the links between packaging and the design of any potential auction, particularly in responding to aggregation risk. It also considered possible choices in auction design, including:

- simultaneous or sequential award of lots;
- a single round (sealed bid) or multiple rounds (ascending bids);
- generic or specific lots; and
- individual lot or package (combinatorial) bidding.

10.28 We proposed four possible formats if an auction was deemed appropriate:

- a “standard” simultaneous, multiple round, ascending auction (SMRA) with predefined lots, which could be augmented by either limited withdrawals or augmented switching;
- an SMRA with predefined lots and package bidding;
- a clock/sealed bid hybrid, with each lot as a unique category (equivalent to having predefined lots); or
- a clock/sealed bid hybrid with a more limited number of categories of generic lot.

10.29 We sought views on which of these formats would be most suitable.

Consultation responses

- 10.30 Most respondents did not, or felt unable to, respond on this issue. The vast majority of the 89 responses that we received either offered no firm view or did not support an auction at all, calling on us to resist a repeat of the 3G auction in 2000. There were also calls to reserve spectrum on policy grounds for particular uses (e.g. local television, PMSE and DTT services in HD) before any auction of the remainder took place.
- 10.31 No one format was favoured by those respondents who did express a view. Many needed more information before they could comment, while others believed that the format depended on packaging. A simple, flexible approach was, however, supported.
- 10.32 Some respondents thought that the auction design should incorporate a stage to assess broader social value to assist bidders seeking to provide such services.
- 10.33 OSAB raised the need to better educate industry and the public about auctions to increase confidence in them and counter the view that they sought to maximise revenues (a view expressed by many individual respondents). It also raised potential concerns about a UK-centric approach and accepting bids from participants in countries (particularly EU Member States) that did not offer reciprocal opportunities to UK organisations.
- 10.34 It was noted that competitors for cleared and interleaved spectrum might be quite different and that this should be reflected in our proposals. It was also suggested that local television operators would have difficulty prevailing over MNOs if they competed for the same packages of interleaved spectrum.

Our response

- 10.35 The suitability of auctions and the arguments for reserving spectrum for specific uses are considered earlier in this statement.
- 10.36 Other issues raised on auction design will inform our consultations on detailed award design.

London Olympics

- 10.37 On 6 July 2005, London was chosen to host the 2012 Olympic Games and Paralympic Games. These will take place between 27 July and 9 September 2012 at some 35 competition venues in London and across the UK.
- 10.38 As part of London's bid for the Olympics, the Government gave two binding guarantees to the International Olympic Committee, covering:
- the allocation of the spectrum required for the organisation of the Olympics; and
 - the waiving of fees payable by members of the Olympic family for the allocated spectrum required for the Games.
- 10.39 We are responsible for organising a full spectrum plan for the London Olympics and for arranging all the spectrum licences in good time in support of the plan.

- 10.40 The London Organising Committee of the Olympic Games and Paralympic Games will be working closely with its partners to ensure that it uses existing and emerging technologies in innovative and powerful ways. Wireless technologies, in particular, will play a fundamental role both in the build-up to and during the London Olympics. We therefore expect that the Games will see an increase in spectrum requirements, principally in London, where spectrum is already heavily used. Meeting these requirements, and hence the Government guarantees, will be a complex task. We are also concerned to minimise any negative impact on other spectrum users and, ultimately, on citizens and consumers who benefit from those uses.
- 10.41 It is for these reasons that we started the task of spectrum planning for the London Olympics in 2006, some six years before they begin. Our work to date is described in a discussion document that we published on 30 November 2007.⁴⁶ At the core of the issues that it addresses is identifying what applications at the Games might require spectrum and whether they could use spectrum more efficiently. Understanding these factors will assist us in constructing a draft spectrum plan, on which we expect to consult after the 2008 Beijing Olympics. The discussion document seeks information and views to aid our understanding.
- 10.42 The document does not address the supply of spectrum to meet the requirements of the London Olympics. Many of the details are heavily dependent on the nature and extent of the requirements to be met. But we have considered the role that the digital dividend could play. In particular, there might be a case for:
- holding back some cleared spectrum from new uses in London until after the Games, allowing us to meet the requirements for audio links (principally wireless microphones, in ear monitors and talkback systems). This would involve a delay in making spectrum available for other uses of only a few months given DSO in London is scheduled to take place in the first half of 2012; and
 - retaining a power of direction over the band manager for interleaved spectrum with PMSE obligations so that we can access the spectrum awarded to it to meet the requirements for audio links and require its assistance with spectrum planning and licensing where necessary.
- 10.43 We will explore these issues further when consulting on detailed award design. Responses will inform both the terms of the digital dividend awards in question and our draft spectrum plan for the London Olympics.
- 10.44 The Government has given similar guarantees on spectrum for the Glasgow 2014 Commonwealth Games. We will also take these into account.

Multiplex licensing

- 10.45 The DDR consultation document noted that the Communications Act gave us the power to operate a simpler and more flexible regime, solely under the Wireless Telegraphy Act 2006,⁴⁷ for licensing multiplexes carrying broadcast services. It indicated that that we expected to use this new regime in licensing any new multiplexes using the digital dividend, removing the requirement to hold a licence under the Broadcasting Act 1996.⁴⁸

⁴⁶ www.ofcom.org.uk/consult/condocs/spectrum2012/condoc.pdf.

⁴⁷ www.opsi.gov.uk/acts/acts2006/pdf/ukpga_20060036_en.pdf.

⁴⁸ www.opsi.gov.uk/acts/acts1996/plain/ukpga_19960055_en.

10.46 We still expect to use this new regime for the digital dividend, but we have considered whether it would be desirable to retain some limited elements of the Broadcasting Act regime. We will set out proposals when consulting on detailed award design, for instance to disqualify certain groups from operating a television or radio multiplex using the digital dividend and to address interoperability between the existing DTT platform and any new television multiplexes using this spectrum.

Crown Dependencies

10.47 The Crown Dependencies—Guernsey, Jersey and the Isle of Man—are independent jurisdictions that can choose to adopt certain UK laws, reflecting their internal policies. Under the Wireless Telegraphy Act, we allocate and assign spectrum on their behalf, taking their interests into account. We also represent them internationally in bodies such as the ITU. Consequently, we help to resolve interference issues at both the national and the international levels.

10.48 Each of the Crown Dependencies has adopted certain parts of the Wireless Telegraphy Act. Both auctions and trading are permissible in Guernsey but only auctions in Jersey and the Isle of Man. Jersey has decided to introduce trading in the near future.

10.49 We have discussed the DDR at length with the Crown Dependencies. Table 14 summarises their preferences for inclusion or otherwise in the licences that we will award for the digital dividend. We will publish our proposals when consulting on detailed award design.

Table 14. Crown Dependency involvement in the digital dividend awards

	Guernsey	Jersey	Isle of Man
Cleared spectrum	Include	Include	Separate award
Interleaved channels 61 and 62	Include	Include	Separate award
Packages suitable for local television	Consult	Consult	Separate award
Package with PMSE obligations	Include	Include	Include

Conclusion

10.50 Our consultations on detailed award design will set out proposals in respect of:

- technical constraints;
- usage rights and obligations, particularly relating to competition;
- auction design;
- the London Olympics;
- multiplex licensing; and
- the Crown Dependencies.

Section 11

Next steps

Introduction

11.1 This section sets out the next steps in the DDR.

Consultations on detailed award design

11.2 We will consult on the detailed design of the digital dividend awards in spring 2008. We anticipate publishing consultation documents covering:

- the award of cleared spectrum, channel 36 and interleaved channels 61 and 62 (where available);
- the award of geographic packages of interleaved spectrum suitable but not reserved for local television; and
- the award of a package of interleaved spectrum with PMSE obligations to a band manager by beauty contest.

11.3 If not simultaneous, these consultations will be published very close to each other given the close links between the different awards. Before publication, we will work with key public bodies to improve their understanding of the interaction between the digital dividend and their policy responsibilities so that they can better respond.

Awards

11.4 We expect to publish an information memorandum and draft regulations setting the rules for each award during autumn 2008. We would bring the final regulations for each award into force in time for us to hold them in late 2008 or early 2009.

11.5 We hope to issue licences for use of the digital dividend during the first half of 2009.

Timetables

11.6 Tables 15, 16 and 17 set out the current timetables for the three digital dividend awards. These are subject to factors outside our control and may therefore change during the course of the rest of the DDR.

Table 15. Timetable for awarding a package of interleaved spectrum with PMSE obligations to a band manager by beauty contest

Spring 2008	Consultation on award design
Summer 2008	Consultation closes
Autumn 2008	Invitations to tender
Late 2008	Award

Table 16. Timetable for awarding geographic packages of interleaved spectrum suitable for local television

Spring 2008	Consultation on award design
Summer 2008	Consultation closes
Autumn 2008	Information memorandum and draft regulations
Late 2008	Awards in Border, Granada, West Country and Wales
Summer 2009	Remaining awards

Table 17. Timetable for awarding cleared spectrum, channel 36 and interleaved channels 61 and 62

Spring 2008	Consultation on detailed award design
Summer 2008	Consultation closes
Late 2008	Information memorandum and draft regulations
Summer 2009	Award

Annex 1

Glossary of abbreviations

3G	Third generation mobile phone standards and technology
ACNI	Advisory Committee for Northern Ireland
ACOD	Advisory Committee for Older and Disabled People
ACS	Advisory Committee for Scotland
ACW	Advisory Committee for Wales
AIP	Administered Incentive Pricing
ARCEP	Autorité de régulation des communications électroniques et des postes
CEPT	European Conference of Postal and Telecommunications Administrations
COCOM	Communications Committee
DDR	Digital Dividend Review
DECT	Digital Enhanced Cordless Telecommunications
DSO	Digital switchover
DTT	Digital terrestrial television
DVB-H	Digital Video Broadcast—Handheld
DVB-T/-T2	Digital Video Broadcast—Terrestrial
ECS	Electronic communications services
EU	European Union
FCC	Federal Communications Commission
GDP	Gross domestic product
GE-06	Geneva 2006 Agreement
GHz	Gigahertz
GSM	Global System for Mobile
HD	High definition
ICT	Information and communications technology
IMT	International Mobile Telecommunications

ITU	International Telecommunication Union
LEFR	Licence Exemption Framework Review
MHz	Megahertz
MNO	Mobile network operator
MOD	Ministry of Defence
NPV	Net present value
OCP	Ofcom Consumer Panel
OSAB	Ofcom Spectrum Advisory Board
PAL	Phase Alternating Line
PMR	Private mobile radio
PMSE	Programme-making and special events
PSB	Public service broadcaster/broadcasting
PVR	Personal video recorder
RFID	Radio-frequency identification
RSC	Radio Spectrum Committee
RSL	Restricted Service Licence
RSPG	Radio Spectrum Policy Group
SD	Standard definition
SFN	Single-frequency network
SFR	Spectrum Framework Review
SMRA	Simultaneous, multiple-round, ascending auction
TG4	Task Group 4
UHF	Ultra High Frequency
UWB	Ultra-wideband
WAPECS	Wireless access policy for electronic communications services
WiMAX	Worldwide Interoperability for Microwave Access
WRC-07	World Radiocommunication Conference 2007